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Report

Development Opportunities for Flounder as an Important Recreational Sea Angling Species

Pilot Project

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Contents

1. Executive Summary

This project was conducted in response to the Marine and Coastal Access Act 2009, which will see the formation of Inshore Fisheries and Conservation Authorities (IFCA) from the current Sea Fisheries Committees (SFC). IFCA's will be required to consider the demands and interests of all stakeholders, including the recreational sea angling (RSA) sector in the future development of inshore finfish management plans. It is envisaged that the present study of *Platichthys flesus*, the European Flounder, will serve as a pilot study towards Eastern Sea Fisheries Joint Committee (ESFJC) drawing up inshore finfish management plans in the future.

From existing literature and surveys conducted within the ESFJC district it was evident that the inner estuary is the most important for juvenile *P. flesus*, which migrate towards the freshwater, some time before metamorphosis is complete; once settled, they appear to remain in the inner estuary throughout their first year. The adults are much more sparsely distributed and large concentrations are uncommon; they occur in areas capable of supporting large numbers of individuals, one such place being Breydon Waters, where large numbers of all age classes are seen in the same location. Long-term data within the district are scarce, but RSA match records indicate a decline in *P. flesus* abundance over time, although this may be due to natural fluctuations. Many explanations have been proposed for the decline, including loss of habitat, increased predation, increased inshore fishing efforts, decreased water quality and the unrecorded use of all size classes of *P. flesus* as pot bait.

Recommendations

- Further habitat mapping of the district with regards to important juvenile *P. flesus* nursery grounds such as intertidal mudflats, inner estuaries and brackish water bodies
- Mapping of RSA activity throughout the district via social surveys and continued involvement of fishing clubs and alliances
- Development of a long-term multi-method survey on selected estuaries and inshore water bodies to determine fish population structure and improve knowledge of inshore species, via increased collaboration between organisations conducting survey work
- Monitoring of 8mm post-larvae recruitment, to better understand breeding season and reproduction
- Monitoring of *P. flesus* commercial use i.e. landings and use as pot bait

2. Introduction

SFCs operating around the country are responsible for inshore fisheries management in waters within the 6 nautical mile limit and are made up of representatives from Local Authorities, DEFRA appointees drawn from environmental, commercial and recreational fishing interests, and the Environment Agency. Under Section 153 of the Marine and Coastal Access Act 2009 (Marine Act), SFCs are to become Inshore Fisheries and Conservation Authorities (IFCAs) and are to be responsible for the sustainable exploitation of all inshore sea fisheries resources within their districts, thus, ensuring a balance is met between the socio-economic benefits of exploiting such resources and the need to protect the marine environment from, or promote its recovery from, the effects of these exploitative procedures. The success of IFCAs will rely heavily on a clear understanding of the differing needs of all stakeholder groups engaged in the use of sea fisheries resources within the district. One such stakeholder group is the recreational sea angling (RSA) sector; with well over one million participants UK wide, RSA is increasingly felt to be an important sector of activity from environmental, social and economic perspectives (Drew Associates, 2004). The emergence and growth of recreational fishing interest groups over the past thirty years and increased political activity from these groups in the USA (Ditton 1991; Coleman 2004), is set to be mirrored in the UK; there is growing awareness that marine recreational fisheries are highly significant in terms of the number of people participating in them, the total catch and their economic and social impacts. Management of these fisheries, however, has lagged behind recognition of their importance. Its biological impact is thought to be small, yet some have argued that its economic contribution to some coastal communities is now greater than that of commercial fishing. IFCAs will be required to consider management of fisheries specifically for the RSA sector as well as for the commercial sector, and in turn the RSA sector must acknowledge its role wholly, as a stakeholder in the future of inshore fisheries management. The Marine Act represents the first time in UK fisheries management history where consideration of the different needs of the fishing sectors at a district level will be possible, representing an opportunity to demonstrate that often both sectors share a common interest in the continued conservation and growth of resources. Failure to recognise the similarities of commercial and recreational angling may see these sectors further polarised (Cooke & Cowx 2006).

With a need to demonstrate that the interests of all stakeholder groups are being considered during the formation of IFCAs and the development of management measures, this project aims to assess a single key species which is valuable to the RSA sector, and identify where local management of the species could make improvements to the stocks and the RSA sector. *Platichthys flesus*, the European flounder, was identified by RSA representatives on the ESFJC as a suitable species of interest for this pilot project; traditionally valued by the RSA sector as a target species for beginner and experienced sea anglers alike, it remains accessible throughout the district and the year, and is one of the most common of the flatfish species found in European waters. *P. flesus* are impacted but not targeted by the commercial catching sector; however, there is growing concern for the unregulated use of *P. flesus* as pot bait. Although *P. flesus* is locally abundant, it is found throughout the UK coastline but most commonly within 50m of the shore predominantly in estuaries and brackish waters (Summers 1979; Hemmer-Hanson *et al.* 2007). Densities tend to be highest where the benthic substratum is soft such as sandy shores, mudflats and estuaries; the distribution extends to and can exceed the freshwater-tidal limit, making *P. flesus* an important fish species in the estuarine and inshore community (Wheeler 1969; Hemmer-Hanson *et al*. 2007). Despite continued

value to the RSA sector, *P. flesus* has received comparatively little study since it does not have the commercial or economic importance of other flatfish, such as plaice (*Pleuronectes platessa*) or sole (*Solea solea*); on a commercial scale it is mostly caught incidentally and unrecorded. However, for decades it has been considered a popular sport fish, due to its availability in shallow waters and readiness to take bait (Wheeler 1969). Information on estuarine and inshore fish population dynamics and distributions is scarce, most work traditionally being conducted via postgraduate studies, power station cooling water intake screens and selective beam trawling (Rajuddin 1997; Thomas 1998; Colcough *et al.* 2002; Hemingway & Elliott 2002; Kirk *et al.* 2002). However there is great scope for *P. flesus* to be successfully managed, in part due to the low commercial value of the species and its distinct local populations. For successful management to be achieved it is important that reasonable scientific data appropriate for specific fish and fisheries are available.

This pilot project is intended to summarise the current state of knowledge of *P. flesus'* biology, life history, distribution, and population trends in a review of the existing literature. It will increase understanding of distribution, observed interannual and seasonal trends in abundances of *P. flesus* throughout the ESFJC district by analysis of existing data, and of local and expert knowledge. It will provide evidence to support the development of a *P. flesus* management plan. A pilot social survey among local sea anglers will be conducted to increase knowledge of where this species is fished, and where the RSA sector operates. Key areas important for juvenile and adult *P. flesus* should be identified for a succinct management plan to be formed; and recommendations made towards a district wide management plan with the goal to protect, preserve and restore the marine environment, ultimately improving local populations and enhancing the fishing experience for the RSA sector.

3. Study area, approach and data sources

The study area is the ESFJC district which includes the inshore waters of Lincolnshire, Norfolk, and Suffolk: the northern limit is a line seaward East from the control tower at the Royal Air Force Gunnery and Bombing Range at Donna Nook in Lincolnshire, and the Southern is the Stour and Orwell Estuary in Suffolk where the district abuts northern boundary of the Kent & Essex Sea Fisheries District (Appendix 1 a). The ESFJC jurisdiction covers over 2,500 km^2 of sea, including all sea fisheries resources within the 6 nautical mile seaward limit, up to the freshwater limit. This covers a large area of sea fisheries activity, from Donna Nook in the north to Gibraltar Point at the entrance to the Wash, where lack of suitable harbours means small beach-launched boats target commercial demersal species, crabs, lobsters, and other shellfish; however many RSAs operate in this area. Good ports exist throughout the rest of the district, such as Boston, and King's Lynn, with Lowestoft the largest port for commercial landings, with lesser inshore activity at the southern most end of the district (esfjc.co.uk). All data were derived from within the district, although the literature review draws on information from further afield. For the literature review the initial intention was to use peer reviewed scientific journals obtained via search engines such as Web of Knowledge for information, however, existing peer-reviewed information about *P. flesus* remains sparse. Therefore the literature search was extended to include consultancy reports, grey literature, student theses and personal comments from contacts. The literature review was completed by July 2010.

Through numerous contacts, research and networking in the district, relevant *P. flesus* population data were obtained from: the Environment Agency, Unicomarine, CEFAS and the MMO; many other organisations and

authorities had no information or little interest in *P. flesus*. The Environment Agency data sets, are taken from the Water Framework Directive (WFD) fish survey programmes, an international commitment to assess the ecological status of transitional waters, to date these data cover only the Adle and Ore Estuaries 2003-2006, Breydon Waters 2007-2008, and Great Ouse 2007-2008 (Appendix 1 b, c, d). The Alde-Ore Estuary is located on the Suffolk coast and comprises the estuarine complex of the rivers Alde, Butley and Ore. There is a variety of habitats including intertidal mudflats, salt marsh, vegetated shingle, and saline lagoons; it is regarded as a unique and highly valuable habitat within the UK. Breydon Waters is a large tidal estuary in Great Yarmouth (Norfolk); >5km long and >1.5km wide in places, it also includes mud-flats, salt marsh and saltings. It is another highly valued estuary, protected by the RSPB, and is a European Union Special Protection Area (SPA). The mouth of the Great Ouse lies in Kings Lynn (Norfolk); the river is 230km long making it a major navigable river in the East of England. The Ouse Washes are another internationally important area for wildlife consisting of washlands, mud-flats and salt marshes. All data from the Environment Agency were gathered using their multi-method sampling strategy unless otherwise noted (Coates *et al.* 2007). Limitations of single-strand survey approaches, such as channel beam trawls or power station fish impingements (Attrill 1998; Kirk *et al.* 2002), led to the multi-method monitoring programme (Colclough *et al.* 2000, 2002). As different survey techniques differ in selectivity, a range of techniques offers a more comprehensive picture of populations (e.g. seine netting, beam trawling and otter trawling) (European Commission, 2000; Coates *et al.* 2007).

Since 1999, Unicomarine has undertaken a monthly (bimonthly post-2003) survey of the Stour and Orwell estuaries for Harwich Haven Authority. The Stour and Orwell include extensive mud-flats, low cliffs, salt marsh and areas of vegetated shingle; it is an important area for birds, is a designated SPA and important as shrimp and fish nurseries of many commercially and ecologically important shrimp and fish. The data used were obtained from the fish and shrimp monitoring of six stations along the course of each estuary sampled on a spring tide in the morning (Appendix 1 e); alterations have been made to the method throughout the decade including the addition of an intertidal, young fish survey and additional stations, but the fish survey technique has remained similar: a 2m beam trawl with a cod end mesh of 16mm was used, constructed to the same specification as CEFAS beam trawls. The Unicomarine data cover many aspects of the estuarine community, including non-commercially important species, and all large species present. The study areas used throughout this report are all important juvenile nursery fish habitats, particularly for juvenile *P. flesus* which utilise shallow inshore water systems and intertidal mudflats. It is important to concentrate efforts on areas of high importance to juvenile and spawning populations of *P. flesus* as simplistically a fisheries stock is ruled by growth and recruitment.

The CEFAS data were from the Eastern English Channel survey (August-September) (Appendix 1 f) which includes *P. flesus*, the inshore Norfolk/Suffolk coastline being sampled between 1995 and 2008. Sampling gear consisted of a commercially rigged 4m beam trawl, fitted with chain mat, flip-up ropes and a 40mm cod-end liner. Although this technique is much more selective than that of the WFD multi-method approach, it is largely consistent over a very large temporal scale and therefore equally valuable in assessing trends in *P. flesus* populations. The *P. flesus* inshore population, particularly at the depths this survey was carried out, are largely adult and due to the large mesh size used observed numbers are minimal, although size data are not recorded. The

area surveyed is one of the more heavily commercially fished areas within the district, so impacts of overfishing may be observed.

A social survey was conducted to help elucidate demographics preferences, motivation and amount and catch records of *P. flesus*. The questionnaire was kept simple, and after feedback from a pilot run conducted with the RSA representatives, consisted of one page comprising six questions in total, and a map of the relevant area for the respondent to illustrate key fishing areas, and key *P. flesus* areas (Appendix 2 a). The survey was conducted by using ESFJC contacts and via contacts of the RSA representative and the Eastern Leisure Sea-Anglers Alliance (ELSAA); several copies of the questionnaire with relevant maps attached were sent to fishing associations affiliated with ELSAA, which were expected to elicit a higher response rate than non-affiliated clubs. Fifteen copies of the questionnaire with addressed business post envelopes with a covering letter addressed to the secretary (Appendix 2 b) were sent to 19 fishing associations between 7 May 2010 and 13 May 2010, a total of 270 surveys were sent with a total return of 19 responses (~7% return rate). These posts were followed up by telephone calls throughout the week of 17 May 2010. Some contact information was out of date, some individuals could not be contacted, but feedback from the secretaries was largely positive. The majority of the respondents completed the questionnaires as expected, and there was little confusion or misinterpretation of the questions. From discussion with secretaries it was implied that younger anglers and the keenest anglers were most eager to reply and help with the progression of RSA based finfish management.

4. *P. flesus* in the ESFJC district

The results of the synthesis of existing data and social data from the present survey are summarised in sections, while the wider literature review is summarised in the discussion.

4.1. Distribution

Inshore waters include nursery grounds vital for juvenile *P. flesus*, as reflected in the WFD and Stour and Orwell survey data. The Environment Agency's multi-method survey highlights the importance of the inner estuary sites for 0+group *P. flesus*. Once juvenile *P. flesus* enter the estuarine system in spring, they continue to migrate upstream towards freshwater during the autumn months; the Great Ouse, 0+ group *P. flesus* do not reach South of Kings Lynn until autumn, and 1+group fish tend not to penetrate much past the Low Cut (Appendix 3 a). 1+group *P. flesus* rarely penetrate as deep into the estuary as 0+ groups perhaps due to lack of suitable feeding grounds. In the Great Ouse data, there are observations of 0+group fish at least as far upstream as Denver Sluice, where they will have passed Salters Lode Lock, Old Bedford Sluice and A G Wright Sluice; they were also recorded as far as Dedham River in 2000 (Environment Agency, 2000) showing that the 56-gate sluice on the Orwell is penetrable, and there is tolerance of freshwater conditions. For Alde and Breydon (Appendix 3 b, c, respectively), 0+ groups *P. flesus* were observed in the innermost reaches of the Alde estuary in 2003 and 2005, but sightings of 1+group *P. flesus* were only recorded along the Ore and at the mouth of the estuary, indicating the importance of the inner estuary for the juvenile *P. flesus* during their first summer. Breydon Water data show 1+group *P. flesus* only at Caister beach, and low abundances of 0+ groups in the outer estuary during the spring. Breydon Water appears unusual in that the inner waters appear to have all life stages of *P. flesus* in abundance; large concentrations of adult *P. flesus* are uncommon in previous studies because they tend to disperse along the middle and lower estuary and

the near shore sublittoral environment. The adults are less associated with a particular habitat or location, however Breydon Water is important for adult *P. flesus,* at least during the autumn months (otter trawl sampling unavailable during other periods).

Like the WFD data, extensive Stour and Orwell Fish and Shrimp Monitoring survey data also show that the inner estuary is highly important particularly for juvenile *P. flesus*, with the majority of individuals being recorded at stations OR6 and ST6 and the largest specimens being more regularly observed in the Harbour (H) and the Approaches (ORA/STA); in contrast to the other flatfish, large *P. flesus* are not uncommon in the estuary with many individuals >150mm length in the mid-lower estuary measured (Appendix 3 d).

4.2. Seasonal trends

The size and structure of the inshore *P. flesus* population is generally influenced by four major migrations: the winter emigration of mature spawning *P. flesus*; the subsequent immigration of returning spent fish; immigration of 0+ *P. flesus* post-larvae; and the winter emigration of all age groups for deeper feeding grounds, leaving a small estuarine population of mainly 0+ and maturing fish.

The Unicomarine reports consistently show small numbers of *P. flesus* were caught throughout the year, however some larger catches were observed between December and April of most years, with December or February showing the highest abundances, few specimens being caught in the summer (Appendix 3 e). *P. flesus* are more abundant in the Orwell than the Stour, however, this is so for nearly all fish and shrimp species; the cause remains unclear. Between 2002 and 2004 *P. flesus* went from the 5th to the 9th most common species. Juvenile *P. flesus* (<60mm) were observed in the Stour and Orwell estuaries from December 1999 to February 2000, and then reappeared in May 2000. The juveniles in Dec 1999 to Feb 2000 were likely late immigrants from the 1999 spawning and those in May 2000 were probably from the 2000 spawning, juveniles <50mm were never recorded and may be due to inappropriate methodology. The immigration of flounder post-larvae (<8 mm) in the Stour and Orwell may start in late April-early May. Different times of larval immigration are attributable to differences between *P. flesus* populations, between locations or environmental conditions and/or differing sample methodologies (e.g. mesh size and date of study). These juveniles observed in December and February may be those of the previous spawning season, and therefore have a slower growth, growing only 40mm ca. 6 months. The Unicomarine data show juvenile and maturing *P. flesus* in the size range 80-160mm, in which *P. flesus* will rarely leave the confines of the estuary.

4.3. Interannual trends

Most notable in the monthly abundances of *P. flesus* Unicomarine beam trawl data are the abundance peaks occurring in December to March. Catch rates have declined, particularly between April 2004 and February 2008 when the highest recorded catch (14) was almost nine times smaller than the previous highest catch of February 2002 (121) (Fig. 1; Appendix 3 f). These data suggests a possible reduction in survival or recruitment or both, of juvenile *P. flesus*, based on the winter peaks. This suggestion of decline is echoed by the CEFAS data from the Suffolk Coast (Appendix 3 g), although fish populations typically show natural temporal fluctuations (Pomfret *et al.* 1991; Ravier & Fromentin 2001). Apart from the high catch of juvenile *P. flesus* in 2002 in the CEFAS data, these data suggest a decline in juvenile abundance since 1999 with frequencies of specimens below three for seven

stations each year. Although juvenile *P. flesus* here are expected to be more abundant in the estuary, abundances are low throughout the coast of Suffolk, the highest abundances being near Lowestoft. Densities of *P. flesus* in the nearshore environment have been consistently low in comparison to other inshore species.

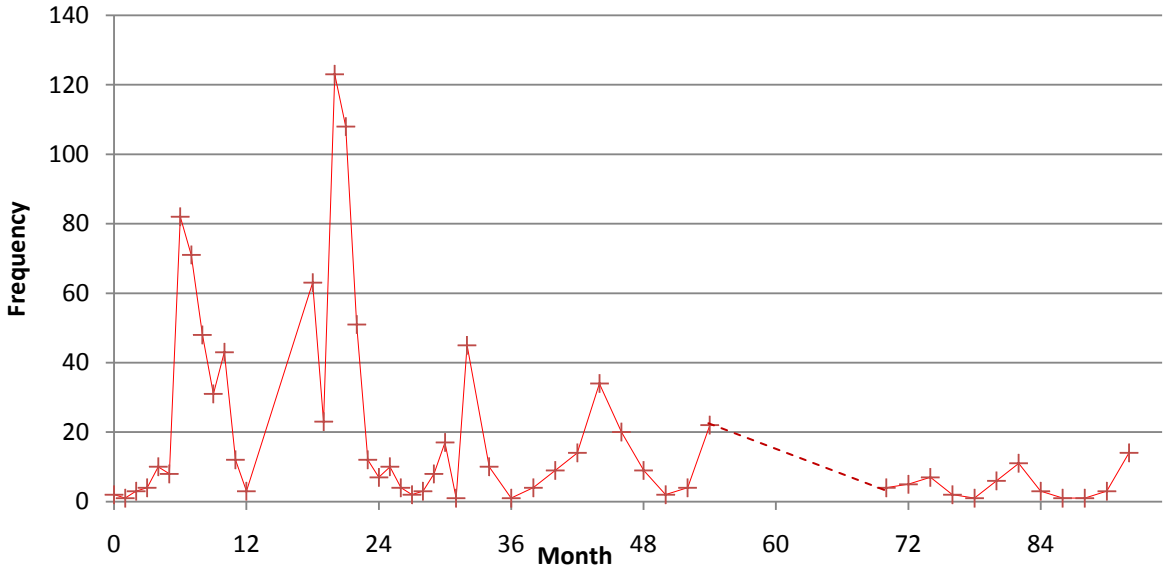

Fig. 1 Graph showing the total *P.flesus* beam trawl catch from Unicomarine Stour and Orwell fish and shrimp monitoring survey from June 1999 to February 2008, using a standard methodology (Dyer 2000). Month 0=June 1999; 12=June 2000; 24=June 2002 etc. Note the surveys become bi-monthly after February 2003. Data provided by Unicomarine.

Although it is unclear from the commercial catch data (Appendix 3 h) whether there has been a decline in catch rate, abundance or fishing effort for *P. flesus.*

4.4. Social survey

Responses to the pilot social survey indicated very few *P. flesus* are caught by the RSA sector, with those that are caught generally being below 200mm. Declines were reported by almost all those contacted, most notably older fisherman. The RSA sector have observed a decline in catch rate of *P. flesus* over the past decades, and their catch records support this, but with little long-term monitoring and a previous lack of interest this decline has gone largely unrecorded by scientific surveys. Several newspaper articles and match reports suggest numbers of *P. flesus* in district estuaries during 1970-1980 were much greater than they are now, based upon recorded total match weights. Responses to the survey are summarised in a map of areas that are regularly fished by the RSA community (Appendix 3 i), it should be noted that the responses came from a variety of fishing clubs from throughout the district. Also highlighted are habitats important to *P. flesus*, thus, ensuring that future management can focus on key areas where the RSA sector will notice the benefit. There was no significant difference among the rankings of the four motivational criteria (Kruskal-Wallis $p=3.40$, $p<0.05$). The motivations of RSAs within the district are thus not homogenous and differing participants have different goals.

5. Discussion

5.1. Distribution and population trends

The district-wide distribution and accessibility of *P. flesus* as an inshore species make it ideal for a pilot RSA management plan. The potential lifetime dispersal of a single individual does not correlate with the full

distributional area of the species; this along with hydrographical and bathymetric factors may keep populations relatively distinct (Rogers & Millner 1996). The life history traits, relatively site-attached nature, and zonation of differing size classes of *P. flesus* along the inshore water-system may allow for accurate local studies of populations, leading to the effective use of RSA management on a local scale, this would be a relatively new prospect for UK fisheries management.

It would be useful to extend the mapping of habitats within the district to that of habitats important to *P. flesus*, to gain a more accurate understanding of their potential distribution, and highlight areas that may need environmental improvement, or continued monitoring. Further habitat mapping to distinguish important juvenile and adult *P. flesus* areas is recommended; this might be extended to improve understanding of the impacts of the changing environment on *P. flesus* and other impacts such as sea level rise, development of waterways, flood defences, and creation of wetlands. Altered waterways are often ill suited to *P. flesus*, which rely on intertidal mudflats and the reduced flows in the shallows.

Unicomarine data showed seasonal highs during the winter although the winter generally has the lowest estuarine abundances of *P. flesus* (Summers 1979). Any differences between studies could be explained by differences in survey methodology and the ambient estuarine temperature, which is lowest in late winter. *P. flesus* post-larvae (>8mm) are often located in the fringes of the estuary, using selective tidal stream transport to move upstream (Jager 1999), shallow waters offering higher temperatures, lower predation risk, abundant food, appropriate substrate, and less tidal influence. *P. flesus* are generally considered to move to deeper waters in the winter (Muus 1964), therefore *P. flesus* will tend to aggregate in the main channel, they are also comparatively less active during this period, and this may explain the observation of season highs in abundance during the colder winter months as they are more likely to be caught than during the summer months. The method of Summers (1979) involved a wire mesh trap whose mouth faced the shore, catching *P. flesus* (>55m) as the tide changed, the data reflecting thus abundances in the intertidal mudflats. A mutli-method approach that includes the intertidal and channel is required to establish a representative analysis when studying *P. flesus* in inshore waters. The use of a beam trawl from an inshore fishing vessel means that only the deepest central channel of the estuaries can be successfully surveyed at high tide (see; Dyer, 2000), thus the intertidal mudflats and shallows of the estuary, which are known to hold the highest numbers of *P. flesus* are not represented in the data.

Throughout the study it became clear that the estuaries of the district are vitally important for *P. flesus* and that habitat quality and quantity appears to have a significant impact upon the recruitment of juveniles. 1+group *P. flesus* rarely tend to penetrate as deep into the estuary as 0+ groups perhaps due to lack of suitable feeding grounds; as adult *P. flesus* target larger, more saline derived prey species (Summers 1979; Summers 1980; Pihl 1982; Westberg 1997).

5.2. Management Implications

Management measures such as fish size and bag limits, permanent or seasonal closure of areas and gear restrictions have their benefits and value in commercial fishery management, but are sometimes enforced with poor focus on

the initial goals of the management plan. In some cases enforcement may be counterproductive or irrelevant to the motivations of all RSA participants; for many the primary motivation derives from the 'fishing experience' rather than 'catching fish' (Kirkegaard & Gartside 1998). This is supported by the present social survey, which highlighted that no one motivation was ranked significantly higher than the others. An improved fishing experience does not necessarily mean increased catches; for example it could include improved surroundings, the exclusion of commercial fishermen, or improved access to waters. Therefore commercial management measures should not be directly transferred to RSA management as the goals differ. What remains vital in any management is to define criteria to evaluate the success of implemented procedures; therefore in the case of RSA management this means not assessing only changes in catches, but also assessment of the satisfaction of the RSA participants and the increased utilisation of the resource.

Over the centuries human alterations to the coast including land reclamation have induced a relatively unrecorded reduction in intertidal habitat. With continued canalisation of waterways and the maintenance of river channels it may be more appropriate to protect and preserve those areas that can ensure healthy recruitment and to extend the area of nursing grounds, rather than attempt to monitor and improve fish stocks in ill-suited estuaries. There is an increased realisation across Europe for the need to improve efforts to rehabilitate or restore habitat structure and function sometimes as replacement for traditional recreational fisheries management approach to intensively stock fish (Meffe 1992; Arlinghaus *et al.* 2002; 2005). Some successful recreational finfish management has succeeded by enriching the environment rather than enriching the stock (Arlinghaus 2005).

River restoration has been utilised in some regions to counter such habitat loss, providing protection during times of flooding, and shelter for juveniles. This restoration can be implemented at various scales and aims to improve the health and diversity of estuaries (Booth 2003; Colclough *et al.* 2005; Wallasea; Dixon *et al.* 2008). However, every habitat rehabilitation project has to be carefully planned and executed in order to minimise unexpected outcomes (Cowx & de Jong 2004). The introduction of the special areas of conservation (SACs) may affect *P. flesus* populations via the process of overspill, increasing recruitment or increasing predation; the impacts of these developments could be closely monitored. Positive effects of small marine reserves on adjacent fisheries have been well documented (Roberts *et al.* 2001).

Although habitat-orientated recreational fisheries management offers solutions to many management problems, advances in research, training and support from stakeholders are paramount. From personal conversations it is apparent that RSAs are generally in agreement that regulations are essential to the conservation and proper management of these fisheries, although enforcement of new regulations is difficult due to uncontrolled participation. The local unenforced adoption of catch-and-release method supports this theory; where fishermen record measurements as soon as they are caught to minimise stress and damage inflicted on the fish (Cooke 2007), this can be increasingly vital for larger females due to increased fecundity and larval survival (Birkeland & Dayton 2006). Although there are limitations to the usefulness of data from fishing club records in management of recreational fisheries, with careful analysis, trends relevant to resource management can be discerned (Gartside *et al.* 1999). This also highlights the need to monitor fishing effort, which is currently unreliable due to the lack of a licence or membership; many recreational sea anglers are not club affiliated. With improvements to the fishery and subsequent increased use of the resource new management issues will likely arise; improved fishing experience

may increase the number of fishermen drawn to the region and increase revenues, but potentially nullify any fish stock improvements. Proper enforcement is required; this is best achieved with full participation of stakeholders (Caddy, 1999).

The social benefits of an improved *P. flesus* fishery are clear, for young people, outside activity, enjoying natural surroundings and raising awareness of environmental issues. The RSA sector is very large in the UK, and numerous recent studies show their potential strength in economical matters (Drew Associates, 2002; Poseidon, 2006). However the Drew report does not reflect on urban sea angling (Drew Associates, 2002), which is largely not monitored; improvements in the health of urban estuaries will probably see an increase in inshore recreational angling species, including *P. flesus* (Gill *et al.* 2001) thus bringing economic gain to the area. The economic importance of RSA fisheries is often overlooked, and the use of *P. flesus* as pot bait for commercial fisheries is a poor use of the resource when the economic value to the RSA sector is considered. Therefore participation in decision and management must be increased in the RSA sector, to help identify common goals and general stakeholder consensus, as alliances such as ELSAA are. With a recognised voice in management and continued interest from authoritative bodies, a sustainable and effective management regime is possible by increasing compliance via participatory management. Anglers should be increasingly involved personally in designing and implementing management programs to facilitate in a representative stakeholder management plan and also to facilitate understanding about the outcomes and risks of various management actions. The novel USA approach of 'angling management organisations' is successfully combining management partial devolution and co-management (Sutinen & Johnston 2003).

The impact of commercial fishing on *P. flesus* in the UK remains difficult to assess, the majority of what is recorded being sold to mainland Europe where there is more demand for the fish, the rest being unrecorded by-catch or being used as pot bait. There is scope for commercial catch data to be useful for recreational fisheries management (Terceiro 2002) commercial catch records of *P. flesus* having been used to assess the stock of a recreational fishery; the *P. flesus* RSA fishery in the USA has seen notable increases in stock size since 1990, and proves that a fishery involving both the commercial and recreational fishing industries and the relatively recent involvement of environmental advocacy groups can work. CEFAS data may be available as far back as 1989, and over 107 stations, the number of stations has been cut to 75 since 1999, providing scope for further assessment of *P. flesus* stocks. Future social surveys could be extended to include types of baits used, targeted fish species etc. SS could be extended in the future to include many additional angling clubs, fishing associations, boat owners and tackle shops throughout the district. The potential for gaining valuable information from the RSA sector is vast. The biggest issue with social surveys is achieving representation of all stakeholders in the district; only a fraction of the total number of estimated sea anglers are affiliated to clubs, some remain unapproachable and some may only visit the district to fish. Different levels of fishing activity and commitment will in turn arise to differing demands and interests of the anglers. For a management plan intended to benefit the stakeholders to work, a high representation of the stakeholders must be consulted, affiliated anglers may have a higher level of mediated interaction than a pleasure angler.

There is a growing need within the district for more holistic surveying methods to prevent patchy, non-quantitive data and avoid incomplete work with overstated conclusions. Such development should be coupled with an attempt

to overcome the disjunction between fisheries and ecosystem management; the estuary as a whole should be monitored as the whole ecosystem should inform management decisions. Fisheries management decisions need to be based on sound scientific data or evidence which can only be achieved by sound, standardised and effective scientific monitoring practices tailored to the environment or a particular species. As each species is unique, not only are species-specific surveys required but species-specific management guidelines may be required (Cooke & Suski 2005). Varied sampling such as that of the WFD should be the goal so that realistic overview of species present and abundances can be attained and management plans put in place thereafter, this can be achieved by collaboration with organisations and universities.

6. Acknowledgements

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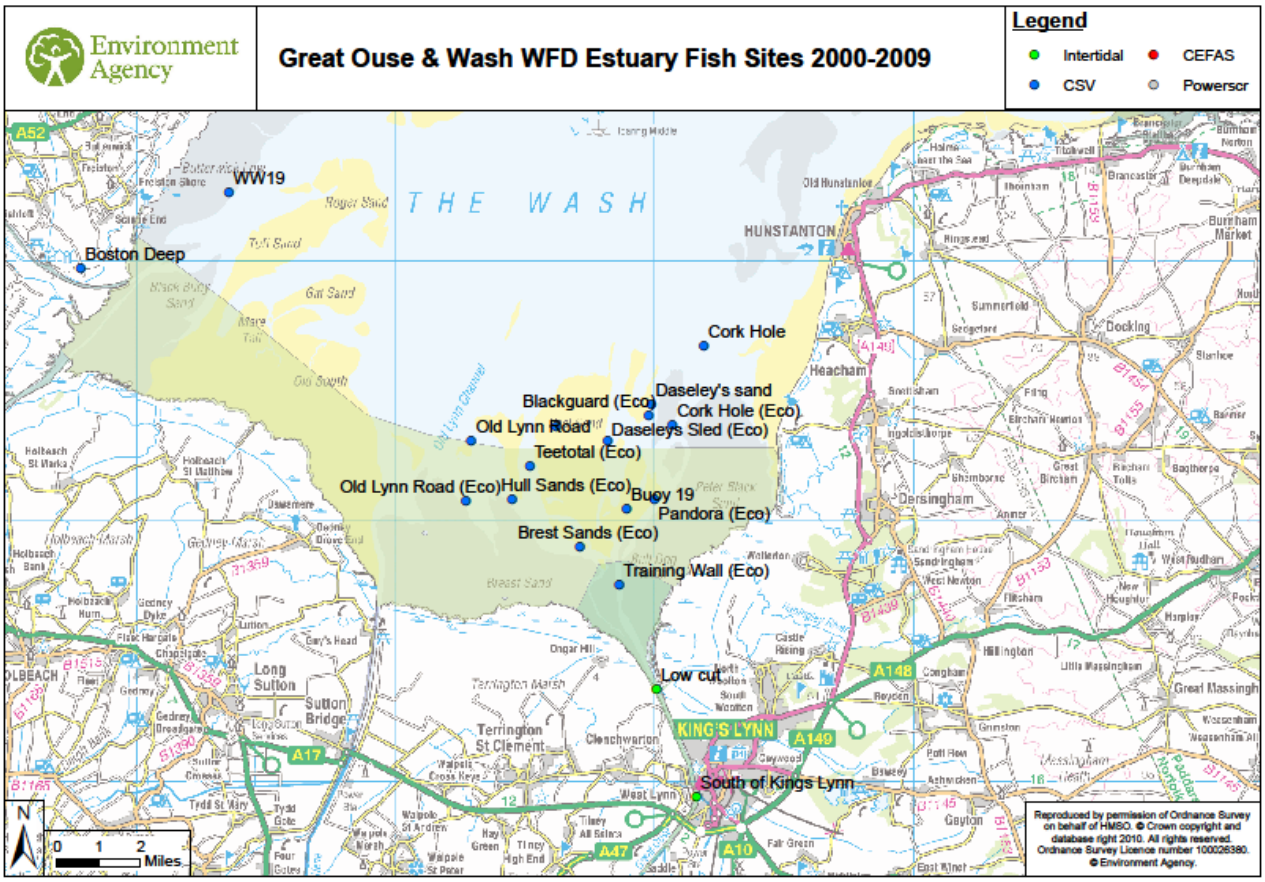
8. Appendices

8.1. Appendix 1

a.

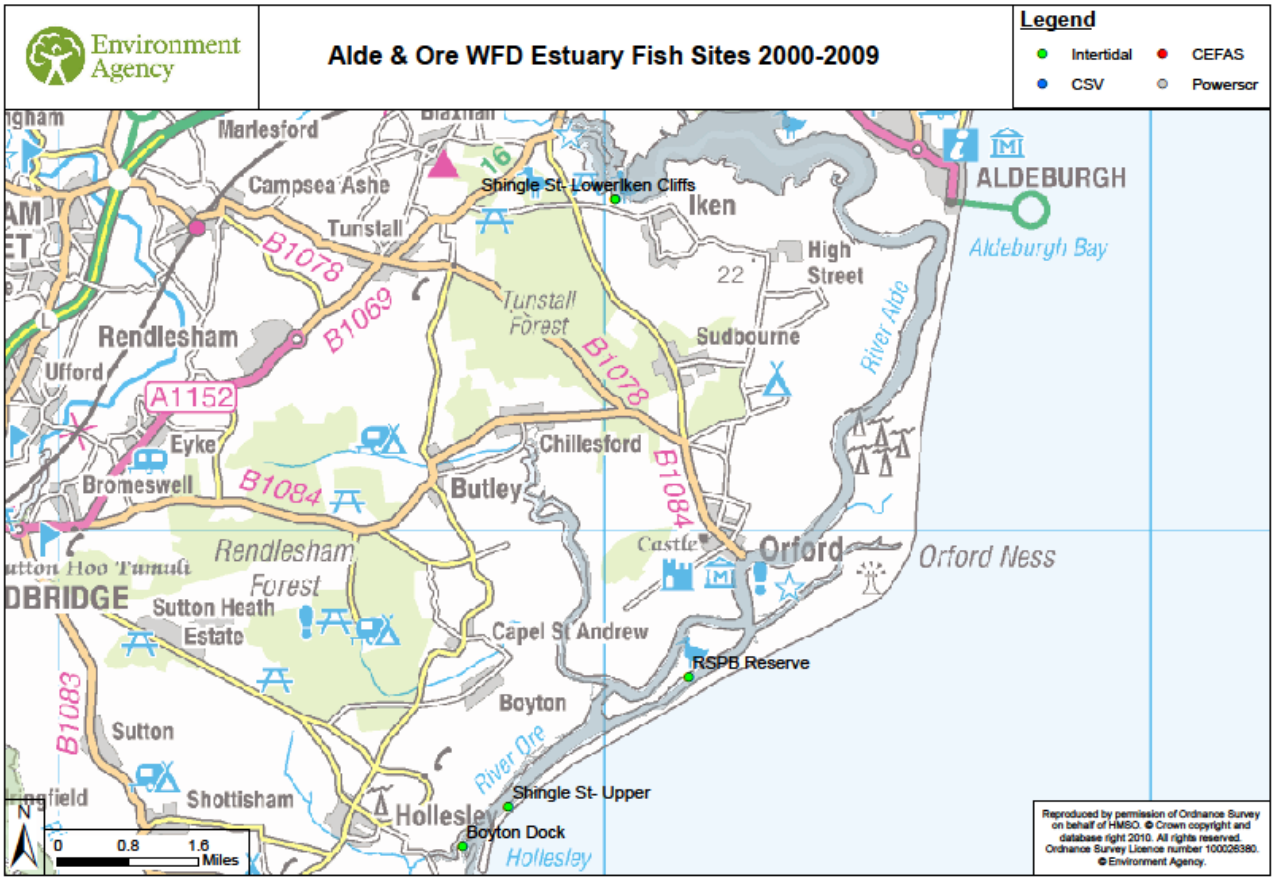
Map of the ESFJC district doundary, from Donna Nook in the North to the Stour and Orwell estuaries in the South. Covering over 2,500km^2 of sea it is one of the largest SFC districts. Provided by ESFJC.

b.



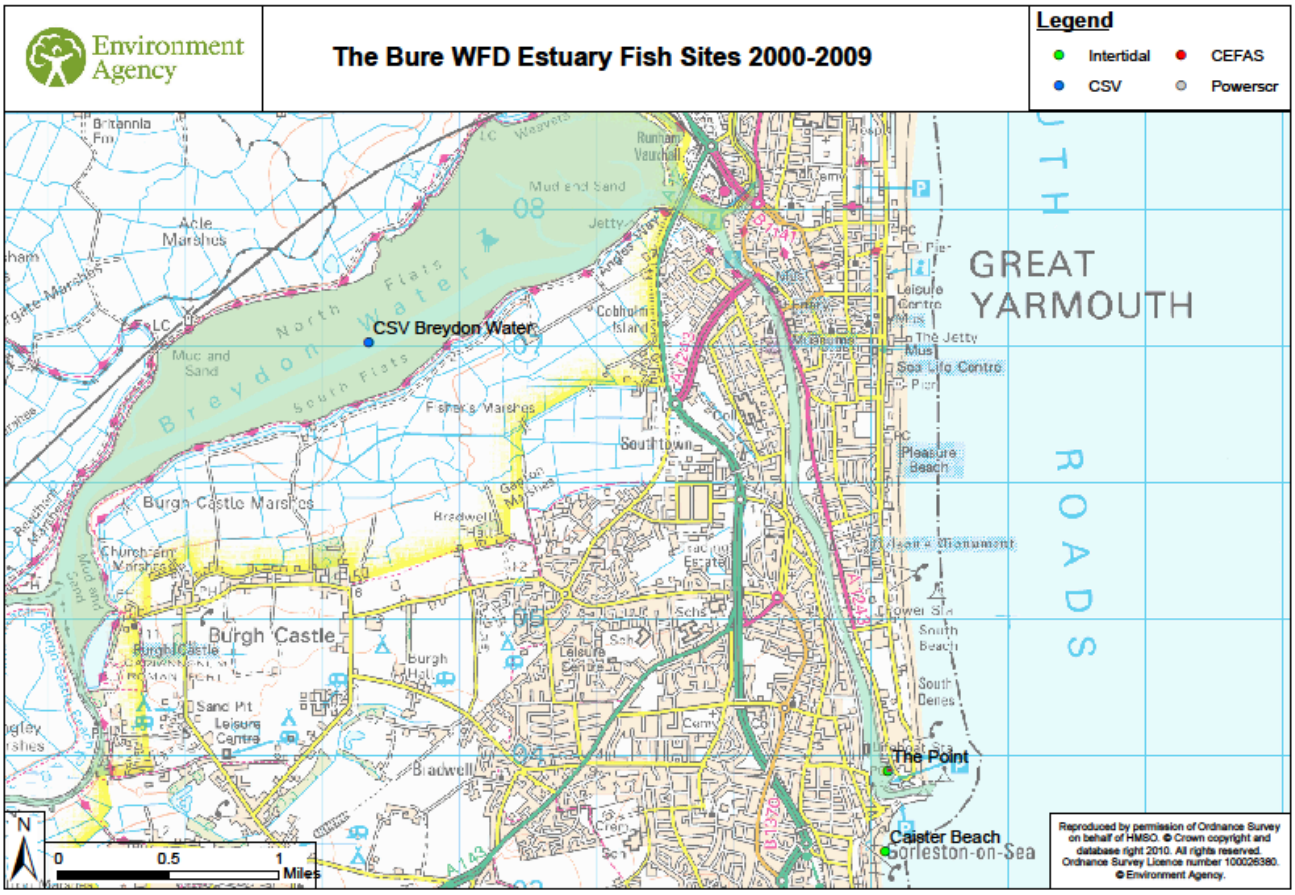
Map showing the study area of the WFD on the Great Ouse, Kings Lynn. Provided by the Environment Agency.

c.



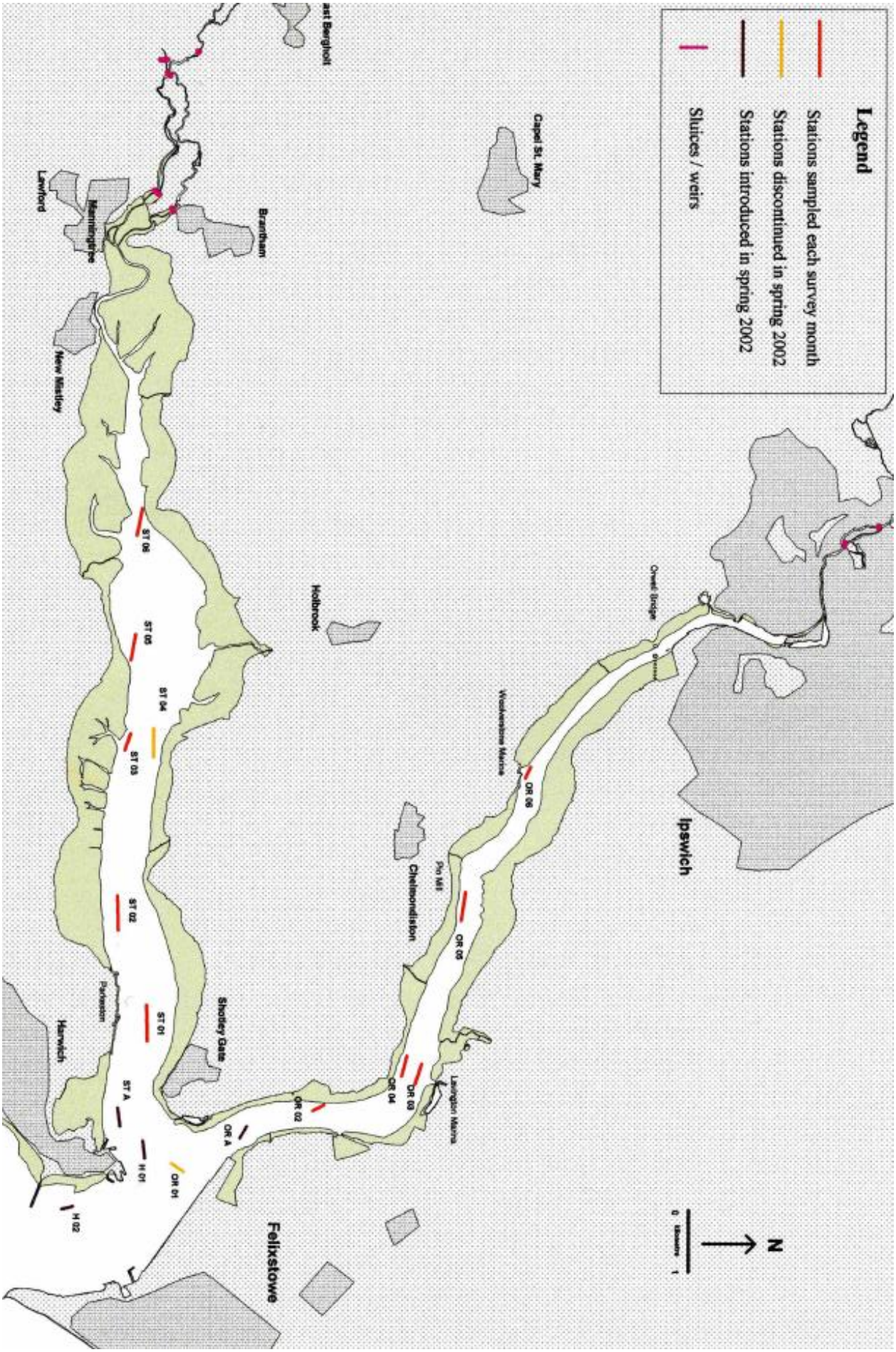
Map showing the study area of the WFD on the Alde and Ore, Norfolk. Provided by the Environment Agency.

d.



Map showing the study area of the WFD on the Bure, Norfolk. Provided by the Environment Agency.

e.



Map showing the study area of the Stour and Orwell Fish and Shrimp Monitoring Survey, it highlights the 15 study sites used for this report, ORA, STA, OR1-OR6, ST1-ST6, & H01. Provided by Unicomarine.

f.

Map showing the station location of the CEFAS Eastern English Channel Survey. Produced using google maps.

8.2. Appendix 2

a.

Consultation on the Flounder Fishery for the East of England

Please take your time to answer the following questions completely....

Name: Contact Details:

1. Score the importance of each of the following criteria individually, from 1 (high) to 5 (low) when deciding where you fish:
   - Size/number of fish _____
   - Surrounding environment _____
   - Accessibility _____
   - Distance to travel _____
   - Other (please specify) _____

2. On average how often do you fish?
   - More than once a week _____
   - Once a week _____
   - Once a month _____
   - Other (please specify) _____

3. On an average day fishing how many flounder would you expect to catch?
   - 0 _____
   - 1 – 5 _____
   - 5 – 10 _____
   - 10 + _____

4. Approximately what size is the average flounder caught?
   - Less than 10 cm _____
   - 11 – 20 cm _____
   - 21 – 30 cm _____
   - 30 cm+ _____

5. What changes have you seen in flounder catches over the past years? (i.e. distribution, size, number)
   _____-
   _____

6. Do you keep a log of your catches?
   - No _____
   - Yes _____

On attached maps of districts clearly highlight and distinguish between areas and estuaries you frequently fish, and areas you would expect to find flounder:

Once complete please return using the stamped, addressed, envelope provided.

Thank you for your time...

Mr D J Skerritt
07724230647
35 Clive Place
Byker
Newcastle upon Tyne
NE61DE
d.j.skerritt@ncl.ac.uk

b.

Mr D J Skerritt
Eastern Sea Fisheries Joint Committee
6 North Lynn Business Village
Bergen Way
King's Lynn
Norfolk
PE30 2JG
01553 775321 (mob: 07742430647)
d.j.skerritt@ncl.ac.uk

Dear Mr Secretary,

I am a Newcastle University Masters Student currently undertaking a placement at the Eastern Sea Fisheries Joint Committee, Kings Lynn (to become EIFCA). Under the Marine and Coastal Access Act 2009, which will commence 2011, Inshore Fisheries and Conservation Authorities (IFCA's) are to be responsible for the exploitation of marine resources within their districts. IFCA's will be required to consider specific management of fisheries for the Recreational Sea Angling (RSA) sector as well as for the Commercial sector. Therefore the Marine Act represents the first time in the UK management of fisheries where consideration of the different needs of the fishing sectors will be possible. The Eastern Sea Fisheries Committee is ahead of many of its peers in this field, with a well established link with the RSA sector already in place.

My work is a pilot project for developing opportunities for important recreational sea angling species; in this case focusing on the European Flounder. Due to a lack of information on this particular species I am conducting a social survey to establish important fishing areas for the RSA sector and to identify the distribution of flounder throughout the district. I am contacting all the fishing associations throughout Lincolnshire, Norfolk and Suffolk, to improve our understanding of the flounder by targeting the RSA sectors valuable local knowledge. I hope that you can see the importance of this project for the future benefit of the RSA sector. With enough support this could see a change in future management of our coastal waters.

Please find enclosed a number of copies of a short questionnaire, relevant maps of the districts' estuaries and coast line, and stamped addressed envelopes for the completed forms to be returned. It would be of great help if you could raise interest in this cause and distribute these surveys to members of your association. The questionnaires will only take 10 minutes to complete, and no cost will be incurred for them to be returned.

If you require more questionnaires, have any queries or further interest in this project please do not hesitate to contact me. I am always available on my mobile at the top of the page.

I look forward to hearing back from your association.

Kind Regards

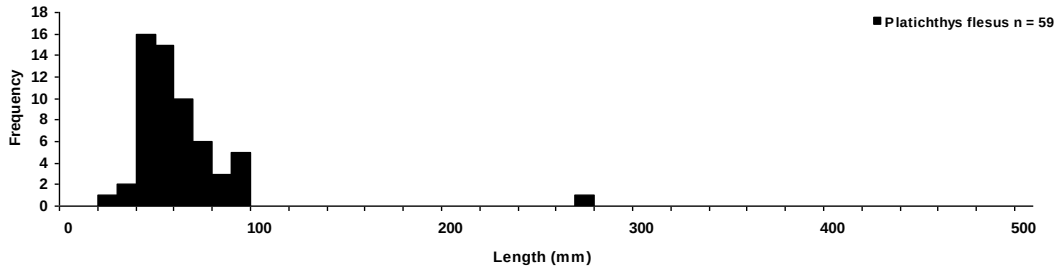
Daniel J Skerritt

8.3. Appendix 3

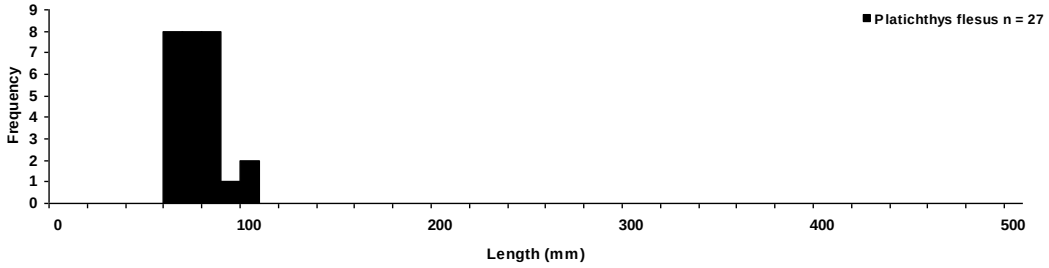
a. The Great Ouse- Flounder distribution

South of Kings Lynn

Autumn 2007

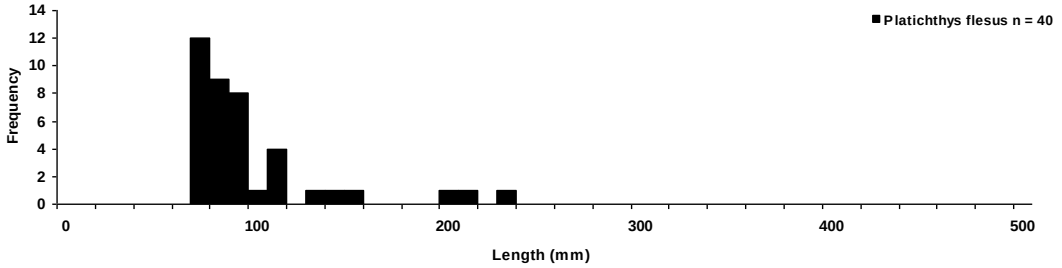


Spring 2008



Low Cut

Spring 2008



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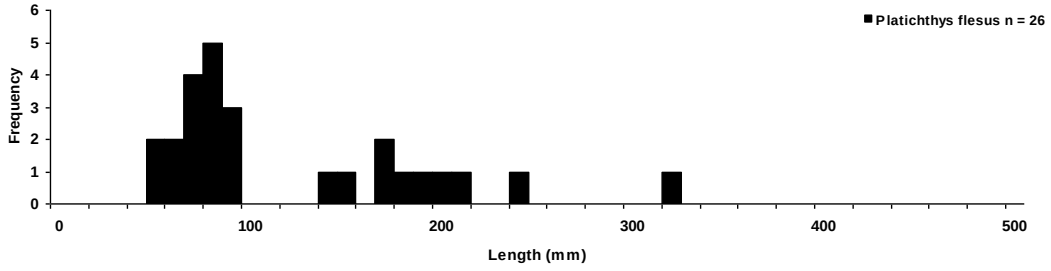
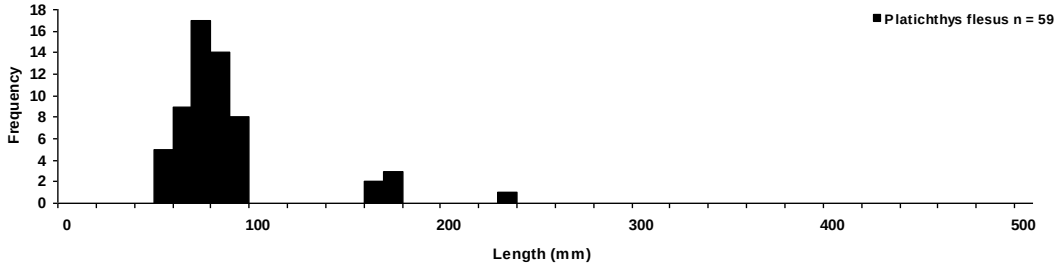


CSV Otter Trawl

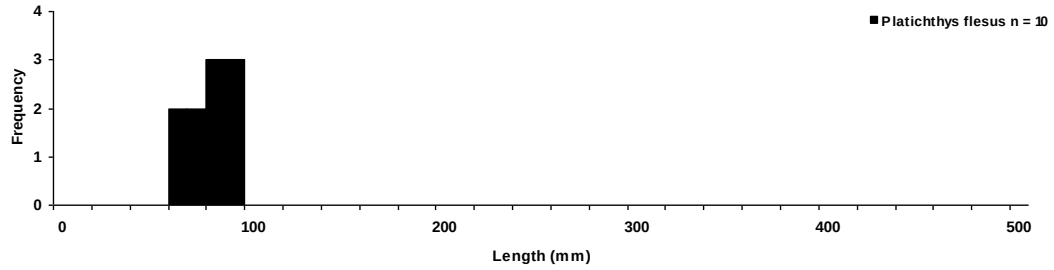
Autumn 2008



b. Alde – Flounder distribution

Iken Cliffs

Autumn 2003



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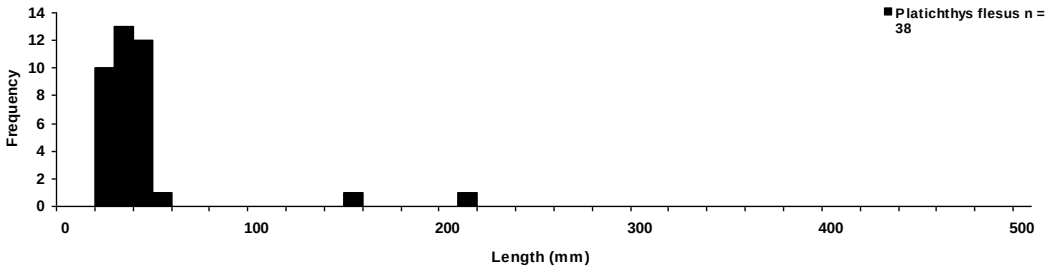

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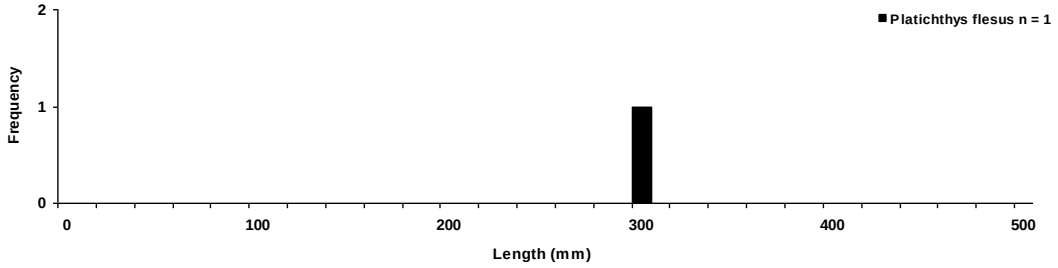
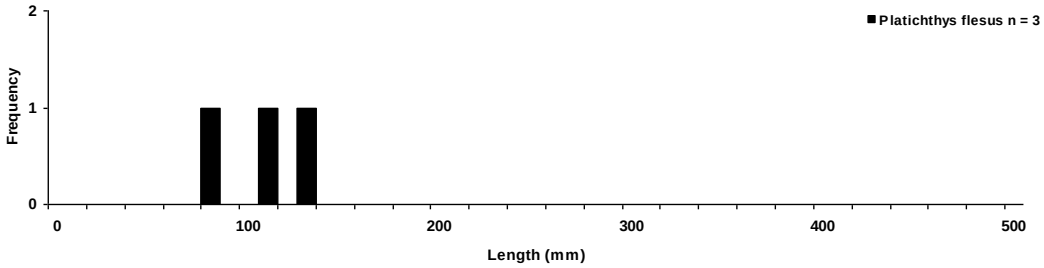


RSPB Reserve

Spring 2006



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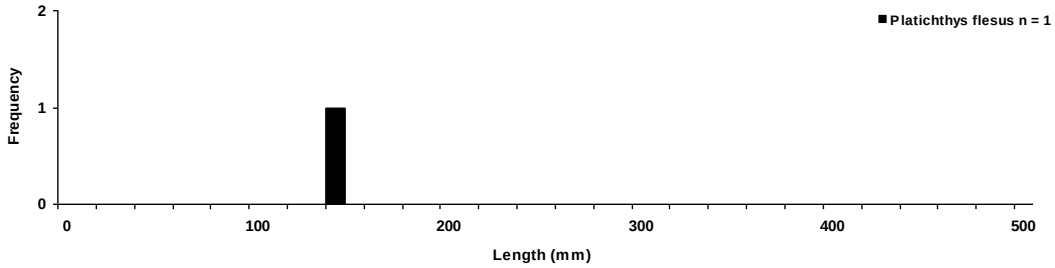
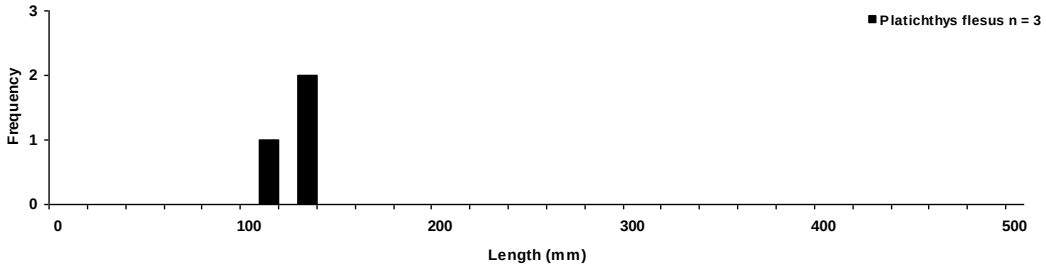


Boyton Dock

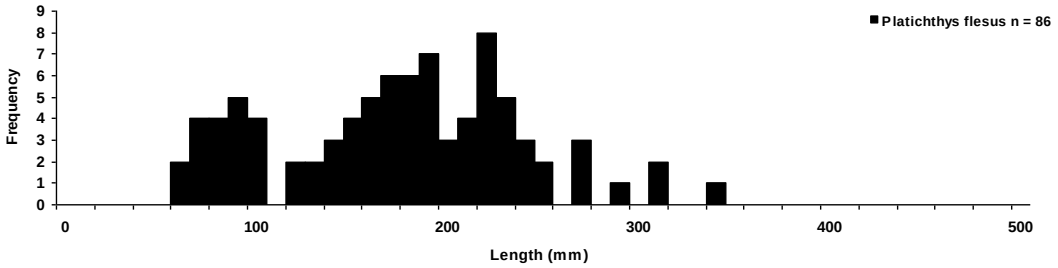
Spring 2004



c. Bure- Flounder distribution

Breydon Water – Otter trawl

Autumn 2007



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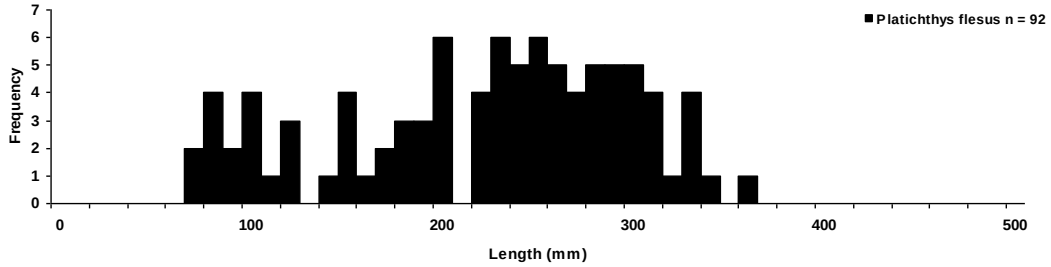

Caister Beach

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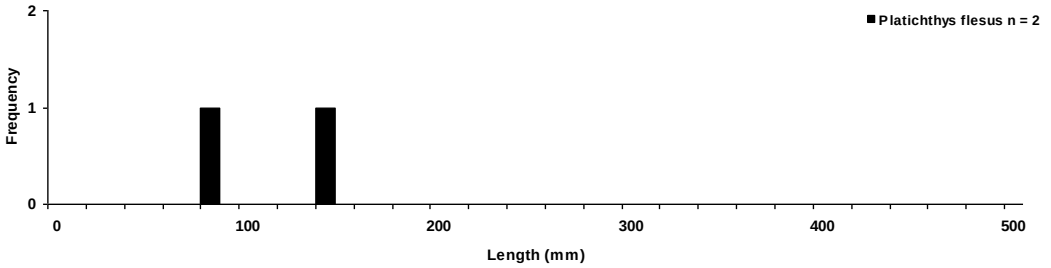
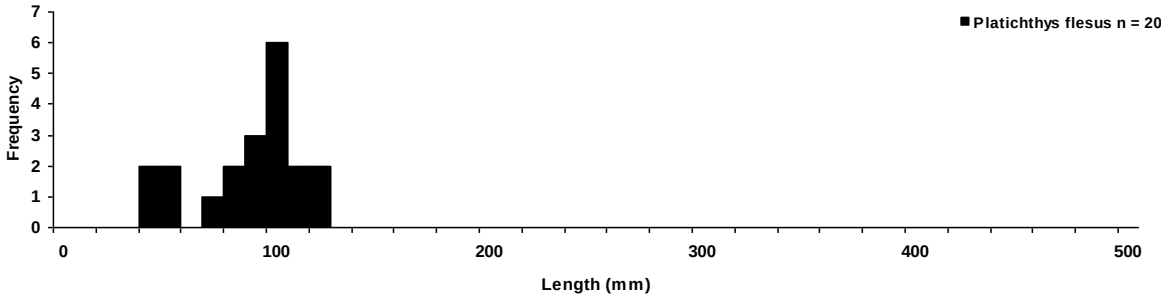
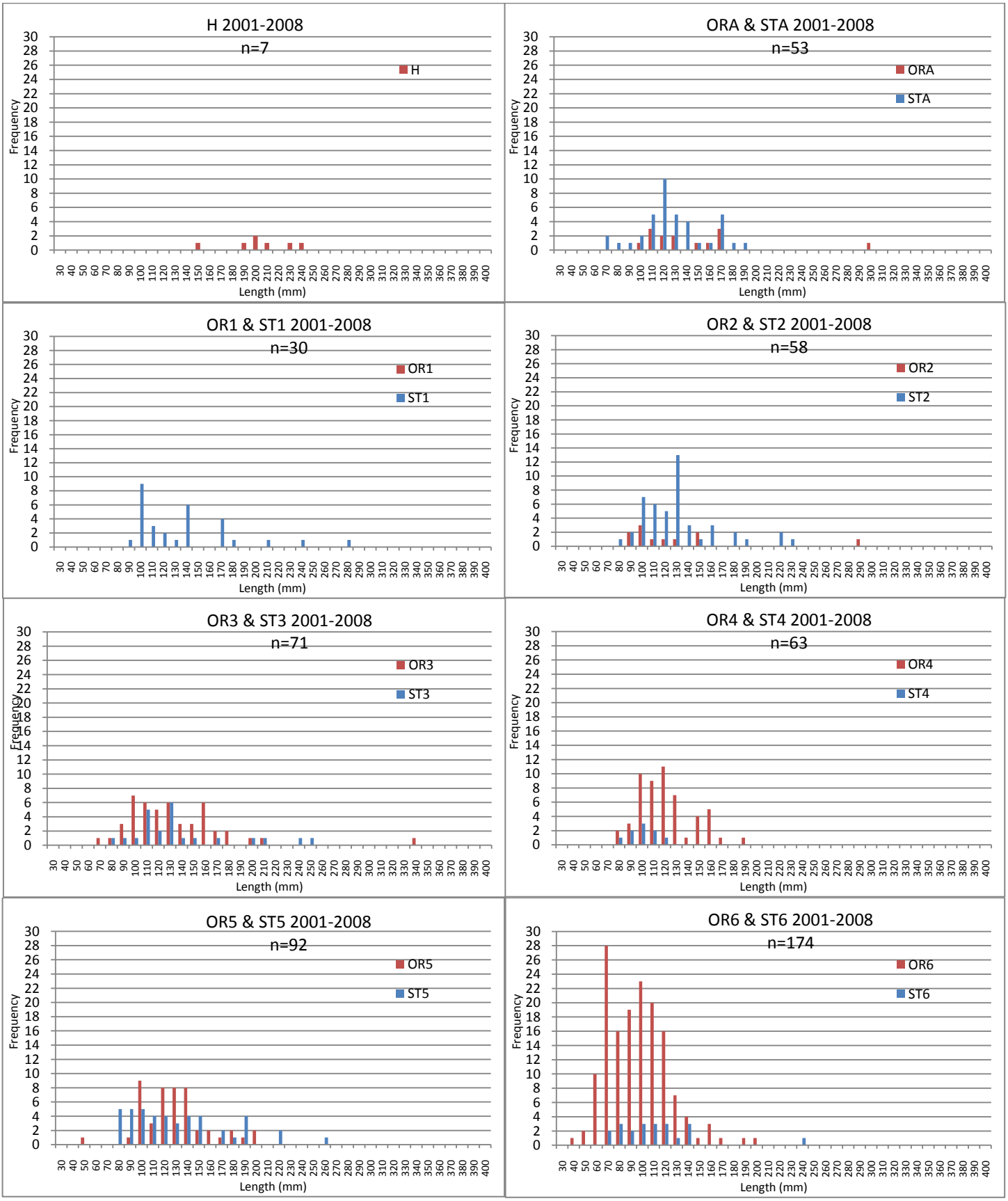


Waveney - The Point

Spring 2007

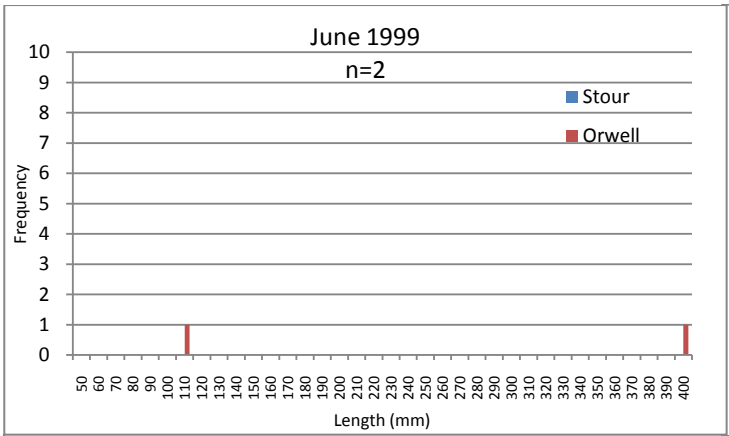


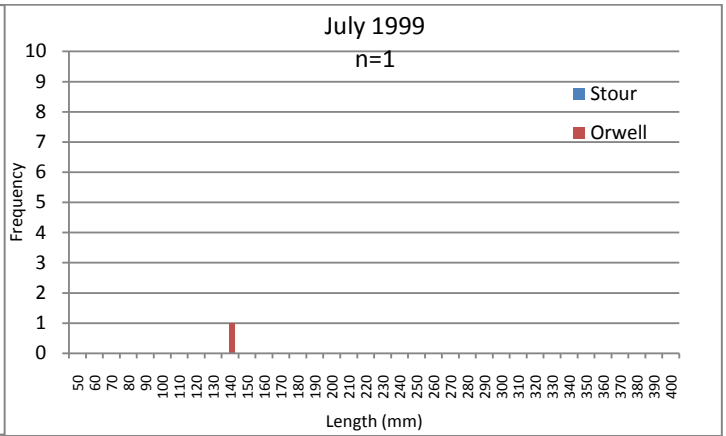
d. **Stour & Orwell Estuaries- Fish & Shrimp Monitoring 2001-2008**

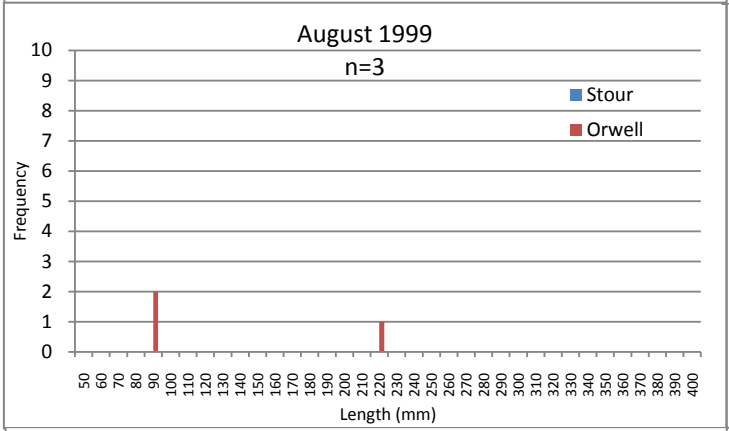


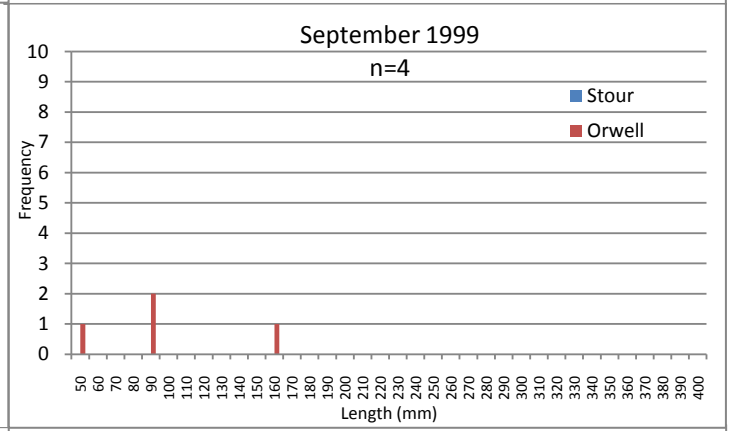
Analysis of monthly fish and shrimp trawls taken at twelve stations in the Stour and Orwell estuaries between 2001 and2008. Using a 2m beam trawl for five minutes, with a mesh size of ~16mm. Martin Dyer, Unicomarine for Harwich Haven Authority

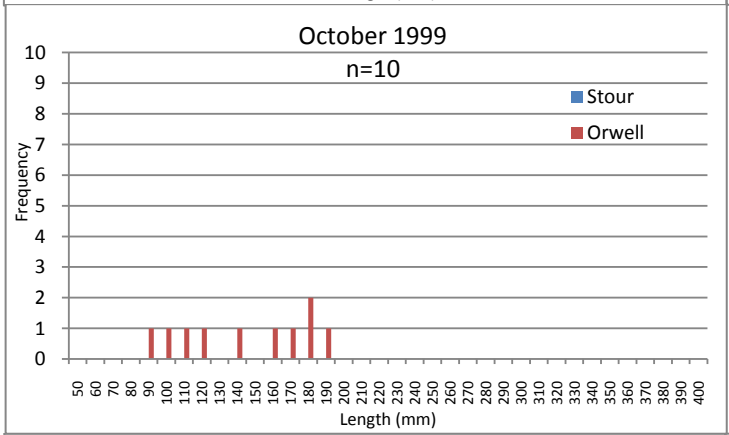
e. **Stour & Orwell Estuaries- Fish & Shrimp Monitoring 1999**

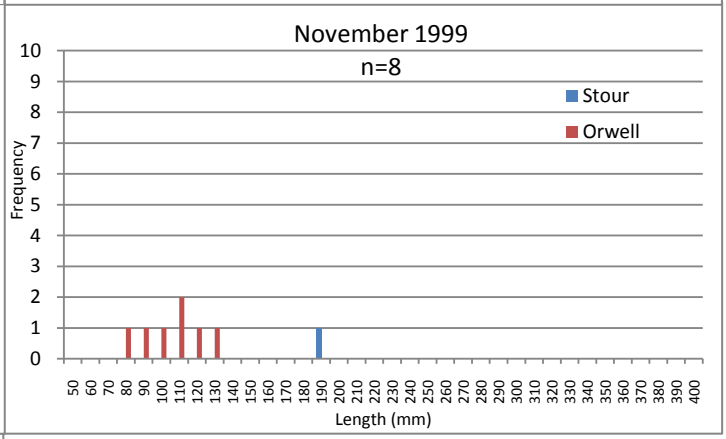


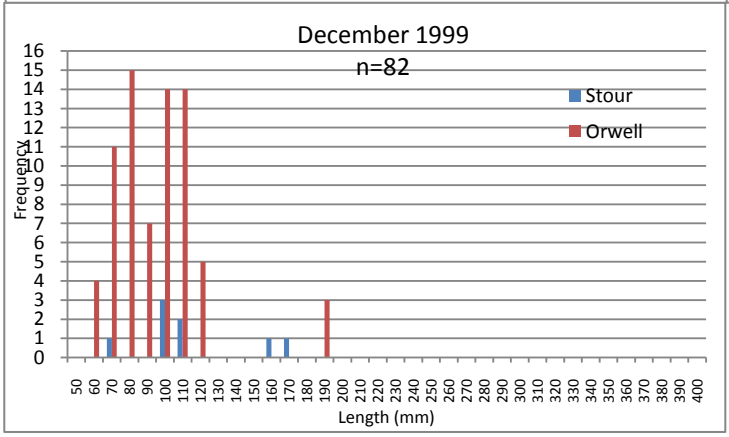




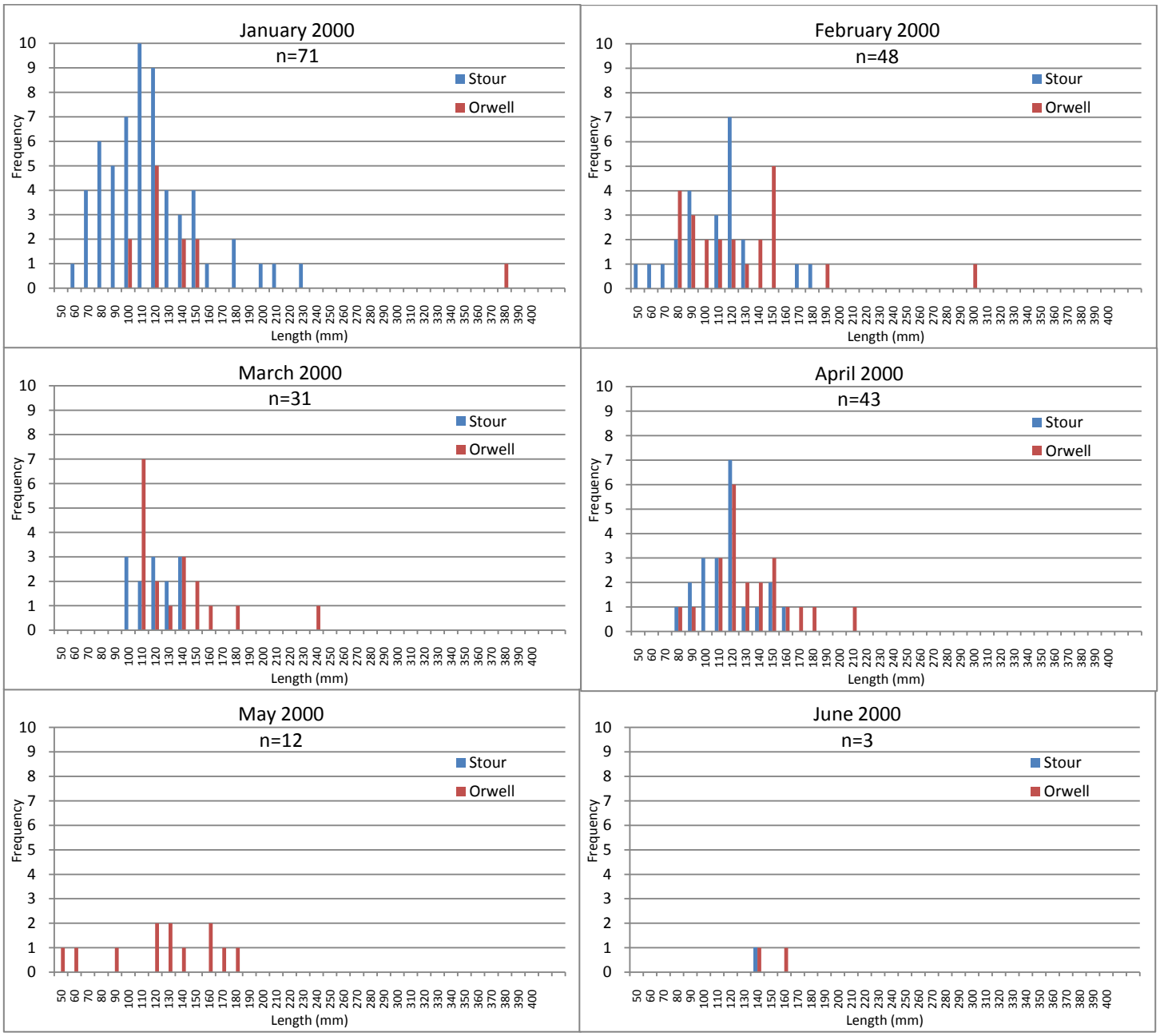




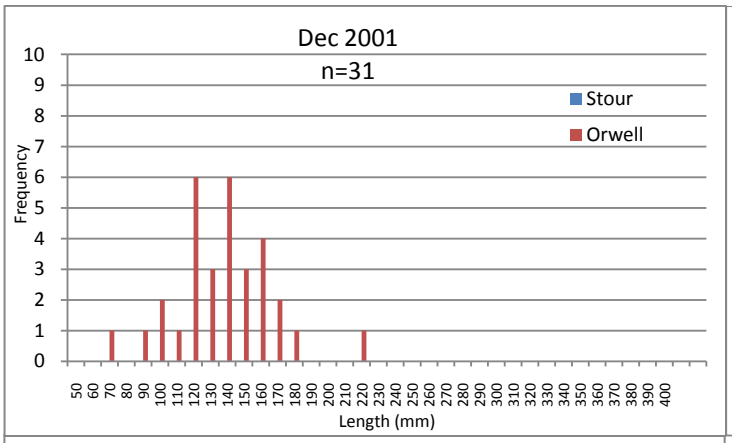




Analysis of monthly fish and shrimp trawls taken at twelve stations in the Stour and Orwell estuaries between June and December 1999. Using a 2m beam trawl for five minutes, with a mesh size of 11mm. Martin Dyer, Unicomarine (2000) for Harwich Haven Authority.



Analysis of monthly fish and shrimp trawls taken at twelve stations in the Stour and Orwell estuaries between January 2000 and June 2000. Using a 2m beam trawl for five minutes, with a mesh size of 16mm. Martin Dyer, Unicomarine (2000) for Harwich Haven Authority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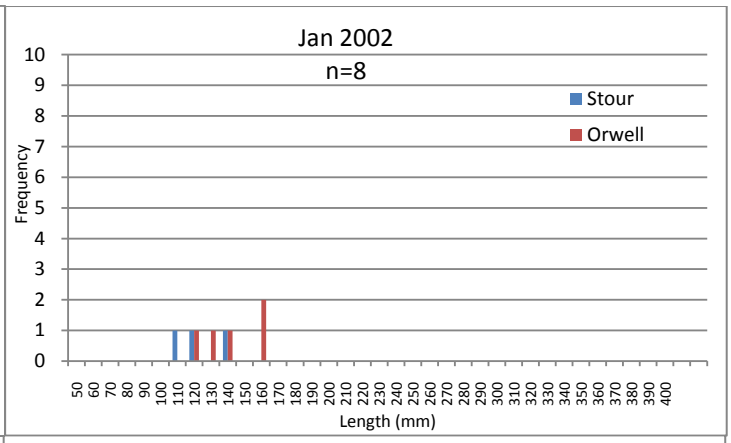
Stour
Orwell
Frequency
Length (mm)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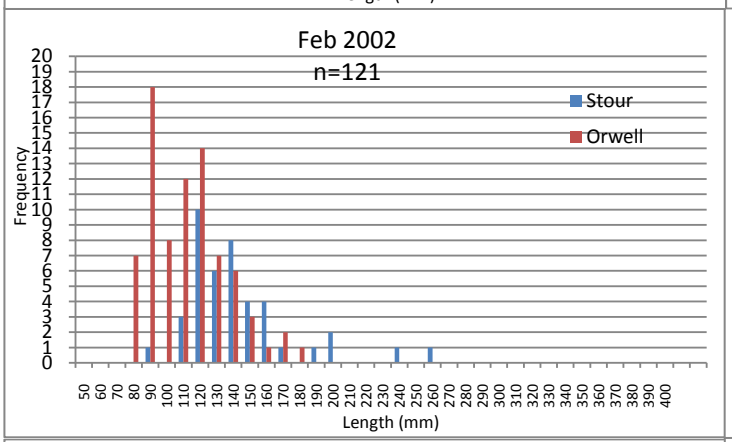
Stour
Orwell
Frequency
Length (mm)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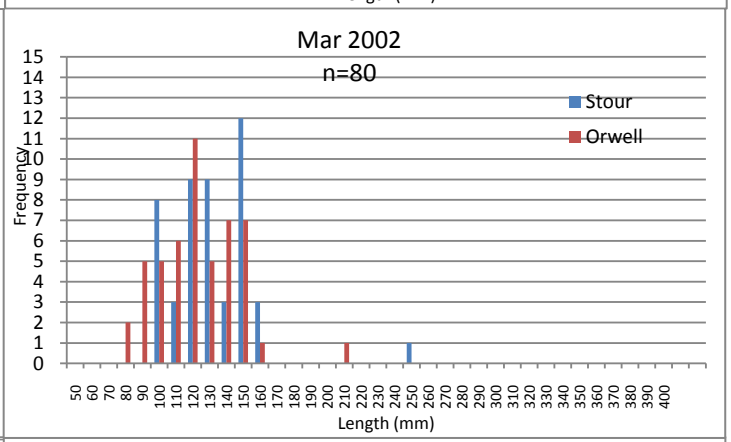
Stour
Orwell
Frequency
Length (mm)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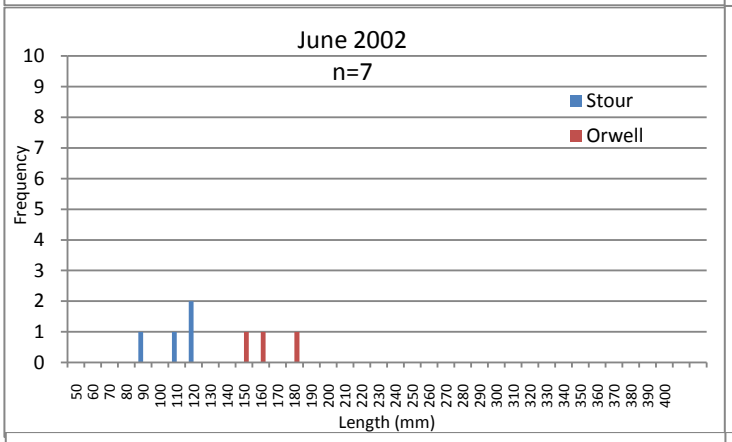
Stour
Orwell
Frequency
Length (mm)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Orwell
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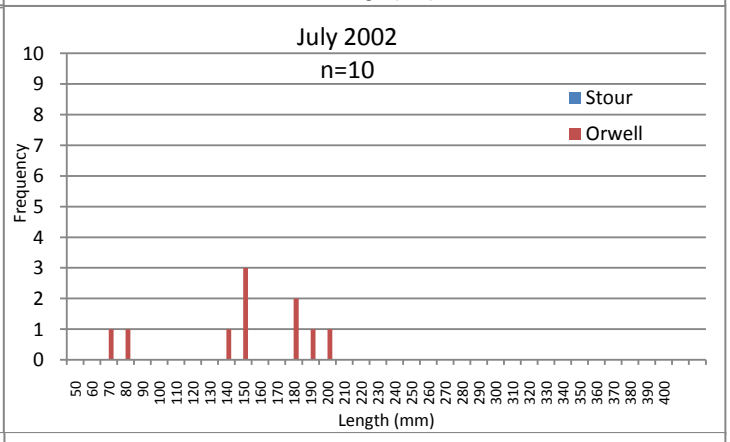
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Orwell
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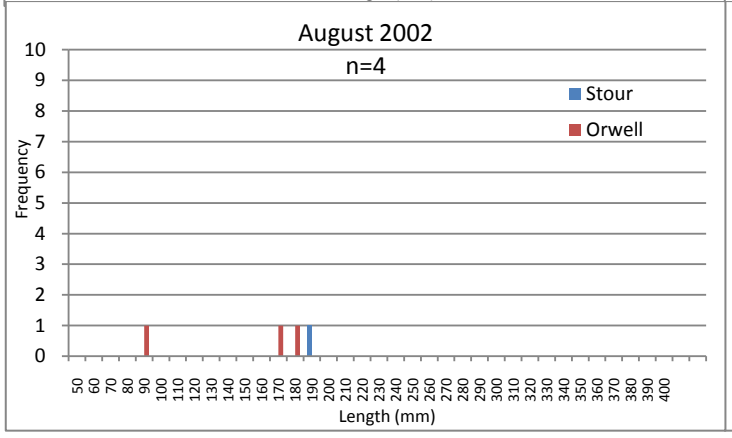
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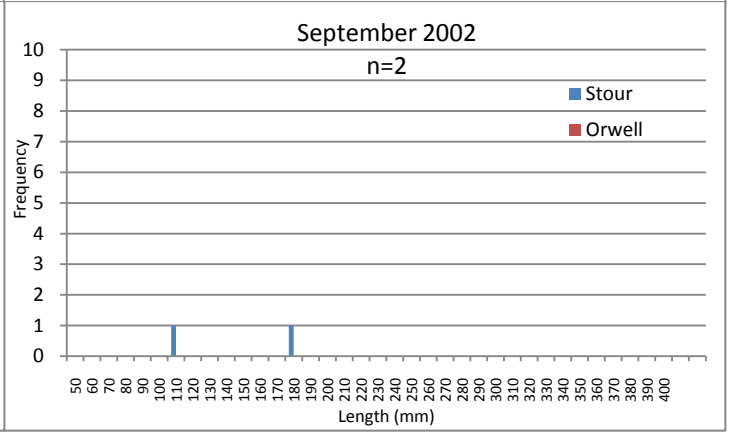
Orwell
Frequency
Length (mm)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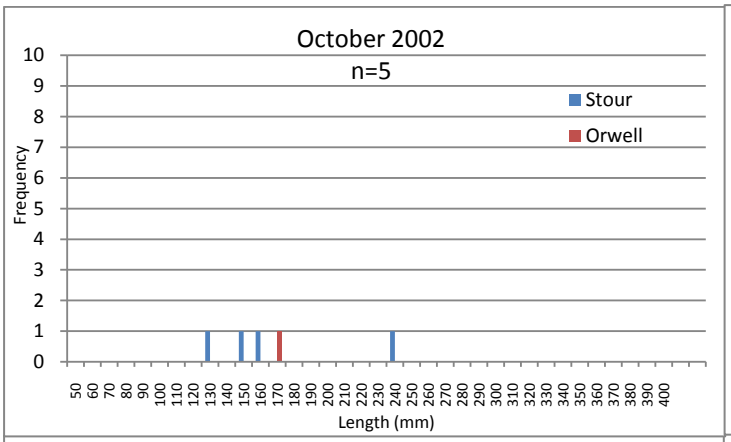
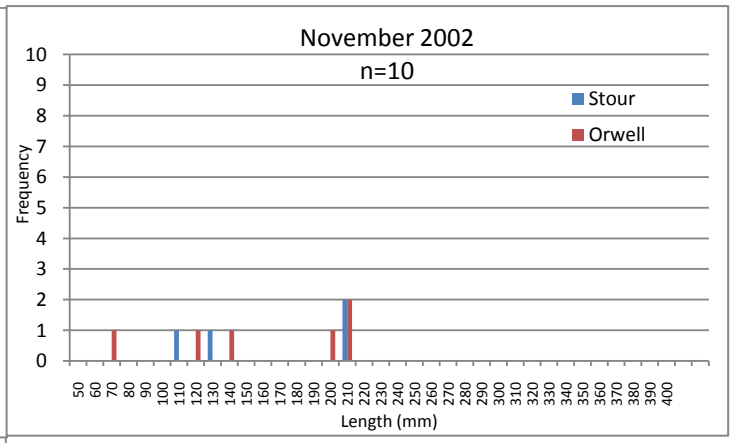
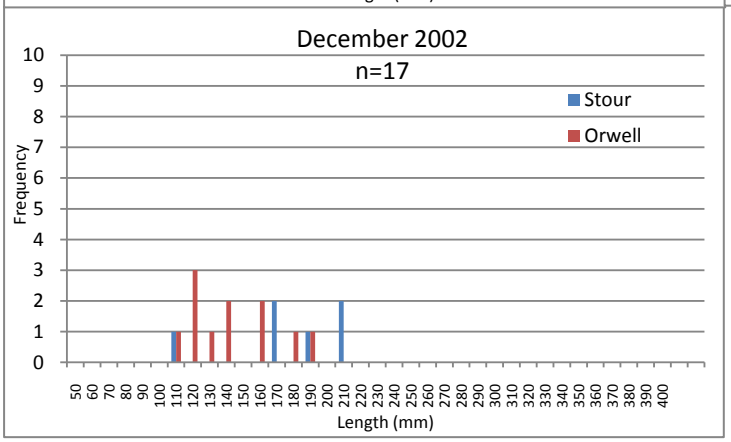
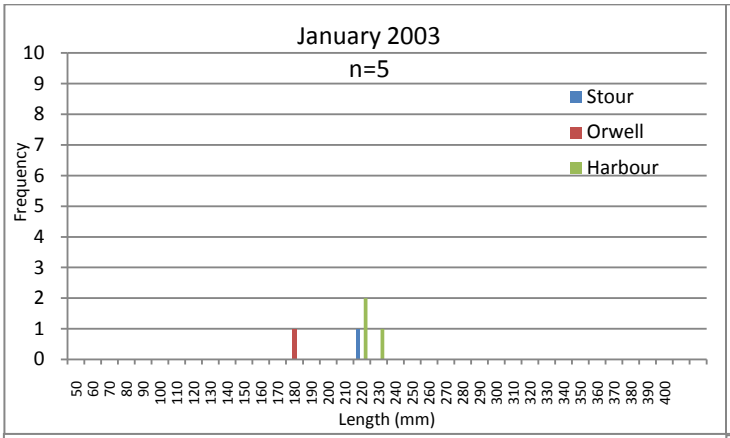
Orwell
Frequency
Length (mm)

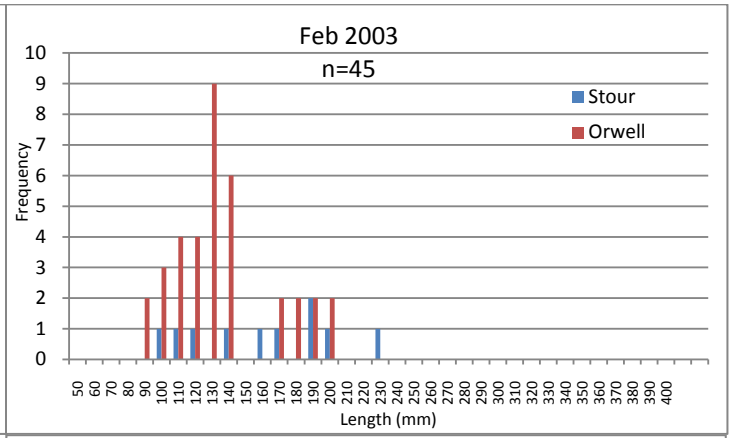


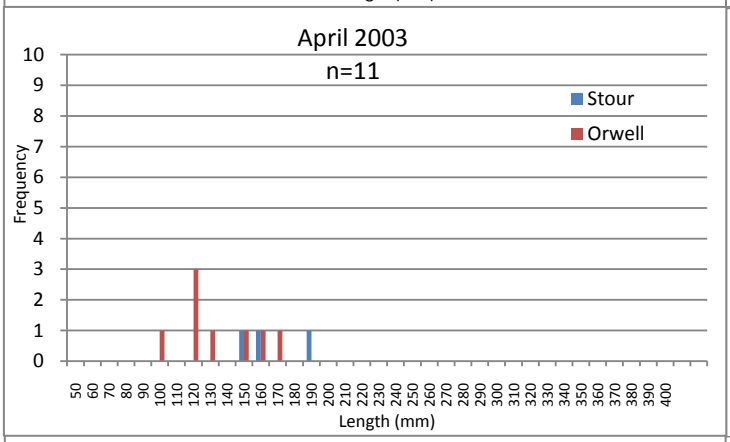


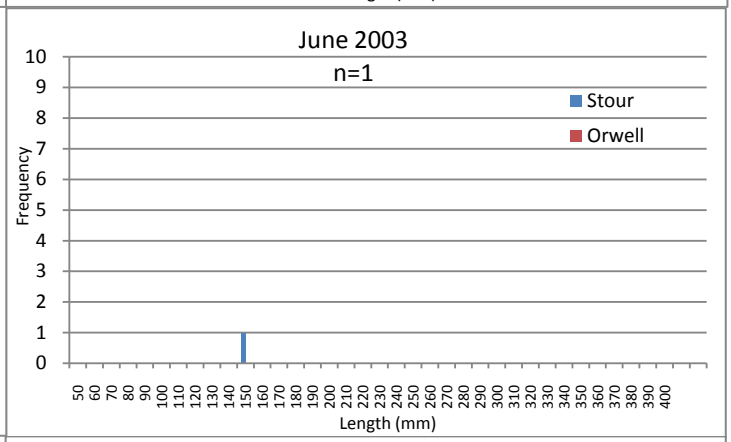


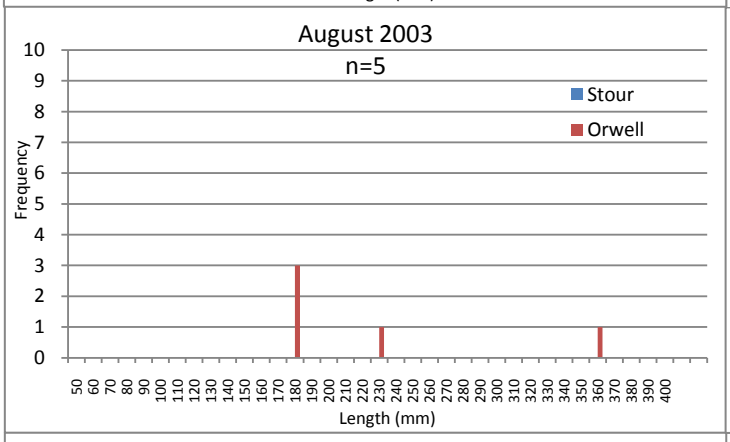
Analysis of monthly fish and shrimp trawls taken at twelve stations in the Stour and Orwell estuaries between December 2001 and December 2002. Using a 2m beam trawl for five minutes, with a mesh size of 16mm. Martin Dyer, Unicomarine for Harwich Haven Authority

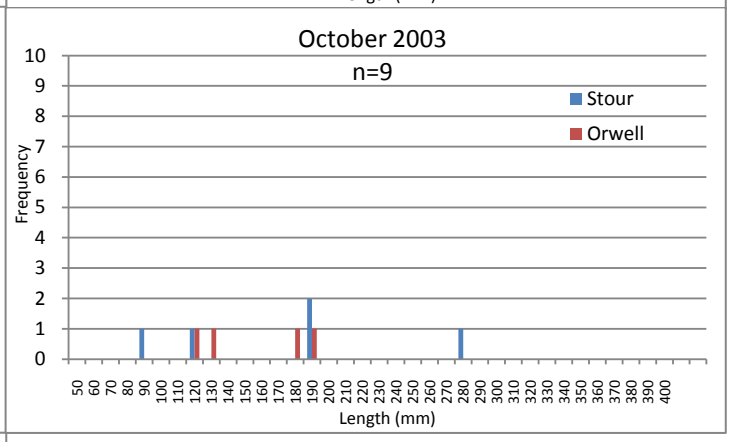


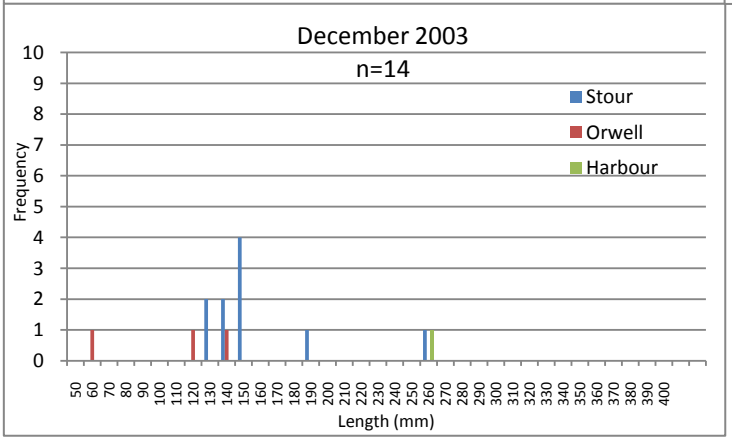




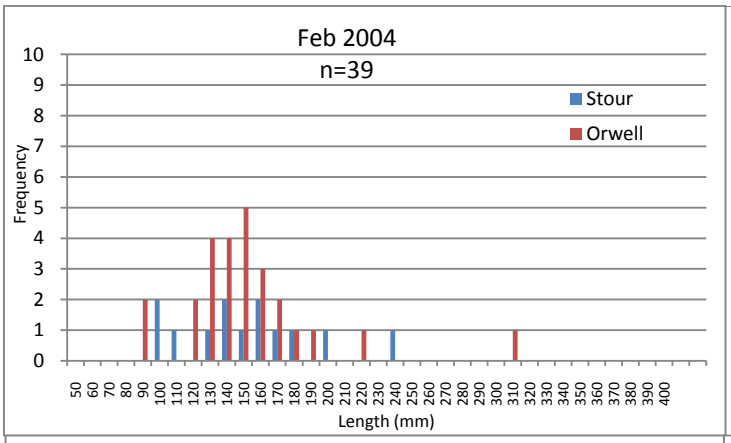


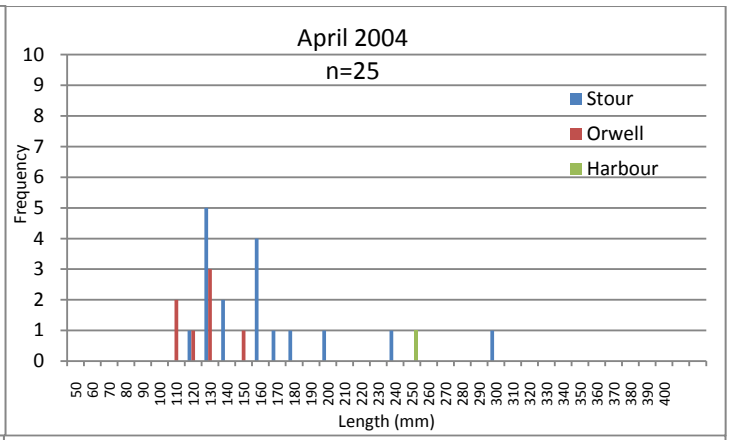


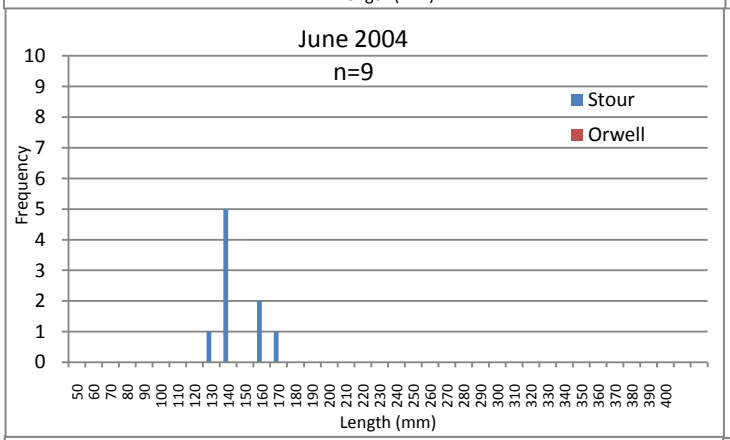


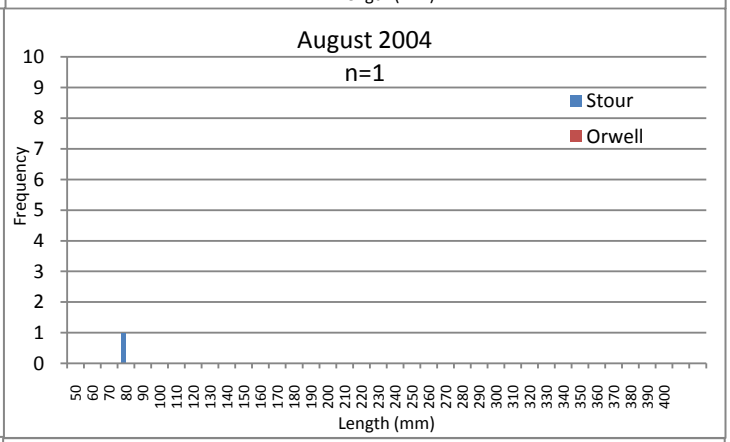


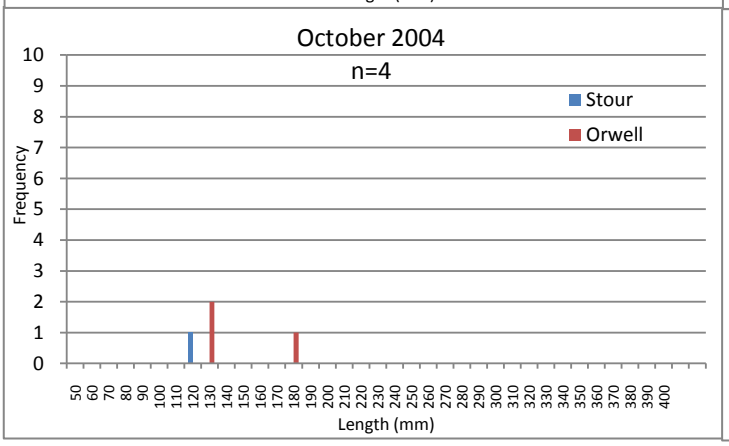
Analysis of bi-monthly fish and shrimp trawls taken at twelve stations in the Stour and Orwell estuaries between January 2003 and December 2003. Using a 2m beam trawl for five minutes, with a mesh size of 16mm. Martin Dyer, Unicomarine (2000) for Harwich Haven Authority

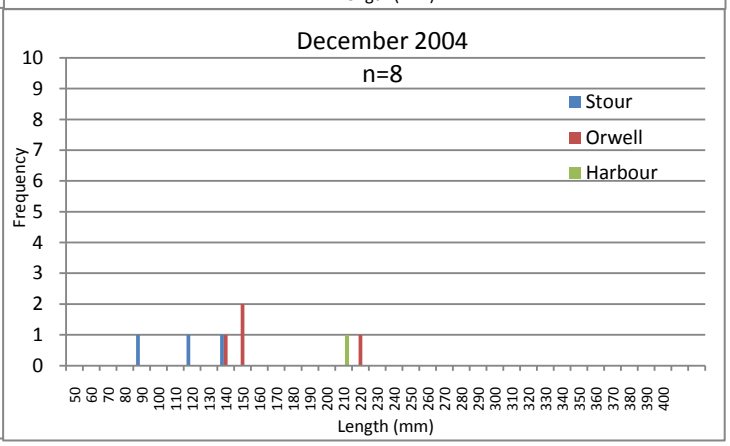




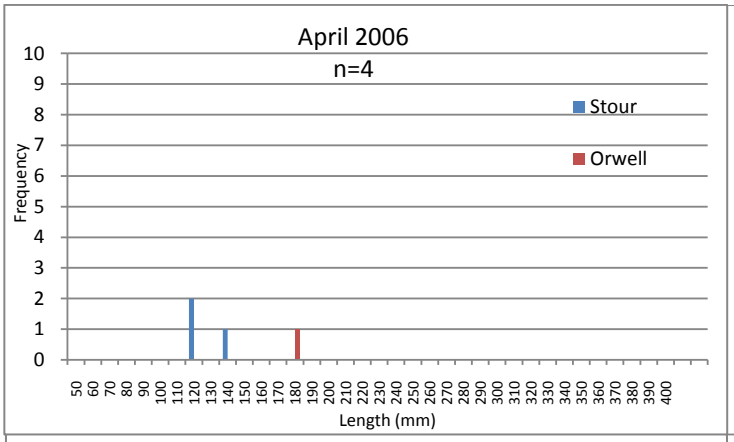


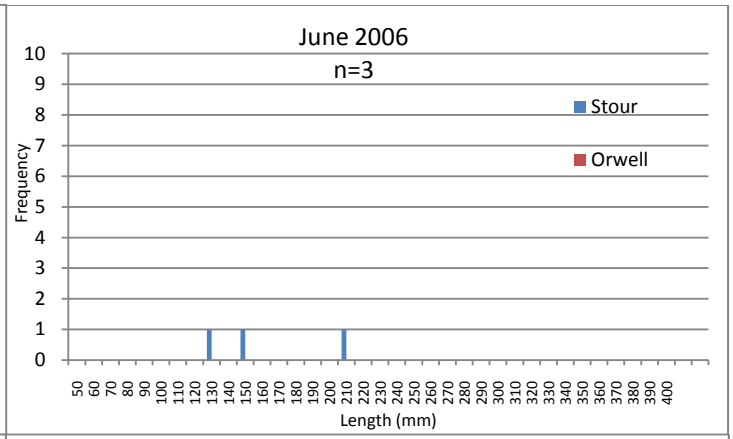


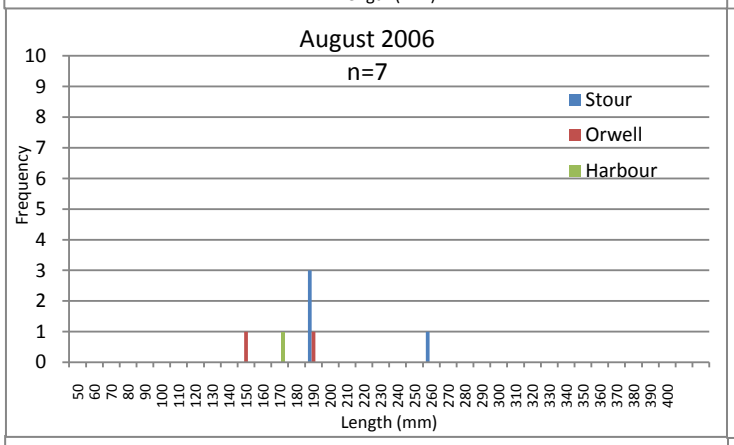


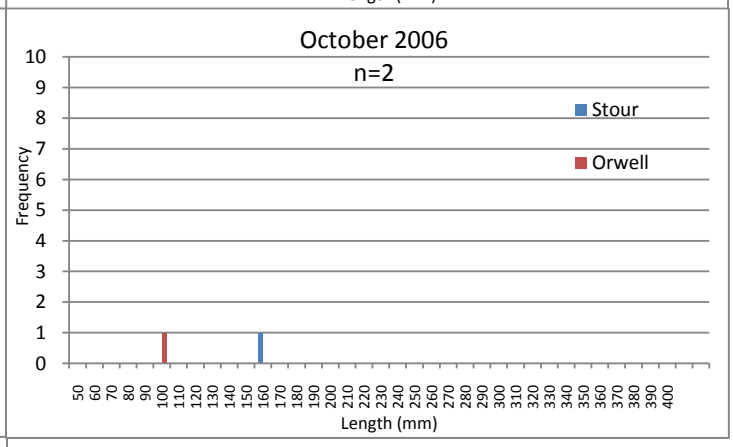


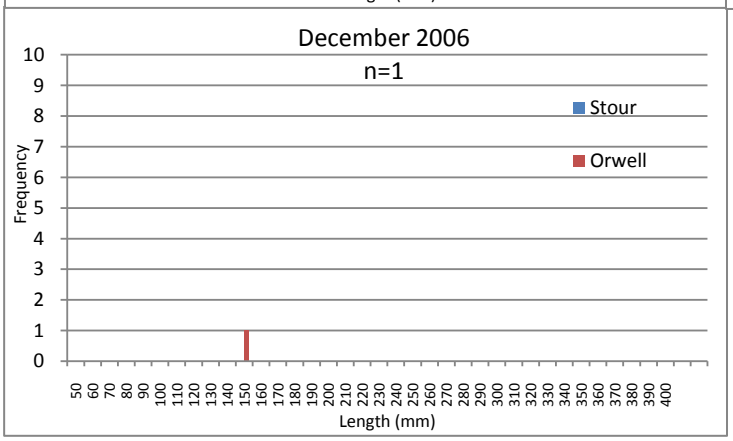
Analysis of bi-monthly fish and shrimp trawls taken at twelve stations in the Stour and Orwell estuaries between February 2004 and December 2004. Using a 2m beam trawl for five minutes, with a mesh size of 16mm. Martin Dyer, Unicomarine for Harwich Haven Authority



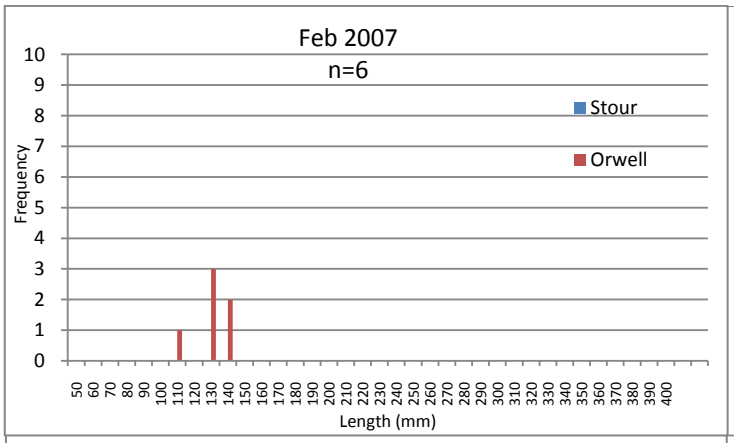


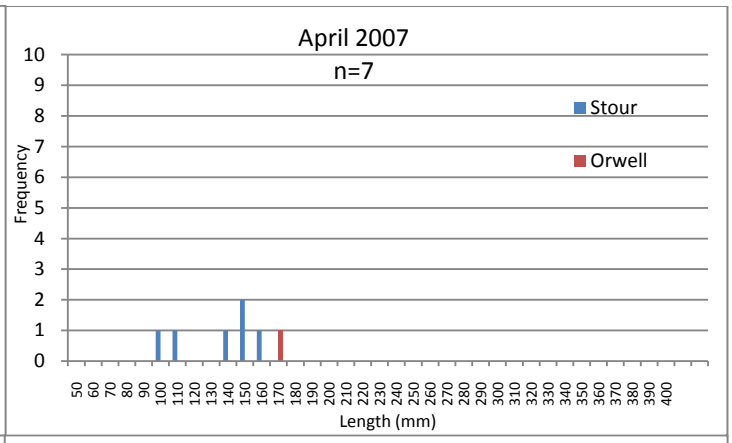


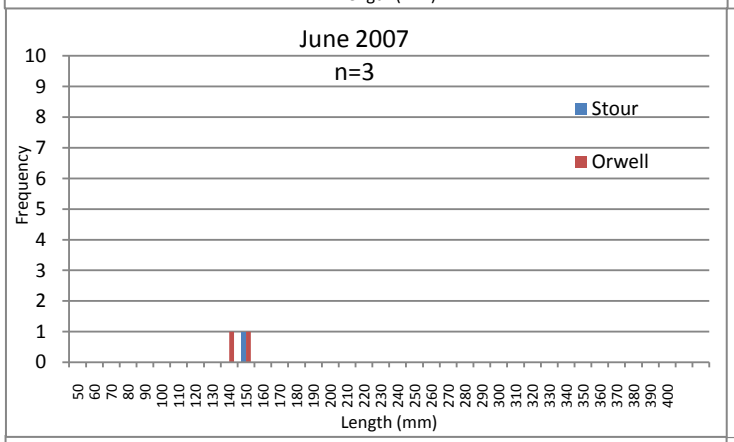


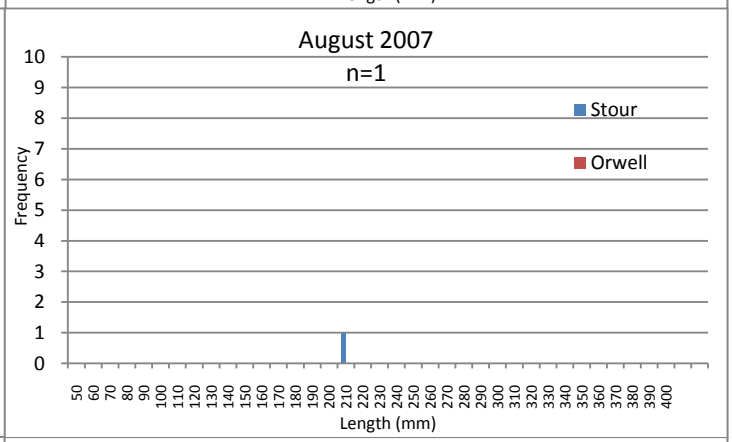


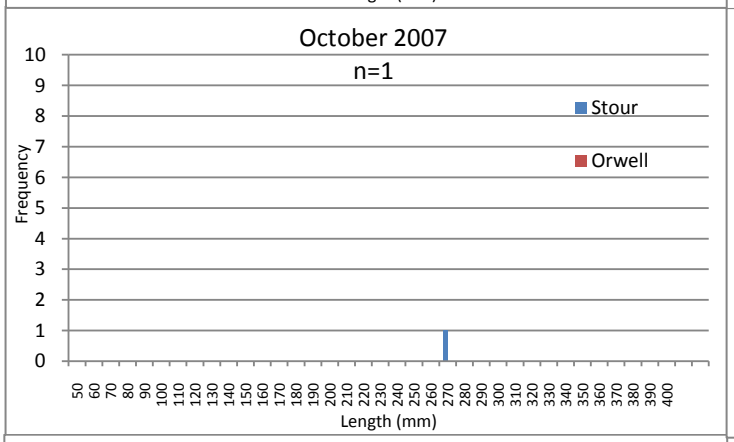
Analysis of bi-monthly fish and shrimp trawls taken at twelve stations in the Stour and Orwell estuaries between April 2006 and December 2006. Using a 2m beam trawl for five minutes, with a mesh size of 16mm. Martin Dyer, Unicomarine for Harwich Haven Authority

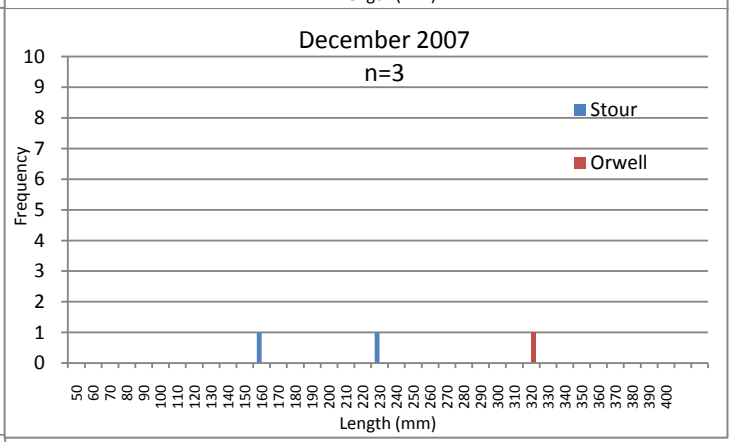


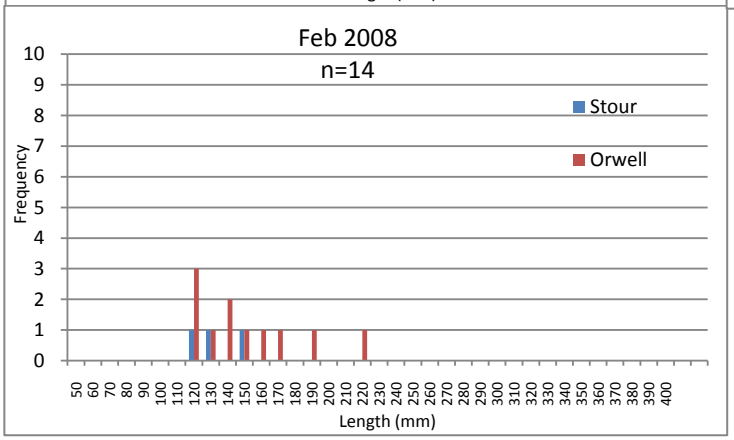






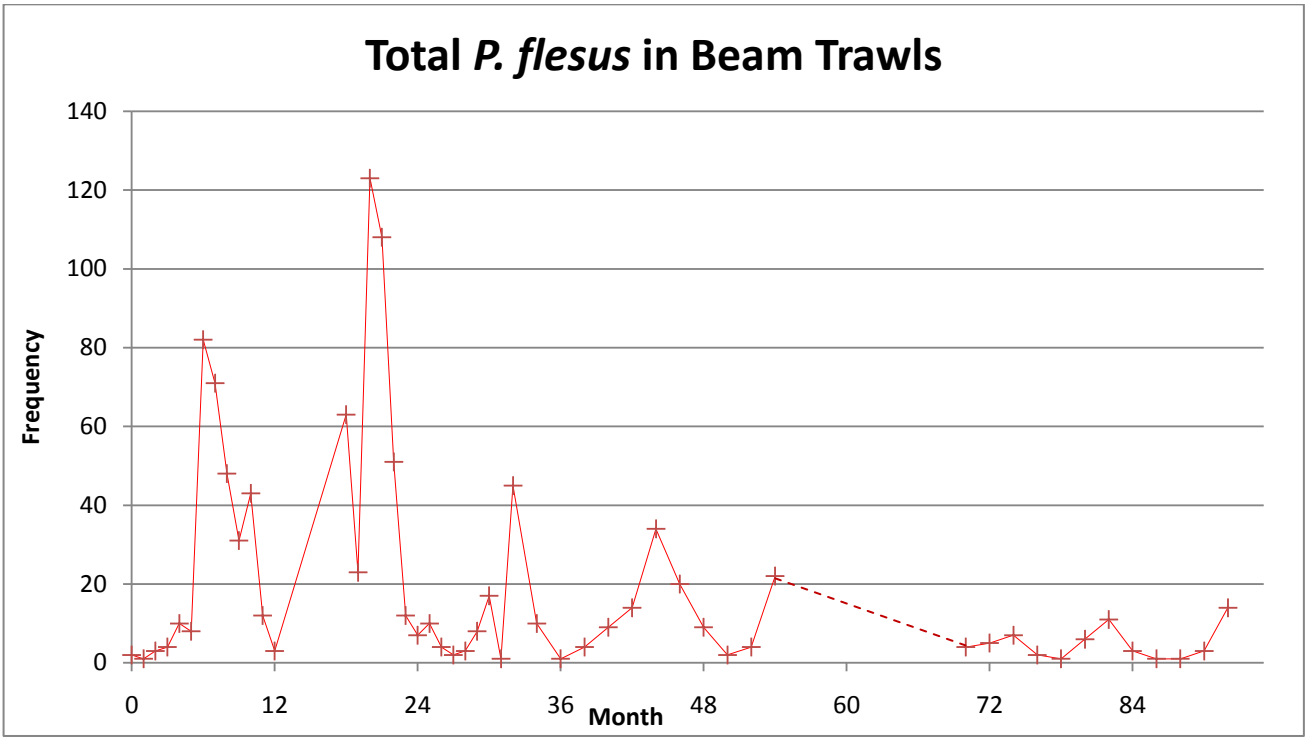






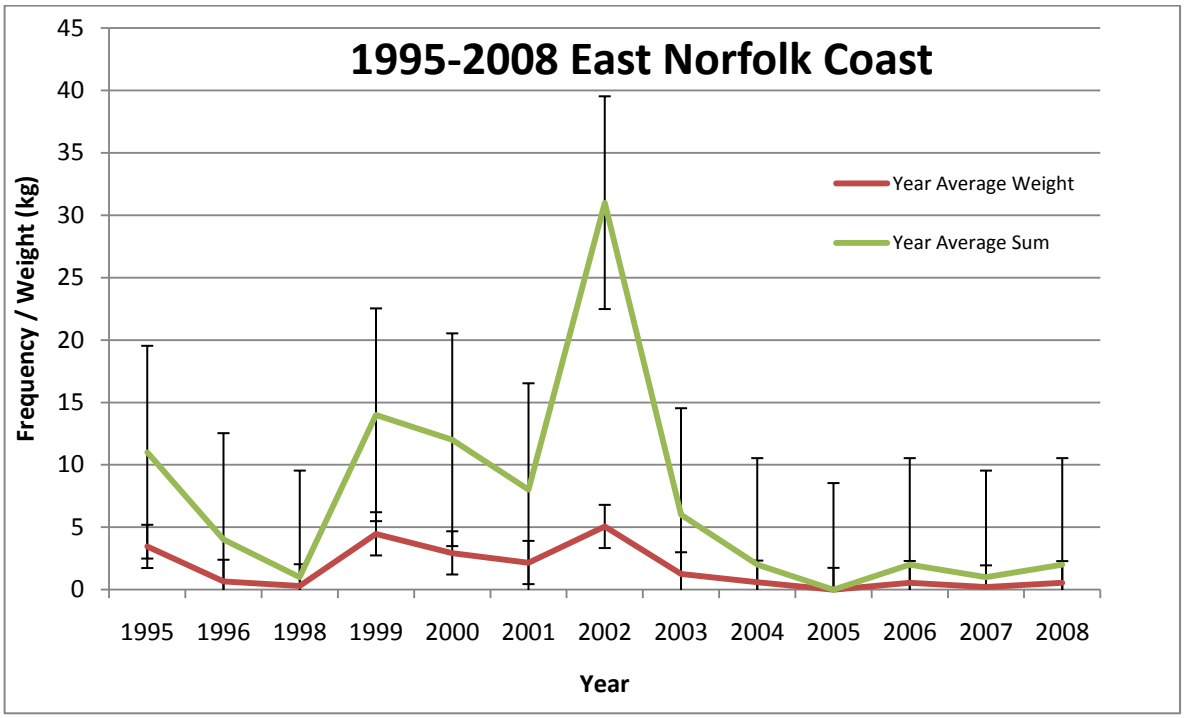
Analysis of bi-monthly fish and shrimp trawls taken at twelve stations in the Stour and Orwell estuaries between February 2007 and February 2008. Using a 2m beam trawl for five minutes, with a mesh size of 16mm. Martin Dyer, Unicomarine for Harwich Haven Authority

f. **Unicomarine- Stour & Orwell- Fish & Shrimp Survey**



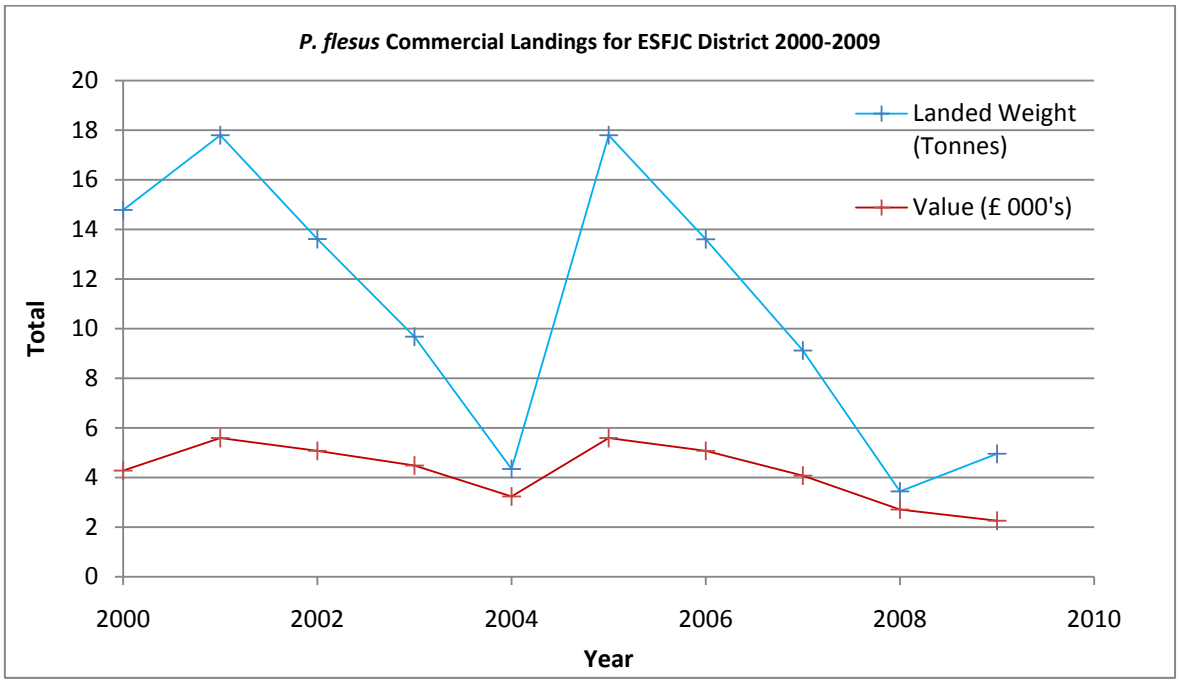
Graph showing the total *P.flesus* beam trawl catch from Unicomarine Stour and Orwell fish and shrimp monitoring survey from June 1999 to February 2008. Months start at 0=June99; 12=June00; 24=June 2002 etc. Note the surveys become bi-monthly after February 2003. Data provided by Unicomarine.

g.



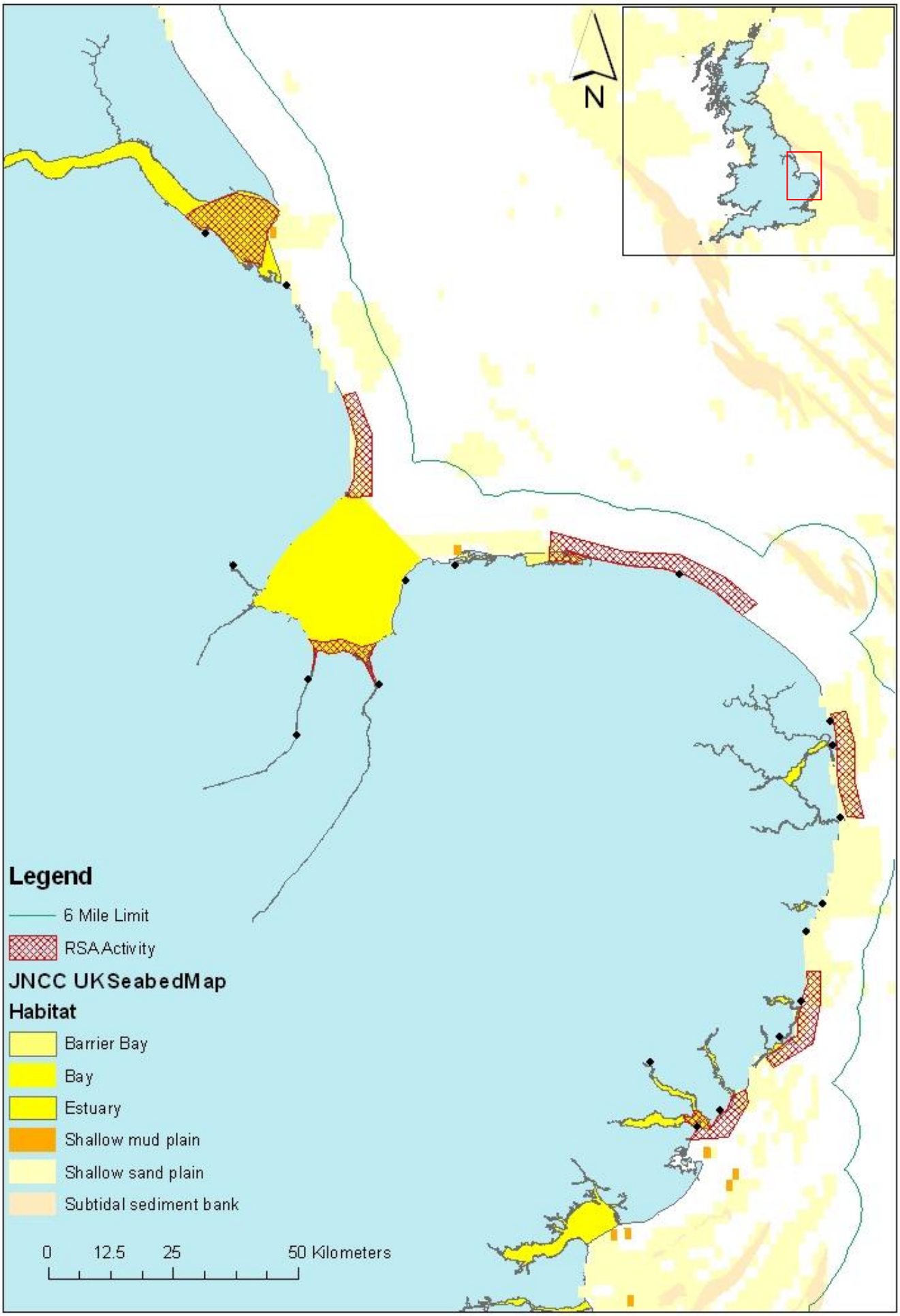
Graph showing the year average weight (kg) and year average sum of *P. flesus* from the CEFAS Eastern English Channel Survey from 1995 to 2008. The error bars are one standard deviation either side of the figure. Data provided by CEFAS.

h.



Graph showing the recorded total commercial landings (tonnes) of *P. flesus* within the ESFJC district for 2000 to 2009 and its associated value (£'000's). The 2009 data is provisional. Data provided by Marine Management Organisation.

i.



Map showing habitat distribution throughout the ESFJC district, habitat mapping data provided by JNCC, UK seamap survey. The habitats highlighted are those important for *P. flesus*, highlighted in yellows are those habitats where juvenile *P. flesus* are likely to be most numerous. UK coastline and 6NM shapefiles provided by digimap, UK. The red hatched area represents areas where the RSA are most active within the district, data extracted from pilot social survey responses.