

Deben Estuary
Citizen Science Fish Survey Programme

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**Institute of Fisheries
Management**



Plate 1 Seine netting at Kyson Point, Martlesham Creek

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Draft Report

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EXECUTIVE SUMMARY

Estuaries are extremely productive environments, playing a crucial part in the life cycle of many fish species, acting as both key marine fish nursery grounds and as vital corridors for migratory species. These are highly dynamic environments, with abrupt changes in oxygen concentration, temperature, turbidity and salinity applying over both the short term and over longer seasonal cycles. The intertidal areas and saltmarsh of the estuarine fringes are vitally important refuge and feeding habitats for fish fry. Saltmarshes exist as a natural component of the estuarine system in the more saline reaches, extending as a band of higher plants on the foreshore between mean high water neap tide level and the mean highwater mark.

The fish communities in estuaries were not well studied in the UK prior to the millennium. The advent of the Water Framework Directive UK regulations in 2003 required an assessment of ecological status of estuaries, including an assessment of the fish life present, for the first time. Even so only one third of UK estuaries have ever been sampled formally to examine the fish life present. The EA has not conducted a full WFD fish survey in the Deben to date. In 2013 & 2014, Eastern IFCA conducted a small fish survey in the estuary at a number of sites using the WFD specification 43m seine net. The author has conducted small scale fish surveys for specific purposes at both Wood bridge in 2007 and Waldringfield in 2016.

The River Deben Association (RDA) are keen to develop a citizen science-based fish survey programme at in the Deben estuary. Through an initial dialogue with Eastern IFCA, the author (acting through the Institute of Fisheries Management) agreed to deliver an initial survey with staffing support from the RDA. A site at Bawdsey was fished with a 15m seine deployed from the shore on August 16th 2022 (Colclough, 2022).

Given the success of this venture, the RDA were keen to attempt to repeat and extend the survey programme in 2023. Two sites were selected, the original one at Bawdsey plus a further site in the middle reaches at Martlesham Creek. The survey was delivered as before with technical support and equipment from the IFM (Steve Colclough & Tanya Ferry) and staffing by citizen scientists. This year the base was much broader with active field support from members of the RDA and members of the Alde/Ore Association together with staff from Suffolk Wildlife Trust, Cefas and Eastern IFCA. Since the 2022 survey, the IFM citizen science process is now funded in part by Natural England as part of a wider government backed trial to assess how citizen science might assist in delivery the marine Natural Capital Ecosystem Assessment project. Natural England are cognisant of the social benefits arising from citizen science engagement as much as the scientific benefits. The Bawdsey survey was conducted on September 19th, 2023 and the Martlesham Creek survey on the following day.

This report describes the findings of the 2023 survey and contrasts these with those arising from previous works. Sufficient material from the 2022 report is provided to provide a full background for the new reader. For further information., please consult the 2022 survey report (Colclough, 2022).

It remains clear that Deben estuary and its associated saltmarshes form an important nursery ground for a range of marine fish species today and the survey findings demonstrate the functioning of these resources as Essential Fish Habitat.

The Bawdsey site data demonstrates how dynamic marine and estuarine fish communities can be. Even though there are significant and predictable seasonal cycles in the behaviour of these species, sampling at similar times of year in the same locations does not necessarily mean that the

communities reported are indeed similar. Each survey is no more than a snapshot in time, driven by the specific forcing factors (e.g. salinity, temperature etc.) applying at that time. However, the 2023 survey results are still generally consistent with what has been reported from the lower reaches of other estuaries in the South East in recent years. One notable feature of the Bawdsey survey was the presence of juvenile herring and some evidence of recent spawning.

The Martlesham Creek results are entirely consistent with the type of communities found in the middle reaches of estuaries in the South East of England and agree with past findings by the author at other sites in the middle reaches of the Deben estuary in past years.

The difference between the communities at Bawdsey and Martlesham Creek demonstrate how salinity is a prime driver of fish distribution in estuaries and demonstrates the value of extending the survey programme to at least two very different sites.

the 2023 survey demonstrated once again the scientific value of such efforts, helping fill in some of the data gaps where other parties do not have the resources to investigate. Working alongside other bodies, citizen science going forward can prove to be a critical and supportive element in a more holistic understanding of our inshore coastal and estuarine waters, leading to more informed management strategies.

The RDA are keen to develop a long term fish survey programme in the estuary. With continuing support from Natural England, the IFM can hopefully continue to support the RDAs with this vision.

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1. INTRODUCTION

Fish in estuaries

Estuaries provide extremely productive environments, playing a crucial part in the life cycle of many fish species (McHugh, 1967; Haedrich, 1983). They act as key marine fish nursery grounds, as well as vital corridors for migratory species. These are highly dynamic environments, with abrupt changes in oxygen concentration, temperature, turbidity and salinity applying over both the short term and over longer seasonal cycles (Thomas, in Attrill, 1998). This tends to limit the species of fish which survive in these conditions, but those that can do so thrive. (Blaber *et al*, 1989). As a reflection of these challenging conditions, the fish communities associated with estuaries are highly dynamic (Blaber, 1991; Colclough *et al*, 2000 & 2002). Very few species are sedentary, most are moving continually in response to this complex of factors. Migrating fish utilise Selective Tidal Stream Transport (STST) to minimise effort (Colclough *et al*, 2000; Jager, 1999). Those fish which are not actively migrating through the estuary, move passively with the tidal excursion to minimise osmotic stresses. Superimposed on this complex picture are pronounced seasonal rhythms in the movements of the fish species themselves. The sheer dynamic scale of all of these processes together has dictated that until recently, the fish communities of many estuaries across Western Europe have been poorly studied in comparison to their freshwater and marine counterparts. Therefore, the importance of these habitats for fish life is still not fully recognised (Elliott, in Elliott & Hemingway, 2002).

Fish in saltmarshes

Saltmarshes exist as a natural component of the estuarine system in the more saline reaches, extending as a band of higher plants on the foreshore between mean high water neap tide level and the mean high water mark. The largest remaining expanses of saltmarsh in Britain lie in the greater Thames estuary along the Essex coast and in Suffolk (Waite, in Attrill, 1998).

Elliott & Taylor (1989) demonstrated that intertidal habitats in estuaries are twice as productive in terms of invertebrate production when compared to subtidal equivalents. The intertidal areas and saltmarsh of the estuarine fringes are vitally important refuge and feeding habitats for fish fry (McLusky *et al.*, 1992). This is particularly important for round fish fry, and for some species, such as sea bass (*Dicentrarchus labrax*), saltmarshes in particular may represent the optimal nursery habitat for the early life stages (Laffaille *et al*, 2001). This understanding of the importance of saltmarshes as nursery grounds for marine fish species is well understood in the US (Bell, 1997; Boesch & Turner, 1984; Roundtree & Able, 1992; West & Zedler, 2000) but is very new to Europe (Laffaille *et al*, 2001; Lyndon, 2002; Colclough *et al*, 2005; Stamp *et al*, 2022).

80% of the historic saltmarsh habitat has been lost across Europe, with significant but often unrecognised impacts, such as loss of vital fish nursery grounds (Stamp *et al*, 2022). McLusky *et al* (1992) estimated that land-claim and sea defence works in the Forth estuary over the past 200 years have reduced overall fish production in the estuary by 66%. In the Thames estuary, less than 1% of the original bank form still exists (Colclough *et al*, 2002). It is now recognised that juvenile fish use the intertidal foreshore for both feeding and as a refuge during the ebb tide. A continuous band of foreshore is an essential element in the ability of small fish to ascend estuaries using STST. (Colclough *et al*, 2000).

Two per cent of English saltmarshes are lost to the sea every year as a consequence of sea level rise (Dixon *et al*, 1998). Saltmarshes are a UK Biodiversity Action Plan habitat and, in England, form part of the Government High Level Target nine habitat series. Under these initiatives the intention is that there should be no further net loss of habitat and opportunities for environmental enhancement should be sought. The new Net Gain planning principle strengthens the case for positive action to create new habitat. Given the functional importance of these areas for fish production, Stamp *et al*, (2021) recommend that estuaries and saltmarshes should be considered as Essential Fish Habitat in both management and marine planning contexts.

Managed realignment has been developed in the UK since the early 1990's as one of a suite of effective flood risk management measures to meet the challenges provided by storm surges and rising sea levels. There have now been more than 40 such treatments in the UK, with sites in the Humber, Greater Thames and Severn estuaries and on a number of coastal locations on the East, South and West coasts.

A lot of information on how saltmarshes function and the ecosystem services they provide, including fish utilisation, has been developed over the last 20 years in the UK, through the study of managed realignment treatments which develop saltmarsh plant communities over a period of years (Colclough *et al*, 2005; Dixon *et al*, 2007; Fonseca, 2009; Fonseca, *et al*, 2011; Green *et al*, 2012; Nunn *et al*, 2016; Colclough, 2017; Stamp *et al*, 2023). Saltmarshes can provide a number of other valuable ecosystem services, including nutrient and micro-pollutant removal and carbon sequestration. (Luisetti, 2011; Viera da Silva, 2012). Placing all of the currently known functionality of estuaries and saltmarshes in Water Framework Directive terms (WFD), these habitats may prove to be vital components in achieving good ecological status.

Dixon *et al*, (2007) provided a review of the early experiences with design and development of some of the first UK sites (Blackwater and Crouch estuaries). As our knowledge of how sites evolve and how fish utilise these sites over time, we have begun to improve our guidance on site design (Burgess *et al*, 2019).

Intertidal habitat creation is also now occurring even in the confines of urban and industrial estuaries. Intensive development in the Thames estuary led to the development of an Encroachment Policy in the early 00's led by the Environment Agency (EA), to resist further encroachment on the grounds of unacceptable impacts on flood risk as well as a range of ecological issues. This policy led to the development through the Thames Estuary Partnership of the Estuary Edges Guidance to encourage no net loss of habitat and the proliferation of artificial marginal habitat features. A second iteration of this guidance in 2018 required assessments of how the early sites had performed. This process included fish surveys on a range of installed features with recommendations provided for future design improvement. (Colclough and Cucknell, 2018). For information see <https://thamesestuarypartnership.org/our-projects/estuary-edges/>

Deben Estuary

The historic loss of intertidal habitats has seen a very large decline in marine fish production over the past 200 years as the nurseries have disappeared. The importance of the resource still available in the Deben and other estuaries on the Essex and Suffolk coasts cannot be understated when set in this context and against the developing impacts of climate change.

The fish communities in estuaries were not well studied in the UK prior to the millennium. The advent of the WFD UK regulations in 2003 required an assessment of ecological status of estuaries, including an assessment of the fish life present, for the first time. The author led the team that developed the estuarine fish sampling protocols for the Environment Agency (EA) to meet the requirements of the new directive. Even so only one third of UK estuaries have ever been sampled formally to examine the fish life present.

In 2007, as a former fisheries scientist in the EA, the author was invited by Simon Read of the River Deben Association (RDA) to conduct a survey of the fish communities present in Sutton Marsh, opposite Woodbridge Tide Mill. The information was used to strengthen the case to appropriate regulars for a timber training barrage to be constructed to protect the marsh from erosion. Simon Read later advised the author that the information gathered on fish utilisation of the marsh helped turn the argument in favour of construction.

The EA have conducted WFD surveys in the Roach & Crouch, Blackwater, Stour/Orwell, Alde/Ore and Blyth over the past 20 years, but never in the Deben. Eastern IFCA employed a WFD compliant large seine net deployed from a vessel in October 2013 at three sites in the estuary. Opposite Waldringfield Golf Club (named the upper site), Ramsholt Arms (middle) and Bawdsey saltmarsh edge (mouth). This programme was repeated in July 2014 as before and a different site near the mouth opposite the Felixstowe Ferry was substituted. The purpose of this two-year programme was to begin a long-term data set. Sadly, that never transpired due to operational constraints.

In 2016, the Water Management Alliance were proposing restoration measures to an area of relict saltmarsh in poor condition at Waldringfield. Restoration included redefinition of the creek system in the marsh using staked hazel hurdle structures. Concern had been expressed by Stephen Thomson (then of the Eastern IFCA) that the structures might hinder fish migration across the marsh during the tidal cycle. Fish which had entered the marsh near the surface on the flood might be stranded behind the structures as they attempted to egress, near the bed, on the ebb tide. The author was engaged by Karen Thomas of the WMA to refine the design of the structures to address this concern. Gaps in the structures were built in at intervals to provide effective drainage channels to encourage fish egress on the ebb tide. On 16th October 2016, a survey was delivered to assess which fish species were present in the marsh and how they were able to use the gaps provided.

In 2019, Stephen Thomson (then of Eastern IFCA) had suggested to the River Deben Association (RDA) that some form of community based fish survey might be possible. In 2021, the author provided a lecture on behalf of Suffolk Wildlife Trust about the ecology of fish in estuaries and saltmarshes. Subsequently, the author was approached by Richard Verrill of the (RDA) to conduct a fish survey in the estuary. The author agreed to provide the sampling gear and technical support. The RDA agreed to provide volunteer labour. The exercise was viewed as a trial to test the potential for the development of a long-term multi-method multi-site sampling programme in the estuary. A site at Bawdsey (similar to the Eastern IFCA mouth site in 2014) was fished with a 15m seine deployed from the shore on August 16th 2022 (Colclough, 2022).

In 2022, the IFM had been invited by Natural England to deliver their citizen science fish survey programme (with Steve Colclough as technical field lead) as part of a wider Defra led project engaging citizen scientists in marine monitoring (the marine Natural Capital Ecosystem Assessment programme), given both the scientific and social benefits apparent.

Building upon the success of the 2022 survey, an extended River Deben survey programme was planned for 2023 taking in the original site at Bawdsey (now designated as the lower site) plus a new (upper) site at Kyson Point in Martlesham Creek. The surveys took place on September 19th 2023 at Bawdsey and 20th September 2023 in Martlesham Creek. The survey was delivered as before with technical support and equipment from the IFM (Steve Colclough & Tanya Ferry) and staffing by citizen scientists. This year the base was much broader with active field support from members of the RDA and members of the Alde/Ore Association together with staff from Suffolk Wildlife Trust, Cefas and Eastern IFCA.

This report describes the findings of the 2023 survey and contrasts these with those arising from previous works. Sufficient material from the 2022 report is provided to provide a full background for the new reader. For further information., please consult the 2022 survey report (Colclough, 2022).

2. FISH SURVEY METHODOLOGY

Effective methods of capturing fish in the intertidal margins of estuaries and saltmarsh require a clear understanding of how (and when) the tide moves across the site. In such dynamic environments, a single sampling method is unlikely to capture a broad range of the species present. A multi-method approach pioneered for WFD and later described as European Best Practice in the field has now been extended to citizen science work in intertidal areas as demonstrable good practice.

The methods employed in such surveys are -

- a) *5m winged fyke nets (reducing mesh 10,8,6.5mm) set after low water, facing upstream. Often used in key discharge channel in saltmarshes. The nets are removed after the ebbing tide renders the nets accessible on foot and before the water entirely leaves the net. The nets are fitted with otter guards as an Environment Agency consent condition.*
- b) *A 15m seine net (2.7m deep with a 3mm micromesh knotless mesh) is deployed from the shore around slack water at low tide on three occasions.*
- c) *A fine mesh (1mm) intertidal scoop net applied opportunistically on a flooding tide as a block net to demonstrate how very young life stages of ever fish species use the first the flood to move up into the marshes.*

For further details on the sampling strategy and rationale see Franco et al, 2022.



Figure 1 Site plan for citizen science fish sampling at Bawdsey, Deben estuary
September 19th 2023



Figure 2 Site plan for citizen science sampling at Kyson Point, Martlesham Creek, Deben estuary
September 20th 2023

3. RESULTS

In practice, only the seine net was deployed at Bawdsey (three sweeps), as in 2022. Local ground conditions prevent use of the fyke nets here. September 19th, 2023 was an exceptionally windy day with a strong onshore breeze. The three sweeps with the seine net were completed by 14.30pm. With worsening weather, the site was abandoned an hour before high water.

The full suite of methods was employed in Martlesham Creek. Three sweeps of the seine net were made at Kyson Point. A single winged fyke net was deployed in a main creek channel in saltmarsh adjacent to the seine netting station. Sampling locations are shown in Figs 1 & 2.

All fish captured were identified, measured and returned to the water. Identification was aided with a field guide developed by ZSL for citizen science base fish surveys on the Tidal Thames (ZSL, 2021) see - <https://www.zsl.org/sites/default/files/media/2021-08/2531%20ZSL%20estuarine%20fish%20web%20guide.pdf>.

A summary of the data for Bawdsey on September 19th appears in Appendix I. A similar report for Martlesham Creek on the 20th appears in Appendix II. Appendices III & IV present relevant length frequency distributions. Appendix V shows sampling methodologies and fish species captured during the survey. Appendix VI displays the raw fish data.

4. DISCUSSION

At Bawdsey, the common goby was dominant in all three seine sweeps. This was unexpected. Common goby commence spawning in the early spring at the base of estuaries, making small nests in old shells and other cover. During the summer months, they move upstream into the inner parts of estuaries and can tolerate almost freshwater conditions. They descend again as freshwater flows increase and temperatures drop in the late autumn (Fouda and Miller 1981). Eastern IFCA reported gobies in abundance at this site in October 2013 (although these were all noted by the family name only (see Colclough, 2022 Appendix III). They did not report any gobies at this site in July 2014. No common goby were reported in the August 2022 survey at this site. The sand goby dominated at this site in August 2022. This is more expected at this time of year and location. Although the distributions of the two species overlap, in general the sand goby tends not to penetrate deep into estuaries, preferring higher levels of salinity (Colclough 2000). Gobies under 30mm are difficult to identify in the field, so it is possible that some of the smaller gobies captured at this site in 2023 were misidentified, but the majority taken were larger than this size (see Appendix III).

Sand smelt were less common at this site in September 2023 than reported in August 2022 or by the IFCA in October 2013 or July 2014.

The single small juvenile squid taken in all three nets at Bawsey are of interest. These could not be identified on site. Two were pinkish in colour and one clear. There are three species of squid commonly found in the Southern North Sea. The most common is the European common squid *Alloteuthis subulata*. The other two are the veined or long finned squid *Loligo forbesii* and the European squid *Loligo vulgari*. Juveniles of all three species at around 5mm in length appear in shallow coastal waters in the spring and summer months after overwintering offshore. The *Loligo* spp. have pink/orange/red chromatophores from the juvenile stage onwards. *Alloteuthis* has yellow chromatophores. This may or may not explain the colouration differences seen in the three individuals captured. All species of squid are becoming more common and are moving northwards in

response to our warming seas (Jareb, 2015). None of these species tolerate low salinities so would not have been expected at Martlesham Creek.

As described, September 19th at Bawdsey was an exceptionally windy day with a strong onshore breeze. It is possible that these juvenile squid were moved further onshore than would normally have been the case at this time of year

The really interesting find in September 2023 at this site was the herring, which was the sub-dominant species taken in each seine sweep. The IFCA took a small shoal of sprat at the Ramsholt Arms in October 2013 and again at Bawdsey in July 2014, but reported no herring. Herring were not taken at this site last year. Herring stocks in British waters are divided into a number of different overlapping stocks. The once highly abundant North Sea stocks spawn in the autumn months (Henderson, 2014). The Thames and Blackwater stock is a recognised almost discreet group that spawn in the spring (Wood,1981). The data appearing in Appendix III suggests two cohorts here. The majority are probably 0+ fish arising from a spring spawning. The single very small fish at 10mm indicates a very local and recent spawning, although identification as herring at this size was tentative. Both sprat and herring will enter the middle reaches of estuaries in the autumn months.

At Kyson Point, Martlesham Creek, the community of fish present is entirely consistent with expectations for the middle reaches of an estuary where the salinity is reduced but still relatively high and changing significantly over the tidal cycle (Appendix II 22-28ppt). Common goby were super dominant in all three seine sweeps. Some 0+ bass were present, 0+ and older thin lipped grey mullet were also present. Both of these species penetrate deep into estuaries in the first few years of life. The thin lipped grey mullet can exist in freshwater conditions indefinitely. This is the type of community described by the Environment Agency (S. Colclough, 2007) at Woodbridge and by the same author at Waldringfield in 2016., One notable find at this site was the single example of a lesser pipefish in each of the three seine sweeps. Of the six species of pipefish in British coastal waters, the lesser pipefish is the only one which is commonly found in estuaries. Off the Suffolk coast it is most abundant in the winter and spring (Henderson, 2014).

The juvenile sand smelt and bass recovered from the winged fyke net set in a saltmarsh creek adjacent to Kyson Point demonstrate how species such as these penetrate such creeks on the flooding tide to find cover and abundant food in these productive environments (Colclough *et al*, 2005).

5. CONCLUSIONS AND RECOMMENDATIONS

The Deben estuary and its associated saltmarshes form an important nursery ground for a range of marine fish species today and the survey findings demonstrate the functioning of these resources as Essential Fish Habitat.

The Bawdsey site data demonstrates how dynamic marine and estuarine fish communities can be. Even though there are significant and predictable seasonal cycles in the behaviour of these species, sampling at similar times of year in the same locations does not necessarily mean that the communities reported are indeed similar. Each survey is no more than a snapshot in time, driven by the specific forcing factors (e.g. salinity, temperature etc.) applying at that time. However the 2023 survey results are still generally consistent with what has been reported from the lower reaches of other estuaries in the South East in recent years.

The Martlesham Creek results are entirely consistent with the type of community found in the middle reaches of estuaries in the South East of England and agree with past findings by the author at other sites in the middle reaches of the Deben estuary in past years.

The difference between the communities at Bawdsey and Martlesham Creek demonstrate how salinity is a prime driver of fish distribution in estuaries and demonstrates the value of extending the survey programme to at least two very different sites.

the 2023 survey demonstrated once again the scientific value of such efforts, helping fill in some of the data gaps where other parties do not have the resources to investigate. Working alongside other bodies, citizen science going forward can prove to be a critical and supportive element in a more holistic understanding of our inshore coastal and estuarine waters, leading to more informed management strategies.

The RDA are keen to develop a long term fish survey programmes in the estuary. With continuing support from Natural England, the IFM can hopefully continue to support the RDAs with this vision.

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Appendix I

Bawdsey , Deben Estuary Fish survey 19th September 2023

Site Information and Fish Catches

Low Tide (BST)	High Tide (BST)
08:06	14:39 (3.36m Bawdsey)

Water NB: Three seine net sweeps were conducted on rising tide across a fine stone and sand base at NGR TM33122 38007. Temperature and salinity (calibrated refractometer) were measured after each sweep.

Summary of catches in the first seine net sweep at 9:45 am. Temperature 18°C Salinity 33.5ppt. Figures in parentheses indicate additional fish captured, counted but not measured

Latin Name	Common Name	No. Caught	Length Range mm	Percentage of total catch
<i>Atherina presbyter</i>	Sand smelt	4	25-84	3
<i>Chelon ramada</i>	Thin lipped grey mullet	2	32,90	1
<i>Clupea harengus</i>	Herring	10	48-64	7
<i>Dicentrarchus labrax</i>	Sea bass	1	48	<1
<i>Platichthys flesus</i>	Flounder	1	210	<1
<i>Pomatoschistus microps</i>	Common goby	35 (93)	15-61	84
<i>Pomatoschistus minutus</i>	Sand goby	6	55-65	4

NB. Melon comb jelly *Beroe Cucumis* were also captured (common) together estuarine prawn *Palaemon* spp (common) and European shore crab *Carcinus maenas* (common), plus single examples of *Maja brachydactyla* common spider crab (small juvenile) and a juvenile squid (pinkish colour 5mm).

Summary of catches in the second seine net sweep at 10:15 am. Temperature 18°C Salinity 32ppt

Latin Name	Common Name	No. Caught	Length Range mm	Percentage of total catch
<i>Atherina presbyter</i>	Sand smelt	7	70-78	13
<i>Clupea harengus</i>	Herring	17	25-63	31
<i>Dicentrarchus labrax</i>	Sea bass	2	164,170	4
<i>Pomatoschistus microps</i>	Common goby	(27)		49
<i>Pomatoschistus minutus</i>	Sand goby	2	60,64	4

NB: A single squid also taken (clear 5mm)

Summary of catches in the third seine net sweep at 13:30 pm. Temperature 18°C Salinity 32ppt

Latin Name	Common Name	No. Caught	Length Range mm	Percentage of total catch
Atherina presbyter	Sand smelt	2	73,82-	4
Chelon ramada	Thin lipped grey mullet	2	28,35	4
Clupea harengus	Herring	20	34-82	40
Pomatoschistus microps	Common goby	(28)		51
Pomatoschistus minutus	Sand goby	3	25-65	6

NB: 2 common shrimp *Crangon crangon* and 1 squid (pinkish colouration 5mm) also taken

Appendix II

Martlesham Creek (Kyson Point), Deben Estuary Fish survey 19th September 2023

Site Information and Fish Catches

Low Tide (BST)	High Tide (BST)
09:02	16:10 (3.87m Woodbridge)

Water NB: Three seine net sweeps were conducted on rising tide across a fine stone and muddy shore at NGR TM 27140 47389, adjacent to a slipway. Temperature and salinity (calibrated refractometer) were measured after each sweep. A winged fyke net was set in a small creek in established saltmarsh adjacent to the seine netting site (NGR TM27088 47354) The fyke was set before water entered the marsh, at 12:30 pm and recovered on the ebbing tide at 17:10pm before the net was fully exposed and fish stranding took place.

Summary of catches in the first seine net sweep at 10:30 am. Temperature 19°C Salinity 22ppt. Figures in parentheses indicate additional fish captured, counted but not measured

Latin Name	Common Name	No. Caught	Length Range mm	Percentage of total catch
Chelon ramada	Thin lipped grey mullet	3	24-34	2
Dicentrarchus labrax	Sea bass	1	45	<1
Pomatoschistus microps	Common goby	35(109)	20-40	95
Pomatoschistus minutus	Sand goby	2	50,53	1
Sygnathus rostellatus	Lesser pipefish	1	100	<1

NB. Common shrimp *Crangon crangon* and estuarine prawn (*Palaemon spp.*) were common in all three sweeps of the seine net.

Summary of catches in the second seine net sweep at 10:50 am. Temperature 19.8°C Salinity 24ppt

Latin Name	Common Name	No. Caught	Length Range mm	Percentage of total catch
Chelon ramada	Thin lipped grey mullet	3	22-28	2
Pomatoschistus microps	Common goby	21 (131)	23-44	96
Pomatoschistus minutus	Sand goby	2	38,42	1
Sygnathus rostellatus	Lesser pipefish	1	154	<1

Summary of catches in the third seine net sweep at 11:10 Temperature 19°C Salinity 24ppt

Latin Name	Common Name	No. Caught	Length Range mm	Percentage of total catch
Atherina presbyter	Sand smelt	1	40	<1
Chelon ramada	Thin lipped grey mullet	25	27-155	9
Dicentrarchus labrax	Bass	7	35-73	3
Pomatoschistus microps	Common goby	3 (233)	15-47	86
Pomatoschistus minutus	Sand goby	3	25-65	1
Sygnathus rostellatus	Lesser pipefish	1	95	<1

**Summary of catches in the fyke net recovered at 17:10 . Measurement just before recovery
Temperature 19oC Salinity 28ppt**

Latin Name	Common Name	No. Caught	Length Range mm	Percentage of total catch
Atherina presbyter	Sand smelt	2	72,74	50
Dicentrarchus labrax	Bass	2	54,55	50

NB: The fyke also held numerous shore crabs, one bass head and numerous shrimp & prawn.

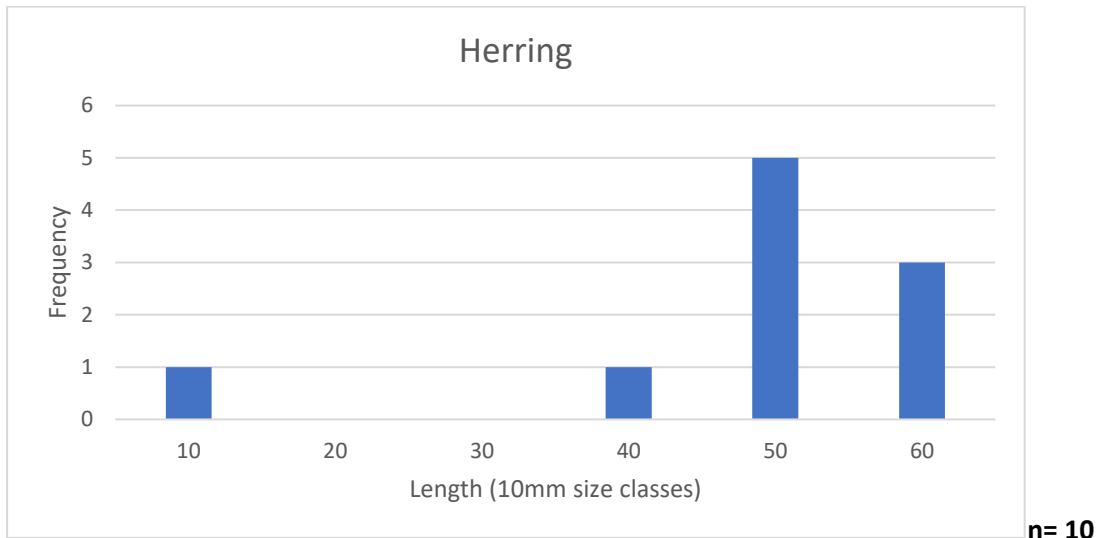
Appendix III

Length frequency distributions

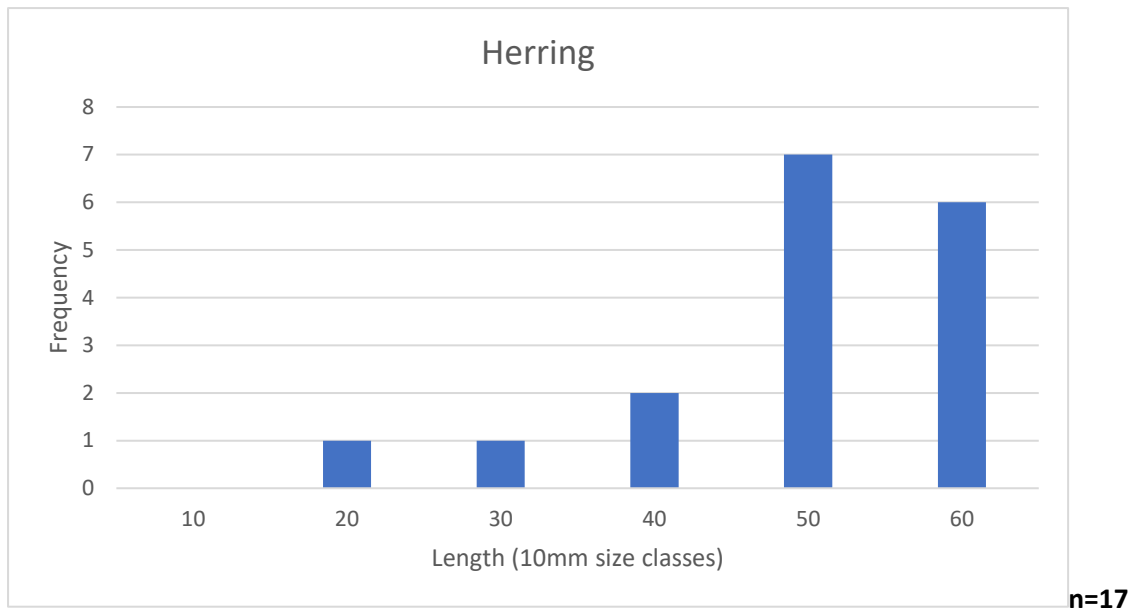
Bawdsey 19th September 2023

Three seine nettings conducted on a rising tide on the main shingle and sand beach at Bawdsey

1st seine net 9.45am



2nd seine net 10.15am



3rd seine net 13.15 pm

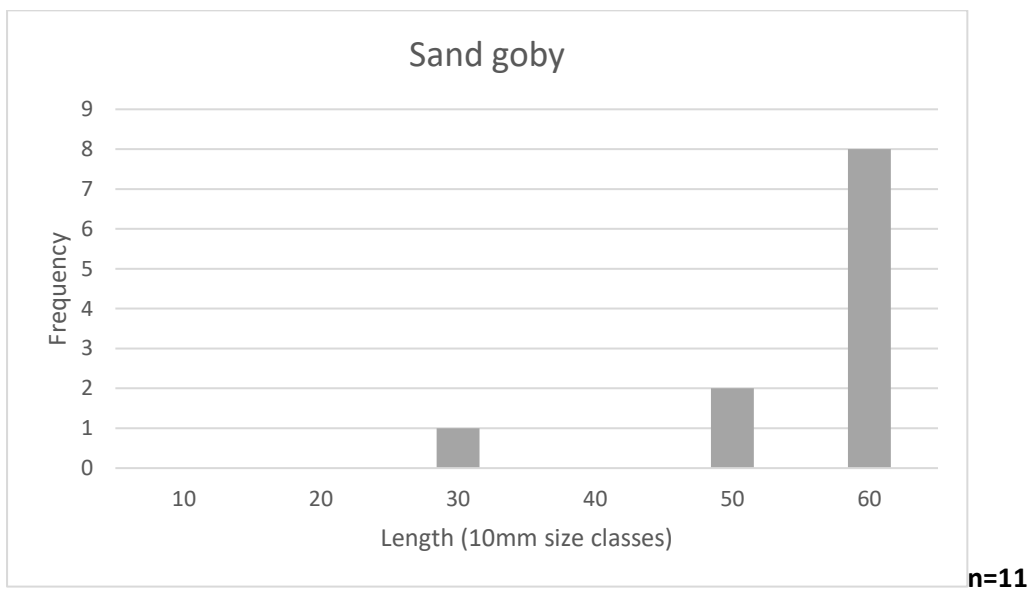
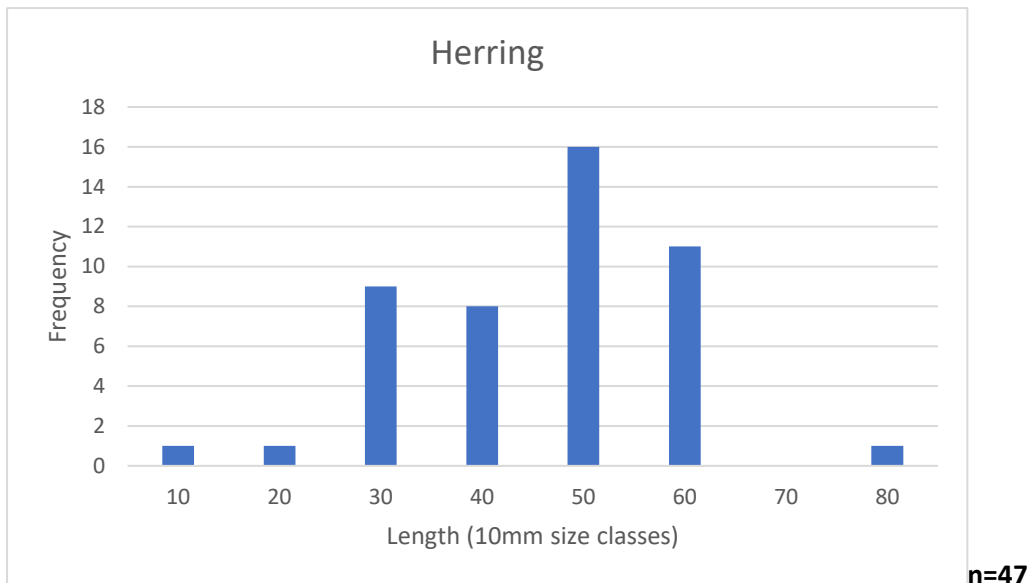


n=20



n=5

Combined data from 3 seine nettings



Appendix IV

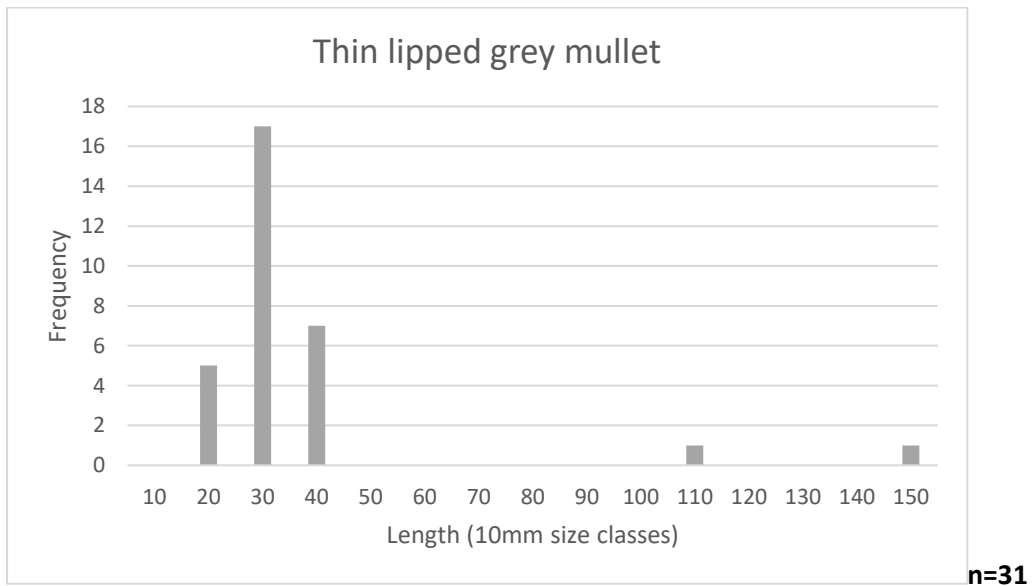
Length frequency distributions

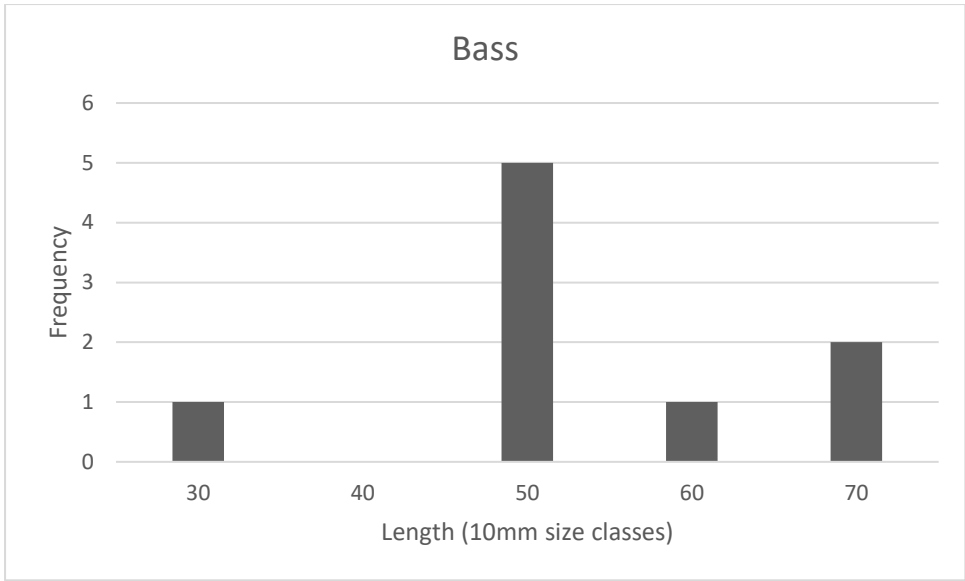
Martlesham Creek 20th September 2023

Three seine sweeps at Kyson Point plus 1 fyke net set in adjacent saltmarsh

1st sweep 10.30.

Remainder of data combined across all 4 sampling sessions to aggregate length frequencies





n=9

Appendix V

Sampling methodologies and species of fish species captured



Plate 2 Setting the winged fyke net in saltmarsh creek adjacent to Kyson Point



Plate 3 Fish processing at Kyson Point



Plate 4 Lesser pipefish



Plate 5 Lesser pipefish (Peau Blue Association)

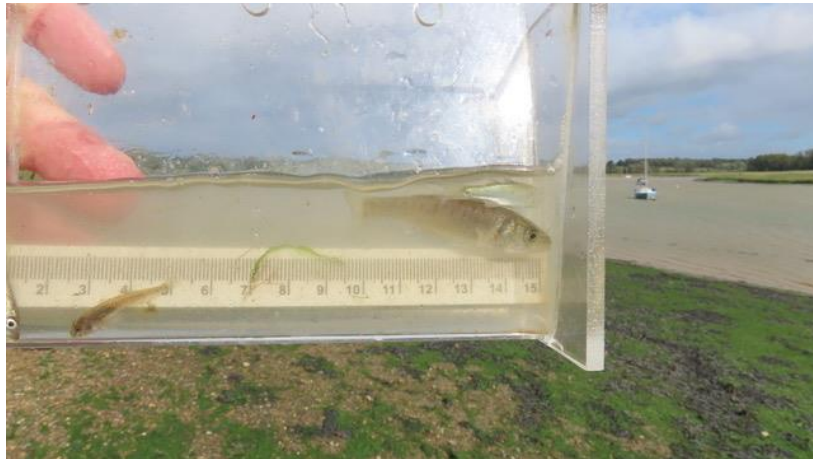


Plate 6 Sea bass and goby in Perspex viewer



Plate 7 & 8 Juvenile thin lipped grey mullet



Plate 9 Juvenile herring



Plate 10 Juvenile sand smelt



Plate 11 Spider crab

Appendix VI

Deben Estuary Bowdler Survey 19th September 2023
Raw Fish Data

9.45am Seine netting

Herring	Common goby	Flounder	Sea bass	Sand goby	Sand smelt	Thin lipped grey mullet
48	41	210	48	64	74	90
64	32	n=1	n=1	58	25	32
62	24			65	72	n=2
62	42			66	84	
52	34			60	n=4	
50	37			55		
58	41			n=6		
55	20					
55	33					
10	15					
n=10	61					
	37					
	32					
	25					
	32					
	31					
	34					
	51					
	55					
	27					
	n=35					
	Plus 93 counted					

10.15 am Seine netting

Herring	Common goby	Sea bass	Sand goby	Sand smelt
60	27 counted	164	60	70
45		170	64	74
46		n=2	n=2	74
25				70
64				78
52				74
60				72
63				n=7
55				
50				
51				
55				
56				
60				
38				
62				
58				
n=17				

11.15 Seine netting

Herring	Common goby	Sand goby	Sand smelt	Thin lipped grey mullet
34	counted 28	61	82	35
38		25	73	28
38		65	n=2	n=2
36		61		
38		62		
37		n=6		
34				
55				
82				
62				
54				
44				
41				
42				
44				
58				
45				
65				
34				
56				
n=20				

Appendix VI

Deben Estuary Kyon Point Martlesham Creek Fish Survey 20th September 2023

10:30 am Seine netting

Common goby	Sand goby	Sea bass	Lesser pipefish	Thin lipped grey mullet
34	50	45	100	24
27	53	n=1	n=1	20
32	n=2			24
33				n=3
27				
25				
26				
30				
24				
22				
24				
24				
27				
27				
33				
32				
35				
33				
32				
36				
28				
n=35 plus 109 counted				

10:50 am Seine netting

Common goby	Sand goby	Lesser pipefish	Thin lipped grey mullet
29	42	154	27
26	38	n=1	22
24	n=2		28
32			n=3
44			
28			
30			
27			
40			
23			
35			
29			
40			
47			
20			
46			
23			
29			
26			
28			
24			
n=21 Plus 131 counted			

11:10 Seine netting

Common goby	Sea bass	Lesser pipefish	Thin lipped grey mullet	Sand smelt
30	61	95	27	40
47	73	n=1	35	n=1
15	70		31	
n=3	58		33	
plus 233 counted	56		45	
	58		43	
	35		27	
	n=7		151	
			35	
			115	
			44	
			45	
			39	
			31	
			26	
			33	
			25	
			24	
			40	
			28	
			31	
			47	
			40	
			30	
			30	
			n=25	

Winged fyke net removed 1hr after HW

Sea bass	Sand smelt
54	72
55	74
n=2	n=2
Plus 10 shore crabs and 1 bass head	