Fish Stock Survey of Transitional Waterbodies around the Irish Coast

2015

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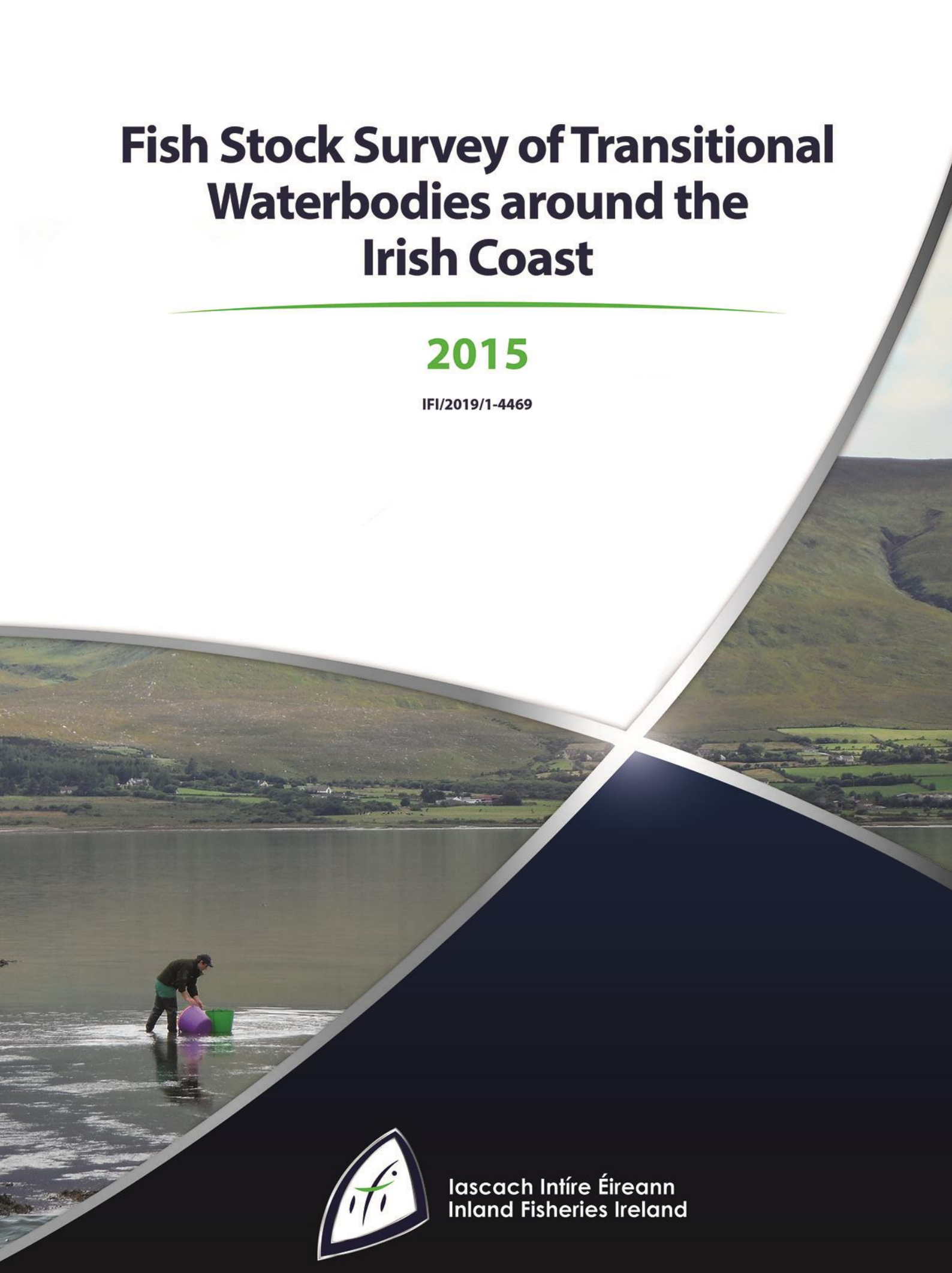

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Inland Fisheries Ireland

Inland Fisheries Ireland

National Research Survey Programme

Fish Stock Survey of Transitional Waterbodies around the Irish Coast 2015

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

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1. Summary

The main objective of the current monitoring programme is to measure the ecological status of fish populations in a selection of transitional waters around Ireland. This information will contribute to meeting the reporting requirements of the EU Water Framework Directive (WFD). Furthermore the programme underpins IFI's national role in marine recreational fish species management by providing data on species and species assemblages which will assist in identifying important nurseries for marine sports fish species and monitoring their status.

Surveys were carried out in nine transitional water bodies between September and October 2015. A total of 276 samples were taken using three different methods (seine nets, fyke nets and bean trawls). 26,179 fish were captured, counted and identified to species level prior to release. 54 different fish species were encountered over the course of the 2015 programme.

For the nine transitional water bodies surveyed in 2015, species richness was lowest in water bodies in located in the east of the country where human influence is most apparent. 16 and 18 different species were recorded in the Avoca and Boyne estuaries respectively. Castlemaine Harbour which is located in the Southwest and the largest transitional water body surveyed in 2015 had the highest species richness with 28 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 the Erne estuary, 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. The sampling cycle commenced in 2007. Since 2012 when this set of waterbodies was last surveyed, fish ecological status changed in only the Gweebarra and Ballysadare estuaries, where status improved from 'Moderate' to good.

2. General introduction

Estuaries are formed where rivers enter the sea. These highly dynamic systems experience changes in a number of environmental factors such as salinity, temperature, turbidity and nutrient levels at both diel (tidal cycles) and seasonal scales. These processes interact within these transitional environments to produce a variety of habitats including, salt marshes and reed beds and rock, sand and mud substrates (Phil et al., 2002). This variety of habitat along with the generally sheltered nature of estuaries serve a vital nursery function for a range of

fish species which are often of commercial and recreational angling importance. Estuaries can experience a range of anthropogenic pressures, as they are often located close to population centres which aim to exploit the sheltered bays and productive waters available. Direct pressures may include fishing and aquaculture, shipping and associated activities such as dredging and sea wall development. Discharges (domestic, industrial and agricultural) into estuaries can also be a feature of these dynamic environments. Estuaries may also be impacted by activities in rivers which eventually empty into these systems.

In Europe, the Water Framework Directive (WFD) was established to protect and where necessary, to restore aquatic systems, including transitional waters to good ecological status (Directive 2000/60/EC). According to the WFD, ecological status 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.

Inland Fisheries Ireland (IFI) is tasked as the competent authority under Directive 2000/60/EC to undertake WFD sampling. IFI is the state agency responsible for the conservation, protection, management, marketing, development and improvement of our inland fisheries and sea angling resources. To this end these surveys provide species and species assemblage data which will assist in identifying important nurseries for marine sports fish species management and status monitoring.

The aim of this sampling programme was to establish the status of fish populations in a number of estuaries around Ireland, using the estuarine multi-metric fish index (EMFI) (Harrison and Kelly, 2013). If applicable, any change in fish population structure within estuaries over time was also examined.

The WFD maintains that transitional waterbodies are classed according to range of variables such as ecoregion, salinity, wave exposure, temperature, substratum composition, among a number of other factors. However, only two transitional waterbody typologies were identified in Ireland and during the 2015 sampling programme, only one waterbody type was surveyed. Type 2 transitional waters (TW2) are defined as partially mixed or stratified systems. They are sheltered intertidal or shallow subtidal estuaries that consist of mainly sand and mud substratum. They are mesotidal (mean spring tidal range: 2-4m) with salinities ranging from 5-30. Although, these classifications were developed to establish suitable reference conditions, so that ecological status can be correctly assigned, there is still a noticeable amount of variation between sites of the same typology. For example, a polyhaline site (salinity 18-30) with a predominantly rocky intertidal region would be expected to have very different fish populations to a mesohaline site (salinity 5-17) with a largely muddy intertidal region. Nevertheless, it is accepted that the EMFI is sufficiently

robust to accommodate these variations, provided key metrics such as species richness are not affected (Harrison and Kelly 2013).

3. Methods

Fish stock surveys were conducted in eight 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), between the 9th of September and the 23rd of October 2015 by staff from Inland Fisheries Ireland. Sites surveyed were the Avoca and Boyne estuaries (Eastern River Basin District), the Erne and Gweebarra estuaries (North Western International River Basin District), Camus and Kinvara Bays and Ballysadare estuary (Western River Basin District), Tralee Bay (Shannon River Basin District) and Castlemaine harbour (South West River Basin District) (Fig. 1).

Sampling effort depended on a number of factors including site size, suitable available habitat for each sampling technique and staff availability. However, a minimum of six net deployments per sampling technique per transitional water body was adhered to throughout the survey.

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 for the WFD monitoring programme.

Beach seining was conducted using a 30m x 3m net (10mm mesh size) to capture fish in littoral areas. The bottom of the net has a weighted lead line to increase sediment disturbance and catch efficiency (Fig. 2). Seine netting was conducted in shallow littoral zones, usually <1.5 m deep. Fyke nets (15m in length with a 0.8m diameter front hoop, joined by an 8m leader with a 10mm square mesh) were used to sample benthic fish in subtidal zones. They were set overnight for a minimum of 12 hours. Beam trawls were 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 travelling at a speed of 3-7Km/h Trawls were conducted along transects of 100 – 200m in length.

Sample sites were selected from a desk based study of the site to represent the range of geographical and habitat ranges within the water body, based on such factors as exposure/orientation, shoreline slope, and substrate type. A handheld GPS was used to mark the precise location of each site. Salinity values were taken at various points around the water body.

Samples from all nets were processed on-site by identifying the species present and counting the total numbers caught in each. Length measurements (total lenght) were recorded for each species using a representative sub-sample of 30 fish, while scales were only collected for certain species, such as salmon and sea trout. Unidentified specimens were retained for subsequent identification in the laboratory. Occasionally fish species of particular interest to other IFI projects were also retained for further analysis.

Sampling locations and capture data for individual transitional waterbodies sampled in 2015 are presented in Appendices 1 and 2.

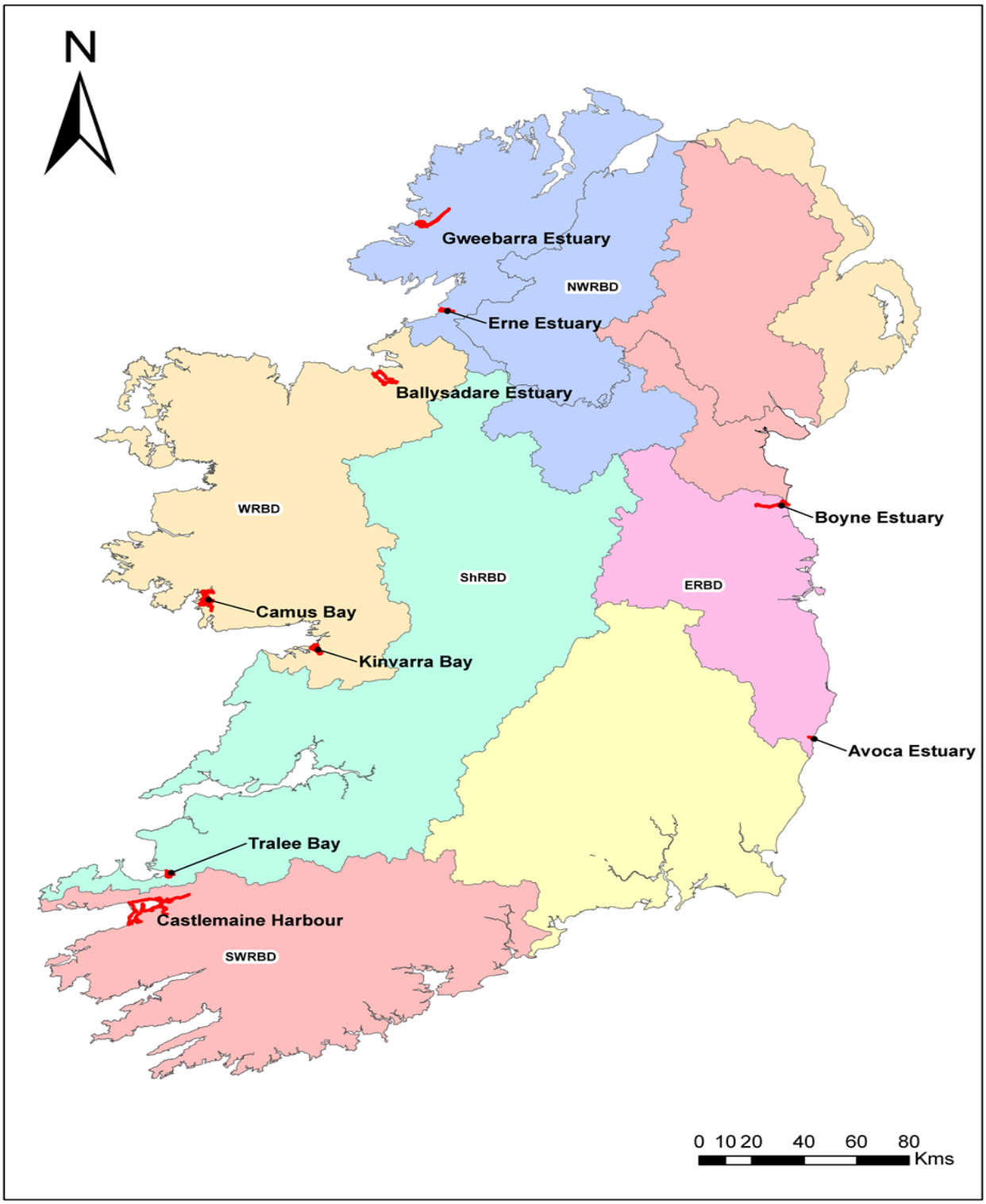

Fig. 1: Transitional waterbodies sampled by IFI in 2015. River basin districts where sampling took place highlighted on Map. NWRBD: North Western International River Basin District, WRBD: Western River Basin District, ShRBD: Shannon River Basin District, SWRBD: South West River Basin District, ERBD: Eastern River Basin District.

Fig. 2: Beach seining in Castlemaine Harbour.

4. Results

4.1. The Avoca Estuary

The survey was conducted on the Avoca Estuary between the 9th and the 10th of September 2015. The Avoca Estuary covers an area of 0.17km^2 and divides the town of Arklow, Co. Wicklow in two. The estuary is situated within an industrialised area with banks that are either walled or steep with heavy tree cover (Fig 3). It is a relatively small and narrow estuary with a high degree of physical modification to the lower portion below the bridge, primarily consisting of sea walls, boat moorings and piers.

Fig. 3: The upper Avoca Estuary.

The Avoca catchment contains some of the most polluted stretches of river in Ireland, with acid mine drainage having a profound impact on the lower 15km of river. These mines leach high levels of lead, copper and zinc (ERBD, 2009). This catchment also has a wide variety of other polluting inputs along its length, including pharmaceutical, chemical and light engineering operations, along with a number of treated and untreated sewerage inputs (EPA 2018). Furthermore, agriculture and forestry contribute to diffuse pollution loads (ERBD, 2009). The estuary was previously surveyed by Inland Fisheries Ireland in September 2008 and October 2010.

A total of five beach seines, six fyke nets and six beam trawls were deployed in the Avoca Estuary (Appendix 1). Although it would have been preferable to deploy more beach seines, suitable habitat was not available. Salinity values taken at beach seine sites ranged from 0.059ppt to 6.43ppt, indicating that the marine influence is relatively minor, compared to other estuaries. Temperatures ranged from 14.1 °C to 16.3°C.

A total of 16 fish species were recorded in the Avoca Estuary (Appendix 2). Sand goby was the most abundant species, followed by flounder and sand smelt. Flounder were well distributed throughout the water body and were the only species captured using all three netting methods. Flounder ranged in length from 2.6cm to 32.0cm. Similar to previous surveys length frequency analysis revealed that a number of different age classes were

present in the sample, with the majority of individuals belonging to the 0+ or 1+ age class (Fig. 4).

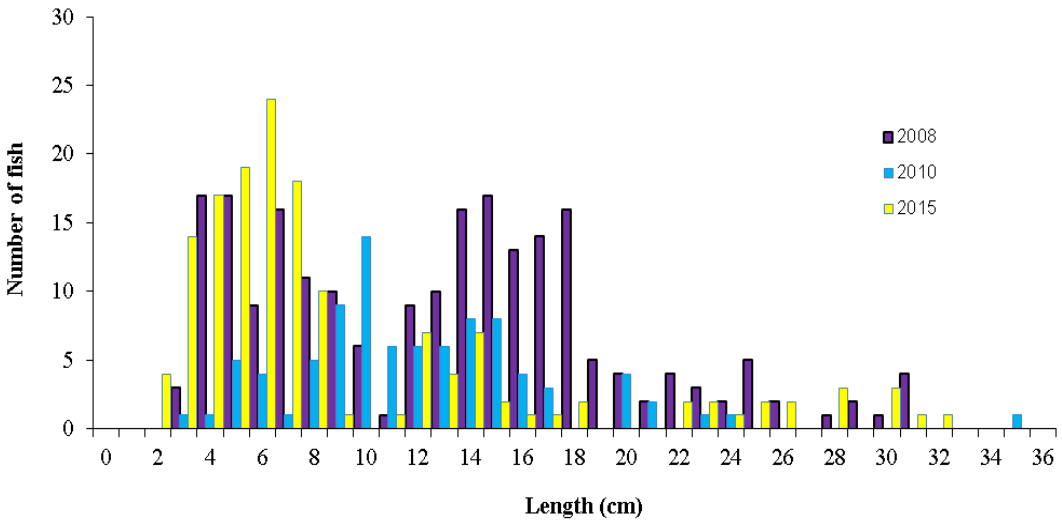

Fig. 4: Length frequency distribution for a subsample of flounder in the Avoca Estuary, September 2008 (n=220) October 2010 (n=90) and September 2015 (n=149).

A single adult river lamprey, a species listed on Annex II and V of the EU Habitats Directive (92/43/EEC) was captured in a fyke net. Brown trout, salmon, and eels (listed as critically endangered in the Irish Red Data Book (King *et al.,* 2011)) were also captured.

Species richness was 16 which is low compared to other transitional water bodies sampled in 2015. Good numbers of salmon parr (16) were captured, compared to previous years. Only a single salmon was caught in 2008. A large reduction in juvenile thick-lipped mullet captured was noted when compared to previous sampling years. Only two juveniles were caught in the present survey, whereas, 35 were caught in 2008 and 31 were caught in 2010. A single river lamprey was caught during the current survey; 5 were captured in 2008 and 9 in 2010.

Transitional waters like the Avoca estuary, where fluvial input is dominant, tend to have a high proportion of freshwater species due to their low salinity and limited connectivity with the open sea. Furthermore, transitional waters with a stronger marine influence typically have higher species richness, due to the larger variety of marine fauna that can potentially inhabit them. Nonetheless, cod, plaice and pollack which are all important commercial or angling species were recorded in this water body, close to the estuary mouth.

The EMFI classified the Avoca estuary transitional water body as 'Good' ecological status (EQR =0.88) based on the fish populations present. There has been a steady improvement in EQR since 2008 when the estuary was classified as of 'Moderate' status (EQR=0.63). Although status was rated as 'Good' in 2010, EQR was 0.73. In fact the Avoca EQR of 0.88 was the highest of all sites sampled in 2015. This was unexpected given the known anthropogenic pressures impacting on the Avoca estuary and the low fish species richness recorded. It is likely that a combination of the estuary's small size and the presence of four transient diadromous species (salmon, trout, river lamprey and eels) contributed to the 'Good' rating. However, this rating must be treated with caution due to the known anthropogenic pressures affecting the estuary.

4.2. The Boyne Estuary

The Boyne Estuary survey was carried out between the 1st and the 3rd of October 2015. This estuary was previously surveyed in 2009 and 20012. The estuary covers an area of 3.16km^2 and is located on Ireland's east coast. In general, the site has been somewhat modified by human activity, such as on-going dredging for shipping. A number of factories are also present along the river, upstream of the estuary. The Boyne River channel, which is navigable and dredged, is defined by training walls that are breached in some places. Intertidal flats occur on the sides of the river channel. The sediments vary from fine muds in the sheltered areas to sandy muds or sands towards the river mouth.

A total of 12 beach seines, six beam trawls and seven fyke nets were deployed in the Boyne Estuary (Appendix 1). Temperature and salinity values taken at beach seine sites ranged from 12.6 °C to 15°C and 0.33ppt to 25.42ppt respectively.

Eighteen fish species were recorded in the Boyne Estuary in October 2015 (Appendix 2). Lesser sandeel was the most abundant species, followed by minnow and sand goby. Flounder were also abundant in the estuary.

Freshwater fish were captured in the upper reaches where salinity was very low. These were replaced by salt-tolerant species closer to the sea. The number of species recorded has declined since 2009. There were 5 less species recorded in 2015 compared to 2009 and 2012. Although sampling effort was slightly lower than previous years, a large range of habitats were sampled throughout the estuary, so this alone cannot explain the reduction in species numbers. Salmon and sea trout (migratory brown trout) were not captured during the current survey, having been present in both previous surveys. Otherwise, generally common marine species such as 15-spined stickleback, pogge and herring appeared in small numbers in one or both previous studies but not the current one. On the other hand, poor cod and sand smelt were captured for the first time in the current survey. With regards to resident freshwater fish, only stone loaches were not recorded during the current survey. A large reduction in eel captures was observed in 2015, compared to previous years. Although less fyke nets were set in 2015 (7 as opposed to 9 in 2012), it is unlikely that reduced sampling effort could have accounted for such a large reduction in European eel captures. A large cohort of 26-36cm fish recorded in previous surveys was absent in 2015 (Fig. 5).

Relatively large numbers of juvenile cod captures over the sampling years may indicate that

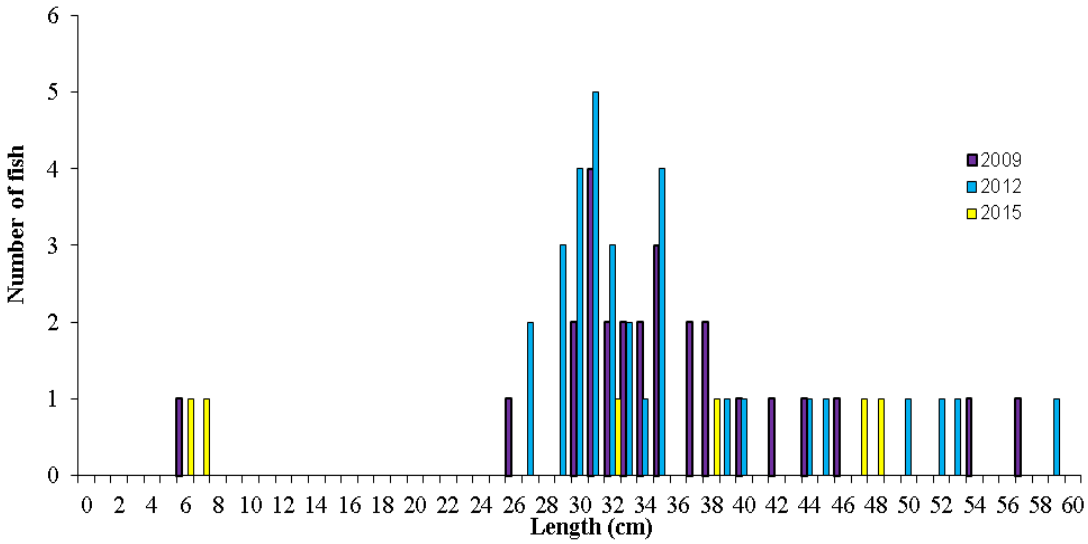

Fig. 5: Length frequency distribution of eels in the Boyne Estuary, September 2009 (n=27), October 2012 (n=32) and September 2015 (n=6).

the Boyne Estuary is a productive nursery habitat for this species. Total numbers captured dropped between 2009 and 2015 (86 to 17). This is largely due to the absence of small (8-10cm) fish in the 2015 population (Fig. 6).

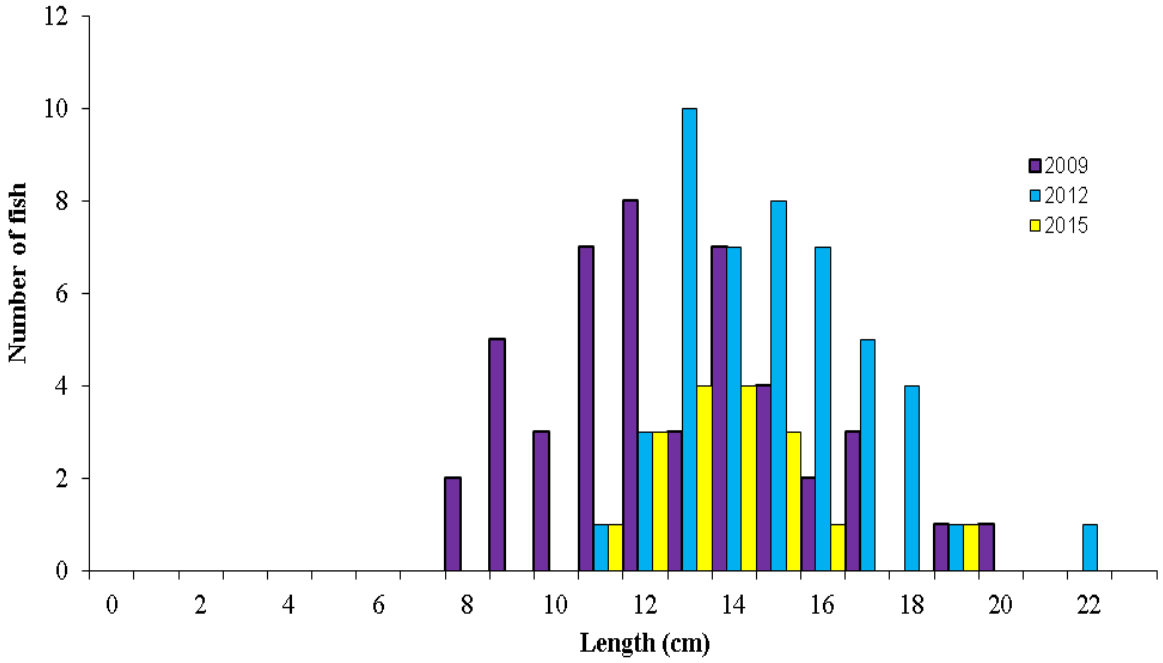

Fig. 6: Length frequency distribution of cod in the Boyne Estuary, September 2009 (sub-sample, n=46), October 2012 (n=47) and September 2015 (n=17).

The EMFI classified the Boyne estuary transitional water body as 'Good' ecological status (Environmental Quality Rating (EQR) =0.66) based on the fish populations present. Although status has remained the same since 2012, the reduction in species richness is reflected by the reduction in the EQR from 0.75 in 2012. For a water body to achieve 'Good' status or higher, the EQR must be ≥ 0.65.

4.3. The Gweebarra Estuary

The Gweebarra estuary survey was carried out between the 10th and the 12th of October 2015. This estuary was previously surveyed in 2009 and 2012. The estuary covers an area of 8.26km^2 and is situated on Ireland's Northwest coast in Co. Donegal. The estuary begins at the small village of Doochary and extends in a south-westerly direction for approximately 15km. This waterbody lies within the West of Ardara/Mass Road SAC, which is important for many habitats listed in Annex I of the EU Habitats Directive, including large shallow inlets and bays, tidal mud flats and estuaries. Annex II listed species present include the common seal and Atlantic salmon (NPWS, 2005). The estuary itself and the upper catchment are relatively free from human activity with forestry and low intensity grazing the only potential impacts in the catchment (Fig. 7).

A total of 15 beach seines, ten beam trawls and eight fyke nets were set in the Gweebarra Estuary in October 2015 (Appendix 1). Salinity values taken at beach seine sites ranged from 0.09ppt at the highest point of tidal influence to 22.1ppt near the mouth of the estuary. Water temperatures ranged from 9.9°C to 12.7°C during the survey.

A total of 20 fish species were recorded in the Gweebarra Estuary during the 2015 survey (Appendix 2). This is modest value when compared with other estuaries of this type surveyed along the west coast of the country in 2015. However, this is a big increase on the 2012 survey when only 14 species were captured. The presence of low numbers of a

Fig. 7: Sorting through a beach seine in the upper Gweebarra Estuary.

number of species in the 2015 survey, not encountered in the 2012 survey accounted for this difference (e.g. Black goby, cod, coalfish, short-spined sea scorpion, tub gurnard and pogge).

Although a variety of species were encountered, the total numbers of fish captured in relation to sampling effort was notably low. Possible reasons for this may be due to the largely homogenous sandy substrate throughout the estuary, or due to the fact that the water was quite cold compared to other sites. Average water temperature during sampling was only 11.5°C, whereas average temperatures further south, for example, in Castlemaine harbour were 15.2°C in early October.

A large proportion of total catch in the Gweebarra estuary consisted of juvenile flounder over the three annual sampling periods. The age profile remained quite constant between sampling years, indicating that this estuary may be an important nursery for the region (Fig. 8).

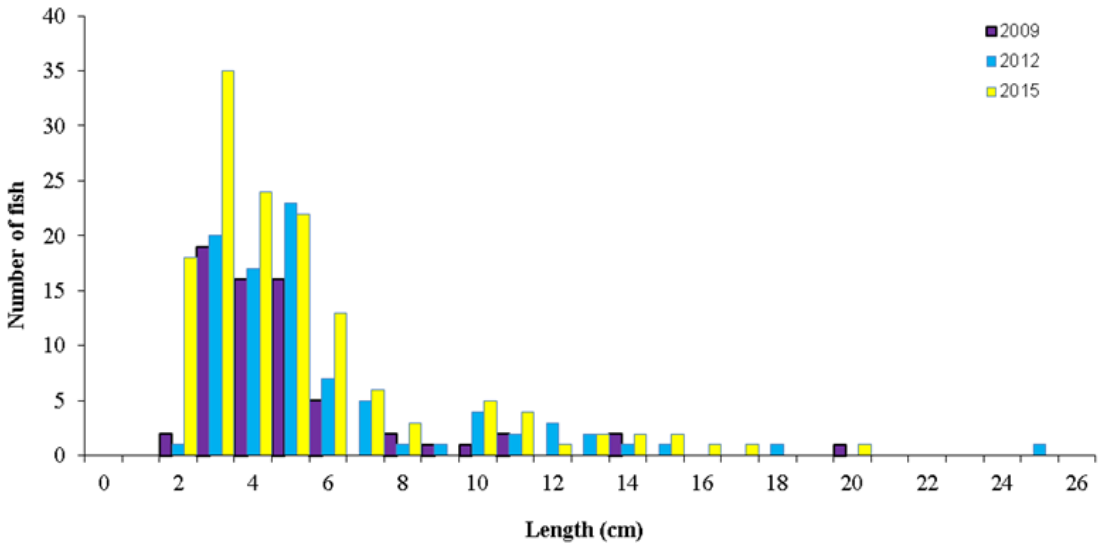

Fig. 8: Length frequency distribution of Flounder in the Gweebarra Estuary, October 2009 (sub-sample, n=67), October 2012 (n=90), October 2015 (sub-sample, n=140).

The EMFI classified the Gweebarra estuary transitional water body as 'Good' ecological status (EQR =0.79) based on the fish populations present. This is an improvement on the

2012 survey when the water body achieved only 'Moderate' status (EQR=0.54), due mainly because of a decreased species richness compared to the current survey.

4.4. The Erne Estuary

The Erne Estuary survey was carried out between the 14th and the 16th of October 2015. This estuary was previously surveyed in 2009 and 2012. The Erne Estuary covers an area of 2.57 km² and is located on Ireland's Northwest coast, adjacent to the town of Ballyshannon, Co. Donegal. It extends for approximately 4km westwards from Ballyshannon (downstream of Cathaleen's Falls Dam) to Tullan Strand, with large portions draining on a low tide to expose sandy beaches (Fig. 9). It receives waters from the River Erne and the Abbey River. The waterbody lies within the Donegal Bay SPA which is important for the protection of a large number of birds that inhabit its wetlands (NPWS, 2010).

A total of 11 beach seines, six beam trawls and six fyke nets were deployed in the Erne Estuary in October 2015 (Appendix 1). Temperature and salinity values taken at beach seine sites ranged from 11.8 °C to 13.9°C and 10.1ppt to 21.5ppt respectively.

Fig. 9: The Erne estuary.

Twenty two fish species were recorded in the Erne Estuary during October 2015 (Appendix 2). Lesser sandeel was the most abundant species, followed by sand goby and plaice. Juvenile plaice, a popular angling species, were common in the Erne in 2009 and 2015 but were not recorded during the 2012 survey (Fig. 10). This may indicate that the Erne estuary has a function as a plaice nursery.

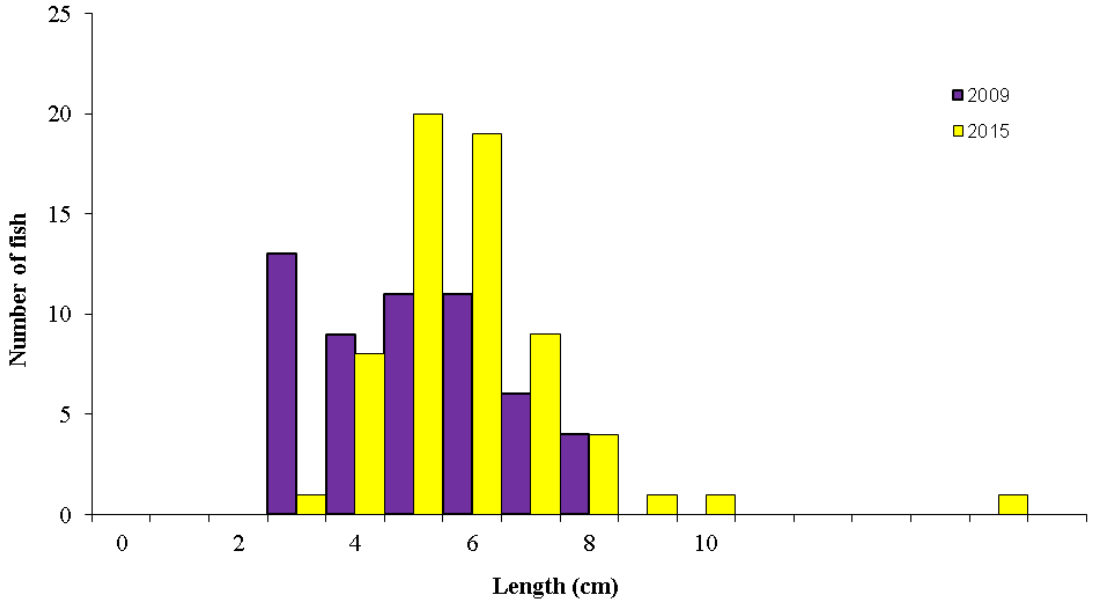

Fig. 10: Length frequency distribution of Plaice in the Erne Estuary, September 2009 (n=54) and October 2015 (n=64).

A total of 22 fish species was recorded in the Erne Estuary during the 2015 survey which was similar to other transitional water bodies in the Northwest RBD. However, this is an increase of 12 species compared to the 2012 survey. A large increase in the number of marine species captured was the main reason for the difference between the sampling years. Coalfish, cod, conger, dab, plaice, two pipefish species and two sea-scorpion species were present only in 2015, albeit in small numbers.

The major difference in species richness may be a function of differential salinities at time of survey. Salinity measurements recorded in 2012 did not exceed 2.4ppt in 2012 and were often far lower. In 2015, the lowest value recorded was 10.1ppt. The Erne estuary is situated at the bottom of a Hydro-electric dam, which is capable of and often does release large quantities of water from an upstream reservoir. This may have been a factor of both the contrasting habitat and fish populations between 2012 and 2015. Planning for future survey schedules should take this into account and test for this effect.

The EMFI classified the Erne estuary transitional water body as 'Moderate' ecological status (EQR =0.61) based on the fish populations present. The status has remained unchanged since 2009. Due to the large increase in species richness between 2012 and 2015 an

improvement in status was expected. However, the dominance of lesser sandeel in the overall sample (95% of all captured fish), reduced the EQR value substantially.

Species dominance is generally a useful metric when measuring ecosystem function and so is included in the EMFI. This is because environmental stress often results in a shift from an even distribution of a number of species across diverse communities to a low number of more tolerant species dominating communities. However, in this case, the dominance of lesser sandeel may not be an accurate reflection of ecosystem functioning. Sandeel are known to move around coastal habitats in large shoals and as such, a single seine net is randomly capable of catching a large number of foraging sandeel, as occurred in the current survey (Fig. 11). Interestingly, the presence of large numbers of lesser sandeel in the estuary during sampling was also the main driver of a classification of 'Moderate' status in 2009. For this reason, the current classification must be qualified by the dominance of one species and recalibration less sandeel should also be reported.

Fig. 11: Large Lesser sandeel capture in the Erne estuary.

4.5. Ballysadare Estuary

The Ballysadare estuary transitional water survey was carried out between the 20th and 23rd of October 2015. A smaller section of the estuary was surveyed in 2008. Ballysadare Estuary

is located approximately 1km north-west of Ballysadare town, in County Sligo and extends for about 5km westwards from Ballysadare to where it enters Sligo Bay. The estuary covers an area of 17.04km². The Ballysadare River is the main river entering the estuary. The inner section of the estuary has extensive mud flats and completely drains at low tide except for a narrow channel created by the Ballysadare River. The outer section widens out and the intertidal mainly consists of sand and cobble substrates where a marine influence dominates (Fig. 12). The Ballysadare River rises in the Curlew Mountains near the boundary between County Sligo and County Roscommon and it flows northwards into Ballysadare Bay. It is fed by two main tributaries, the Owenmore which also rises in the Curlew Mountains and the Unshin which drains Lough Arrow. Both these rivers join near Collooney to form the Ballysadare River. Ballysadare Bay is listed as both a Special Area of Conservation (SAC) and a Special Protection Area (SPA). The site has been designated as a SPA under the EU Birds Directive.

A total of 13 beach seines, nine fyke nets and nine beam trawls were set in Ballysadare Estuary in October 2015 (Appendix 1). Salinity values taken at beach seine sites ranged from 0.39ppt in the upper estuary to 18.5ppt closer to the open sea. Temperatures ranged from 10.7°C to 13.3°C.

Fig. 12: Beach seine netting, Ballysadare Estuary.

A total of 21 fish species were recorded in Ballysadare Estuary during October 2015 (Appendix 2). Sprat was the most abundant species, followed by sand goby and common goby. Five-bearded rockling were quite common compared to other transitional waters sampled in 2015. Angling species of interest caught include cod and pollack. A single worm pipefish was captured in a fyke net. This was one of only two captured in all surveys in 2015.

Although species richness was relatively high, actual numbers of fish captured was low compared to transitional water bodies which were surveyed further to the south in 2015.

Only nine different species were captured in the 2008 survey. However, the 2015 survey is not comparable to this for two reasons. Firstly, the area sampled in 2008 was confined to the uppermost half of the estuary, which is influenced largely by fluvial inputs. This meant that the marine fish which were captured in 2015 were largely absent in the 2008 survey. Secondly, sampling effort was far lower in 2008.

The EMFI classified the Ballysadare estuary transitional water body as 'Good' ecological status (EQR =0.73) based on the fish populations present. This is an improvement on the 2008 survey when the water body achieved 'Moderate' status (EQR=0.43). However, as already noted, the surveys are not comparable. All future surveys will sample the whole 2015 extent of the Ballysadare estuary.

4.6. Camus Bay

The Camus Bay transitional water survey was carried out between the 5th and 8th of October 2015. It was previously surveyed in 2009. Camus Bay covers an area of 10.75km² and is located on Ireland's west coast, approximately 36km north-west of Galway city. It is situated within a sparsely populated area of Connemara, with no large towns nearby, so it is assumed that human impacts are minimal. Camus Bay is a complicated network of wide open water areas, linked by a series of narrow channels that can flow rapidly on rising and falling tides. It has a rocky shoreline (Fig. 13), which in most places gives way to mud in shallow water. The intertidal zone is small with steep rocky shores in many places. Freshwater inputs from various lakes and small rivers flow into the estuary, most notably the Screeb River. This water body is located in the Kilkieran Bay and Islands SAC, which is important for a number of habitats listed in Annex I of the EU Habitats Directive, including lagoons and saltmarsh. Annex II listed species present include the otter (NPWS, 2006).

Fig. 13: Photo showing the rocky shoreline of Camus Bay.

A total of 14 beach seines, 12 fyke nets and seven beam trawls were deployed in Camus Bay in October 2015 (Appendix 1). Salinity values taken at beach seine sites ranged from 8.2ppt in the upper estuary to 29.4ppt in the lower estuary. Temperatures ranged from 12.2°C to 14.5°C.

A total of 24 fish species were recorded in Camus Bay during October 2015 (Appendix 2). This is a high species richness value and more species were found in only one site during 2015. Three-spined stickleback was the most abundant species, followed by sand smelt, black goby and ballan wrasse. This order in abundance is very similar to the survey in 2009. Large numbers of bull huss (27) were captured in fyke nets. Camus bay is the only transitional water body where bull huss were encountered in 2015. A number of otherwise rare species were quite common in Camus Bay (black goby and corkwing wrasse for example).

All of the three-spined stickleback as well as most of the eels were captured in the upper half of the Bay, whereas the wrasse and bull huss were more abundant at the lower sites

closer to the sea. Flounder and plaice were recorded in relatively small numbers. Six common sole were caught in a single fyke net. A number of other species of angling importance were present, including bull huss, brown trout, thick-lipped grey mullet, pollack and cod albeit in small numbers.

Camus Bay contained a high number of fish species, with a composition typical of a marine environment with high salinities. The rocky substrate in the intertidal area, however, was an unsuitable habitat for flatfish species, such as plaice and flounder. This was reflected in the low abundance of flatfish species in this estuary.

Although the 2009 survey detected three more species, this is largely due to differences in species captured in small numbers. For example, in 2009 a single Thornback ray was caught. Also goldsinny wrasse (2) and painted goby (2) were encountered in 2009 but not 2015. However, the more abundant species such as three-spined stickleback, black goby, and bull huss were encountered in very similar numbers, which indicated that this habitat has remained quite stable over the six years. The result that the waterbody stayed at a classification of 'Good' ecological status between 2009 and 2015 confirms this with EQR values very remaining similar between sampling years (2009 EQR = 0.71, 2015 EQR = 0.79).

4.7. Kinvara Bay

The Kinvara Bay transitional water body survey was carried out between the 14th and 16th of September 2015. It was previously surveyed in 2009.

Kinvarra Bay covers an area of 5.73km² and is situated on Ireland's west coast, approximately 13km south-west of Galway City, on the southern end of Galway Bay. The surrounding land remains largely undeveloped. This water body is situated within the Galway Bay Complex SAC, which is important for a number of salt marshes, a habitat listed in Annex I of the EU Habitats Directive. Annex II listed species present include the common seal (NPWS, 2006). The shoreline is largely rocky (Fig. 14), which in inner sections gives way to mud in shallow water. The transitional water body accepts minor freshwater inputs from small rivers and streams.

Fig. 14: Seine net set in Kinvarra Bay with rocky substrate in background.

A total of 11 beach seines, six fyke nets and seven beam trawls were deployed in Kinvara Bay in September 2015 (Appendix 1). Salinity values taken at beach seine sites ranged from 2.6ppt in the upper estuary to 41.3ppt in the lower estuary and temperatures ranged from 12°C to 15.9°C during the survey.

A total of 23 fish species were recorded in Kinvara Bay (Appendix 2). This is an increase of five to the survey in 2009. Kinvara Bay is at the high end of the scale of species richness compared to other WFD transitional water sites surveyed around the country in 2015. A number of species of angling importance were present, including, sea trout, ballan wrasse, pollack and cod. Sprat was the most abundant species captured, followed by lesser sandeel. Ballan wrasse and cod were very common compared to other sites sampled in 2015. Cod ranged in length from 9.0cm to 19.0cm (Fig. 15).

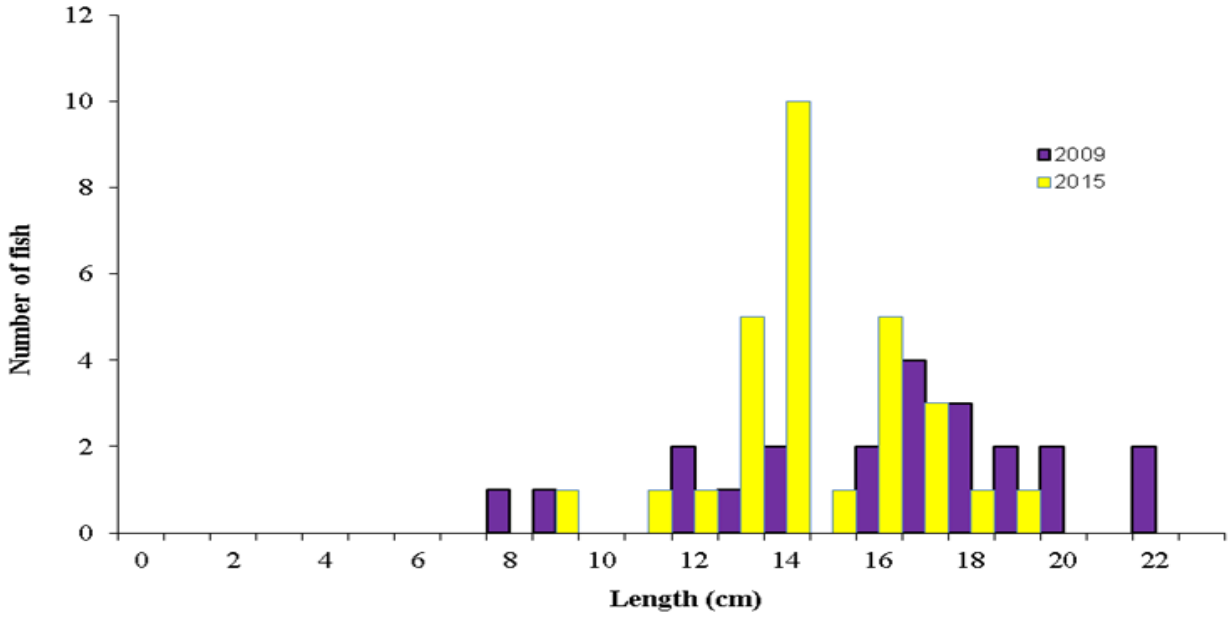

Fig. 15: Length frequency distribution of a sub-sample of cod captured in Kinvara bay (n = 22, 2009), (n=29, 2015).

Kinvara Bay contained a relatively high number of fish species, with a composition typical of a marine environment with low freshwater influence. The rocky substrate in the intertidal area, however, was an unsuitable habitat for flatfish species, such as plaice and flounder. This was reflected in the relatively low abundance of flatfish species in this estuary. As could be expected, a large number of species usually associated with rocky habitat were present in good numbers. Once again, relatively large numbers of juvenile cod were captured in Kinvara bay, indicating that it may be suitable habitat for juvenile cod. The generally rough, rocky substrate was thought to be the major reason for the low capture rate of the beam trawl in this transitional water body.

Although the 2009 survey captured five less species, this is largely due to differences in species captured at low rates. For example, in 2015 a single pogge was caught. Also deep-snouted pipefish (2) and conger eel (3) were encountered in 2015 but not 2009. Although large populations of mobile species, namely sprat and lesser sandeel were captured in 2015 but were not encountered in 2009, the waterbody status remained stable between the two sampling periods. A classification of 'Good' ecological status was given for 2009 and 2015. EQR values were similar between sampling years (2009 EQR = 0.86, 2015 EQR = 0.84).

4.8. Castlemaine Harbour

The Castlemaine Harbour survey was carried out between the 28th of September and 1st of October 2015. Castlemaine Harbour is a large (57.64Km^2) shallow estuary occupying the inner part of Dingle Bay, Co. Kerry, on the southern side of the Dingle Peninsula, close to the town of Killorglin. Five large rivers (Rivers Laune, Maine, Behy, Emlagh and Caragh) and several small streams discharge into the harbour. The estuary is sheltered from the open sea by three sand spits which protrude into the estuary; Rosbehy and Cromane both extend northwards while Inch extends southwards from the Dingle Peninsula. The area has a large range of habitat types, consisting of intertidal sand and mudflats supporting beds of eel grass in some places (NPWS, 2010), as well as shingle and rocky shorelines. The waterbody is largely under fluvial influence in its innermost sections, ranging to nearly fully marine at its outmost edges.

The site was last surveyed in 2011 as two separate transitional waterbodies (Castlemaine harbour and Cromane estuary). These have since been subsumed into a single waterbody, named Castlemaine harbour. The waterbody is a candidate SAC which is designated for a range of marine, coastal and terrestrial habitats (NPWS, 2006), as well as a number of species listed on Annex II of the EU Habitats Directive (i.e. sea lamprey, river lamprey, Atlantic salmon, Otter, liverwort and petalwort). A commercial salmon fishery was reopened in Castlemaine Harbour (inside the Rivers Laune, Maine and Caragh) in 2011 (IFI, 2011). A large proportion of the estuary was designated as a shellfish area in 1994 under the European Communities (Quality of Shellfish Waters Regulations) 2004 (Anon, 2009). One of the largest natural mussel beds in Ireland is located within the Cromane estuary waterbody. Mussels have been exploited within the site since the late 1800s and the fishery is managed by a local co-operative society. More recently oysters and clams are being cultivated within the site (Marine Institute, 2011).

A total of 18 beach seines (Fig. 16), 10 fyke nets and 11 beam trawls were deployed in Castlemaine harbour in 2015 (Appendix 1). Salinity values taken at beach seine sites ranged from 0.072 ppt high up in the estuary to 33.6ppt in the lower estuary. Water temperatures ranged from 13°C to 17.7°C.

Fig. 16: Closing the beach seine. Castlemaine Harbour.

A total of 28 fish species were recorded in Castlemaine harbour during September and October 2015 (Appendix 2). Common goby was the most abundant species, followed by sand goby and sand smelt. A single worm pipe fish was captured. This was one of only two captured in all surveys in 2015. Single specimens of another six species were also captured during the survey. Like 2011, a broad range of flounder were captured during the survey (Fig. 17). Similarly to 2011, large numbers of thick-lipped grey mullet were captured.

Twenty eight species is at the high end of the scale in terms of species richness compared to other WFD transitional water sites surveyed around the country in any year. This number was greater than all other transitional water bodies sampled in 2015. Species of angling importance which were present would include brown trout, salmon, thick lipped grey mullet and pollack. The large variety of species present is not surprising, considering the disparate range of habitats present in the waterbody throughout its large area.

Although the 2009 survey detected two less species than the 2015 survey, it should be noted that five species were caught in 2009 which were not encountered in 2015. Likewise, seven species were caught in 2015 which were not encountered in 2009. These results,

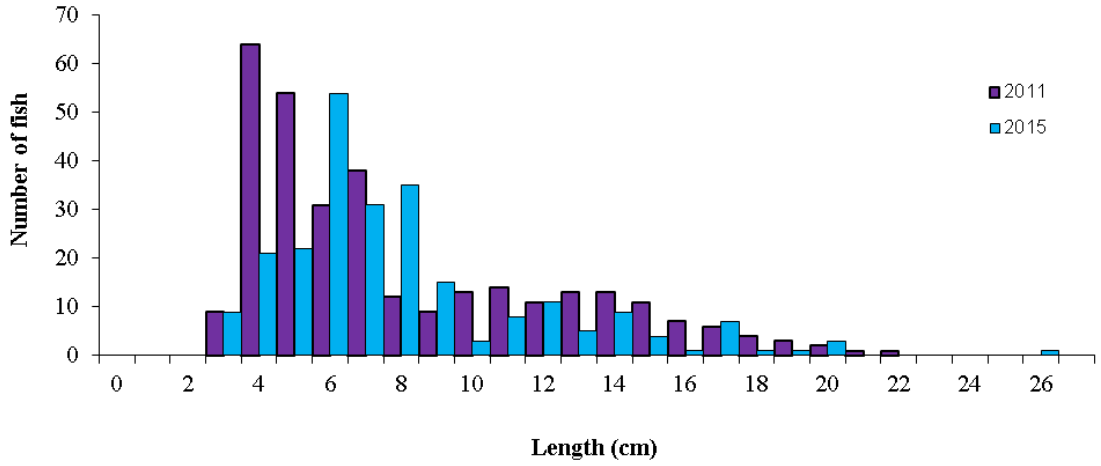

Fig. 17: Length frequency distribution of Flounder in Castlemaine Harbour waterbody, 2011 (n=317) and 2015 (n=243).

along with the fact that only a single member of a number of species was captured (7) during the 2015 survey, mean that it must be considered if current sampling effort is sufficient for transitional water bodies as large and heterogeneous as this one. The waterbody achieved a classification of 'Good' ecological status (EQR = 0.79) due to the fish populations present during the survey.

4.9. Lee (Kerry) Estuary & Tralee Bay inner combined

The Tralee Bay survey was carried out between the 17th and the 20th of August 2015. This is the first time since 2005 that the coastal water body, designated as Inner Tralee bay and the transitional water body, designated as the Lee (Kerry) estuary have been surveyed together. Although Inner Tralee bay is designated as a coastal water body it was felt that a combination of the two water bodies gives a truer reflection of the status of the site. This is because the Lee (Kerry) transitional waterbody is particularly shallow. This makes sampling difficult and there is only a limited opportunity for sampling within each tidal cycle. This is reflected in the previous survey of 2009 where only 4 species were captured and as such status was designated as poor.

The Lee (Kerry) Estuary is part of Tralee Bay and is located approximately three kilometres south-west of Tralee, Co. Kerry. The estuary covers an area of 3.21km². The estuary is extremely shallow and the predominant bed type is soft muddy sediments. The estuary receives the water of the River Lee which runs west through the town of Tralee and into the estuary. Adjoining the Lee Kerry estuary is Inner Tralee bay. Large portions of this section also drain to exposed sand flats at low tide. The margins consist of a combination of sand/cobble and mud substrate (Fig. 18).

A total of 10 beach seines, 6 fyke nets and 9 beam trawls were set in Tralee bay in 2015

Fig. 18: Inner Tralee bay.

(Appendix 1). Salinity values taken at beach seine sites ranged from 37.4 ppt to 41.2ppt which indicates that fluvial influences are minor. Water temperatures ranged from 17.2°C to 20.1°C.

Twenty species were recorded in Tralee Bay in 2015 (Appendix 2). Sand goby was the most abundant species, followed by plaice and greater pipefish respectively. Two highly prized angling species, European sea bass (Fig. 19) and common sole (Fig. 20) were also captured in good numbers during the survey. This is particularly important considering that bass were not encountered and common sole were encountered only once during the other WFD surveys in 2015. This in conjunction with the presence of large numbers of juvenile plaice (Fig. 21) offers good evidence that Tralee Bay is an important nursery for a range of popular angling species.

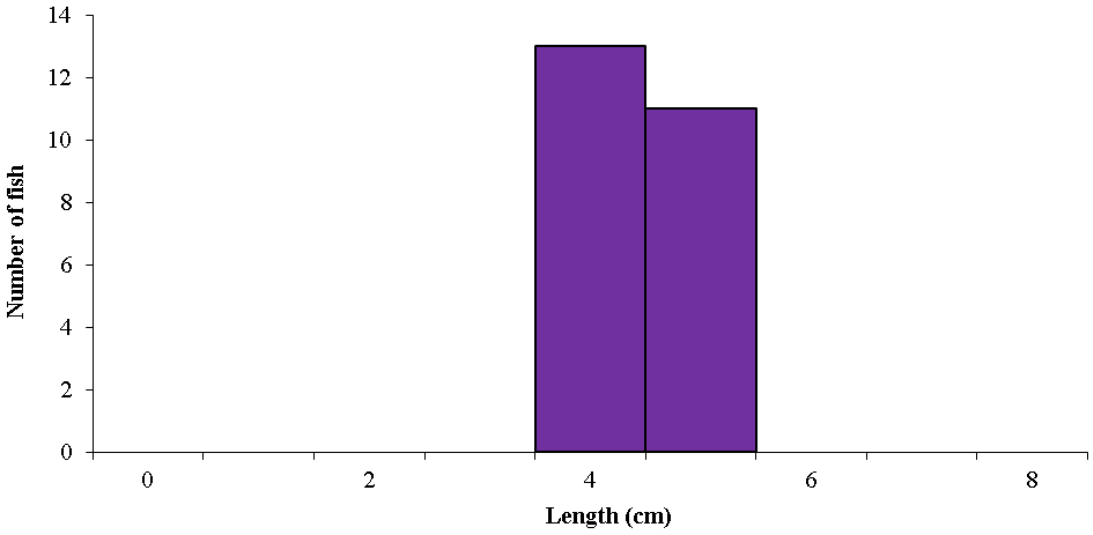

Fig. 19: Length frequency distribution of European Sea Bass in Tralee bay, 2015 (n=24).

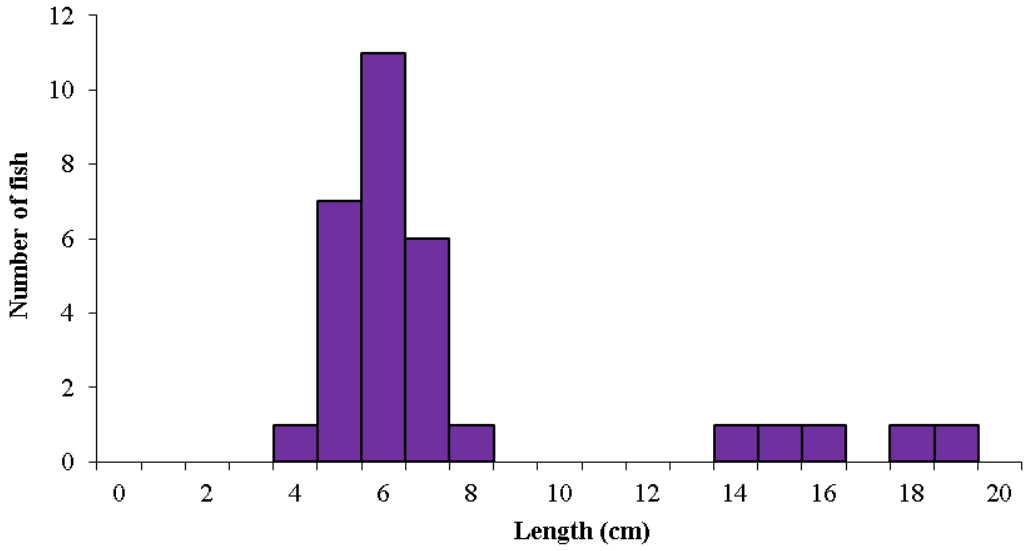

Fig. 20: Length frequency distribution of Common Sole in Tralee bay, 2015 (n=31).

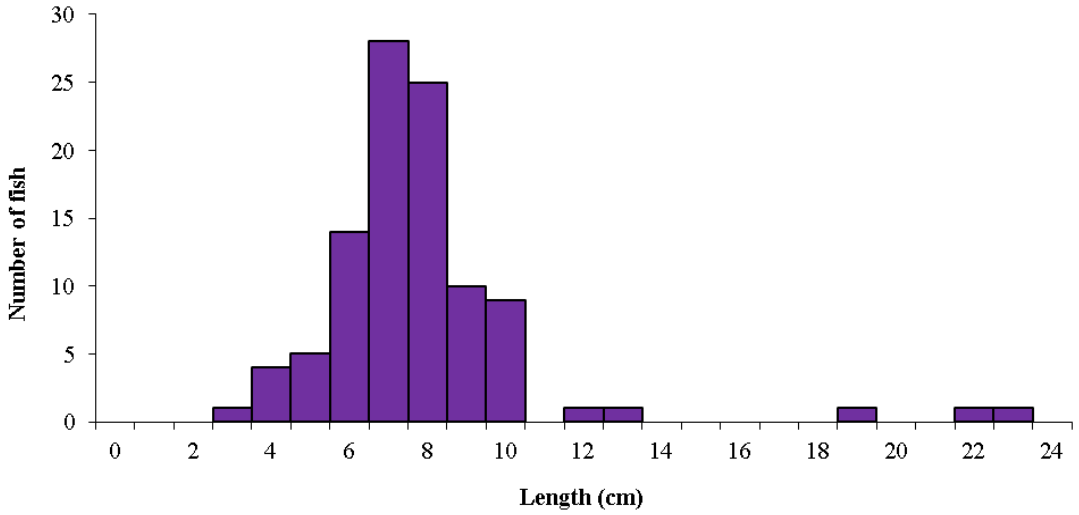

Fig. 21: Length frequency distribution of Plaice in Tralee bay, 2015 (n=101).

5. General Discussion

As required under the WFD, IFI undertook sampling of a number of transitional water bodies in 2015 as part of a rolling national monitoring programme. This also satisfied part of IFI's role in marine recreational species conservation management. Subsequently, a water quality status was assigned to each waterbody based on the multi metric fish index EMFI Harrison and Kelly 2014). When applicable, current fish ecological status was compared to previous years (Table 1).

Overall, the monitoring programme highlighted positive trends from the perspective of the health of fish populations. None of the nine waterbodies sampled in 2015 displayed a reduction in fish ecological status and the status of three improved (although the sampling extent of two of these was amended between sampling years).

Regarding those sites which status improved between monitoring; concerns had been expressed as to the Gweebarra designation in 2012. It is in a region of minor human interference and other criteria (e.g. physio-chemical characteristics,) determined that the transitional water body to be in 'Good' condition. The current designation appears to more accurately reflect a status consistent with other indicators. In 2015 the sampling area of both the Ballysadare and Castlemaine harbour transitional waterbodies were increased substantially to include additional marine type habitat. This resulted in a substantial increase in species richness between sampling years. Both results point to a requirement to

review and sense check some outputs where other indicators are clearly demonstrating a substantially different rating.

Estuary	EMFI EQR	EMFI Classification	Previous EMFI EQR	Previous EMFI Classification
Avoca	0.88	Good	0.73	Good(2010)
Boyne	0.66	Good	0.75	Good(2012)
Gweebarra	0.79	Good	0.54	Moderate(2012)
Erne	0.61	Moderate	0.41	Moderate(2012)
Ballysadare	0.73	Good	NA	Moderate(2012)*
Camus Bay	0.79	Good	0.71	Good(2009)
Kinvara Bay	0.84	Good	0.86	Good(2009)
Castlemaine Harbour	0.79	Good	0.63	Moderate(2011)*

Table 1: EMFI quality ratings of all waterbodies sampled under IFI's transitional waterbody survey programme and their variation between sampling years.
***Extent of survey amended between sampling years**

The Erne estuary was the only transitional waterbody to be classified as 'Moderate' fish status in 2015. However, species richness improved greatly on the previous sampling year. A post analysis "sense check" of the EMFI output found that if lesser sandeel captures were reduced by half, the Erne would have achieved good ecological status. This result will be revisited and it will be decided if a revision of fish ecological status is appropriate.

Fish populations remained extremely stable between 2009 and 2015 in Camus Bay and Kinvara Bay. Due to rocky intertidal habitats and minor fluvial influences, their fish populations were markedly different to other sites sampled in 2015. The presence of a number of different wrasse species found only in these waterbodies is a good example of this. As human impacts are minor, a change in fish status was not expected and the consistent temporal results confirm this. Both sites seem to be potentially important for diverse marine angling species such as wrasse and bull huss.

The transitional water bodies sampled on the East coast both achieved 'Good' status. These results were unexpected considering the environmental pressures both are subject to. The Boyne achieved a borderline 'Good' status and EQR has fluctuated widely at this site since

2009, indicating that the waterbody is experiencing pressures and continued monitoring is important.

The Avoca estuary is known to be under pressure from both acid mine drainage higher in the catchment and raw sewage inputs to the estuary itself. The presence of raw sewage effluent in the estuary was noted during sampling. For these reasons it was surprising that 'Good' status was achieved. Continued monitoring is required to ensure that the diadromous species captured in the 2015 survey, which improved status, continue to use the estuary.

To conclude, all transitional waterbodies sampled in 2015 had fish populations consistent with a well-functioning ecosystem. As expected, those with a large fluvial input and as a result, large areas of sand-silt substrate had abundant populations of juvenile flounder and gobies. Both the benthic invertebrates associated with the sediment and the smaller fish species provide feeding opportunities for the juvenile marine species encountered during the sampling survey. These include species such as cod, pollack, bass and plaice. The two transitional waterbodies sampled without a significant fluvial input, namely Camus bay and Kinvarra held contrasting but equally diverse fish populations. A diverse range of wrasse species were encountered throughout.

Although the Erne estuary didn't achieve good status, the large numbers of lesser sandeel encountered during sampling must provide an abundant food source for the important sea trout population which moves down through the Erne catchment to feed in the estuary at this time of year. Interestingly, a relatively large number of sea trout for a survey of this kind were caught by seine net in the same area of the estuary as the sandeel captures. It is likely that the sea trout were caught while feeding.

It is vital to continue to monitor these important habitats to ensure that they continue to function as spawning, nursery, feeding and shelter areas for a range of fish species using the waters as residents, as seasonal or juvenile visitors or simply passing between the truly marine and the freshwater habitats.

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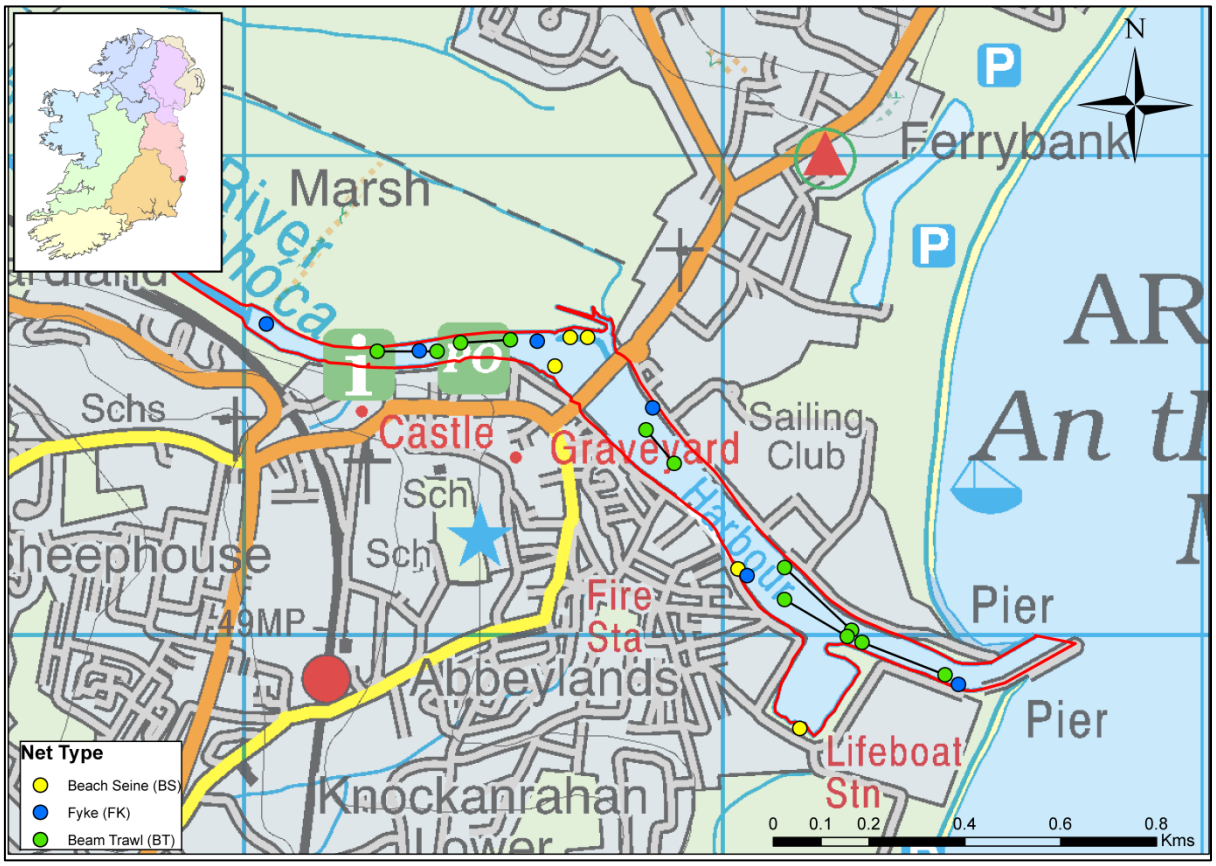
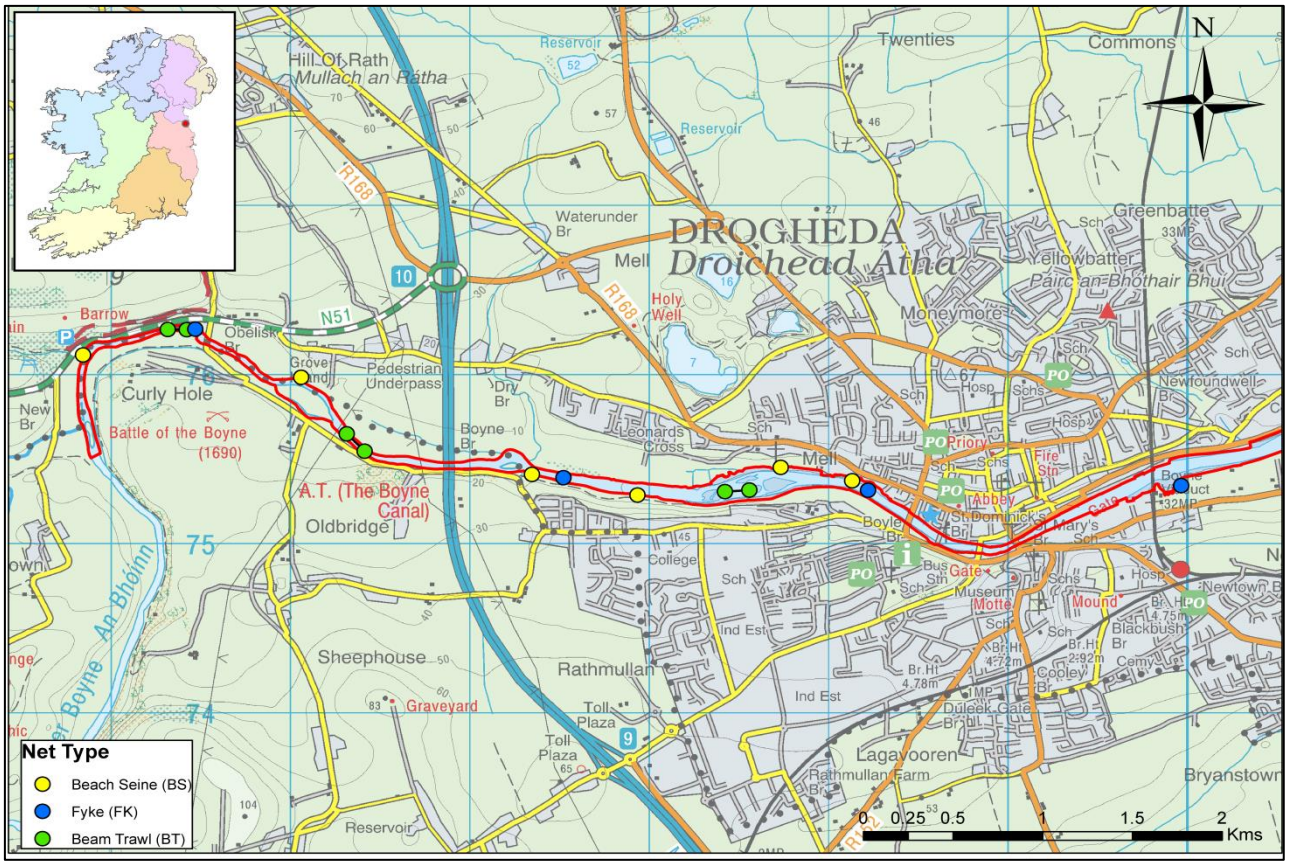
7. Appendices

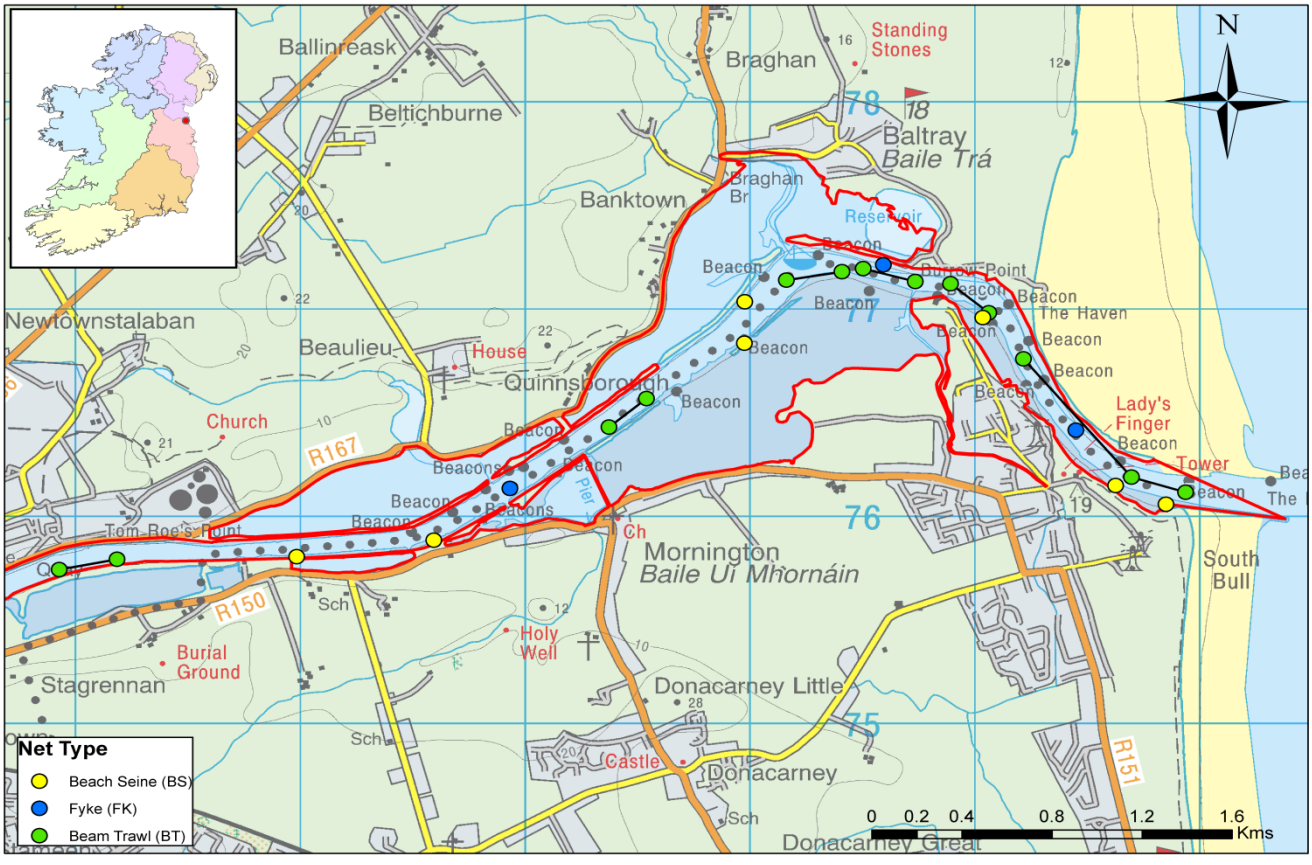
Appendix 1: Sampling Maps 2015 (key to sample type shown within map)



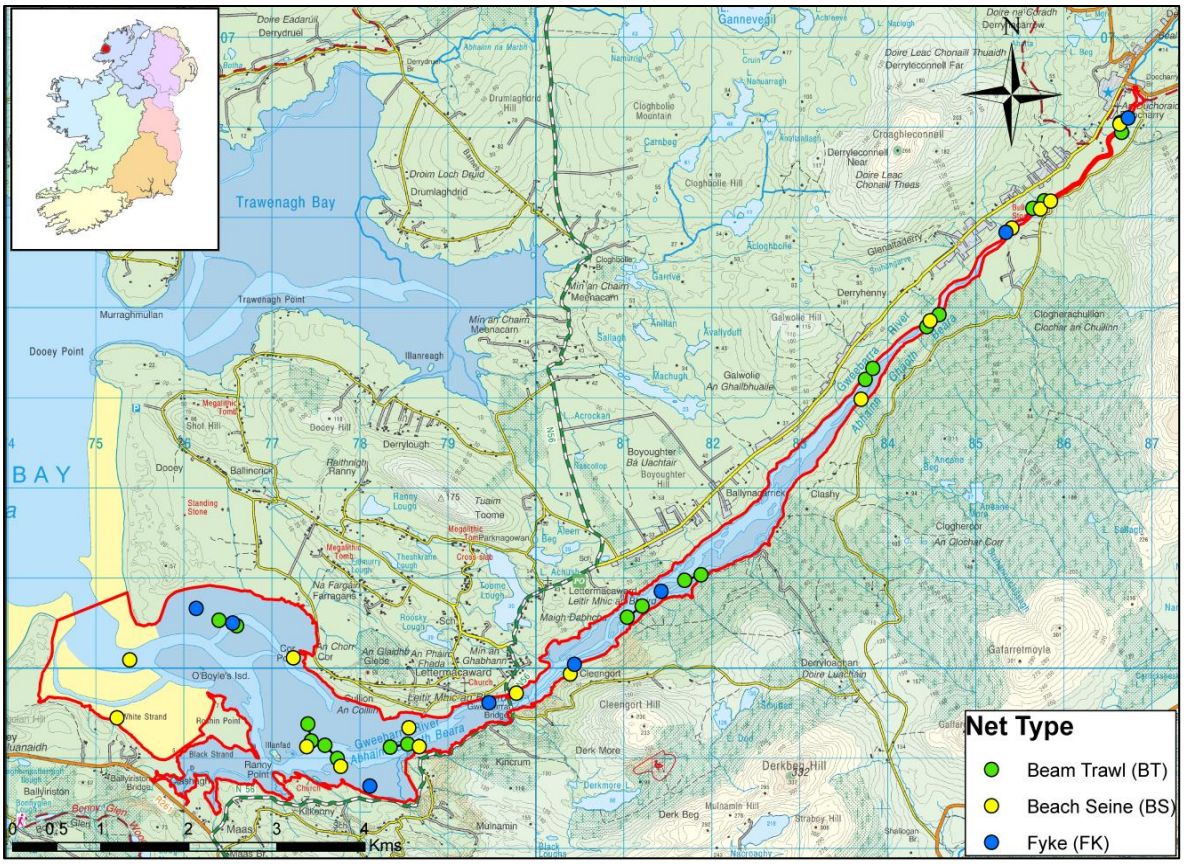
Location map of the Avoca Estuary indicating sample sites, September 2015



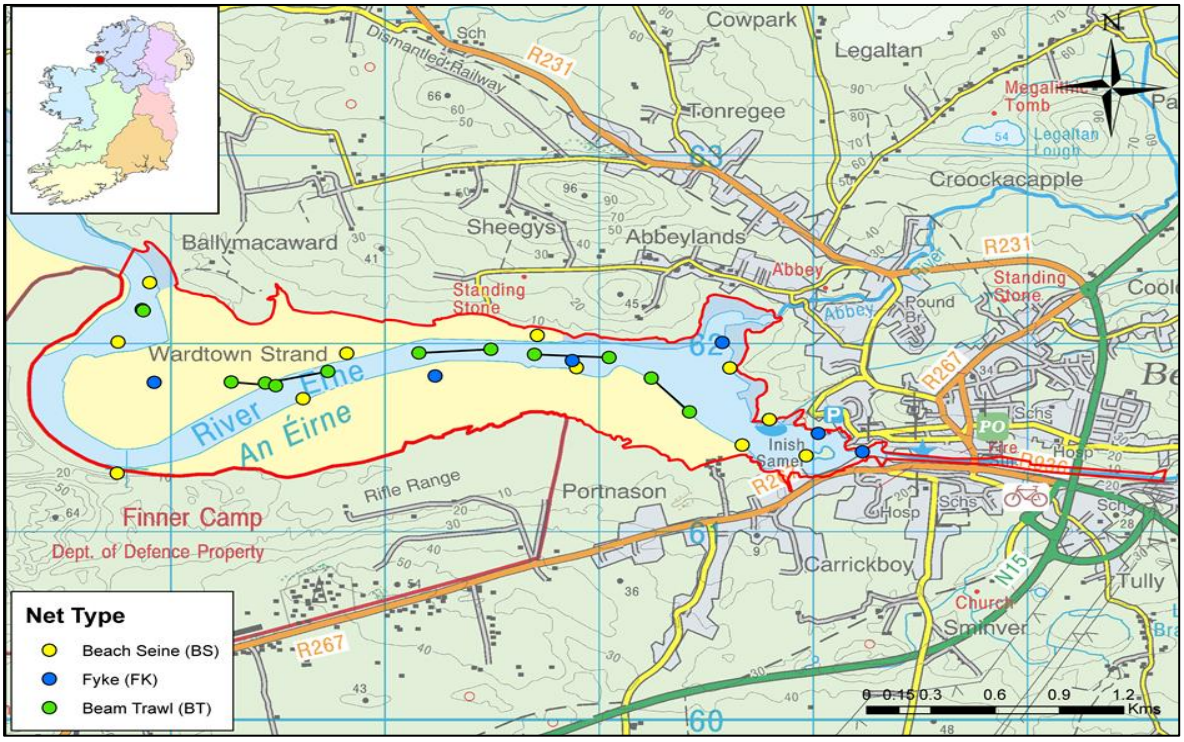
Location map of the Boyne Estuary (west) showing sample sites Sept- Oct 2015.



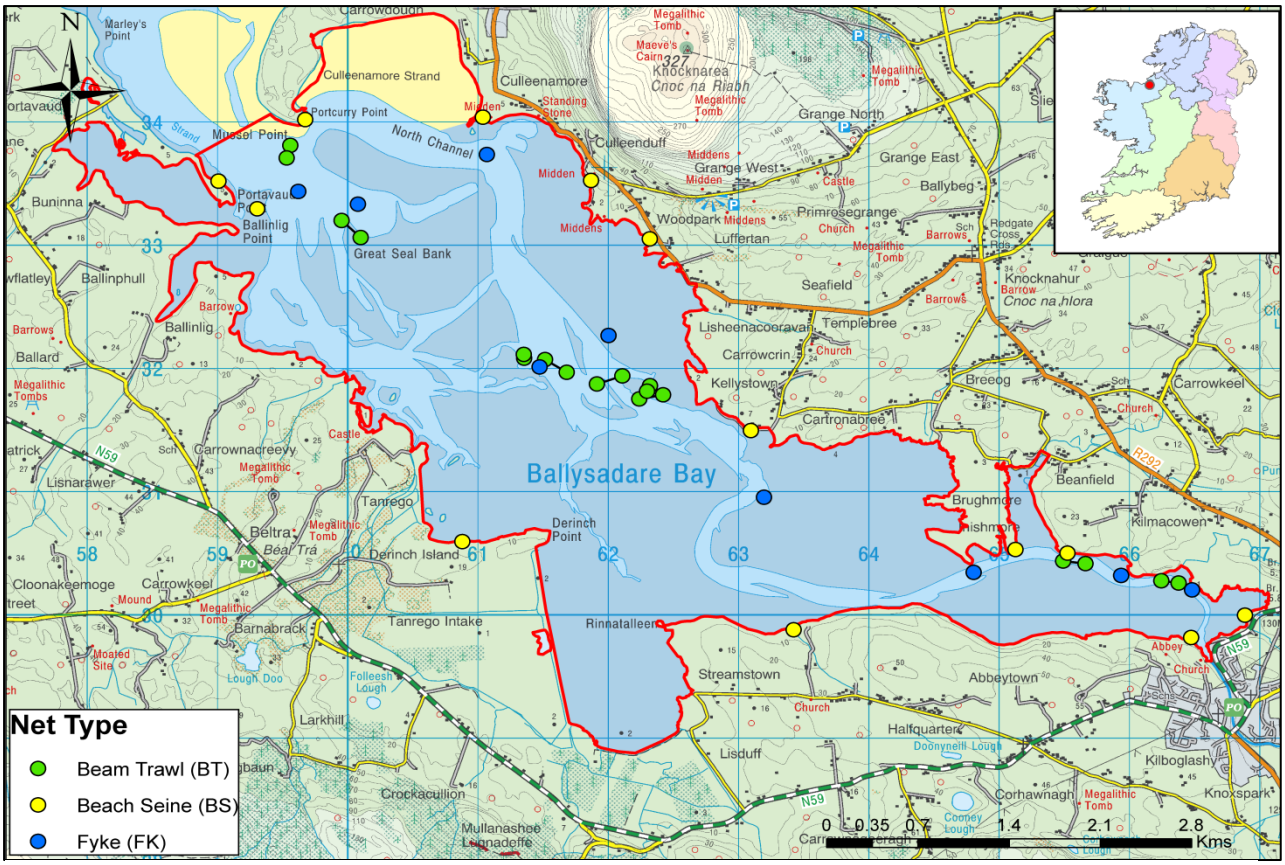
Location map of the Boyne Estuary (east) showing sample sites Sept- Oct 2015



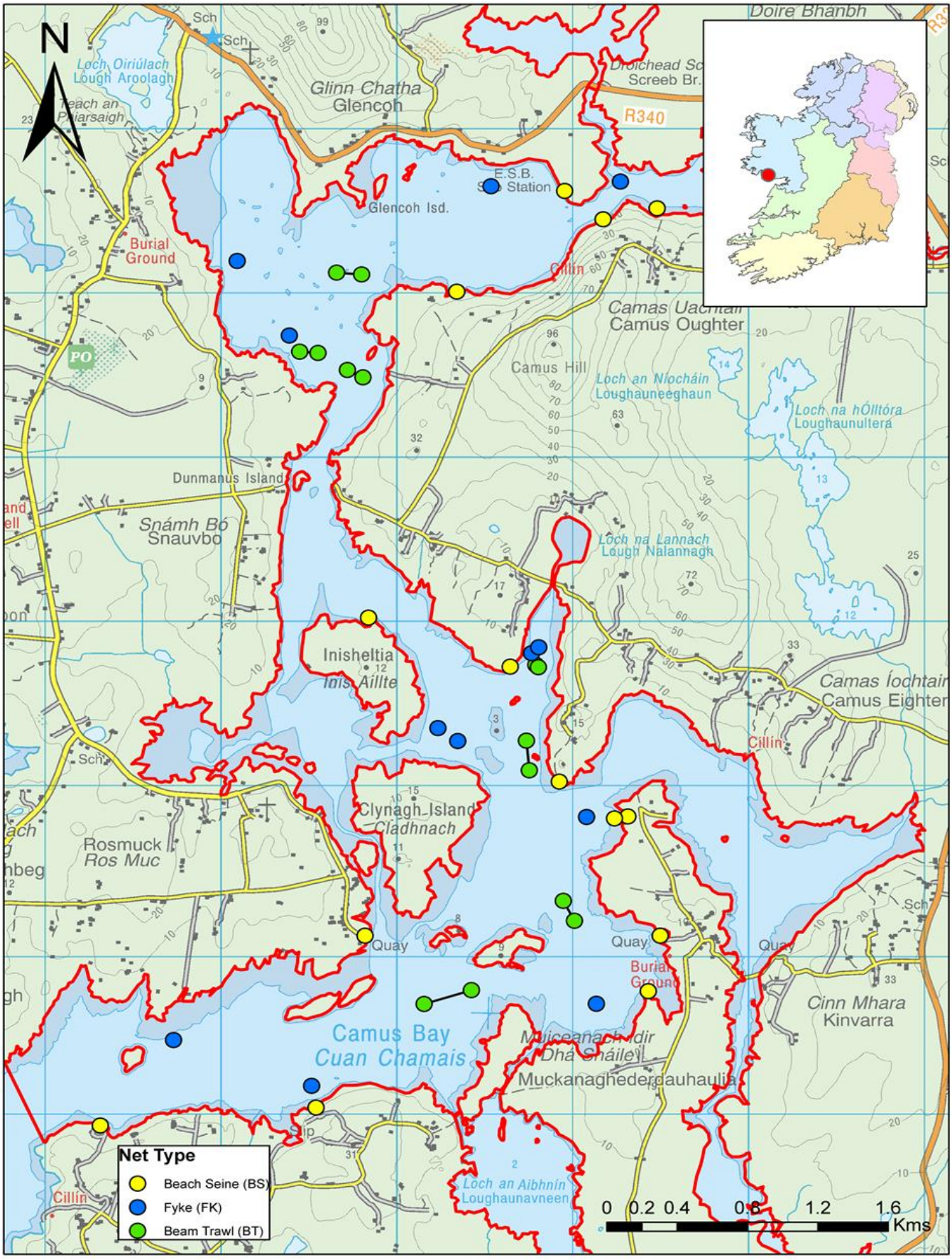
Location map of the Gweebarra Estuary, showing sample sites, October 2015



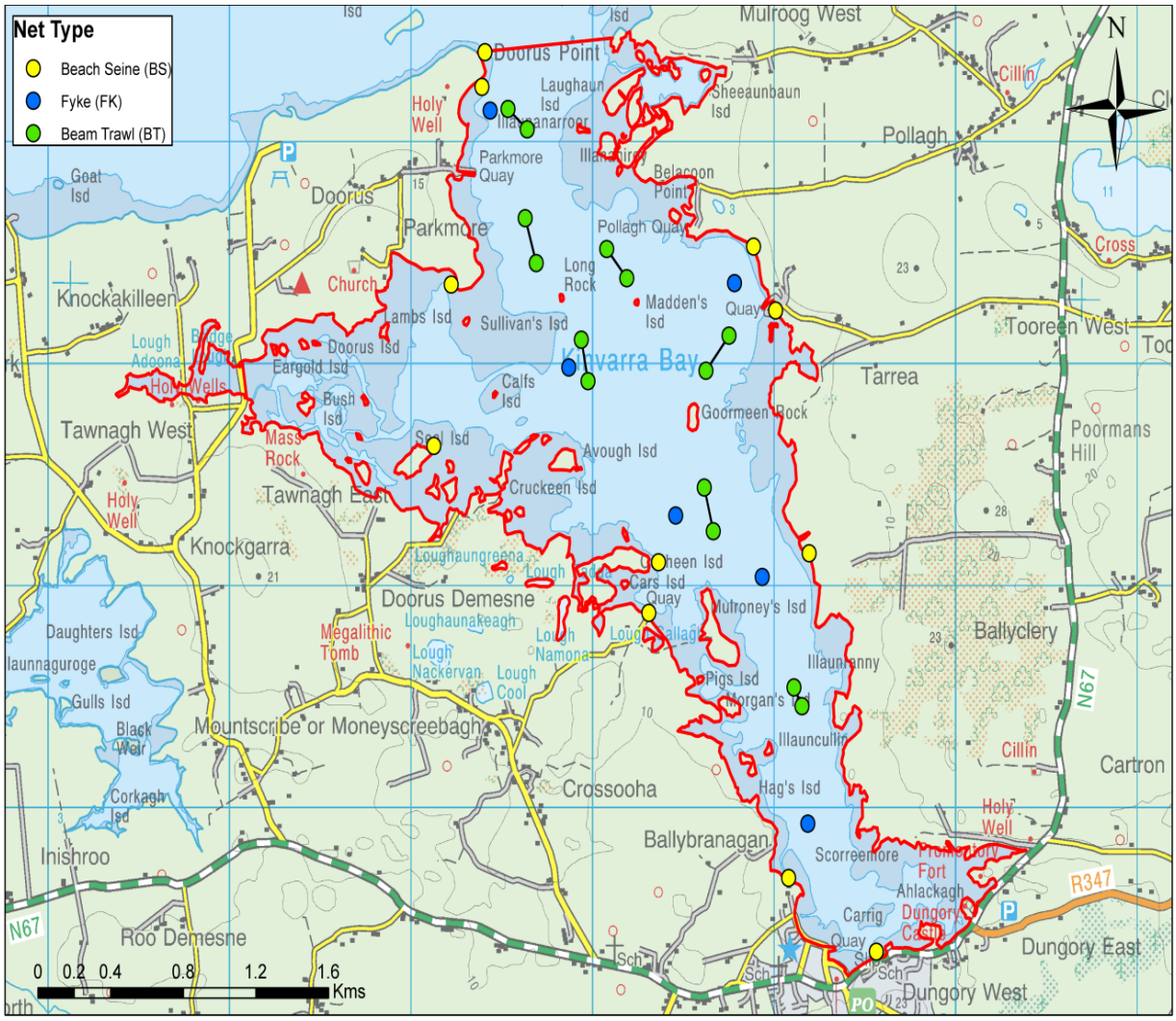
Location map of the Erne Estuary, showing sample sites, October 2015



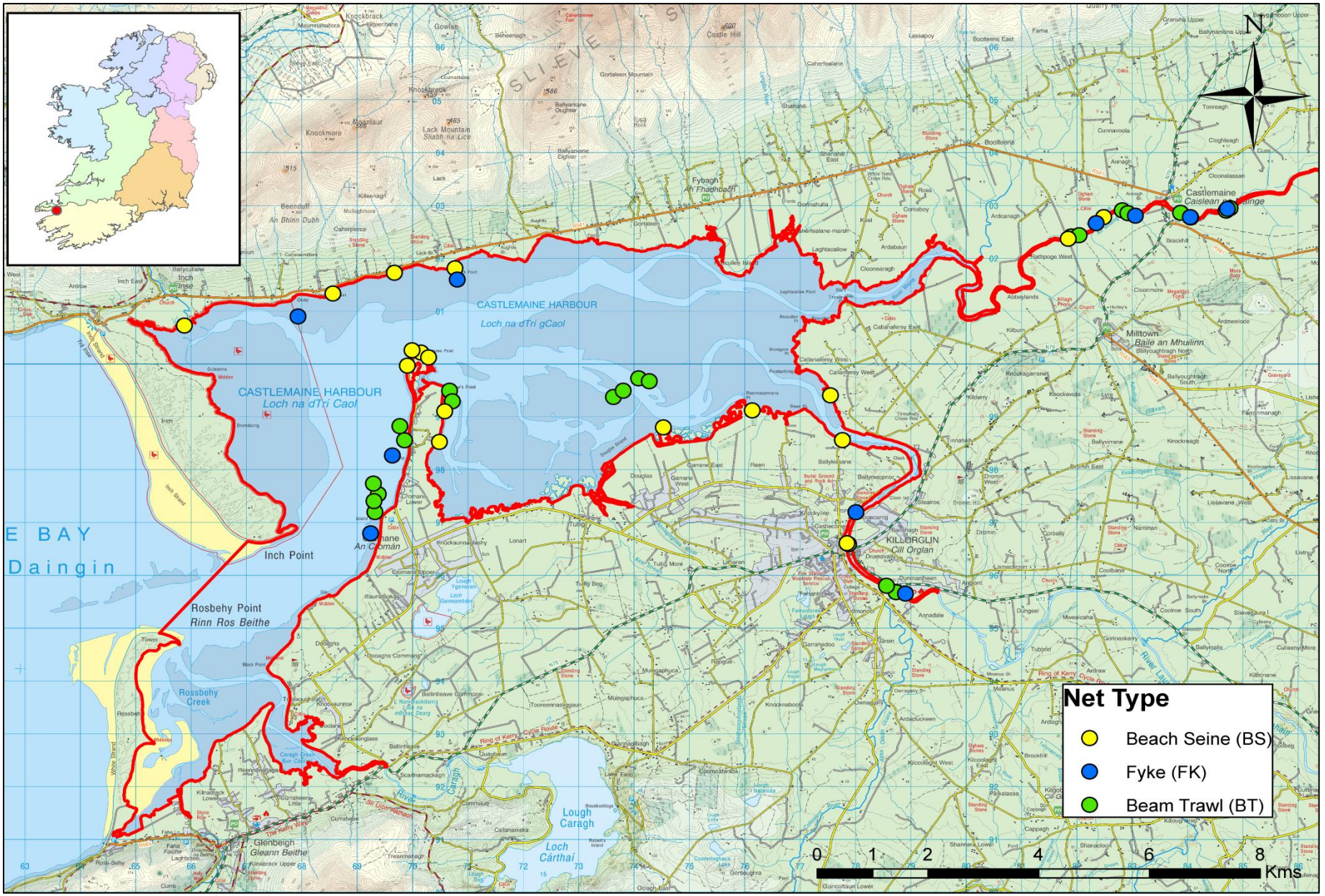
Location of Ballysadare Estuary showing sample sites, October 2015.



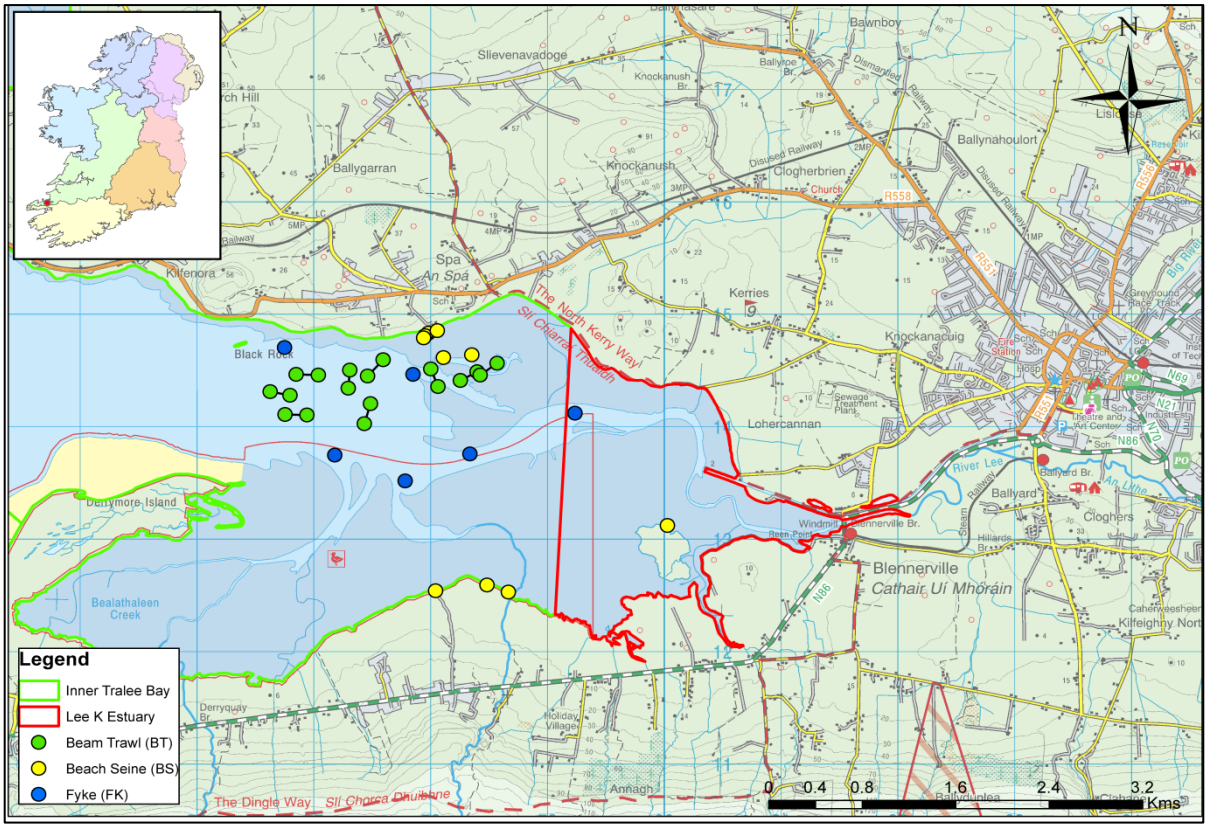
Location map of Camus Bay showing sample sites, October 2015



Location map of Kinvara Bay showing sample sites, October 2015



Location map of Castlemaine Harbour showing sample sites, October 2015



Location map of Tralee bay indicating sample sites and relevant waterbodies

Appendix 2: Sampling Data

Species type and count data for each sampling method, The Avoca estuary 2015

Scientific name	Common name	Beach Seine (5)	Fyke net (6)	Beam trawl (6)	Total
Salmo trutta	Brown trout	2	0	0	2
Gadus morhua	Cod	0	1	0	1
Anguilla anguilla	European eel	0	12	0	12
Ciliata mustela	Five-bearded rockling	0	11	0	11
Platichthys flesus	Flounder	76	41	35	152
Ammodytes tobianus	Lesser sandeel	14	0	0	14
Taurulus bubalis	Long-spined sea scorpion	0	1	0	1
Pleuronectes platessa	Plaice	2	0	0	2
Pollachius pollachius	Pollack	0	7	0	7
Trisopterus minutus	Poor cod	0	1	0	1
Lampetra fluviatilis	River Lamprey	0	1	0	1
Salmo salar	Salmon	16	0	0	16
Pomatoschistus minutus	Sand goby	256	0	2	258
Atherina presbyter	Sand smelt	28	0	0	28
Chelon labrosus	Thick-lipped grey mullet	2	0	0	2
Gasterosteus aculeatus	Three-spined stickleback	3	0	0	3

Number of samples per sampling method in parenthesis. Species richness=18

Species type and count data for each sampling method the Boyne Estuary, September 2015

Scientific name	Common name	Beach seine 2015 (12)	Fyke net 2015 (7)	Beam trawl 2015 (6)	Total fish 2015
Salmo trutta	Brown trout	2	0	0	2
Gadus morhua	Cod	0	17	0	17
Anguilla anguilla	European eel	2	4	0	6
Ciliata mustela	Five-bearded rockling	0	10	0	10
Platichthys flesus	Flounder	90	29	13	132
Syngnathus acus	Greater pipefish	1	0	0	1
Pholis gunnellus	Gunnel (Butterfish)	3	0	0	3
Ammodytes tobianus	Lesser sandeel	593	0	0	593
Taurulus bubalis	Long-spined sea scorpion	4	1	6	11
Phoxinus phoxinus	Minnow	487	0	0	487
Pleuronectes platessa	Plaice	0	0	5	5
Pollachius pollachius	Pollack	1	1	3	5
Trisopterus minutus	Poor cod	0	1	0	1
Rutilus rutilus	Roach	14	0	0	14
Pomatoschistus minutus	Sand goby	136	0	22	158
Atherina presbyter	Sand Smelt	3	0	0	3
Sprattus sprattus	Sprat	27	0	0	27
Chelon labrosus	Thick-lipped grey mullet	1	0	0	1
Gasterosteus aculeatus	Three-spined stickleback	2	0	0	2

Number of samples per sampling method in parenthesis. Species richness =19

Species type and count data for each sampling method the Erne Estuary, September 2015

Scientific name	Common name	Beach Seine (11)	Fyke net (6)	Beam trawl (6)	Total 2015
Scophthalmus	Brill	3	0	2	5
Pollachius virens	Coalfish (Saithe)	2	1	0	3
Gadus morhua	Cod	0	1	0	1
Conger conger	Conger eel	0	2	0	2
Limanda limanda	Dab	1	0	0	1
Syngnathus typhle	Deep-snouted pipefish	1	1	0	2
Anguilla anguilla	European eel	0	1	0	1
Spinachia spinachia	Fifteen-spined	0	1	0	1
Ciliata mustela	Five-bearded rockling	0	29	0	29
Platichthys flesus	Flounder	35	3	7	45
Syngnathus acus	Greater pipefish	1	0	0	1
Hyperoplus	Greater sandeel	8	0	0	8
Ammodytes	Lesser sandeel	14586	0	0	14586
Taurulus bubalis	Long-spined sea	0	4	0	4
Pleuronectes	Plaice	53	6	5	64
Pollachius	Pollack	0	3	0	3
Trisopterus	Poor cod	0	10	0	10
Pomatoschistus	Sand goby	509	2	1	512
Myoxocephalus	Short-spined sea	0	1	0	1
Gasterosteus	Three-spined	2	0	0	2
Agonus	Pogge	0	1	3	3
Salmo trutta	Sea trout	11	0	0	11

Number of samples per sampling method in parenthesis. Species richness =22

Species type and count data for each sampling method, the Gweebarra Estuary, October 2015

Scientific name	Common name	Beach Seine (15)	Fyke net (8)	Beam trawl (10)	Total (2015)
Gobius niger	Black goby	1	0	0	1
Scophthalmus rhombus	Brill	3	0	1	4
Salmo trutta	Brown trout	0	2	0	2
Pollachius virens	Coalfish (Saithe)	0	3	0	3
Gadus morhua	Cod	0	1	0	1
Anguilla anguilla	European eel	0	6	0	6
Ciliata mustela	Five-bearded rockling	0	2	0	2
Platichthys flesus	Flounder	120	12	27	159
Syngnathus acus	Greater pipefish	1	0	0	1
Ammodytes tobianus	Lesser sandeel	52	0	0	52
Taurulus bubalis	Long-spined sea scorpion	1	0	0	1
Pomatoschistus pictus	Painted goby	9	0	0	9
Pleuronectes platessa	Plaice	18	4	8	30
Pollachius pollachius	Pollack	0	4	0	4
Pomatoschistus minutus	Sand goby	64	0	4	68
Myoxocephalus scorpius	Short-spined sea scorpion	0	1	0	1
Sprattus sprattus	Sprat	327	4	0	331
Gasterosteus aculeatus	Three-spined stickleback	1	1	1	3
Chelidonichthys lucernus	Tub gurnard	1	0	0	1
Agonus cataphractus	Pogge	0	0	1	1

Number of samples per sampling method in parenthesis. Species richness =20

Species type and count data for each sampling method, Castlemaine harbour, October 2015					
Scientific name	**Common name**	**Beach Seine**	**Fyke net**	**Beam trawl**	**Total**
		(18)	**(10)**	**(11)**	**2015**
Trachurus	Atlantic horse	4	0	0	4
Salmo trutta	Brown trout	1	11	0	12
Callionymus lyra	Common dragonet	0	1	0	1
Pomatoschistus	Common goby	500	0	0	500
Crenilabrus	Corkwing wrasse	33	0	1	34
Clupea harengus	Herring	2	0	0	2
Anguilla anguilla	European eel	1	19	0	20
Dicentrarchus	European sea bass	1	0	0	1
Spinachia	Fifteen-spined stickleback	44	1	1	46
Ciliata mustela	Five-bearded rockling	1	13	0	14
Platichthys flesus	Flounder	57	134	104	295
Syngnathus acus	Greater pipefish	7	0	0	7
Pholis gunnellus	Gunnel (Butterfish)	1	1	0	2
Ammodytes	Lesser sandeel	1	0	0	1
Taurulus bubalis	Long-spined sea scorpion	0	1	0	1
Phoxinus phoxinus	Minnow	11	0	0	11
Syngnathus	Nilsson's pipefish	7	0	0	7
Pomatoschistus	Painted goby	1	0	0	1
Pleuronectes	Plaice	0	0	1	1
Pollachius	Pollack	9	19	0	28
Salmo salar	Salmon	3	2	0	5
Pomatoschistus	Sand goby	387	0	42	429
Atherina presbyter	Sand smelt	396	0	0	396
Sprattus sprattus	Sprat	73	0	0	73
Chelon labrosus	Thick-lipped grey mullet	77	0	0	77
Gasterosteus	Three-spined stickleback	241	0	5	246
Gobiusculus	Two-spotted goby	14	1	0	15
Nerophis	Worm pipefish	1	0	0	1
Number of samples per sampling method in parenthesis. Species richness =28					

Species type and count data for each sampling method Ballysadare estuary, October 2015

Scientific name	Common name	Beach Seine 2015(13)	Fyke net 2015(9)	Beam trawl 2015(9)	Total 2015
Trisopterus luscus	Bib	0	8	0	8
Scophthalmus rhombus	Brill	1	0	1	2
Gadus morhua	Cod	0	7	0	7
Pomatoschistus microps	Common goby	50	0	0	50
Limanda limanda	Dab	0	0	1	1
Anguilla anguilla	European eel	0	6	0	6
Spinachia spinachia	Fifteen-spined stickleback	7	0	0	7
Ciliata mustela	Five-bearded rockling	0	34	0	34
Platichthys flesus	Flounder	12	6	6	24
Hyperoplus lanceolatus	Greater sandeel	5	0	0	5
Ammodytes tobianus	Lesser sandeel	11	0	0	11
Taurulus bubalis	Long-spined sea scorpion	0	1	0	1
Syngnathus rostellatus	Nilsson's pipefish	5	0	0	5
Pleuronectes platessa	Plaice	5	1	10	16
Pollachius pollachius	Pollack	0	14	0	14
Pomatoschistus minutus	Sand goby	495	0	19	514
Atherina presbyter	Sand smelt	8	0	0	8
Nerophis lumbriciformis	Worm pipefish	0	1	0	1
Sprattus sprattus	Sprat	1370	1	23	1394
Gasterosteus aculeatus	Three-spined stickleback	9	0	0	9
Gobiusculus flavescens	Two-spotted goby	2	0	0	2

Number of samples per sampling method in parenthesis. Species richness =21

Species type and count data for each sampling method, Camus Bay, October 2015

Scientific name	Common name	Beach Seine (14)	Fyke net (12)	Beam trawl (7)	Total
Labrus bergylta	Ballan wrasse	5	27	4	36
Gobius niger	Black goby	27	16	1	44
Salmo trutta	Brown trout	1	0	0	1
Scyliorhinus stellaris	Bull huss	0	27	0	27
Gadus morhua	Cod	0	1	0	1
Callionymus lyra	Common dragonet	0	1	0	1
Solea solea	Common sole	0	6	0	6
Crenilabrus melops	Corkwing wrasse	5	11	0	16
Labrus mixtus	Cuckoo wrasse	0	3	0	3
Syngnathus typhle	Deep-snouted pipefish	8	0	0	8
Anguilla anguilla	European eel	4	1	0	5
Spinachia spinachia	Fifteen-spined stickleback	23	0	0	23
Platichthys flesus	Flounder	8	1	0	9
Hyperoplus lanceolatus	Greater sandeel	1	0	0	1
Taurulus bubalis	Long-spined sea scorpion	0	2	0	2
Pleuronectes platessa	Plaice	0	0	2	2
Pollachius pollachius	Pollack	0	16	0	16
Gobius paganellus	Rock goby	0	1	0	1
Pomatoschistus minutus	Sand goby	34	0	0	34
Atherina presbyter	Sand smelt	46	0	0	46
Myoxocephalus scorpius	Short-spined sea scorpion	0	2	0	2
Chelon labrosus	Thick-lipped grey mullet	1	0	0	1
Gasterosteus aculeatus	Three-spined stickleback	99	1	0	100
Gobiusculus flavescens	Two-spotted goby	32	0	0	32

Number of samples per sampling method in parenthesis. Species richness =24

Species type and count data for each sampling method, Kinvara Bay, October 2015

Scientific name	Common name	Beach Seine (11)	Fyke net (6)	Beam trawl (7)	Total 2015
Labrus bergylta	Ballan wrasse	3	31	0	34
Pollachius virens	Coalfish (Saithe)	4	4	0	8
Gadus morhua	Cod	1	28	0	29
Conger conger	Conger eel	0	3	0	3
Crenilabrus melops	Corkwing wrasse	4	6	0	10
Syngnathus typhle	Deep-snouted pipefish	1	1	0	2
Spinachia spinachia	Fifteen-spined stickleback	23	4	0	27
Ciliata mustela	Five-bearded rockling	0	6	0	6
Platichthys flesus	Flounder	2	0	0	2
Pholis gunnellus	Gunnel (Butterfish)	1	1	3	5
Ammodytes tobianus	Lesser sandeel	401	0	0	401
Taurulus bubalis	Long-spined sea scorpion	1	5	4	10
Pleuronectes platessa	Plaice	6	0	0	6
Pollachius pollachius	Pollack	2	15	0	17
Gobius paganellus	Rock goby	1	7	2	10
Pomatoschistus minutus	Sand goby	126	0	6	132
Atherina presbyter	Sand smelt	99	0	0	99
Myoxocephalus scorpius	Short-spined sea scorpion	2	0	0	2
Sprattus sprattus	Sprat	575	0	0	575
Chelon labrosus	Thick-lipped grey mullet	1	0	0	1
Merlangius merlangus	Whiting	0	1	0	1
Agonus cataphractus	Pogge	0	1	0	1
Salmo trutta	Sea trout	5	0	0	5

Number of samples per sampling method in parenthesis. Species richness =23

Species type and count data for each sampling method Lee K & Tralee bay inner 2015

Scientific name	Common name	Beach Seine (10)	Fyke net (6)	Beam trawl (10)	Total 2015
Trachurus trachurus	Atlantic horse mackerel/Scad	3	0	0	3
Gobius niger	Black goby	2	0	2	4
Scophthalmus rhombus	Brill	0	0	1	1
Solea solea	Common sole	29	0	2	31
Pomatoschistus microps	Common goby	4	0	0	4
Callionymus lyra	Common dragonet	2	1	4	7
Anguilla anguilla	European eel	0	9	0	9
Dicentrarchus labrax	European sea bass	25	0	0	25
Spinachia spinachia	Fifteen-spined stickleback	14	7	0	21
Ciliata mustela	Five-bearded rockling	0	1	0	1
Platichthys flesus	Flounder	46	1	1	48
Syngnathus acus	Greater pipefish	57	0	14	71
Ammodytes tobianus	Lesser sandeel	45	0	0	45
Pleuronectes platessa	Plaice	60	0	41	101
Pomatoschistus minutus	Sand goby	1588	3	0	1591
Atherina presbyter	Sand smelt	88	0	0	88
Sprattus sprattus	Sprat	1	0	0	1
Chelon labrosus	Thick-lipped grey mullet	6	0	0	6
Gasterosteus aculeatus	Three-spined stickleback	5	0	0	5
Chelidonichthys lucernus	Tub gurnard	2	0	1	3

Number of samples per sampling method in parenthesis. Species richness: 20