

Deben Estuary

Citizen Science Fish Survey Programme

August 2022

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Plate 1 River Deben Association members seine netting at Bawdsey

All photographs by Richard Verrill (RDA)

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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. 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. 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 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 author took part in the Suffolk Pioneer project in 2019/20, focusing on the ecosystem services provided by the Deben estuary and made these points forcibly.

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. 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.

The EA has not conducted a full WFD fish survey in the Deben to date. In October 2013 & July 2014 2014, Eastern IFCA conducted small fish surveys in the estuary at three sites with a WFD compliant seine net. The author has conducted small scale fish surveys for specific purposes at Woodbridge in 2007 and Waldringfield in 2016.

In 2019, Stephen Thomson (then of Eastern IFCA) had suggested to the 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 River Deben Association (RDA) in 2021 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-site sampling programme in the estuary.

The sampling was conducted at Bawdsey on August 16th 2022, with members of the RDA fully engaged and with the kind support of two officers from Eastern IFCA.

Three sweeps of a 15m seine net (3mm knotless mesh) were made on the foreshore at Bawdsey as the tide rose across the shore. Catches were dominated by sand goby and sand smelt, with sea bass, sand eel and one very small juvenile grey mullet, probably a thin-lipped grey mullet.

The results of the current study very much reflect the past history of data from all of the earlier surveys conducted in the estuary. A brief summary of the catches made in all of the previous surveys conducted in the estuary appears in Appendix III. The Deben estuary and its associated saltmarshes form an important nursery ground for a range of marine fish species today and all of the survey findings demonstrate the functioning of these resources as Essential Fish Habitat.

The RDA are keen to develop a long term fish survey programme in the estuary. As described, fish movements in estuaries are highly dynamic and seasonal. The WFD programme recognises this complexity by using a multi-method sampling strategy (to avoid sampling bias), applied in both the spring and autumn to capture seasonality. On an estuary such as the Deben, three sites would be appropriate (upper, middle, lower). A biannual programme is labour intensive. A single sampling exercise in the late summer or early autumn will still capture much of the available information and much of the seasonality of the fish species involved has now been established. The Eastern IFCA work in 2013/14, in conjunction with the 2022 survey and site selection background, indicates a good way forward. An upper site at Martlesham Creek could be employed as it is suitable for citizen science access on foot. This site is only 1500m upstream of the upper site used in 2013/14 and is probably more suitable for citizen science work. A middle site would be suitable at Ramsholt Arms. The lower site used at Bawdsey in the 2022 survey is almost exactly the same as the two sites used by the IFCA in 2013/.14.

The IFM has been conducting a number of such citizen-based fish surveys across England during the last few years, demonstrating that such surveys can make a valuable contribution to the overall science base, complimenting the work of the regulators. Within the constraints that apply to volunteer operations in tidal waters, such surveys can add particular value where long term monitoring is required, which is often prohibitively expensive for regulators to develop and maintain in the current economic environment.

The citizen science support in this survey programme has been excellent. The reader can see the level of engagement from the photographs included. Having recently secured new funding from Natural England (who have become impressed by both the scientific and social benefits arising from such studies) the Institute is now in a position to support these programmes going forward. The author and the Institute stand ready to support such efforts in the Deben estuary going forwards.

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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; Yates, 2012; 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 and may represent Essential Fish Habitat (Stamp *et al*, 2022).

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

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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 regulators, 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 and Alde/Ore and Blyth over the past 20 years, but never in the Deben estuary. Eastern IFCA used 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. The upper and middle sites were repeated 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.

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 long 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 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) in 2021 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.

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. Seine netting techniques are normally applied in these situations at either high water slack or low water slack to minimise flow. Fixed fyke net are normally set after low water, fish through the tide and are removed during the ebb before fish become stranded. (Colclough *et al*, 2005).

The sampling was conducted at Bawdsey on August 16th 2022, with members of the RDA fully engaged and with the kind support of two officers from Eastern IFCA using a 15m by 2.7 m (knotless micromesh 3mm) seine net from the foreshore.

The locations of the netting operations are produced in Figure 1.

In other circumstances the following additional techniques are often employed. Each method provides a sampling bias. The use of more than one method provides a broader mosaic picture. This multi-method ethos lay behind the development of the WFD transitional waters (estuaries) sampling strategy for WFD. (Coates *et al*, 2007). These additional methods could be employed alongside the seine net as appropriate, in any future surveys at other sites in the estuary.

Winged fyke net: 5m in length with a reducing knotless mesh of 10.8.6mm. The 2.5m wings have a 10mm knotless mesh. The fykes were fitted with rectangular otter guards and fixed in place with five metal stakes.

Intertidal net: 2.5m by 1.5m wall of 1mm knotless mesh set out on two 1.5m ash poles with a lead core line at the base.



Figure 1 Site plan for citizen science fish sampling at Bawdsey, Deben estuary on August 16th 2022

3. RESULTS

On 16th August 2022, three sweeps of the 15m seine net (3mm knotless mesh) were made on the foreshore at Bawdsey as the tide rose across the shore, one hour apart starting one hour after low tide. Catches were dominated by sand goby and sand smelt, with sea bass, sandeel and a very small grey mullet, probably a thin-lipped grey mullet. Full details of the catches and site description appear in Appendix I. Length frequency histograms appear in Appendix II. A summary of the fish captured in the cited surveys before 2022 appear in Appendix III. Photographs of the citizen scientists during the fish processing in 2022 are included in Appendix IV. Site photographs for the 2007 survey conducted by the author in the Deben at Sutton Marsh, Woodbridge are provided in Appendix V. Site photographs for the survey at Waldringfield in 2016 are provided in Appendix VI. Raw data for the 2022 survey is provided in Appendix VII

All fish captured in the 2022 survey 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>.

4. DISCUSSION

The EA have conducted WFD surveys in the Roach & Crouch, Blackwater, Stour/Orwell and Alde/Ore and Blyth over the past 20 years. The raw data from these surveys is available to the author.

Sand goby and sand smelt dominated the catches at Bawdsey in July 2022. The sand smelt shown in Appendix II are all young of the year fish (0+) exploiting the warmer productive waters of the estuary which provide the optimal nursery grounds in the shallow intertidal margins, with abundant food and reduced predation pressures from larger fish. A similar background applies to the sea bass. Most of the sea bass captured are (0+) although the largest examples at 80mm at this time of the year may be second year fish (1+). There appears to be two modal groups in the sea bass length frequency. This has been reported elsewhere. Sea bass spawning takes place at a number of locations at different times. Travel times of post-larvae using coastal flow patterns to the same estuary can be very different (Sabriye, 1988). Capture of the Lesser sandeel (*Ammodytes tobianus*) is notable, in that the species they have only been reported previously once in the Orwell estuary in low numbers in the EA dataset. Ellis *et al* (2012) have described spawning sites along the English coast in the southern North Sea.

5. CONCLUSIONS AND RECOMMENDATIONS

Comparison of the EA data set for other estuaries in Essex and Suffolk together with the results of the 2007, 2014 & 2016 works (see Appendices I, II & III) shows that the fish communities present at Bawdsey in August 2022 fit in very well with those described in these other works in both the Deben estuary and elsewhere regionally. All of these works provide further confirmation that the Deben estuary and its associated saltmarshes form an important nursery ground for a range of marine fish species today and clearly demonstrate the functioning of these resources as Essential Fish Habitat.

The RDA are keen to develop a long term fish survey programmes in the estuary. As described, fish movements in estuaries are highly dynamic and seasonal. The WFD programme recognises this

complexity by using a multi-method sampling strategy (to avoid sampling bias), applied in both the spring and autumn to capture seasonality. On an estuary such as the Deben, three sites would be appropriate (upper, middle, lower). A biannual programme is labour intensive. A single sampling exercise in the late summer or early autumn will still capture much of the available information and much of the seasonality of the fish species involved has now been established. The Eastern IFCA work in 2013/14, in conjunction with the 2022 survey and site selection background, indicates a good way forward. An upper site at Martlesham Creek could be employed as it is suitable for citizen science access on foot. This site is only 1500m upstream of the upper site used in 2013/14 and is probably more suitable for citizen science work. A middle site would be suitable at Ramsholt Arms. The lower site used at Bawdsey in the 2022 survey is almost exactly the same as the two sites used by the IFCA in 2013/.14.

The IFM has been conducting a number of such citizen-based fish surveys across England during the last few years, demonstrating that such surveys can make a valuable contribution to the overall science base, complimenting the work of the regulators. Within the constraints that apply to volunteer operations in tidal waters, such surveys can add particular value where long term monitoring is required, which is often prohibitively expensive for regulators to develop and maintain in the current economic environment.

The citizen science support in this survey programme has been excellent. The reader can see the level of engagement from the photographs included. Having recently secured new funding from Natural England (who have become impressed by both the scientific and social benefits arising from such studies) the Institute is now in a position to support these programmes going forward. The author and the Institute stand ready to support such efforts in the Deben estuary going forwards.

6. ACKNOWLEDGEMENTS

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Appendix I

Bawdsey, Deben Estuary Fish survey 16th August 2022

Site Information and Fish Catches

Low Tide (BST)	High Tide (BST)
08:55	15:35

Water NB: Three seine net sweeps were conducted on a 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 10:30 am. Temperature 19°C Salinity 1.025

Latin Name	Common Name	No. Caught	Length Range mm	Percentage of total catch
Atherina presbyter	Sand smelt	12	26-70	8
Dicentrarchus labrax	Sea bass	12	22-80	8
Pomatoschistus minutus	Sand goby	36 (94)	36 (94)	84

Summary of catches in the second seine net sweep at 11:45 am. Temperature 19°C Salinity 1.030

Latin Name	Common Name	No. Caught	Length Range mm	Percentage of total catch
Ammodytes tobianus	Lesser Sandeel	2	52,60	2
Atherina presbyter	Sand smelt	27	55-70	22
Chelon spp	Thin lipped grey mullet?	1	18	1
	Black goby	1	95	1
Pomatoschistus minutus	Sand goby	21 (72)	24-58	74

Summary of catches in the third seine net sweep at 13:30 pm. Temperature 19°C Salinity 1.033

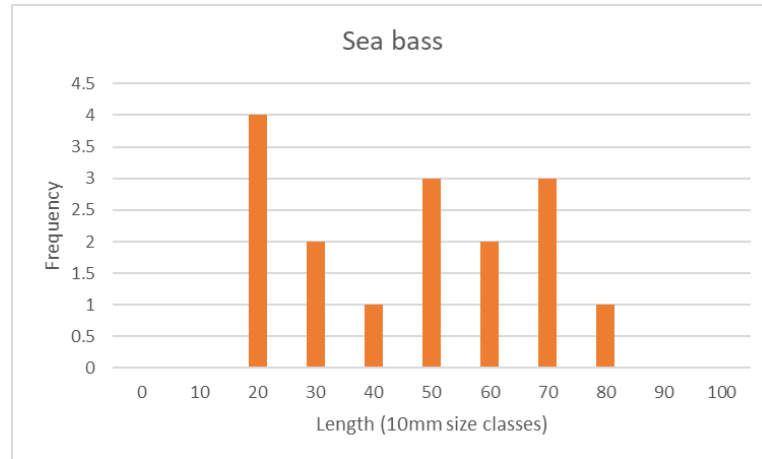
Latin Name	Common Name	No. Caught	Length Range mm	Percentage of total catch
Atherina presbyter	Sand smelt	8 (8)	-	40
Dicentrarchus labrax	Sea bass	3	36-72	15
Pomatoschistus minutus	Sand goby	9 (9)	-	45

NB: Figures in parentheses in the tables above relate to additional specimens that were identified and returned unmeasured after sufficient length information had been established.

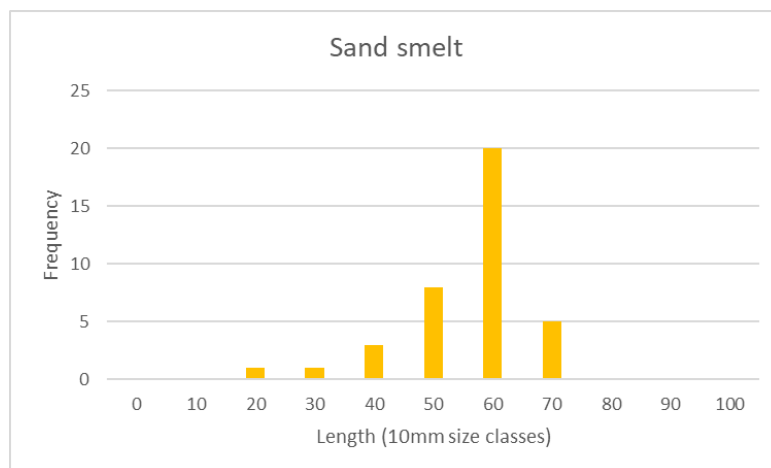
Appendix II

Length Frequency Histograms

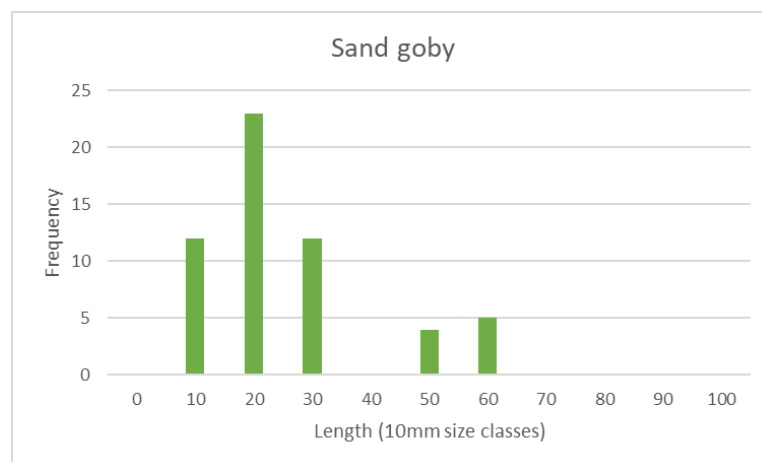
Bawdsey, Deben Estuary 16th August 2022



n=15



n= 39



n=37

Appendix III

A Brief Summary of Fish Surveys in the Deben Estuary prior to 2022

Date	Operator	Site	Fish Captured	Methodology
20th July 2007	S. Colclough Environment Agency	Ferry Cliff, opposite Woodbridge Marine TM 28001 48674	77 fish in total comprising 27 bass at 25-124mm, 37 common goby at 30-46mm, 11 grey mullet (spp) at 38-50mm, 1 3 spined stickleback at 55mm and 1 flounder at 55mm.	Seine netting and block netting with a 25m micromesh seine net (3mm mesh) at low water.
1 st October 2013	Eastern IFCA	Opposite Waldringfield Golf Course -Methersgate Quay TM 28307 46393	10 sand smelt at 50-70mm, goby (spp), 3 bass at 45-55mm.	43m seine net with 50mm centre used on an ebbing tide
1 st October 2013	Eastern IFCA	Ramsholt Arms TM30551 41543	170 sprat at 40-74mm, 10 sand smelt at 50-75mm, 700 goby (spp) at 40-75mm	43m seine net with 50mm centre used on an ebbing tide.
1 st October 2013	Eastern IFCA	Bawdsey Manor saltmarsh edge TM 33065 38205	30 sand smelt at 40-80mm, 900 goby (spp) at 40-70mm.	43m seine net with 50mm centre used on an ebbing tide.
21 st July, 2014	Eastern IFCA	Opposite Waldringfield Golf Course	40 sand smelt at 50-70mm, 12 bass at 35-45mm.	43m seine net with 50mm centre used on an ebbing tide.
21 st July, 2014	Eastern IFCA	Ramsholt Arms	7 sand smelt at 45-55mm, 70 goby(spp) at 35-70mm, 3 bass at 35-45mm.	43m seine net with 50mm centre used on an ebbing tide.
21 st July, 2014	Eastern IFCA	Shingle Beach opposite Felixstowe Ferry TM 33127 37968	30 sprat at 55-80mm, 45 sand smelt at 40-60mm & 100- 125mm, 1 thick lipped grey mullet at 545mm, 1 3-spined stickleback at 30mm	43m seine net with 50mm centre used on an ebbing tide.
16 th October 2016	S.Colclough Institute of Fisheries Management	Waldringfield salt marsh restoration site TM 28534 44993	23 bass 15 60-102mm, 943 common goby at 32-44mm, 32 thin lipped grey mullet at 32- 52mm.	Winged small fyke nets (10, 8,6.5mm mesh reducing to cod end) set over a flood tide.

Appendix IV

Survey processing photographs for August 2022



Plate 2 RDA volunteers & Eastern IFCA staff processing



Plate 3 Typical catch (with aeration)



Plate 4 Juvenile sea bass in perspex measuring viewer

Appendix V

Sampling in the relict saltmarsh at Woodbridge in 2007



Plates 5 & 6 Seine netting and block netting

Appendix VI

Fish sampling at Waldringfield Salt Marsh Restoration Site on 16th October 2016



Plates 7 & 8 Setting micromesh fyke net in a breach in the new structure

Appendix VII

Raw Data Files for Bawdsey, Deben Estuary 16th August 2022

Bawdsey Raw Fish Data 16th August 2022

First sweep 10:30					
	Salinity 1.025	Temperature 19 degrees C			
bass	sand smelt	sand goby	sand eel	black goby	
78	50	57			
76	45	56			
80	62	15			
60	26	30			
24	70	15			
68	35	18			
50	50	15			
25	52	22			
47	42	64			
50	52	12			
65	46	36			
22		52			
22		25			
		17			
		26			
	n=10	28			
		18			
		20			
		24			
		32			
		22			
		18			
		24			
		24			
		18			
		24			
		28			
		20			
		24			
		24			
		50			
		22			
		24			
		18			
n=12	n=10	n=36 plus 94 unmeasured	0	0	
Second sweep 111:45					
	Salinity 1.030	Temperature 19 degrees C			
bass	sand smelt	sand goby	sand eel	black goby	thin lipped grey mullet
0	65	18	60	95	18
	65	22	52		
	60	15			
	60	35			
	55	30			
	60	25			
	60	20			
	62	32			
	65	35			
	55	35			
	70	60			
	70	55			
	65	60			
	65	30			
	65	20			
	65	30			
	70	30			
	65	25			
	52	21			
	60	60			
	70	60			
	68				
	55				
	60				
	60				
	60				
	60				
	60				
	60				
0	n=27	n=22	n=2	n=1	n=1
Third sweep 13:30					
	Salinity 1.033	Temperature 19 degrees C			
bass	sand smelt	sand goby	sand eel	black goby	thin lipped grey mullet
72					
35					
36					
n=3	8 fish unmeasured	9 fish unmeasured			