Pagham Harbour
Pilot Small Fish Survey
2015

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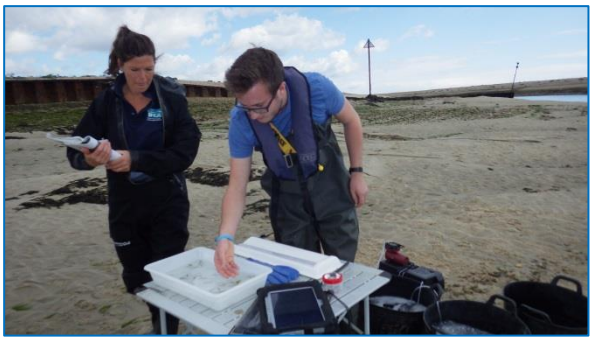

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INTRODUCTION

Pagham Harbour is part of Pagham Nature Reserve, a Local Nature Reserve designated in 1964. It is also a Site of Special Scientific Interest, a Special Protection Area, a RAMSAR site and more recently, a Marine Conservation Zone. Pagham Harbour is less than $3km^2$ and mainly comprised of saltmarsh and tidal mudflats, with lagoons, shingle banks and areas of open water. The harbour also contains sea grass, a recognised habitat used as a nursery area by bass (Kelly 2002).

AIMS

The aim of this pilot small fish survey (SFS) at Pagham Harbour was to provide present-day information on the local fish population. The impetus for this exploratory survey was the request from a volunteer associated with the Bass Anglers Sportfishing Society (BASS) for support with collecting current information on Pagham Harbour's fish population, to compare to previous data. In addition, the Royal Society for the Protection of Birds (RSPB) were interested in assessing what fish were available as prey for protected bird species (such as common and little terns) within this important site. The recent identification of Pagham Harbour as a potential Bass Nursery Area (BNA) by Sussex Inshore Fisheries and Conservation Authority (IFCA) provided further utility for SFS data collection.

PREVIOUS STUDIES

2007 Environment Agency and University of Portsmouth SFSs

SFSs have been conducted at Pagham Harbour previously. In 2007, the Environment Agency (EA) in partnership with the University of Portsmouth conducted SFSs to determine diversity of the species that use the salt marshes of Pagham Harbour, whether the marshes are used as nursery areas by juvenile fish, and what the fish ate when they were in the marshes. This study used both fyke and 18m x 1.5m seine netting at two survey areas in Pagham Harbour; one towards Sidlesham and the other towards Pagham, near Grey Barn on Church Lane (see Table 1). The mesh size of the seine net was 5mm. This study found seabass (*D. labrax*) to be the most abundant fish in both number and estimated biomass and that the majority of all fish caught were juveniles. They also analysed gut contents of some bass caught to identify feeding patterns, finding that crab, *Carcinus maenas,* was the main prey of seabass in Pagham Harbour.

Table 1. Details of survey conducted in 2007 by EA and University of Portsmouth

Date	Location	Methodology
16th Jul 2007	Pagham site*	Seine net, nine hauls. Large fyke net, one haul
17th Jul 2007	Sidlesham site**	Seine net, fifteen hauls. Large fyke net, one haul. Small fyke net, one haul
30th Jul 2007	Pagham site*	Seine net, fourteen hauls. Large fyke net, one haul
31st Jul 2007	Sidlesham site**	Seine net, fifteen hauls. Large fyke net, one haul
13th Aug 2007	Pagham site*	Seine net, thirteen hauls. Large fyke net, one haul
29th Aug 2007	Pagham site*	Seine net, twelve hauls
30th Aug 2007	Sidlesham site**	Seine net, five hauls
27th Sep 2007	Pagham site*	Seine net, eight hauls. Large fyke net, one haul. Small fyke net, one haul

*Pagham site net locations: seine – 50°46'14.87"N 000°45'19.14"W, large fyke– 50°46'11.52"N 000°45'19.68"W and small fyke– 50°46'15.19"N 000°45'20.07"W.
**Sidlesham site net locations: seine – 50°45'47.49"N 000°46'48.66"W, large fyke– 50°45'46.60"N 000°46'40.54"W and small fyke – 50°45'48.17"N 000°46'42.49"W.

1992 – 1998 Independent SFSs

From August 1992 – August 1998, an independent individual with an interest in bass conducted 25 SFSs in Pagham Harbour, looking to discover whether juvenile bass used Pagham Harbour as a nursery area. Pagham Harbour had not been declared a bass nursery area because it was thought to be afforded sufficient protection by being a designed Local Nature Reserve. Almost all surveys were conducted with a seine net, deployed from the shore. The seine net was 15m long and 1m deep, with a mesh size of 3mm. The survey on 19th September 1996 utilised a 50m Environment Agency (EA) net with a 'sandeel mesh', net depth and mesh size not specified. Furthermore, on 8th August 1994 a stop net was utilised. This was unsuccessful and not used again. Dimensions and mesh size of the stop net are unknown. Surveys were mostly carried out towards high water (HW) in one of the two pools in the marsh vegetation near Pagham Spit carpark (which floods during high tide, referred to in this study as 'Pagham Pool'), in front of the Kay Optical Hide and about 2 hours after low water (LW) in the flooding Harbour mouth channel (referred to in this study as 'Pagham Channel'). On most occasions, a single haul was conducted (see table 2). Throughout these surveys, only bass were identified and measured. All surveys but one found bass to be present. During the 09/06/96 survey, only one goby was caught.

Table 2. Details of study conducted between 1992 and 1998

Date	Survey Location	Methodology
26th Aug 1992	Kay Optical Hide	Seine net, one haul, flood ~HW
12th Sep 1992	Kay Optical Hide	Seine net, one haul, flood ~HW
19th Sep 1992	Pagham Pool	Seine net, two hauls, flood ~HW
11th Sep 1993	Pagham Pool	Seine net, one haul, flood ~HW
24th Sep 1993	Kay Optical Hide	Seine net, one haul, ~LW +2hrs
23rd Oct 1993	Kay Optical Hide	Seine net, one haul, ~LW +2hrs
31st May 1994	Pagham Pool	Seine net, one haul, flood ~HW
20th Jul 1994	Kay Optical Hide	Seine net, one haul, flood ~HW
8th Aug 1994	Pagham Pool	Stop net, one haul, flood ~HW
25th Sep 1994	Pagham Pool	Seine net, one haul, flood ~HW
10th Oct 1994	Pagham Pool	Stop net, one haul, flood ~HW
2nd Jun 1995	Pagham Pool	Seine net, one haul, flood ~HW
2nd Jul 1995	Pagham Pool	Seine net, one haul, flood ~HW
14th Aug 1995	Pagham Pool	Seine net, one haul, flood ~HW
29th Aug 1995	Pagham Pool	Seine net, one haul, flood ~HW
29th Aug 1995	Kay Optical Hide	Seine net, one haul, flood ~LW
17th Sep 1995	Pagham Pool	Seine net, one haul, flood ~HW
30th Sep 1995	Pagham Pool	Seine net, one haul, flood ~HW
9th Jun 1996	Pagham Pool	Seine net, one haul, flood ~HW
21st Jul 1996	Pagham Pool	Seine net, one haul, flood ~HW
22nd Aug 1996	Pagham Channel	Seine net, one haul, ~LW +2hrs
19th Sep 1996	Pagham Channel	EA seine net, five hauls, ~LW +2hrs
13th Sep 1997	Kay Optical Hide	Seine net, one haul, flood ~HW
28th Sep 1997	Kay Optical Hide	Seine net, two hauls, flood ~HW
16th Aug 1998	Pagham Pool	Seine net, one haul, flood ~HW
30th Aug 1998	Pagham Pool	Seine net, one haul, flood ~HW

METHODOLOGY

Three sites were selected in the south eastern corner of Pagham Harbour, following local advice on independent surveys conducted at these sites between 1992 - 1998 (see Table 3 and Figures 1 and 2).

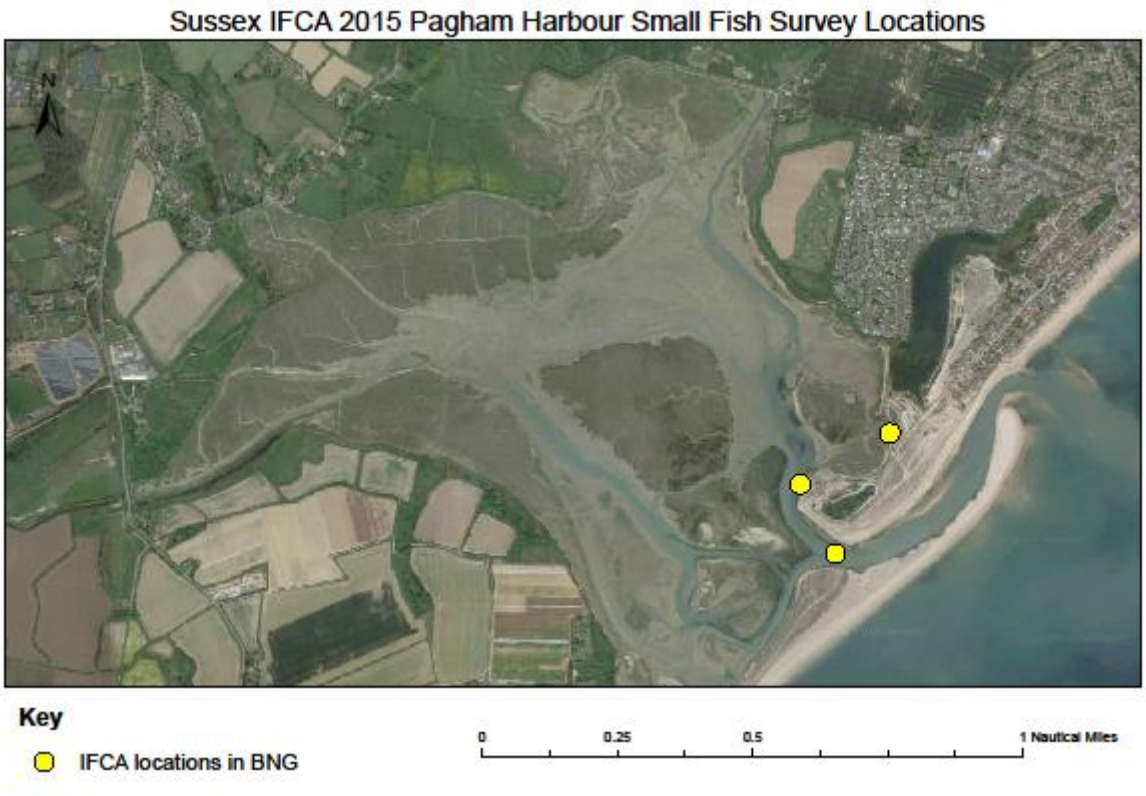

Figure 1. Sussex IFCA Pagham SFS Locations

The survey was conducted on 4th September between 1145 and 1540 BST. It was during a neap tide and over a flood tide (high water = 1618 BST). The survey was conducted over the flood to catch fish entering the Harbour. This survey involved five people; three from Sussex IFCA, one from Pagham RSPB and a volunteer associated with BASS. Two replicate hauls were conducted at the Pagham Channel site and at the Kay Optical Hide site. Due to time limitations a single haul was carried out at the Pagham Pool site.

Table 3. Positions of Sussex IFCA sampling points

Location Description	Position (DDMMSSss)
Pagham Channel	50o 45’ 28.62”N 000o 45’ 10.70”W
Kay Optical Hide	50o 45’ 36.15”N 000o 45’ 15.32”W
Pagham Pool	50o 45’ 41.12”N 000o 44’ 59.95”W

As an opportunistic exploratory survey, with limited resources, only one sampling method (seining) was used at each site. If Sussex IFCA initiates a regular programme of SFS at Pagham Harbour, data will be collected more closely following WFD guidelines, as with SFSs elsewhere in the district.

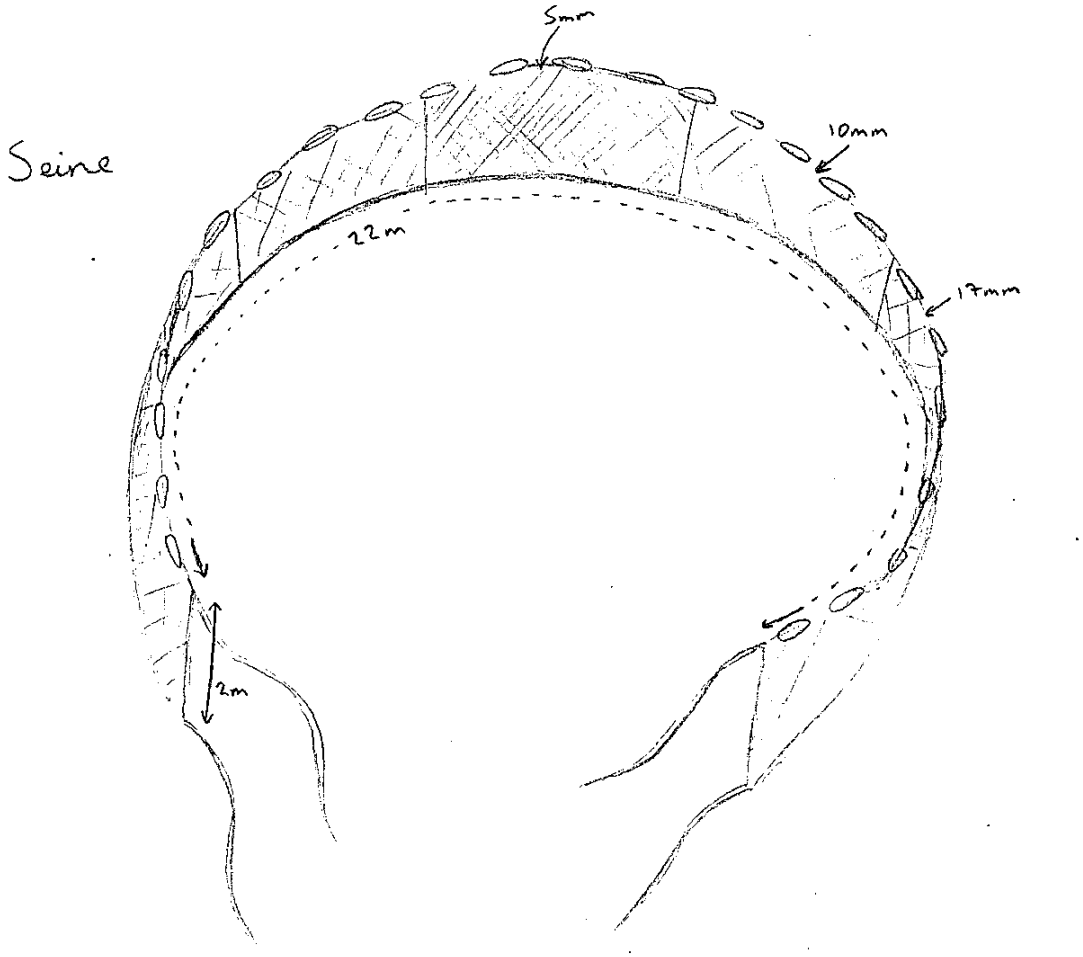

Figure 2. Hand drawn diagram of seine net used with mesh sizes labelled

A micromesh seine net of 22m long and 2m deep was used (see Figure 2). The mesh sizes of the net were 5mm in the central panel, 10mm in the surrounding panels and 17mm in the wing panels. The net was deployed in a semicircle by wading and both ends were carefully hauled, ensuring that the float line was kept high from the water and the lead line kept close to the seafloor. All the fish caught in that haul were emptied into a bucket of aerated sea water. Fish from different hauls were kept separately. The next haul was conducted immediately afterwards, in exactly the same way and in approximately the same place. The fish were identified and measured. Identification was to species level where possible and measuring the total length of all the fish, additionally measuring the fork length of seabass. All fish were returned to the sea, alive if possible. No water chemistry data was collected during this survey.

Figure 3. Preparing the seine net for deployment, Pagham Channel 2015

DATA ANALYSIS

Species richness, abundance and diversity were analysed. Species richness (S) represents the number of species in a sample but it does not take into account the proportion and distribution of each species within the community sampled. Species abundance is the number of individuals found from a specific species and relative abundance refers to the evenness of distribution of individuals among species in a community. Species diversity was calculated in two ways; using the Shannon-Weiner and the Simpson's indexes of diversity.

The Simpson's Index of Diversity (D_s) accounts for both the species richness and the distribution of abundance across those species. This index assumes that the proportion of individuals in a community indicates the species' importance to diversity, where 1 indicates infinite diversity and 0 indicate no diversity.

$$D = 1 - \left(\frac{\Sigma\, n(n-1)}{N(N-1)} \right)$$

The Shannon-Weiner Index of Diversity (H') takes into account rarity and commonness of a species, it assumes an indefinitely large population and that random sampling has taken place and that every species within the population is represented within the sample. It gives an idea of species evenness, giving a value on how equal the community is. The Shannon-Weiner index of diversity is compared against species evenness (E_H) which measures how similar the abundance of species in a community are.

$$H' = -\sum_{i=1}^{S} p_i \ln p_i$$

Statistical analysis was conducted on the group-0 bass (those <70mm according to Armstrong, 2010) to determine if there were significant differences between lengths sampled in the Sussex IFCA survey, compared to previous studies.

Hypotheses:

H_0 = there is no statistically significant difference between the lengths of group-0 seabass in Pagham Harbour between the 2015 Sussex IFCA survey and other years surveyed.

H_1 = there is a statistically significant difference between the lengths of group-0 seabass in Pagham Harbour between the 2015 Sussex IFCA survey and other years surveyed.

If required, a post-hoc test will determine specifically where the statistically significant differences lie. This data is considered to be unmatched as data collected in one survey does not affect the data collected in another.

Data analyses were carried out using the statistical software packages R (version 3.2.2) and Microsoft Excel (version 2010).

RESULTS

Sussex IFCA data

During the survey, a total of 5403 fish were caught over 5 hauls, comprising 9 different fish species (see table 2 and figure 3).

Table 4. Abundance of Species Captured in 2015

Seine Location / Species (common name, *latin*)	Pagham Channel		Kay Optical Hide		Pagham Pool	Total	Total Species Relative Abundance (%)
	Seine 1	Seine 2	Seine 1	Seine 2	Seine 1		
Bass, *Dicentrachus labrax*	0	1	3	18	3	25	0.46
Sandsmelt, *Atherina presbyter*	4	2050	1414	1795	90	5353	99.07
Cuckoo Wrasse, *Labrus mixtus*	1	0	0	0	0	1	0.02
Corkwing Wrasse, *Symphodus melops*	0	1	2	1	0	4	0.07
Greater Sandeel, *Hyperoplus lanceolatus*	0	2	0	0	0	2	0.04
Shortspined Scorpionfish, *Myoxocephalus scorpius*	0	1	0	0	0	1	0.02
Sand Goby, *Pomatoschistus minutus*	0	5	0	0	1	6	0.11
Herring, *Clupea herengus*	0	7	0	0	0	7	0.13
Sprat, *Sprattus sprattus*	0	4	0	0	0	4	0.07
TOTAL	5	2071	1419	1814	94	5403	

Table 2 demonstrates that, during the Sussex IFCA 2015 survey, sandsmelt was the most abundant fish (n=5353) and bass was the second most abundant (n=25). The total number of fish caught per seine haul varied significantly (Pagham Channel seine 1 n=5, Pagham Channel seine 2 n=2071).

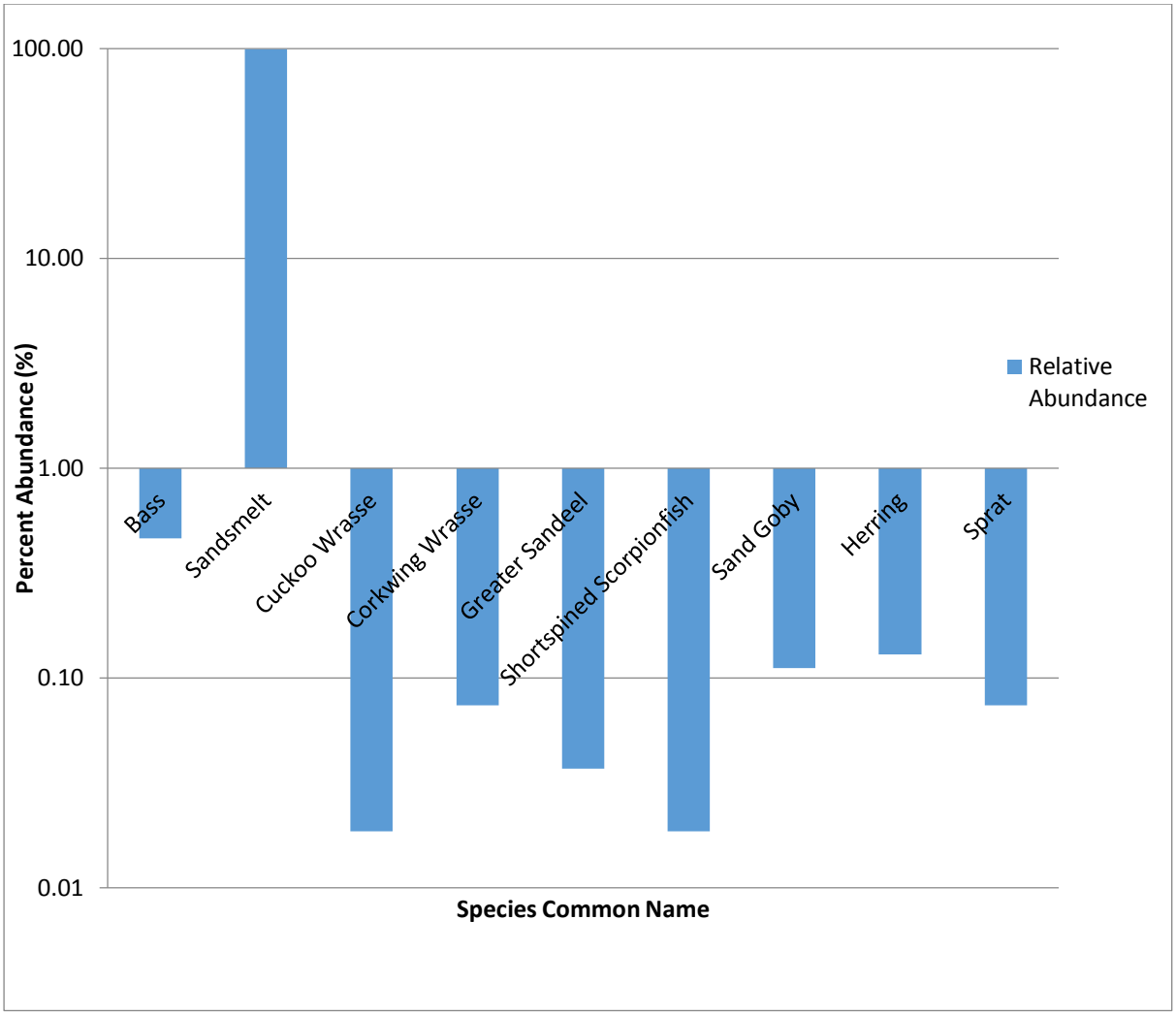

Figure 4. Logarithmic Graph of Total Species Relative Abundance Captured at Pagham 2015

Figure 3 further demonstrates that sandsmelt were the most abundant fish species during the Sussex IFCA 2015 survey (relative abundance = 99.07%). Seabass were the second most abundant (relative abundance = 0.46%) and herring the third most abundant (relative abundance = 0.13%).

Table 5. Statistical Analysis of 2015 Data

Diversity Index / Location	Species Richness (s)	Number of Individuals (n)	Shannon-Wiener Index of Diversity (H')	Equitability (E_H)	Simpson Index of Diversity (D_s)
Pagham Channel	9	2076	0.078	0.035	0.0211
Kay Optical Hide	3	3233	0.047	0.042	0.0148
Pagham Pool	3	94	0.200	0.182	0.0830

Table 3 shows that Pagham Channel was the most species rich (s = 9), however Kay Optical Hide was the most abundant (n = 3233). Pagham Pool had the lowest overall abundance (n=94).The low values of equitability across all sites (E_H = 0.035, 0.042, 0.182) demonstrates that the large quantities of sandsmelt captured during this survey compared to all other species caught have skewed results.

Pagham Pool had the most even distribution of species (E_H = 0.182). Both Shannon-Wiener and Simpson's Index of Diversity show that Pagham Pool was the most diverse of all 3 sites sampled (H' = 0.2, Ds = 0.08). The overall Simpsons Index of Diversity for all sites sampled at Pagham Harbour was 0.018.

Multi-Survey Comparison

Specific aspects of previous studies are used in a cross year comparison. The data has to have been collected by seine net, over a flood tide, near to high water, and within two weeks either side of 4th September (between 21st August and 18th September). This ensures similar sampling techniques and comparable fish sizes when taking into account seasonal growth. There are several caveats associated with this comparison. Firstly, the data was collected by different bodies and therefore methodology regarding net deployment and fish identification skills will vary, albeit slightly. Differences in methodology between the 2015 and 2007 surveys are mitigated by the fact that the Environment Agency receives training in both fish identification skills and net deployment. Secondly, whilst seine nets were used in all three surveys, the nets used to collect the samples were different in both area fished and mesh size. Furthermore, the survey locations between the 2007 sampling and the other two surveys were different. All factors considered, there is some comparability between data sets, however any conclusions made from the cross-survey comparison would be relatively weak.

There were 10 different fish species captured in the 2007 fish surveys, of which 3 were caught in 2015 (seabass, goby and sandsmelt). These species were caught in very different quantities in Pagham Harbour survey locations between survey years (see table 4). Little has changed with regard to total species richness from 2007 – 2015, however there was a difference in 6 species found over the year. Species found in 2007 and not in 2015 include *Mugilidae spp., Liza aurata, Liza ramada, Chelon labrosus, Spondyliosoma cantharus, Platichthys* flesus and *Gasterosteus aculeatus.*

Table 6: Comparison of goby and sandsmelt lengths and caught by seining in 2007 and 2015

Survey site and date/ Species (common name, *latin*)	Pagham 29/08/07		Sidlesham 30/08/07		Pagham 04/09/15	
	Mean Length (mm) ± SD	CPUE (n/haul/m net)*	Mean Length (mm) ± SD	CPUE (n/haul/m net)*	Mean Length (mm) ± SD	CPUE (n/haul/m net)*
Goby, *Pomatoschistus spp.*	30.7 ± 29.9	1.60	29.0 ± 2.3	0.06	42.0 ± 10.9	0.05
Sandsmelt, *Atherina presbyter*	40.5 ± 3.2	0.43	43.4 ± 3.2	0.53	41.6 ± 5.1	48.66

*Catch per unit effort (CPUE) calculated as abundance per haul, per metre length of seine net deployed (n/haul/m).

Table 4 shows that there was a difference in the lengths of goby caught between 2007 and 2015. The smallest gobies, were caught in the Sidlesham 30/08/07 survey (mean length = 29.0 ± 2.3mm) and the largest gobies were caught on 04/09/15 (mean length = 42.0 ± 10.3). The most gobies were caught at the 2007 Pagham sites (CPUE = 1.60 gobies/haul/metre net). Data was not normally distributed (Shapiro-Wilk normality test, $P<0.05$; Quantile-quantile plot). There was a significant difference in the lengths of goby caught in Pagham Harbour between 2015 and 2007; when compared to 04/09/2015, 29/08/2007 goby lengths were statistically significant (Mann-Whitney

U=100.5, p = 0.0002) as it was when compared against 30/08/2007 goby lengths (Mann-Whitney U=0.5, p = 0.0101).

In addition, Table 4 shows that sandsmelt lengths did not greatly differ between 2007 and 2015 (mean length ranged from 43.4 ± 3.2mm on 30/08/97 to 40.5 ± 3.2mm on 29/08/07), however the catch per unit effort in 2015, compared to 2007 sites was greatly increased (CPUE 04/09/15 = 48.66 sandsmelt/haul/metre net; CPUE 29/08/07 = 0.43 sandsmelt/ haul/metre net). Sandsmelt length data was not normally distributed (Shapiro-Wilk normality test, P<0.05; Quantile-quantile plot). When compared to 04/09/2015, 29/08/2007 the differences in sandsmelt lengths were not statistically significant (Mann-Whitney U=22302, p = 0.2065) however 04/09/15 lengths were statistically significant when compared against 30/08/2007(Mann-Whitney U=6099, p = 0.0080).

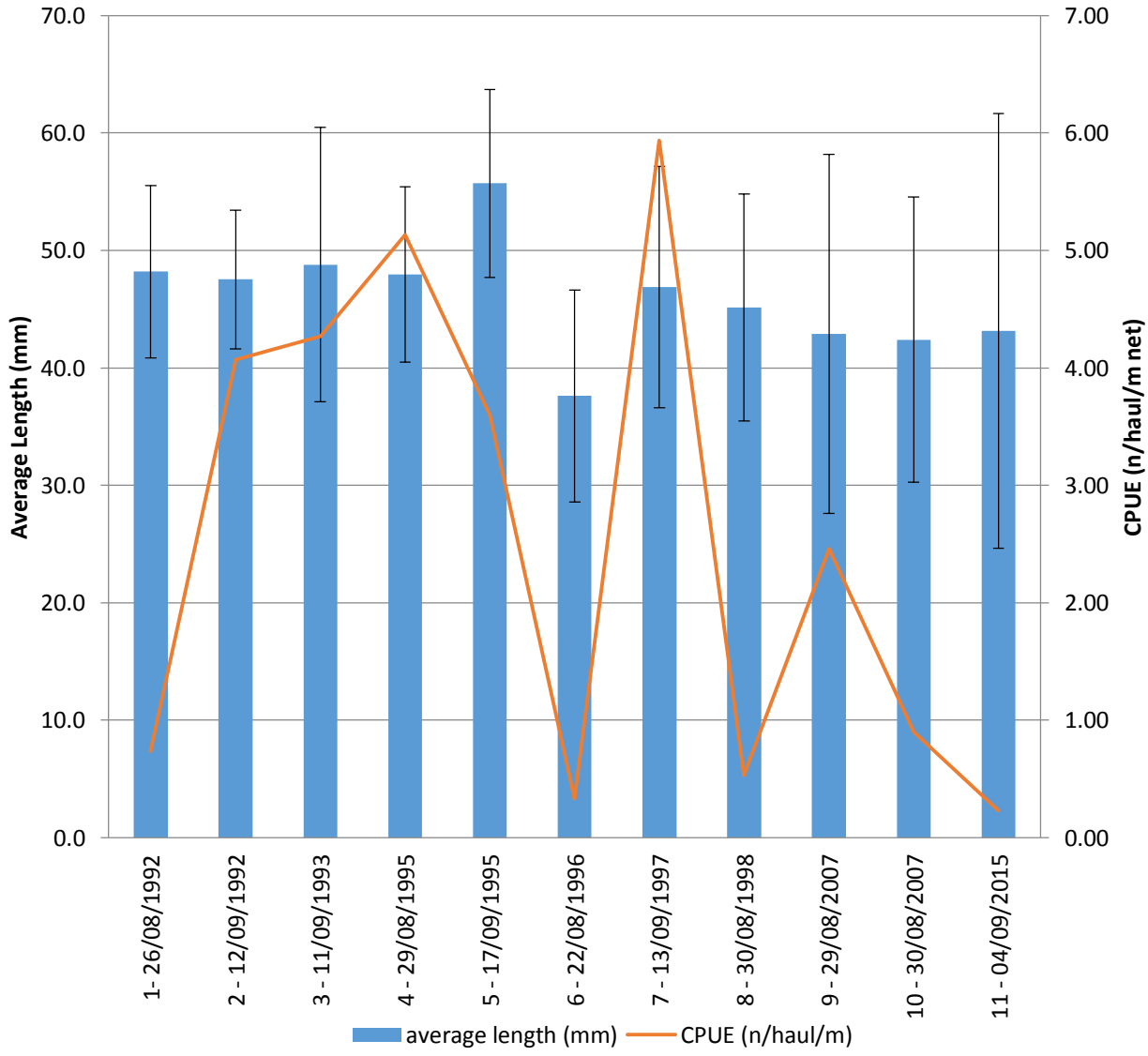

Figure 5. Comparison of seabass (*Dicentrachus labrax)* average length ± SD against CPUE, caught in Pagham Harbour by surveys comparable to the Sussex IFCA 2015 pilot survey

Figure 5 shows that a range of bass lengths were caught over the years (from 55.70 ± 7.99mm on 17/09/95, to 37.60 ± 9.02mm on 22/08/96). The Sussex IFCA survey had the greatest variation in bass lengths caught (mean bass length 43.96 ± 18.50mm), whilst the 12/09/92 had the smallest

variation in bass length (mean bass length = 47.52 ± 5.92mm). Furthermore, catch per unit effort of bass also varied greatly between surveys, the highest CPUE was 5.93 bass/haul/metre net (13/09/97 survey) and the lowest CPUE was 0.23 bass/haul/metre net (04/09/15 survey).

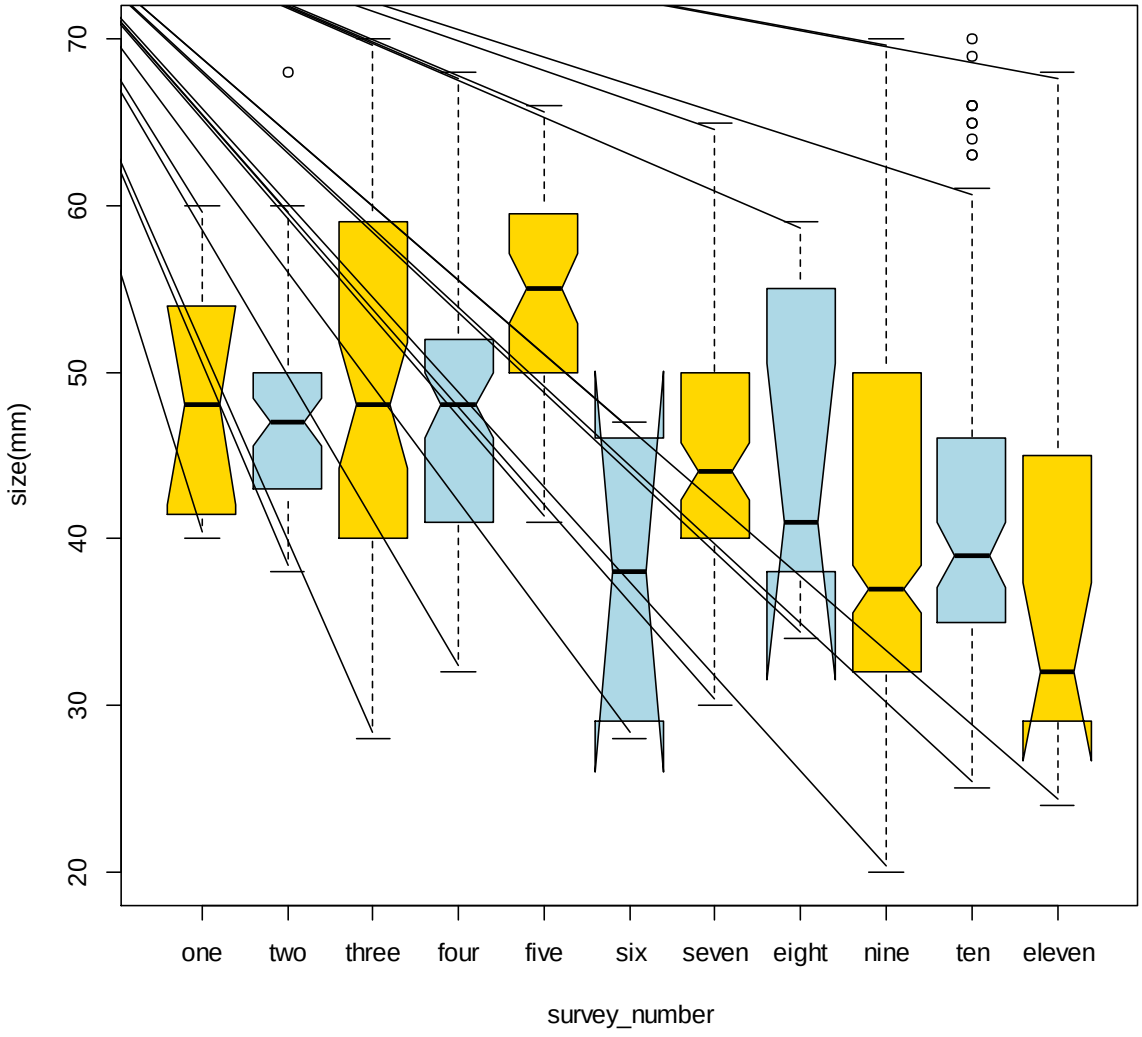

Figure 6. Box and Tukey-style whisker plot, with notches of group-0 bass lengths caught. Notches represent (approx.) 95% CI limits, calculated as ±1.58*IQR/√(n)

*Survey Number one = 26/08/92, n=11; two = 12/09/1992, n=61; three = 11/09/1993, n=63; four = 29/08/1995, n=77; five = 17/09/1995, n=51; six = 22/08/1996, n=5; seven = 13/09/1998, n=85; eight = 30/08/1998, n=8; nine = 29/08/2007, n=397; ten = 30/08/2007, n=81; eleven = 04/09/2015, n=22.

Figure 6 shows detail specifically about the lengths of group-0 bass caught at Pagham Harbour, at similar times of year, by seine netting. The median and interquartile range (IQR) of group-0 bass caught on 4/9/15 varies greatly when compared to other surveys conducted, as do the 95% confidence intervals (CI). According to Chambers (1983), when comparing boxplot notches, although not a formal test, if there is no overlap there is 'strong evidence' (95% confidence) their medians differ. Therefore, comparing the box plot information on group-0 bass lengths from 04/09/15 to all

other survey dates reveals that 04/09/15 median length data differs significantly from 30/08/07, 13/09/98, 17/09/95, 29/08/95, 11/09/93, 12/09/92 and 26/08/92 data.

Length data of group-0 seabass was not normally distributed (Shapiro-Wilk normality test, $P<0.05$; Quantile-quantile plot). The test for significance in this unmatched data was the Mann-Whitney U test. For the Mann-Whitney tests, figures given below are rounded to four decimal places. The bass lengths measured on 04/09/2015 were significantly different to the bass lengths measured in all other surveys in Pagham Harbour, except for 29/08/2007, where there was no significant difference (Mann-Whitney U=5257.5, p = 0.1073). When compared against all other dates, bass lengths were significantly different (30/08/2007 (Mann-Whitney U=1167, p = 0.0264), 30/08/1998 (Mann-Whitney U=130.5, p = 0.0484), 17/09/1995 (Mann-Whitney U=994, $p = 4.164 \times 10^{-6}$), 29/08/1995 (Mann-Whitney U=1301, p = 0.0001), 11/09/1993 (Mann-Whitney U=1043.5, p = 0.0004), 12/09/1992 (Mann-Whitney U=1031, p = 0.0002), 26/08/1992 (Mann-Whitney U=188, p = 0.0110)). Therefore, the null hypothesis is rejected and there is a statistically significant difference between the lengths of group-0 sea bass caught in Pagham Harbour between surveys.

DISCUSSION

Sussex IFCA SFS

The first haul at the Pagham Channel site had a much reduced abundance compared to all other seines. At both sites where repeat seines were conducted (Pagham Channel and the Kay Optical Hide), the second haul was the more abundant. This may be due to the fact that fish had been 'kicked up' by the net deployment, or that they moved in to feed in the disturbed area. Should there have been a repeat haul at Pagham Pool, the abundance of fish caught could have increased and thus made it comparable with the two other locations surveyed.

Pagham Channel, compared against the other two sites, was the most species rich. Laffaille et al., (2000) found that the marshes in Mon Saint-Michelle, France had a lower diversity than open estuary, so it is possible that main channels are naturally more diverse.

The Kay Optical Hide site had the highest abundance. This could be due to a number of factors. For example, it might be due to the reduced catch in the first seine of Pagham Channel. It may also be the most abundant due to conditions. It is part of the main, partially-enclosed, subtidal body of Pagham Harbour and therefore potentially has less tidal energy than Pagham Channel, whilst still experiencing some water mixing, which may provide more favourable conditions for a fish nursery area (Ellis et al., 2012). Furthermore, at low tide, the site at Pagham Pool had very little water in it. It is possible that the Kay Optical Hide site was the easiest for fish to inhabit. However, it should be noted that Armstrong (2010) recommends feeder creeks, such as those surveyed in the 2007 survey, as being nursery areas for bass. Either way, this would need further investigation.

Pagham Pool had the highest levels of diversity according to both Shannon-Weiner and Simpson's Index. This could be due to the ratio of species abundance to species richness compared to the other two sites surveyed. A repeat seine would have made this site more comparable with the other 2 sites. However, overall Pagham Harbour diversity levels were extremely low when compared to Sussex IFCA SFSs conducted at nearby Medmerry and Chichester (2015 Pagham Harbour SFS D_s = 0.018, 2016 Medmerry SFS D_s = 0.651, 2016 Chichester Harbour SFS D_s = 0.715). Species evenness was also extremely low due to such high numbers of sandsmelt being caught.

Wheeler (1969) suggests that sandsmelt prefer conditions of low salinity and according to Mitchell et al., (2008), Pagham Harbour experiences a period of reduced salinity until the second hour of the flood tide. Sandsmelt are a naturally schooling fish (Wheeler, 1969). Smaller sandsmelt (<104mm long) feed unselectively on zooplankton, such as annelids, molluscs and arthropods (Turnpenny et al., 1981). They are mostly (73%) able to breed at the end of their first year; when they are approximately between 67-75mm long (Turnpenny et al., 1981). It is likely that, with an average length of 41.6 ± 5.1cm, the sandsmelt caught by Sussex IFCA were juvenile, group-0 fish. Sandsmelt are known to use estuaries and coastal lagoons as a nursery ground (Elliott & Dewailly, 1995).

Small fish are the preferred food for common and little terns (del Hoyo, et al., 1996). Little terns breed in the UK and then have a return migration between August and September. Both little terns and common terns leave England between August and September for their winter roosts (RSPB, 13/12/2016). Little terns are opportunistic and will feed on whatever small fish are available, gathering where small fish are abundant (Birdlife International, 2000). In Portugal, little terns were found to feed mainly on sandsmelt and gobies (*Pomatoschistus* spp.), which were the most abundant fish species in the study's research areas (Catry et al., 2006). On Rigby Island, Australia, chicks were fed entirely on juvenile fish of the Clupeidae, Engraulidae, Pomatomidae and Carangidae families, i.e. pilchard, southern anchovy and blue sprat (Taylor and Roe 2004). The Sussex IFCA SFS therefore has found that there are still small fish in Pagham Harbour able to provide sustenance to local, protected bird species.

Quantities of group-0 bass were captured during this survey, indicating that Pagham Harbour is being utilised as a nursery ground by juvenile seabass.

Multi-Survey Comparison

Although not directly comparable, it is possible to highlight the results found. Considerably more sandsmelt were caught in the 2015 survey than the 2007 surveys. However, the 2007 studies found a greater abundance and diversity than in 2015.

Previous surveys (both 2007 and 1992-1998) caught more seabass than the Sussex IFCA study, which may be due to multiple factors, such as the caveats listed in the Multi-Survey Comparison Results section. The lengths of bass differed greatly between surveys, which again may be due to multiple factors.

FURTHER WORK

In order to determine the best locations for surveying for small fish within Pagham Harbour, some exploratory sampling should be conducted. Furthermore, repeat surveys of the locations tested in 2007 and 2015. The locations utilised by Sussex IFCA were easy to access by road and so make good logistical choices. The most fish were caught at the Pagham Channel and Kay Optical Hide sites, therefore repetition of these sites might give more information than at the Pagham Pool site. It would also be informative for comparisons between years if water chemistry was collected at every site sampled.

ACKNOWLEDGEMENTS

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