UNIVERSITY OF HULL

The coastal fisheries of England & Wales

Data poor or a model for the future?

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Without the cooperation and time from numerous people at all of the Sea Fisheries District committees I doubt I would have understood the delicate nature of coastal fisheries in the United Kingdom.

The support of my family and friends has been paramount in the successful completion of this study and I thank them all for this.

Abstract:

Coastal fisheries account for a significant amount of economic activity and are crucial to the way of life for countless people and their communities. The coastal fleet has reduced in size and effort, but advances in technology and new target species have meant that fleet effort has declined at a slower rate than expected. Coastal fishers are versatile and have adapted to target abundant (increasingly non-quota) species seasonally, showing much less dependence upon any one species or gear, as a result of legislative and environmental pressures. There is evidence that whilst the composition of species targeted has shown little change, the fleet's effort is impacting upon more of the marine ecosystem, the data highlighted the huge pressure that the marine habitat in the North Sea is under, with bordering districts fishing differing species and at different trophic levels.

There are a wealth of data available on the UK coastal fisheries which can be sourced by utilising grey literature sources, indicates over a century of careful and considered management. The SFCs can be considered as a model of fisheries management which has many elements common to many other alternative fisheries management models. With the advent of the IFCAs, analysis of SFCs short comings were identified and presented as options for opportunities to be explored by alternative fisheries managers in the future.

Introduction

In 2009 the United Kingdom fleet comprised around 5,700 vessels and employs around 12,200 fishers. The UK fisheries generated £1,160 per ton of fish product in 2009 (£55,191 / 47.5 tonnes per fisher), generating £674 million (581 thousand tonnes landed) for the UK economy (MMO, 2010). Coastal fisheries are an integral part of the UK fisheries with 77% of the fishing fleet being 10 metres or less in length (MMO, 2010). The fleet primarily fishes in the waters around the UK and adjacent to the European coast line; the North Sea, the English Channel, the Atlantic Ocean, the Celtic Sea and the Irish Sea.

The coast of England & Wales totals approximately 2,442 miles with over 240 coastal fisheries landing present, a landing for every 10 miles of coastline. The coastal waters are relatively shallow, with most fisheries activities taking place between the surface and 50m depth (Hiscock 1998). The coastal shelf of England & Wales presents a wide range of habitat types along the length of the coastline which contributes to species diversity and is crucial as it provides breeding and nursery grounds for many species, such as *Gadus morhua* (Cod), *Solea solea* (Sole), *Dicentrarchus labrax* (Bass) (Symes & Phillipson, 1997; Symonds & Rogers, 1995). Coastal fishers target a vast array of resources throughout the year with a variety of gears (many specialised) and make use of virtually any landing site (Pawson & Benford, 1983; Munro, 1979; Farrugio *et al.,* 1993; Walmsley & Pawson, 2007). The nature of coastal fisheries means the incidence of bycatch and discards is markedly lower than reported by offshore fisheries (Jacquet & Pauly, 2008), solidifying the perception of coastal fisheries as highly efficient, low impacting and sustainable fisheries (Stobart *et al.,* 2009; Jacquet & Pauly, 2008). Consequently leading to the opinion that they are the best practice for sustainable fisheries to be achieved (Nasuchon & Charles, 2010; Prime & Johnson, 2009; Jacquet & Pauly, 2008).

Traditional fisheries management has usually been administrated through central governments (Jentoft *et al.*, 1998), and (whether intended or not) has shown preferential management of the offshore fisheries at the expense of coastal fisheries (Berkes, 1986). In recent years traditional practices have been at the centre of debate; blamed for restrictive practices, mismanagement of local resources and failing to engage local stakeholders in the process (Kuperan & Abdullah, 1994; Nielsen *et al.*, 2004; Johannes *et al.*, 2000; Mulekom 1999; Symes & Phillipson, 1997; Meredith, 1999; Allison, 2001; Hart & Reynolds, 2002b) and leading many to consider alternative management practices (Berkes 1986; Bruckmeier & Hoj Larson 2008; Suarez de Vivero *et al.,* 1997; FAO 2001).

The European Common Fisheries Policy (CFP) is an example of a traditional management tool developed to broadly manage all fisheries across many European regions. Despite being reformed in 2002 the CFP failed in addressing its primary objectives of over capacity, overfishing and collapsing fish stocks. There have been many criticisms of the CFP by scientists, fisheries managers and fishers alike; particularly the management of offshore fisheries who benefit much more from fisheries fund subsides and the CFP's discarding policy (CEC, 2009; Symes & Phillipson, 1997; Ramsay *et al.*, 1997; Daw & Gray 2005; Symes, 1992; Morales-Nin et al., 2010; Symes 2009; Catchpole *et al.*, 2005; Witbooi, 2008; Griffin, 2009; O'Leary et al., 2011; Wakefield, 2010; Laxe, 2010). The current reform of the CFP is centred on implementing sustainable fisheries through a local level (alternative) management model, as growing evidence suggests coastal fisheries can be managed much more efficiently in this way (CEC, 2009; FAO, 2001, Berkes, 1986; Kronen et al., 2010; Pomeroy, 1995).

Alternative management approaches continue to increase in favour as the importance of coastal fisheries and the fishers themselves continues to be recognised (Goncuoglu & Unal, 2011; Prime & Johnson, 2009; FAO 2001). There has been a lot of discussion regarding alternative fisheries management practices, such as self-governance (FAO, 2001; Beem, 2006; Lee *et al*., 2006), co-management (FAO, 2001; Bruckmeier & Hoj Larson 2008; Kuperan & Abdullah, 1994; Nielsen *et al.*, 2004; Pomeroy, 1995; Siry, 2011; Makino & Matsuda, 2005; Marin & Berkes, 2010) community based (FAO, 2001; Ruddle, 1998; Nasuchon & Charles, 2010; Pomeroy, 1995; Maliao *et al.*, 2009; Mulekom, 1999) and even data poor methods (Honey *et al*., 2010). There is clearly a desire for fisheries to be appropriately managed, given the free & open access of fisheries resources (Kuperan & Abdullah, 1994; Berkes 1986; FAO 2001), in order to limit the damage to fish stocks and better utilise fishery resources (Benjamin, 2001).

This shift to alternative management practices is a consequence of the constraints that traditional fisheries management faces when governing multiple, diverse coastal fisheries (Mulekom, 1999). Coastal fisheries are crucial, because of their connection to the local community, sustainable fishing methods and the fishers' local knowledge which is essential to guarantee the security of fisheries for the future (Johannes *et al*., 2000). The characteristics of coastal fisheries are the key to their success; there is a multitude of resources and methods for exploiting coastal fisheries resources, fishers know best how to organise themselves, ensuring optimal fishing and preventing fish stocks from being overfished (Berkes, 1986). Stakeholder involvement in fisheries management provides an understanding of the vulnerabilities that apply specifically to local fisheries (Nauschon & Charles 2010) enabling much more suitable management practices to be implemented.

The coastal fisheries are managed by the Marine Management Organisation (MMO) through 10 regional agencies, the Inshore Fisheries & Conservation authorities (IFCAs), which supersede the previous management agencies, the Sea Fisheries Committees (SFCs). The 12 Sea Fisheries Committees of England & Wales (the channel Isles were managed through their own SFC) were the result of the 1888 Sea fisheries regulation act, which created the foundations for regional management bodies to manage coastal fisheries, the works of Steins & Edwards (1997), Symes & Phillipson (1997) and Winterbottom (2008) provide a comprehensive critique of the formation, structure, responsibilities and powers of the SFCs.

The management of coastal fisheries in England & Wales began at the regional level and has concurrently operated within the functional framework of UK and eventually EU & international fisheries management objectives (Symes & Phillipson, 1997, Winterbottom, 2008).

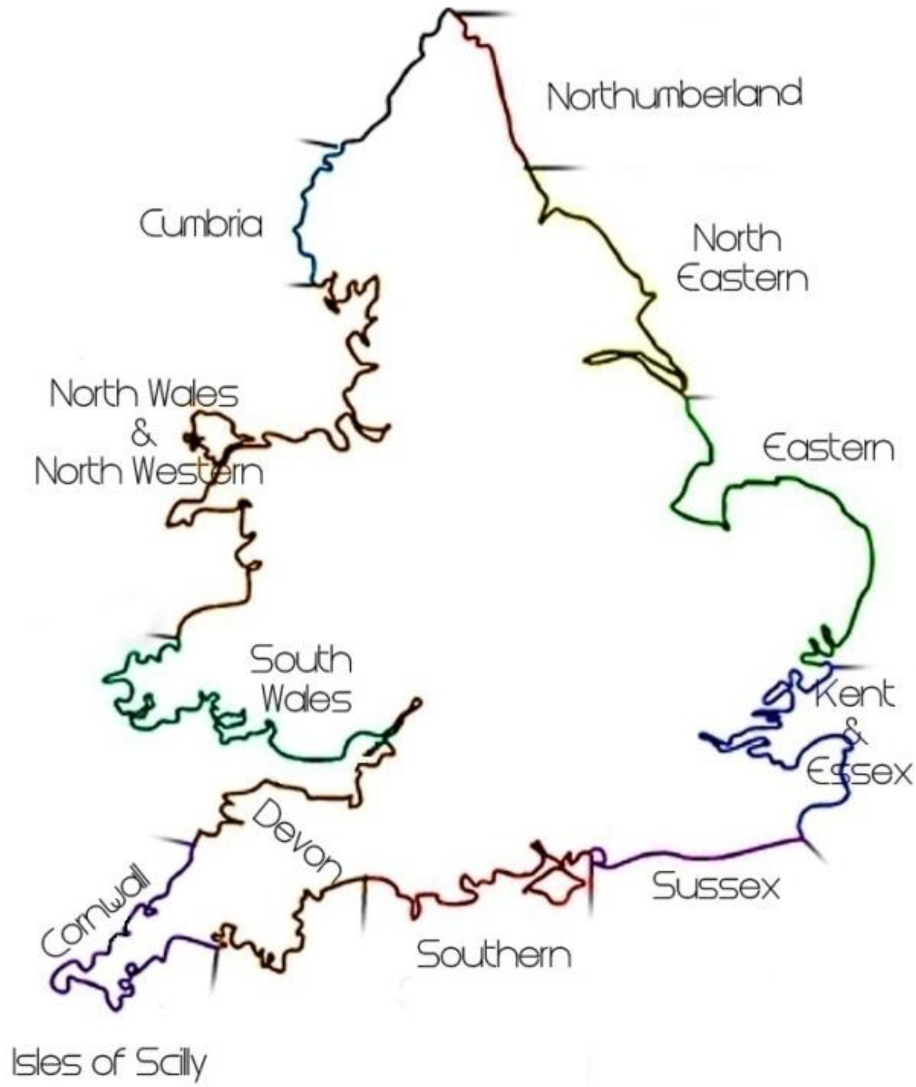

Figure 1: A map of the Sea Fisheries Committees of England & Wales (2010). The Sea fisheries committees are; Northumberland (N), North Eastern (NE), Eastern (E), Kent & Essex (KE), Sussex (SX), Southern (S), Devon (D), Cornwall & Isles of Scilly (CS), South Wales (SW), North Western & North Wales (NWNW), Cumbria(C), Revised Pawson, 1983.

The SFCs and the coastal fisheries are considered to be relatively data poor by both the scientific community and policy makers, as the majority of fisheries data relates to the offshore fisheries (Steins & Edwards, 1997; Phillipson, 2000). Prior to 2001 there were no formal records kept on the UK coastal fleet, when the Marine and Fisheries Agency

(MF&A, the precursor to the MMO) began collecting coastal fisheries vessel and fisher data (MMO, 2010). In 2005 the *registration of fish buyers and sellers and designation of fish auction site regulation* was introduced, for the purpose of tracking fish products, enforcing records for landings in the coastal fisheries (Symes & Phillipson, 2009; Walmsley & Pawson, 2007).

The SFCs primarily collected data for their committee members to make informed decisions on the most appropriate management practices at each quarterly meeting (Symes & Phillipson, 1997). The result was that very little of the data produced was considered to be of use in a broader context, even by other SFCs. The differences in data collection and reporting methodologies between SFCs meant that very little of SFCs data is accessible for immediate analysis. The sheer quantity of qualitative reports coupled with the lack of a suitable methodology provided a significant barrier to utilisation the SFCs data. The SFCs held a huge amount of data on the fisheries; numbers of fishers and vessels involved, types of gears being fished, species targeted, seasonality, fish stock assessments as well as the number of licences and fines issued. Many SFCs also make incidental recordings on entrants and leavers of fisheries, fishing vessel losses, weather conditions, illegal fishing activities and even references to record landings made by local fishers. The SFCs fisheries data set is 120 years old and is the only source that can cover such a length of time in the coastal fisheries management.

In the early 1980s MAFF (the Ministry of Agriculture, Fisheries and Food, the precursor to DEFRA) commissioned their Lowestoft fisheries laboratory (CEFAS) to provide a comprehensive report of coastal fisheries in England & Wales, assessing the value and diversity of the coastal resources and establish the level of effort exploiting them. A total of five coastal fisheries reports have been produced, these reports are considered "grey" literature as they are exempt from peer review, each examining a 1-2 year period of activity and are reported here by their publication year, 1983 (Pawson & Benford, 1983), 1989 (Pawson & Rogers, 1989), 1995 (Gray, 1995) , 2002 (Pawson *et al.*, 2002) and 2007 (Walmsley & Pawson, 2007). These reports were based on the individual quarterly reports of each SFC and validated through direct contact by government inspectorate staff with SFC officers and local fishers. Like the SFCs data they describe the types of ports, vessels, gears, species and even the mood of the local fishers in response to recent regulations, fishing conflicts and catches. These reports were unique providing a national perspective of the coastal fisheries using the SFCs data.

This study aims to highlight the broad changes that have taken place in the coastal fisheries of England & Wales over the 3 decades reported on covering a period of time from the early 1980s through to the late 2000s, utilising the coastal fisheries reports; demonstrating the wealth of information that the SFCs held on the coastal fisheries of England & Wales.

Given that the IFCAs are now the regional agents involved in the management of coastal fisheries, this study will assess the role the SFCs in the management of coastal fisheries and what factors contributed to the SFCs being replaced by the IFCAs.

This study will address the hypothesis that;

- a reduction in fleet numbers has been far greater than the reduction in fleet effort achieved,

- gear efficiency is constantly improving, contributing to increased fleet effort,
- the impact of the fleet's activities have spread over the ecosystem, impacting upon more species, across the food web,
- the SFC "model" delivered effective management and tools, aiding sustainable fishing practices and development of fish stocks towards biological management goals.
- The IFCA "model" of management is a more comprehensive approach at fully sustainable coastal resource management.

Methods and materials

Figure 2 is an excerpt of the text used throughout the coastal fisheries reports; it details the fishing activities of Tunstall & Withernsea, North Yorkshire, highlighting the gears fished, the numbers of vessels active, species targeted, and any division in effort between gears and/or species.

> Up to 15 beach boats regularly fish from this exposed coastline and are joined by many more during the summer, some working up to 400 lobster pots each for brown crabs and lobsters and also netting for flatfish. Some of these boats also use cod nets in winter and spring, when fishing is often restricted by the weather.

Figure 2: Excerpt of Tunstall & Withernsea description from Pawson et al., 2002.

The qualitative nature of these reports placed constraints upon the analysis that could be done, though quantifying the information they contained allowed the data to be interrogated through a wider range of analytical methods than these reports might typically have been subject to. The qualitative data within the reports was quantified using the Grounded Theory method (Strauss & Corbin, 1997). In order to effectively code the data, a sample of 25 quarterly reports produced by 3 SFCs (NWNW, NE, N) were examined for common elements that were used for code training. It provided first-hand experience of the data and developed the intuition vital for coding (Bernard, 1996) the coastal fisheries reports data. As the coastal fisheries reports were coded, new data was compared against the previously coded data and the codes refined. This process ensured that the data was as complete as could be achieved, taking into account differences in the nature of reports (Strauss & Corbin, 1997).

An activity matrix was constructed that recorded the species targeted and the gears used by each vessel at each port, within each district. Explicit vessel numbers were coded directly into the activity matrix (i.e. from figure 2, 15 beach boats). There were ambiguous passages present relating to vessel numbers, so a key was developed to allow coding of ambiguous vessel number statements with an appropriate representative value (Table 1).

Table 1: Ambiguous references key for the coastal fisheries reports.

Ambiguous phrase	**Numbers of vessels used**
"A few" / "Some"	2
"Several" / "a number" / "a small fleet"	5
"Many" / "a lot"	10
"Large Numbers" / "Considerable"	50
"Some of"	=25% of reported vessels
"Many of"	=50% of reported vessels
"Majority of" / "Most of"/ "Mainly"	=75% of reported vessels
"Many more"	Double the reported vessels

Vessel lengths were inconsistently documented between reports, when length data was omitted, the smallest vessel length recorded within that district in that report was used.

Numbers of vessels were used in the activity matrix to elucidate the effort of the coastal fleet, whilst the vessel length data was used to examine overall changes in fleet vessel lengths and its relationship to fishing effort.

An effort score was calculated by conversion of effort to a full time equivalent (FTE) effort score, with the assumption that 1 vessel (accounting for both the vessel itself and a fisher) or 1 shore based fisher, active on a full time basis would score an FTE of 1. This allows analysis into the effort with which the fleet fishes with particular gears or targets particular species (Equation 1).

Equation 1; scoring of effort across species & gear

$$SSPG = \frac{[\frac{ET}{GR_n}]}{SP_n}$$

SSPG = effort score for species χ per gear; ET = FTE; GR_n = Number of gears used; SP_n = Number of species targeted.

i.e. A full time vessel using 2 gears and targets 6 species with the first gear and 3 with the second would be scored with a 0.5FTE for each gear. 0.083 is recorded against the 6 species targeted with gear 1 (totalling 0.5) and 0.1667 for the species targeted with gear 2 (totalling 0.5) so that overall the FTE is scored as 1.

Seasonal effort was recorded as full time effort, as the effort exerted during the season was assumed to be equivalent to that of full time fishers efforts. The coastal fleet has been involved in 2 different types of fisheries, traditional capture fisheries and aquaculture fisheries. As aquaculture fisheries account for less than 2% of the FTE effort they were not analysed.

Throughout all the reports, references exist to species being targeted but not the type of gear used and vice versa. Unspecified gears/species were assigned the effort score to detail a complete record of activity. The recording of species targeted presented problems;

- references to species by their colloquial name, i.e. "Queens" referring to *Chlamys opercularis* (Queen Scallops) which complicated assigning effort to the correct species.
- in the earlier (1983, 1989) coastal fisheries reports there were itemised tables that displayed the total landings and the monetary values for each species, but not all species present in the table were named as targets at any location. As these tables were discontinued in subsequent reports, only species specifically mentioned as targets at each location were recorded in the activity matrix.

Species were grouped into 1 of 4 categories depending upon the habitat that they were most commonly fished from or the type of species that they are;

- *Benthic species*; fished from within the seabed
- *Demersal species*; fished from the water column near the seabed
- *Pelagic species*; fished from the water column
- *Shellfish species*; all hard shelled species.

In order to assess the impact of the coastal fleet upon the marine food webs they fish, trophic level values were collated for all species reported (Table 2) and a measure of the trophic level effort change was calculated by assigning FTE effort score to its corresponding trophic level. In the case where the species was not specified beyond type, e.g. *shellfish, flatfish*, an average of the species group was used.

Table 2: Trophic level data (fishbase.net).

Common name	Scientific Name	Trophic Level
Bass	*Dicentrarchus labrax*	3.79
Bream	*Pagellus spp.*	3.73
Brill	*Scophthalmus rhombus*	3.79
Brown Crab	*Cancer pagurus*	2.6
Brown Shrimps	*Crangon vulgaris*	2.2
Catfish	*Anarhichas lupus*	3.24
Clams M	*Mercenaria mercenaria*	2
Cockle	*Cardium edule*	2.1
Cod	*Gadus morhua*	3.73
Conger Eel	*Conger conger*	4.29
Crayfish	*Palinurus elephas*	2.6
Cuttlefish	*Sepia officinalis*	3.54
Dab	*Limanda limanda*	3.29
Dogfish, unspecified	*Dogfish, unspecified*	3.69
Eel	*Anguilla angullia*	3.53
English Prawns	*Palaemon (leander) serratus*	2.7
Flounders/Fluke	*Platichthys flesus*	3.19
Green Crab	*Carcinus maenas*	3.5
Gurnard/latchet	*Triglidae spp.*	3.46
Haddock	*Melanogrammus aeglefinus*	4.09
Hake	*Merluccius merluccius*	4.42
Herring	*Clupea harengus*	3.23
Horse Mackerel	*Trachurus trachurus*	3.64
Lemon Sole	*Microstomus kitt*	3.25
Ling	*Molva molva*	4.25
Lobster	*Homarus vulgaris*	2.6
Mackerel	*Scomber scombrus*	3.65
Megrim	*Lepidorhombus whiffiagonis*	4.24
Monk/Angler	*Lophius piscatorius*	4.45
Mullet, grey	*Liza ramada, Liza aurata, Chelo labrosus*	2.16
Mullet, red	*Mullus surmuletus*	3.42
Mussel	*Mytilus edulis*	2
Native Oyster	*Ostera edulis*	2
Nephrops/Scampi	*Nephrops norvegicus*	2.88
Octopus	*Octopus vulgaris*	3.55
Pacific Oyster	*Crassostera gigas*	2
Periwinkle	*Littorina littorea*	2
Pilchard	*Sardina pilchardus*	3.05
Pink Shrimps	*Pandalus montagui*	2.29
Plaice	*Pleuronectes platessa*	3.26
Pollack	*Pollachius pollachius*	4.15
Prawns, Pandulus	*Pandulus borealis*	2.46
Queen Scallops	*Chlamys opercularis*	2.09
Saithe/Coalfish	*Pollachius virens*	4.38
Salmon	*Salmo salar*	4.43
Sandeel	*Ammodytes tobianus*	3.11
Scallop	*Pecten maximus*	2

Sea Trout	*Salmo trutta*	3.16
Shark	*Sharks, unspecified*	4.05
Shrimp, unspecificed	*Shrimps, unspecified*	3.19
Silver Smelt	*Osmerus eperlanus*	3
Skate/Ray	*Raja spp.*	3.5
Sole, Dover	*Solea solea*	3.13
European Spider Crab	*Maja squinado*	2.3
Sprat	*Sprattus sprattus*	3
Squid	*Loligo spp.*	3.9
Tope	*Galeorhinus galeus*	4.21
Tuna	*Thunnus thynnus*	4.43
Turbot	*Scophthalmus maximus*	3.96
Velvet Crab	*Liocarcinus puber*	2.6
Whelks	*Buccimium undatum*	3.09
Whitebait	*Sprattus sprattus & Cluepa harengus*	3.11
Whiting	*Merlangius merlangus*	4.37
Whiting pout	*Trisopterus luscus*	3.73
Witch	*Glyptocephalus cynoglossus*	3.14
Wrasse	*Labrus spp.*	3.07
	Unspecified Crustacean	2.66
	Unspecified fish	3.75
	Unspecified flatfish	3.16
	Unspecified Molluscs	2.12
	Unspecified Whitefish	3.29

The total number of ports reported in any given year varies, a randomised sample of 100 ports from each report was made for analysis, allowing each port to be considered an experimental unit and avoid the issue of psuedoreplication, a common problem in fisheries research (Millar & Anderson, 2004).

The composition and diversity of the gears fished and species targeted by the coastal fleet were analysed through the Shannon Weiner species richness index. GIS analysis was carried out with ArcGIS 9.3 and statistical analysis with Minitab 16, while multivariate analysis was conducted with Primer 5.

Analysis

When considering the differences in the configuration of the fleet between reports, there are 2 elements of the fleet that must be examined, the vessel based fishers and the shore fishers, they both contribute to fleet effort and impact upon the marine ecosystems they exploit but they target distinct areas and species.

There has been a 65% reduction in the total number of vessels within the fleet since 1983 (figure 3a), with the largest decline seen between 1983 and 1989.

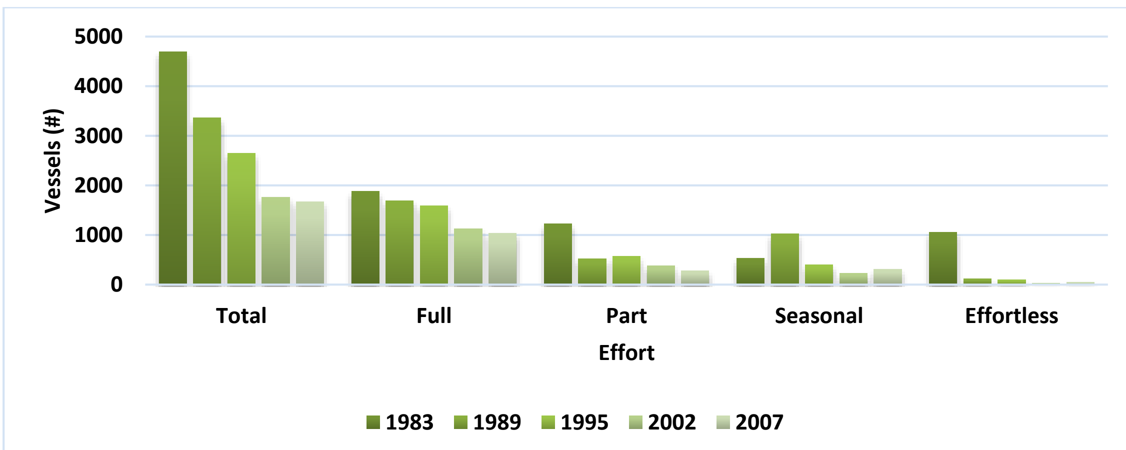

Figure 3a: The number of reported commercial vessels in the English and Welsh inshore fleet between 1983 and 2007.

The number of full time vessels decreased 45%, through larger decreases elsewhere in the fleet, have become the majority of active vessels. Part time vessels decreased in number by78% and currently make up 16.5% of the fleet vessels. Seasonal vessel numbers have fluctuated across the reports. Effortless vessels; those that are licensed to fish but with no gear or species effort recorded numbered 22% of the fleet in 1983, but only 3% in 2007.

Since 1983 there has been an 81% reduction in the total number of shore fishers (Figure 3b), the largest decline occurred between 1989 and 1995.

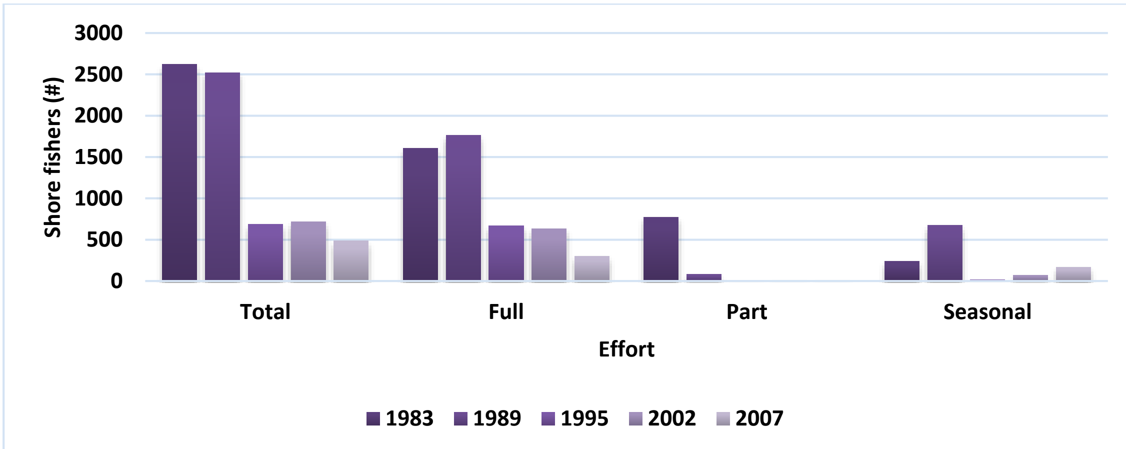

Figure 3b: The numbers of reported commercial shore fishers active on the English and Welsh coast between 1983 and 2007.

Full time shore fishers have decreased to 18% of their former 1983 number, however there was a small rise in their number seen in 1989. Part time shore fishers decreased to negligible numbers by mid 1990s, whilst seasonal shore fisher numbers have responded sporadically, however they number less than seen in 1983.

The combination of vessel and shore fishers and the extent of their effort contributes to the global effort exerted by the fleet.

FTE effort increased in the late 1980s, related predominately to a surge in seasonal fleet numbers, there was a huge drop in FTE effort between the late 1980s and the mid-1990s, since then FTE effort has decreased at a moderate rate (Figure 3c), there has been an overall decrease in the fleet FTE effort by 63%. Despite the proportional FTE effort increases seen over time, overall effort has decreased through the decrease in fleet size.

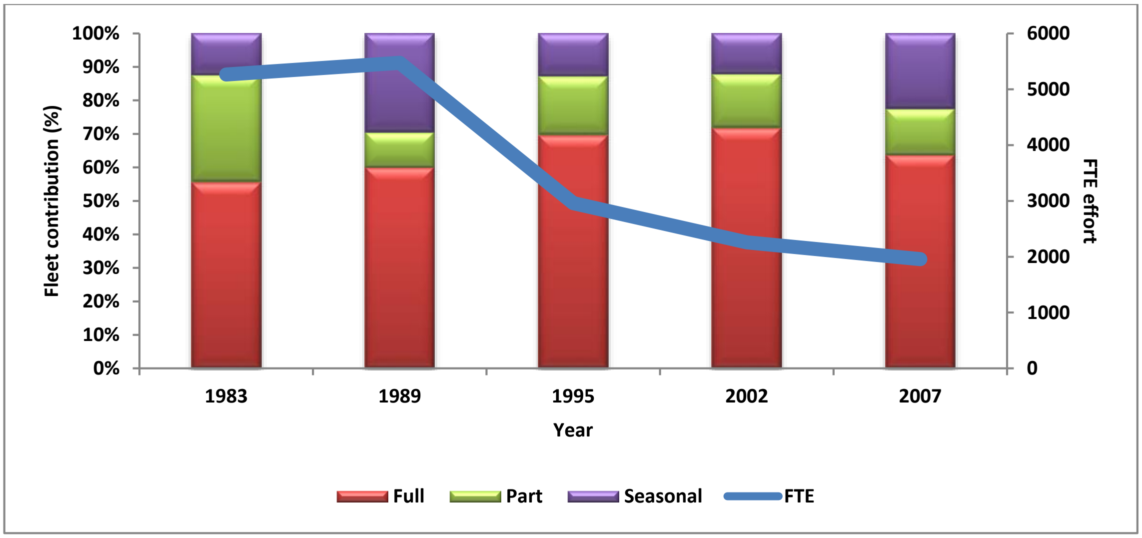

Figure 3c: Changes in effort in the English and Welsh inshore fleet at intervals between 1983 and 2007. Bars are split into Full-time, part time and seasonal proportions. The overall change in full time equivalent effort (FTE) is given by the blue line.

A backwards elimination, stepwise regression analysis (n=500, predictors = 6) was used to best explain the FTE effort data. The variables *Full time vessels, Part time vessels, seasonal vessels numbers* and *Shore fisher numbers* were significant in predicting the FTE effort data (Appendix I Table A1), (ANOVA, $F_{5,495}$=15725.3 p=<0.001). *District* was the only variable that was eliminated from the model, and *Year* was not found to be significant. The analysis would indicate that differences in district fleet numbers does not influence the trends in FTE effort, whilst there are differences in the FTE effort between Year, the differences are driven by the other factors analysed rather than being a factor of time specifically.

Understanding the FTE effort of the fleet can be given context by understanding the gears they fished. The gears were defined by their type (i.e. net, trawl) and the number of gears used has been a consequence of the size of the fleet. The larger the fleet, typically more gears are fished (Figure 4a), with increases in the number of gears used seen in the late 1980s, coinciding with an increase in fleet size. The fleet is very reliant upon net gear types accounting for 50% of all the gears fished, whilst there is also a strong dependence upon trawl gear types which are 19% of the gears fished. The line, gathered and trap gears each account for 6-13% of the gears fished. Other than changes in the numbers of net gears being fished the remaining gear types have been fished with a near consistent number of gears. This does not take into account changes of gears (innovation or obsolescence) between years.

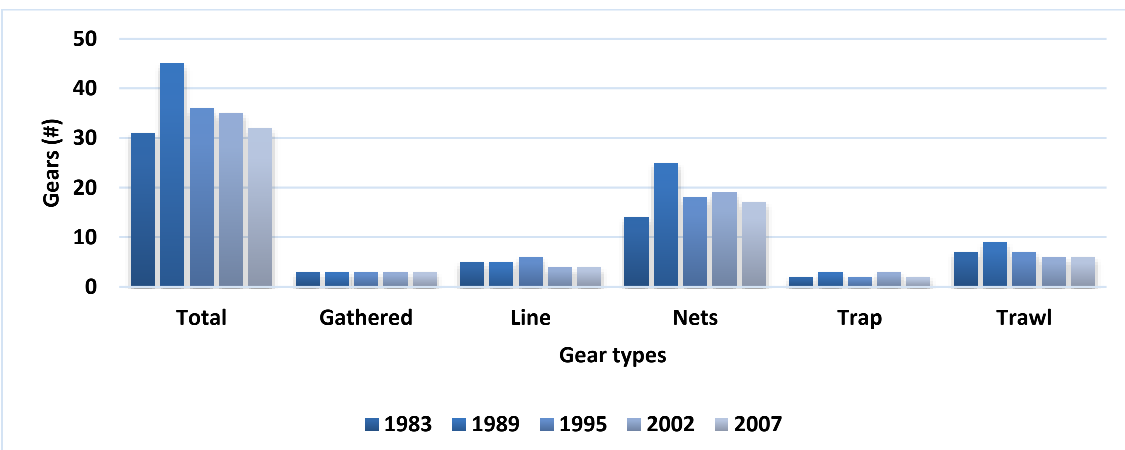

Figure 4a: The change in the number of gear types used by the English and Welsh inshore fleet at intervals between 1983 and 2007. Categorised by main gears fished

Figure 4b shows the cumulative losses and gains of gears over the last 3 decades; 23 gear types were discontinued; the majority (65%) of these were net gear types. Conversely there has been 24 novel gear types introduced, the majority (75%) were net gear types. This analysis of gear innovations and obsolescence is supportive of technology creep, where a technological innovation may see the catch efficiency of a gear improved through change in construction materials and so will allow it superseded and replaced another. The analysis is also suggestive that the coastal fleet is fishing to capacity in terms of the species it targets and the habitats it exploits. If the fleet had been expanding over the last 3 decades, it would not be unrealistic to expect to see innovation in the gears fished to target these new species/habitats.

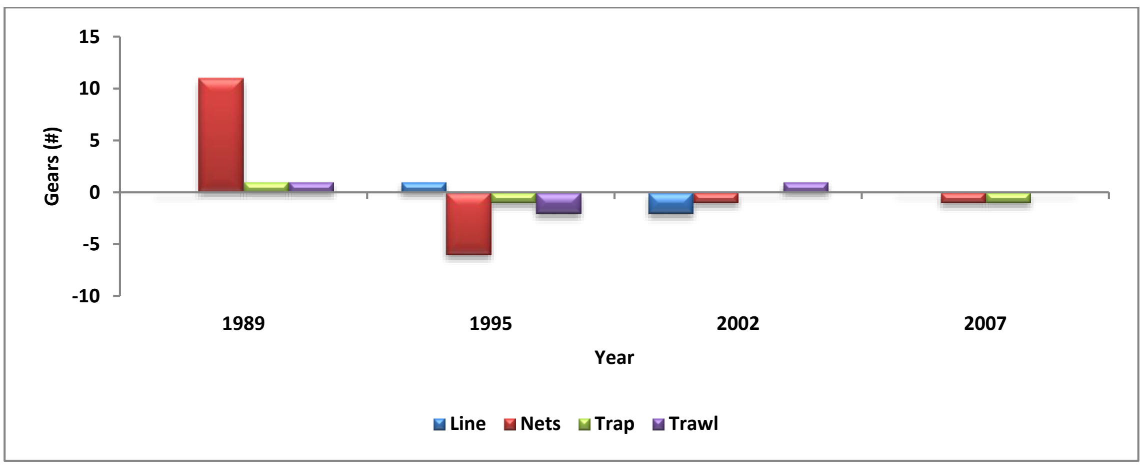

Figure 4b: Cumulative gear type losses (discontinued use of gears) and gains (innovation and use of novel gears) within the English and Welsh inshore fleet at intervals between 1983 and 2007.

Each gear type requires a certain amount of effort for the fisher to use it effectively and maximise its fishing potential. Figure 4c compares the FTE effort scores of the gear types fished. The most labour intensive gear types were trap, gathered gears. The low number of gears used within these gear types and high FTE effort exerted suggests that they are highly specialised gears, requiring a lot of time to set up and fish, furthermore it can also be deduced that these gears are specific in the species they target or the habitats that they are used in. The less demanding gear types can therefore be argued to be general, minimal set up time, multi-target/multi-habitat gears.

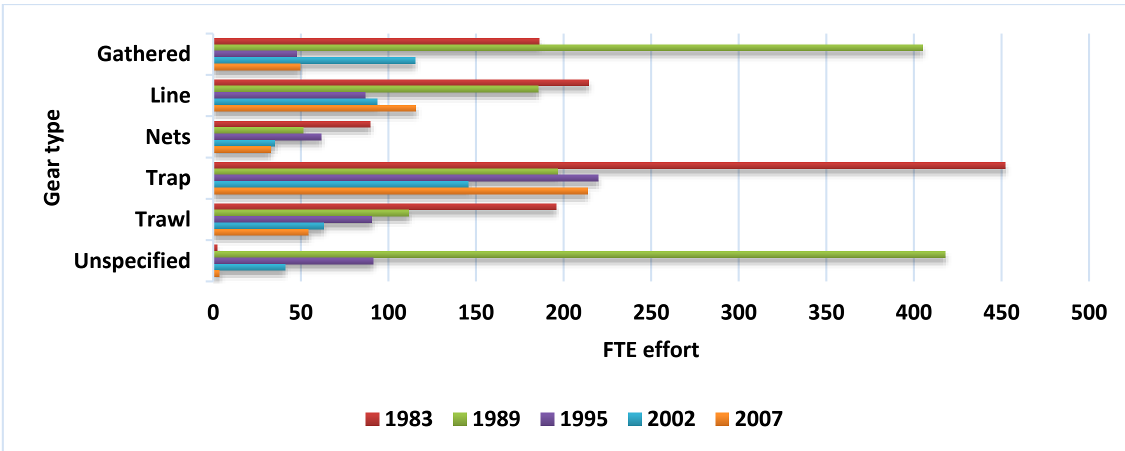

Figure 4c: FTE effort per gear type fished. Changes in full time equivalent effort (FTE) fished with the main gear types by the English and Welsh inshore fleet at intervals between 1983 and 2007.

As a result in the decrease in the fleet size over time, all gear types were fished with less effort by 2007 than had been fished in 1983. The increase in fleet and therefore fleet effort in 1989 is clearly evident by the uptake in gathered (doubling in effort) and unspecified gears at that time. The rise of unspecified gears being reported is a possible consequence of new fishers in the fleet, either being unfamiliar with the administration involved in recording their activities or could be indicative of deception, so that fishers were able to fish with gears that may have been prohibited.

Despite the changes in the numbers and types of gears fished, there was no significant change in the number of gears fished at any year (ANOVA $F_{4,25} = 0.12$, P=0.975).

However there was a significant change in the diversity of gear types used by the fleet (Table 3), with a decrease in fleet gear type diversity by the late 2000s. Devon was found to have significantly greater gear type diversity than any other district. It is possible that the decrease in gear type diversity is a result of the tightening of regulations both nationally and internationally on the use of gears, species targeted and even the continuing efforts to see fishing effort reduced. Devon's higher gear type diversity is also likely to be a factor of the diversity of the fisheries that can be exploited in the district.

Table 3: ANOVA analysis of gear type diversity of the English and Welsh inshore fleet.

Source	**Df**	**Adjusted MS**	**F**	**P**
Year	4	0.046	3.0	<0.05
District	10	0.036	2.4	<0.05
Error	40	0.017		

Analysis of FTE effort exerted with different gear types showed significant differences across Year, District and Gear types, (Table 4). Indicative of the change in fleet size and effort, the differences in fisheries and fishers for each district and the gear types which can be exploited by them.

Table 4: ANOVA analysis of gears used by the English and Welsh inshore fleet.

Source	Df	Adjusted MS	F	P
Year	4	10.0	41.2	<0.001
District	10	1.9	8.0	<0.001
Gear	5	2.4	10.0	<0.001
Error	2467	0.2		

The fleet exerted more FTE effort in the 1980s (1983 mean = 0.619, s.d.= 0.558; 1989 mean=0.596, s.d.=0.572; Tukey P=<0.05) than in subsequent years. The Sussex district exerted more FTE effort than any other district (mean =0.671, s.d.=0.579; Tukey P=<0.05). More FTE effort was exerted using Unspecified Gears (mean =0.765, s.d.=0.719; Tukey P=<0.05) than compared with any other gear.

Multi-gearing, fishing with 2 or more different gears is a prominent feature of the fleet. In the early 1980s multi-gearing accounted for 61% of fleet FTE effort, however by the late 2000s it accounted for 46% of fleet FTE effort. Figure 5 displays the proportion of the fleet FTE involved in multi-gearing, and their choice of secondary gear types. There is a significant difference in the amount of FTE effort used in multi-gearing (ANOVA, $F_{4,20}$ = 22.74, P=<0.05). The data would support the idea that for a significant proportion of the fleet, use of 2 or more gears maximises their activities for economic benefit, likely to be achieved through gear and species diversification. It also suggests that the impact upon the species and their habitats is greater than the fleet could achieved through the use of single gears alone.

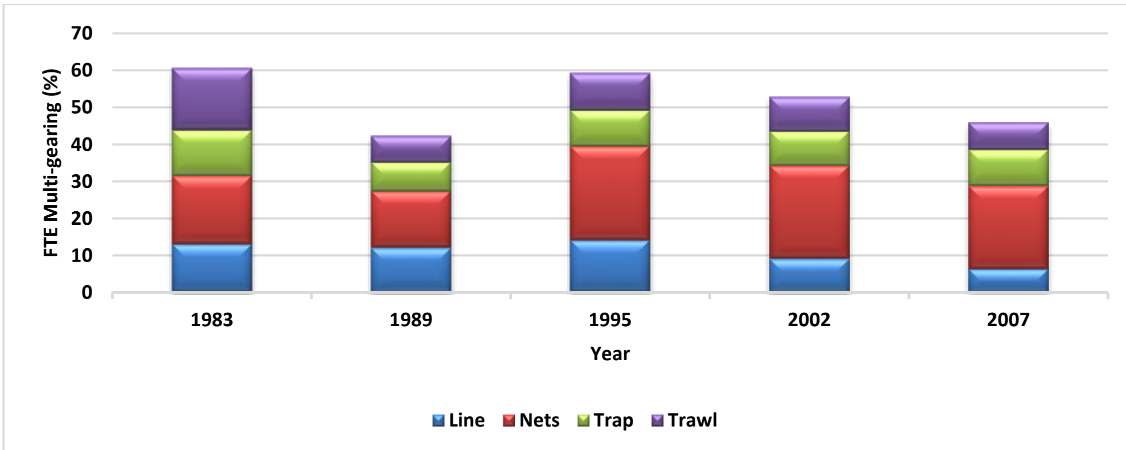

Figure 5: Analysis of multi-gearing by the English and Welsh inshore fleet. The FTE % of secondary gears as used by the fleet between 1983 and 2007.

Analysis of the fishing efficiency of the fleet was carried out by examining the number of species targeted by gear type (Table 5). Trawl gears were found to be the most efficient fishing >5 species for each gear type used, whilst net gears were found to be the least efficient, fishing <2 species for each gear type used.

Table 5: Gear fishing efficiency analysis.

Gear Type	# of Gear	# of species targeted	species/gear type
Trawl	9	51	5.7
Gathered	3	14	4.7
Line	7	32	4.6
Trap	5	16	3.2
Nets	32	47	1.5

The species targeted by the coastal fleet are grouped into 4 categories, defined by the habitat that they are fished from. Figure 6 shows the amount (%) of fleet FTE effort that was exerted targeting the different species groups. Demersal species were the primary target for the fleet until the late 2000s when effort targeting Shellfish species surpassed it. There was a peak in the targeting of Pelagic species in the mid-1990s but effort has consistently decreased since then. Benthic targets were usually third preference for the fleet except in the early 2000s when there was a peak in benthic effort.

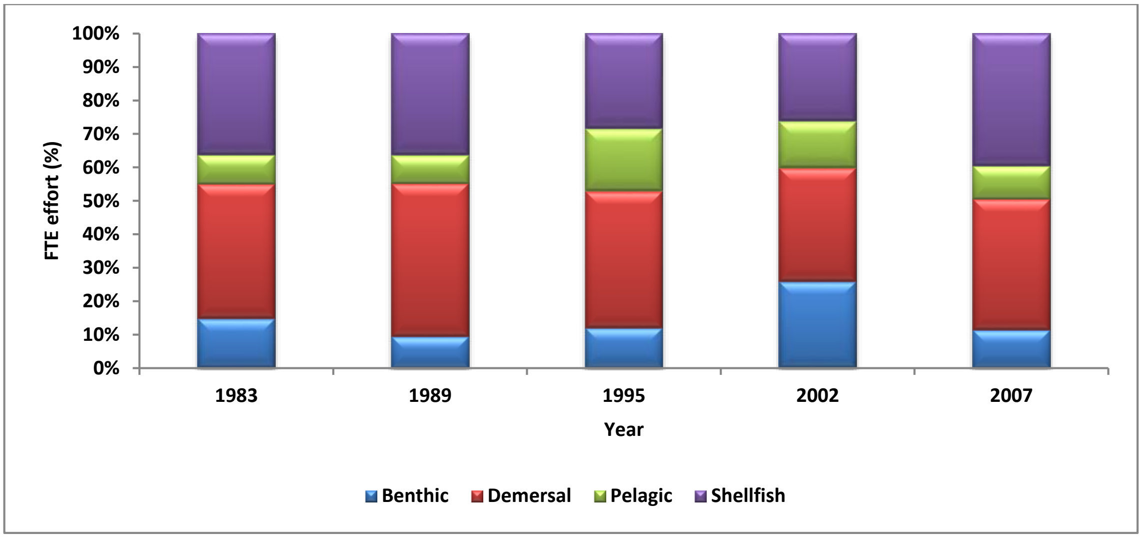

Figure 6: FTE effort (as a percentage) targeting different species groups by the English and Welsh inshore fleet between 1983 and 2007.

There was a significant difference in the FTE effort exerted upon the species targeted by the fleet (Table 6).

Table 6: ANOVA analysis of species targeted by the coastal fleet.

Source	**Df**	**Adjusted MS**	**F**	**P**
Year	4	1.39	8.0	<0.001
District	10	1.29	7.4	<0.001
Species	3	5.17	29.7	<0.001
Error	202	0.17		

The FTE effort exerted by the fleet was significantly less in the 2000s (2002 mean=1.44, s.d.=0.417; 2007 mean=1.272, s.d.=0.666; Tukey P=<0.05) than in previous years. Northumberland, Southern, South Wales and Cumbria Districts exerted significantly less FTE effort than the other districts (Northumberland FTE mean =1.059, s.d.=0.591, Southern FTE mean =1.485, s.d.=0.658, South Wales FTE mean =1.226, s.d.=0.656 and

Cumbria FTE mean =1.325, s.d.=0.571; Tukey P=<0.05). Significantly more FTE effort was exerted targeting Demersal and Shellfish species (Demersal FTE mean =1.846, s.d.=0.474; Shellfish FTE mean =1.753, s.d.=0.386; Tukey P=0.05).

Figure 8 shows the change in the number of species targeted. The fleet targets more shellfish species; an average 22 species, than another other group. There has been no significant change in the number of species targeted by the coastal fleet (ANOVA, $F_{4,15}$ = 0.04, P>0.05).

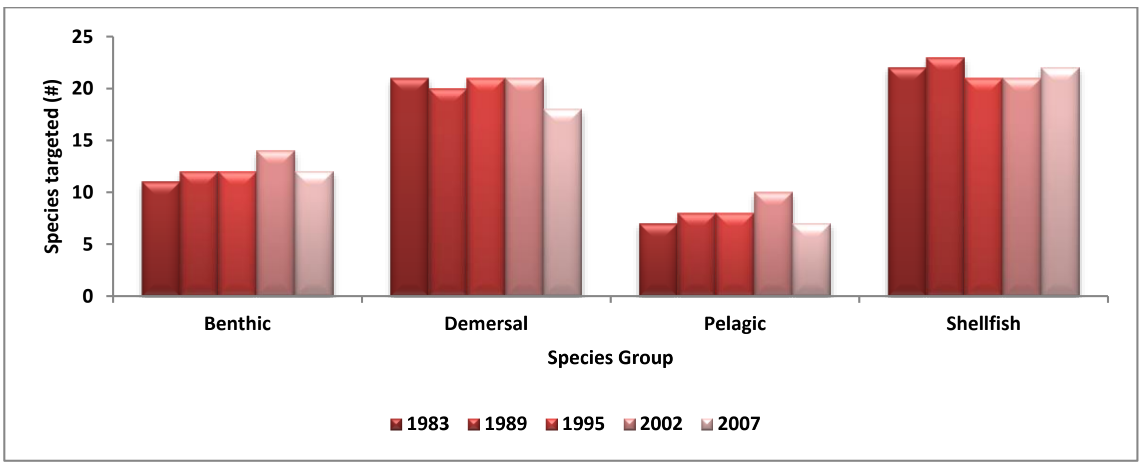

Figure 8: Changes in the number of species targeted (grouped by species type) by the English and Welsh inshore fleet between 1983 and 2007.

Figure 9 details the change in the cumulative number of species targeted, new species were targeted in the late 1980s, coinciding with the expansion of the size of the fleet and its FTE effort capacity. Since then there have been very few new species targeted.

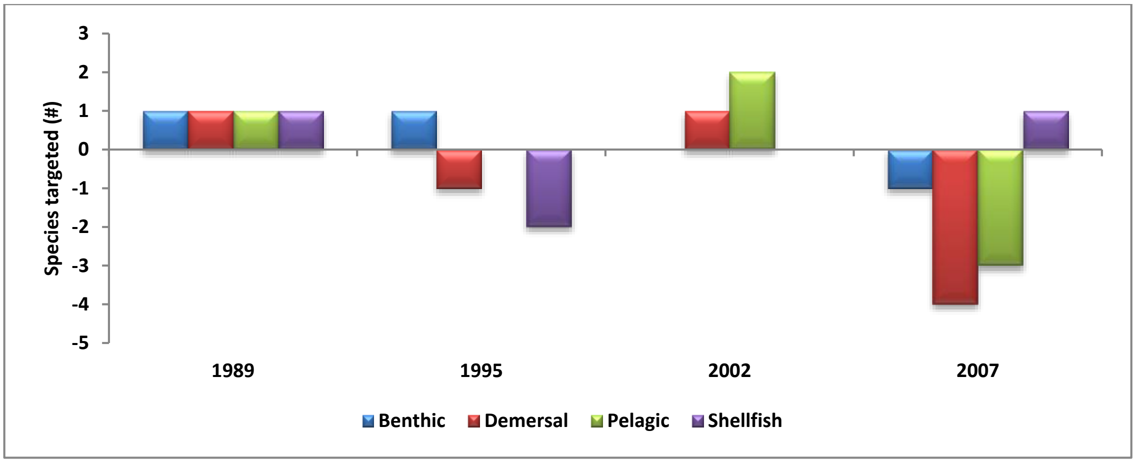

Figure 9: Cumulative species targets lost (species no longer fished) and gained (new species fished that were not previously targeted) within the English and Welsh inshore fleet at intervals between 1983 and 2007.

These changes in species targets can be classified into 1 of 3 types;

- new targets; *Limanda limanda* (Dab), *Pagellus spp.* (Bream), *Loligo spp.* (Squid) and *Necora puber* (velvet swimming crabs)

- ceased to be targeted; *Merluccius merluccius* (Hake), *Lepidorhombus whiffiagonis* (Megrim), *Trisopterus luscus* (The Bib or Whiting pout), *Pandulus borealis* (Boreal Prawn)

- and incidental targets; *Octopus vulgaris* (Octopus), *Argentina sillus* (Silver Smelt), *Galeorhinus galeus* (Tope), *Siluriformes* (Catfish), *Triglidae spp.* (Gurnards), *Labrus* spp. (Wrasse) *Trachurus trachurus* (Horse Mackerel), *Sardina pilchardus* (Pilchards), *Thunnus thynnus* (Tuna), *Pandalus montagui* (Pink Shrimps).

There was no significant change over time in the diversity of species targeted by the coastal fleet (ANOVA, $F_{4,15} = 1.17$, $P>0.05$, Table 7). When compared by district, only

Cumbria was found to have significantly lower targeted species diversity than any other district.

Table 7: ANOVA analysis of gear diversity in the coastal fleet.

Source	**Df**	**Adjusted MS**	**F**	**P**
Year	4	0.007	2.33	>0.05
District	10	0.009	3.0	<0.05
Error	40	0.003		

Analysis of trophic levels was conducted to identify the impact of fleet effort upon the coastal food web. Significant differences were found in the trophic level fished by the fleet (Table 8).

Table 8: ANOVA analysis of trophic level.

Source	**Df**	**Adjusted MS**	**F**	**P**
Year	4	0.23	1.03	>0.05
District	10	0.43	1.94	<0.05
Species Group	3	16.68	74.6	<0.001
Error	202	0.22		

There was no significant change in trophic level fished over time. Northumberland, North Eastern, and Cornwall & Isles of Scilly districts fished significantly different trophic levels than the other districts (Northumberland Trophic level mean =2.9, s.d.=1.389, North Eastern Trophic level mean =3.4, s.d.=0.581, and Cornwall & Isles of Scilly Trophic level mean =3.4, s.d.=0.554; Tukey P=<0.05). There were significant differences in the trophic levels between species groups, with Benthic and Shellfish species from lower trophic levels than Demersal or Pelagic species. (Benthic trophic level mean =3.1, s.d.=0.768; Shellfish trophic level mean =2.5, s.d.=0.131; Tukey P=0.05).

Significant differences were found in the trophic effort exerted by the fleet (Table 9).

Table 9: ANOVA analysis of trophic effort.

Source	**Df**	**Adjusted MS**	**F**	**P**
Year	4	891.94	9.18	<0.001
District	10	299.88	3.09	<0.05
Species Group	3	346.31	3.56	<0.05
Error	202	97.17		

The FTE effort exerted by the fleet was significantly less in the 2000s (2002 mean=5.54, s.d.=5.2; 2007 mean=5.12, s.d.=4.8; Tukey P=<0.05) than in previous years. Northumberland and North Eastern districts fished significantly different trophic effort than other districts (Northumberland mean =4.4, s.d.=3.49 and North Eastern mean =17.1, s.d.=14.93; Tukey P=<0.05). There were significant differences in the trophic effort exerted on Demersal & Benthic species than Shellfish or Pelagic species. (Benthic trophic level mean =7.1, s.d.=8.4; Demersal trophic level mean =13.1, s.d.=13.9; Tukey P=0.05).

Trend analysis

Crew members are inconsistently reported, giving a gross underestimation of the total number of crew fishers. In order to identify the relationship between vessel length and numbers of crew fishers active, crew data was plotted against vessel lengths from the 1983 report. A positive correlation between vessel length and crew fisher number was found (Figure 10).

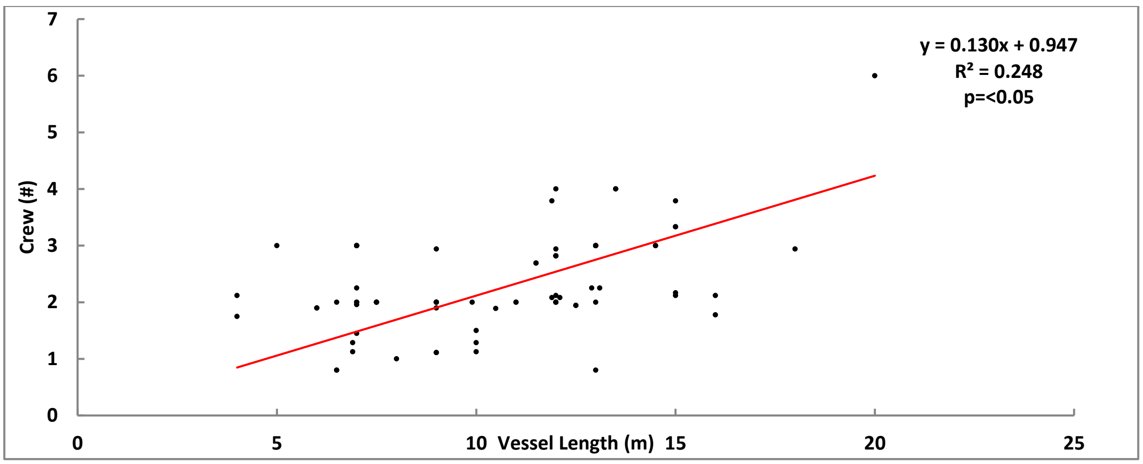

Figure 10: Reported crew fisher numbers plotted against their corresponding vessel length, data from Pawson 1983.

Analysis of crew numbers per vessel, found a significant decrease (ANOVA, $F_{4,491}$ = 8.18, P<0.01) from 2.0 crew members in the early 1980s there to 1.76 crew members by the late 2000s (Figure 11).

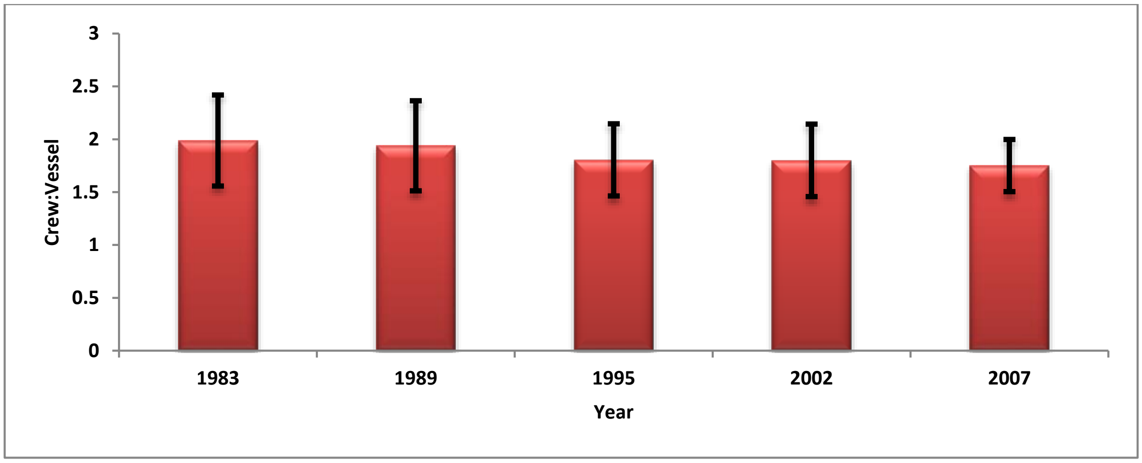

Figure 11: Change in crew numbers/vessel in the English and Welsh inshore fleet at intervals between 1983 and 2007.

There was also a significant decrease in the maximum vessel length of the fleet from 12.5 metres in the early 1980s to 9.8 metres by the late 2000s (ANOVA, $F_{4,491} = 4.93$, $P<0.01$) (Figure 12).

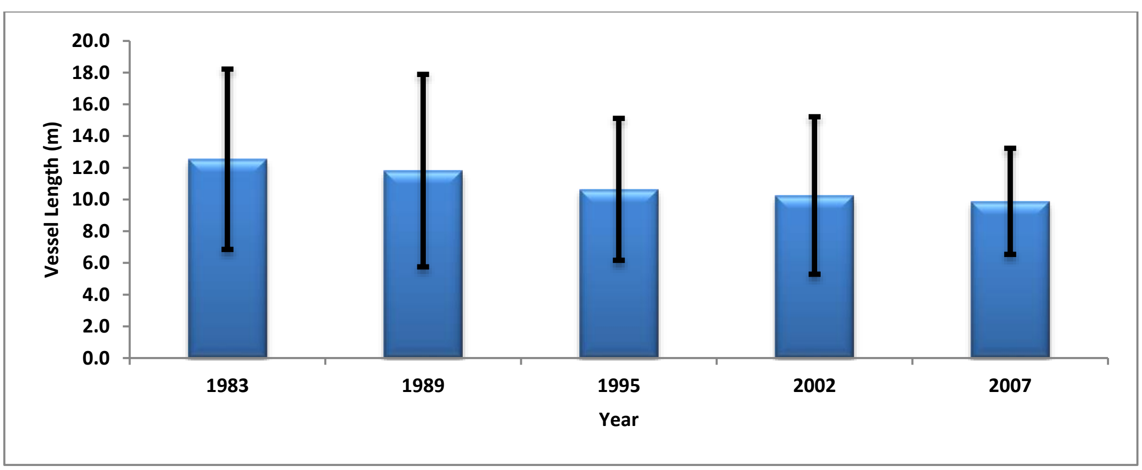

Figure 12: Changes in vessel length (m) of the English and Welsh inshore fleet at intervals between 1983 and 2007.

The make-up of the coastal fleet has changed significantly (ANOVA, $F_{3,16} = 9.57$, $P<0.01$), with the number of larger active vessels decreasing over time. There were no vessels >31m length active by the late 2000s. Vessels >21m length showed an exponential decline and vessels >10 m decreased in fleet proportion by 13%. The vessels of 10 m and less have fluctuated around ~1000 in number but increased in fleet proportion by 33% (Figure 13).

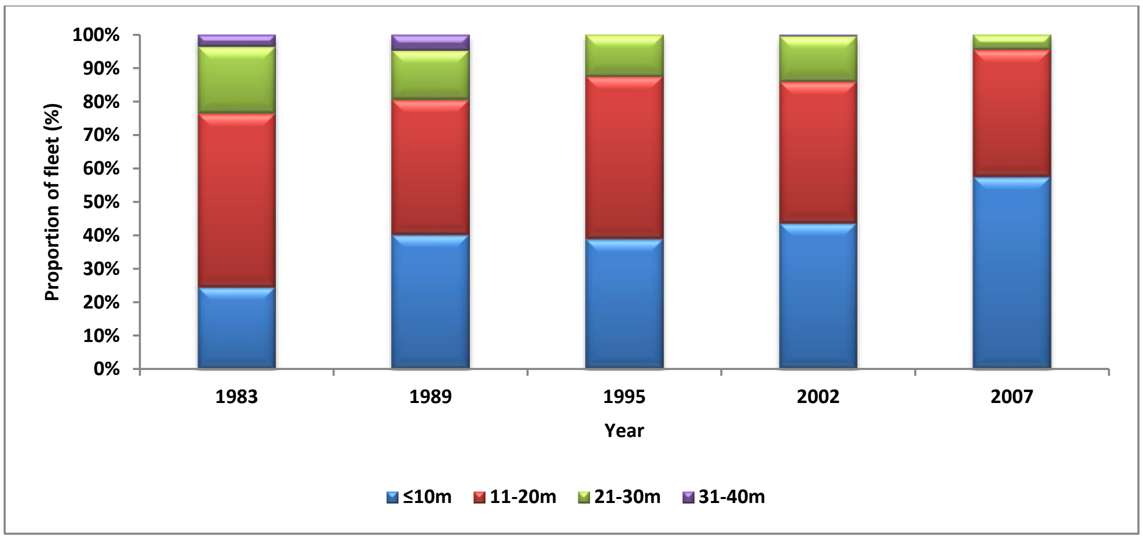

Figure 13: Changes in the vessel lengths of the English and Welsh inshore fleet at intervals between 1983 and 2007.

There was no significant correlation (found between the number of vessels active and the number of gear types fished (Figure 14).

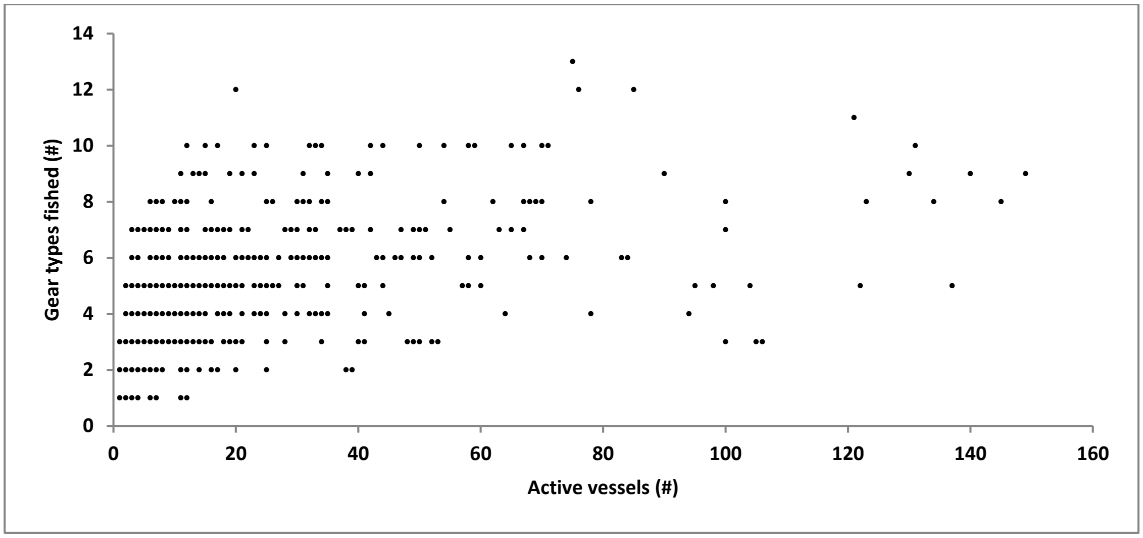

Figure 14: The correlation between the number of gear types fished and the number of vessels that have been active in the English and Welsh inshore fleet between 1983 and 2007.

The data on the amounts of gear fished by individual vessels was inconsistently reported, however pot numbers were the most consistently reported. The pot data was statistically significant with larger vessels fishing with more pot gear than smaller vessels. The relationship indicates about 121 pots fished per metre of vessel (Figure 15).

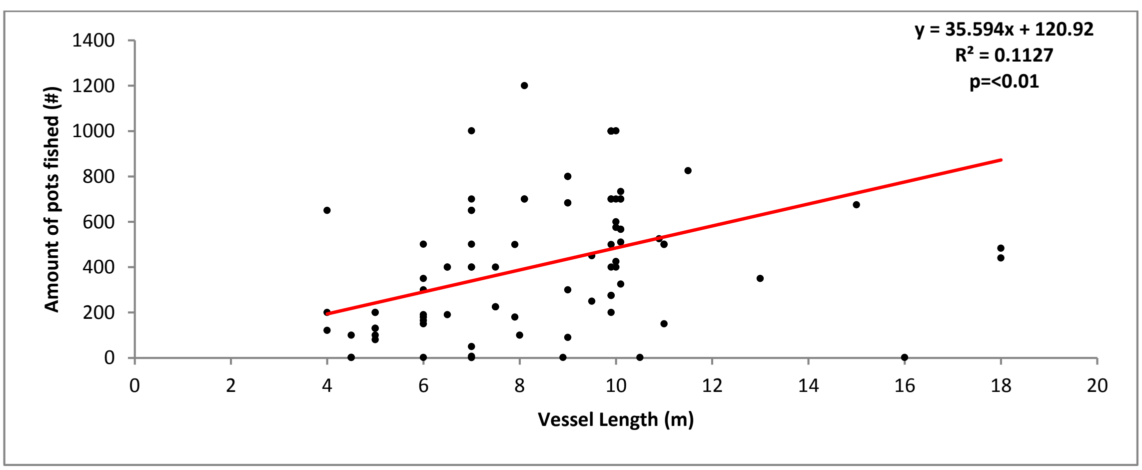

Figure 15: The relationship between vessel length and the amount of pot gear fished by the English and Welsh inshore fleet between 1983 and 2007.

The correlation between the number of gear types fished and the number of species targeted was found to be significant ($r_s(498) = 0.7305$, $p=<0.01$), when analysed through a Spearman's rank-order correlation(Figure 16).

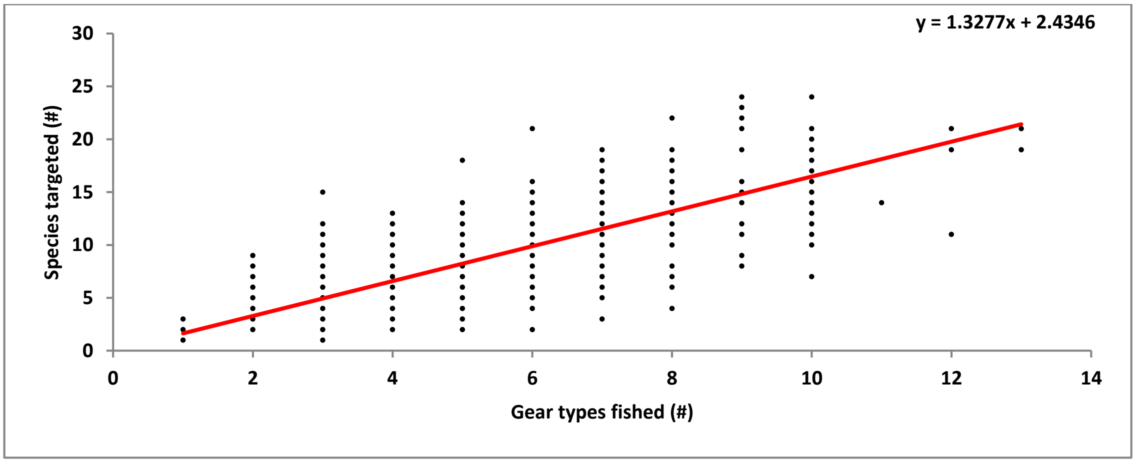

Figure 16: The correlation between the number of species targeted and the number of gear types fished.

There was no correlation between the number of gear types fished and the amount of FTE effort exerted by the fleet (Figure 17).

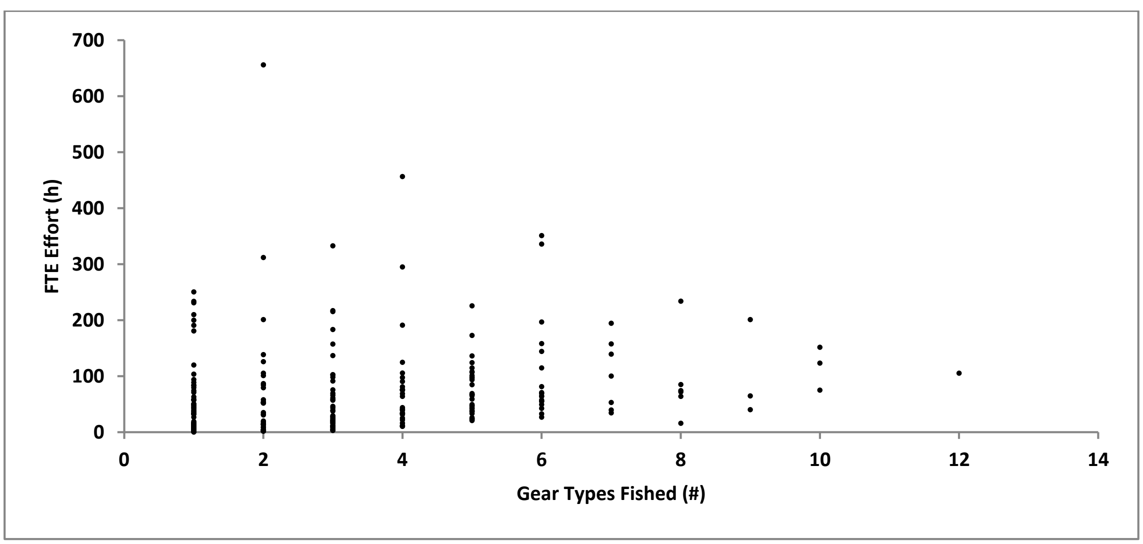

Figure 17: The correlation between FTE effort and the number of gear types fished.

The correlation between FTE effort and the number of species targeted attributes 8 and a half hours per species, as well as an additional 8 and a half hours overall (Figure 18).

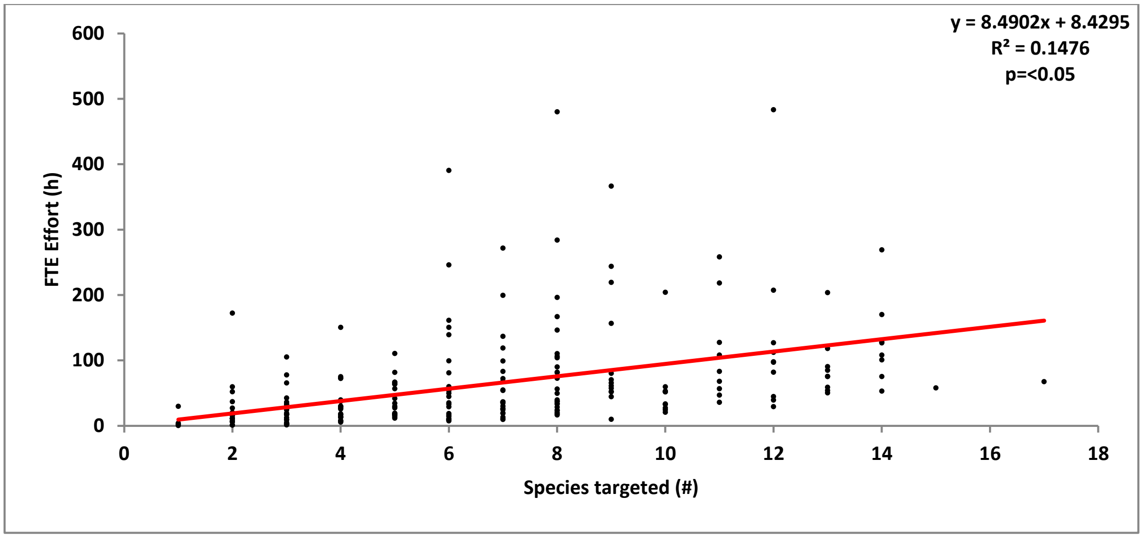

Figure 18: The correlation between FTE effort and the number of species targeted.

GIS analysis;

The following GIS maps allow the representation of numerous pieces of information within the spatial context that they relate to, here they are used to show the FTE effort exerted, along with the number and types of species targeted. The colour of the district inshore area relates to the amount of FTE effort hours exerted by the district, within this are upto 4 circles with correspond to the types of species that the district targeted, and the size of the circle relates to the number of the species targeted.

Here we examine the relationship between each district, the amount of FTE effort and the species targeted. A further 2 GIS maps are used to look cumulatively at the gears fished (where the district inshore area is coloured by the main gear type used, and the name of the particular gear is listed in a size that represents the FTE effort hours that the district has fished with that gear) and the predominant species targeted (where the district inshore area is coloured by the main species type targeted, and the name of the particular species is listed in a size that represents the FTE effort hours that the district has fished).

Figure 19 details the coastal fisheries as reported in the 1983 report, the most active districts were the Eastern, Kent & Essex, Sussex, Southern and North West & North Wales, all of which predominantly targeted shellfish species.

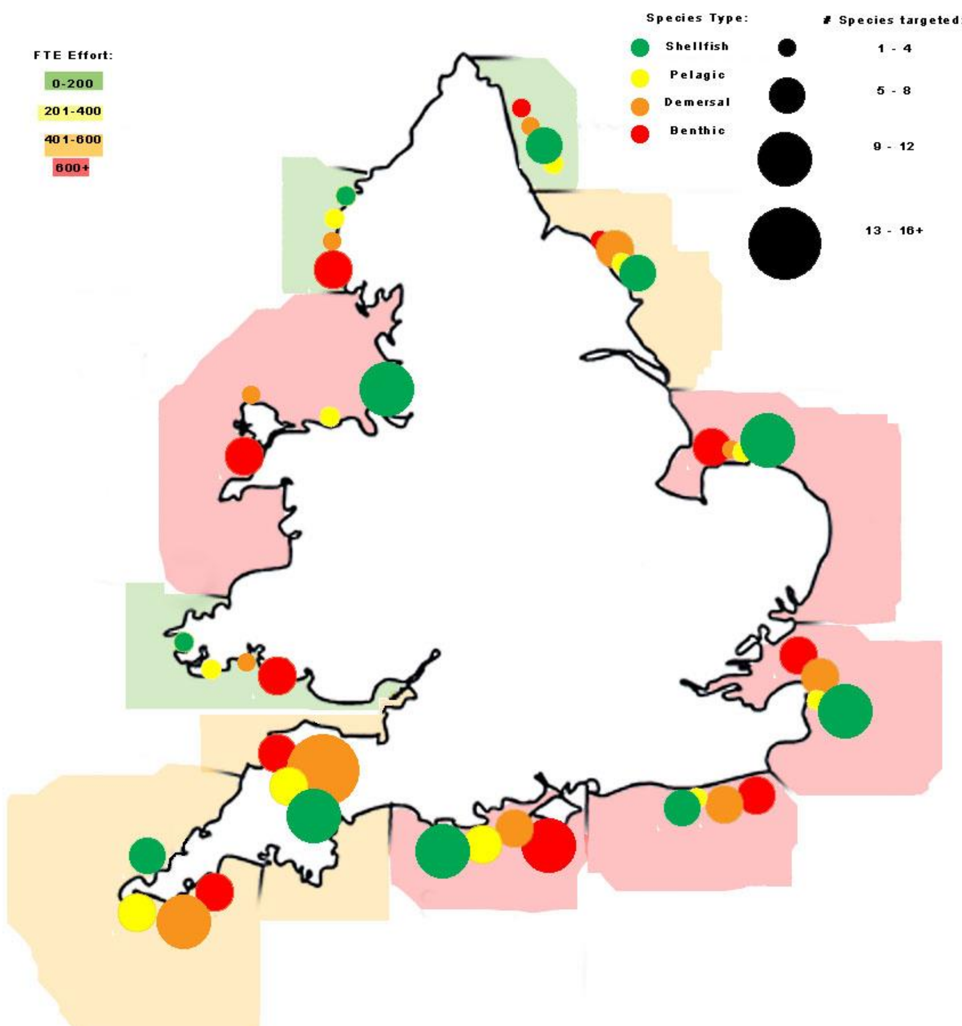

Figure 19: The spatial representation of fleet FTE effort and Species targeted as reported in 1983.

By the late 1980s, the increase in the number of fishers active in coastal fisheries meant increases in FTE effort particularly for Northumberland and North West & North Wales whose FTE effort had more than double, while some of the North Sea / English Channel districts saw a decrease in the amount of FTE effort compared to the early 1980s. Benthic species targets increased in the districts along the English Channel (Figure 20).

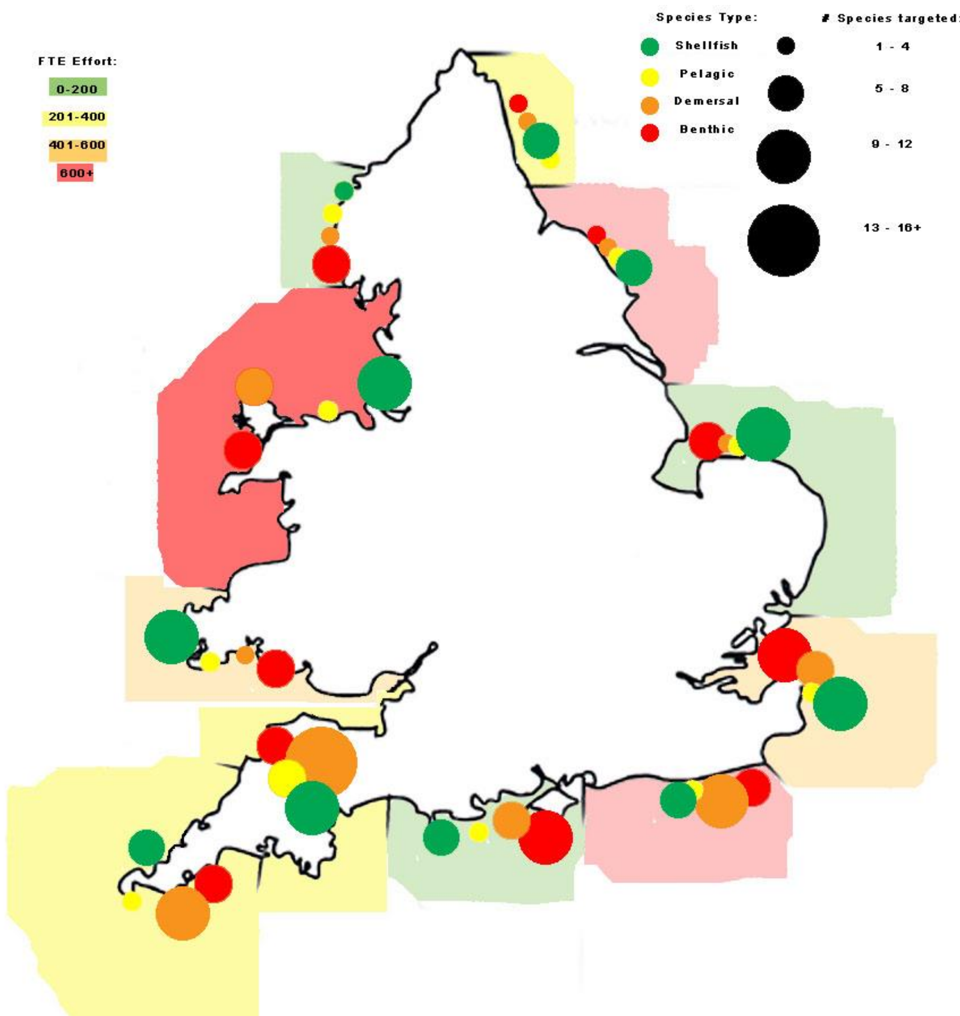

Figure 20: The spatial representation of fleet FTE effort and Species targeted as reported in 1989.

Reported in 1995, was a decrease in fleet FTE effort across all the districts and an increase in numbers of species targeted. The Eastern districts (with the exception of the North Eastern district) showed proportionally lower FTE effort than the Western districts (Figure 21).

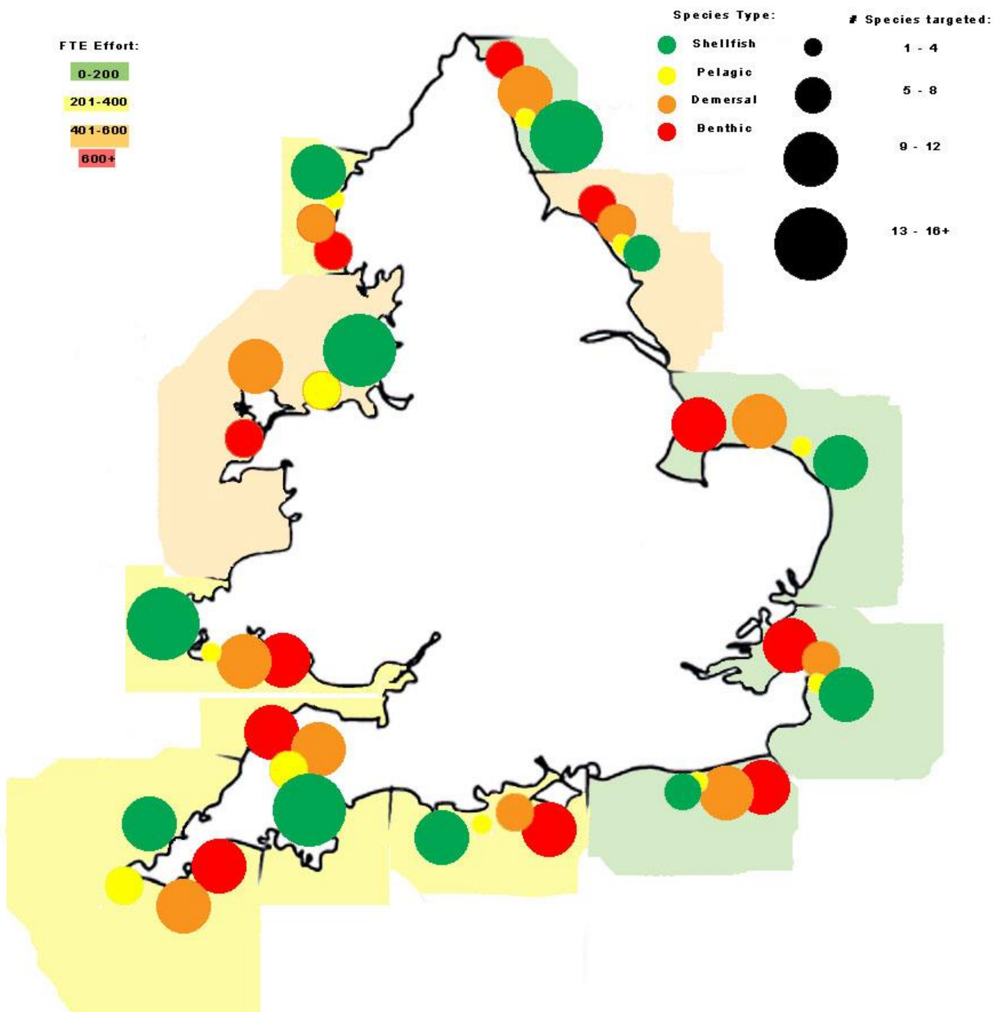

Figure 21: The spatial representation of fleet FTE effort and Species targeted as reported in 1995.

In the 2002 report was a continuation of the decrease in fleet FTE effort, although Devon district did not follow this trend. There was also a drop in the number of species targeted overall by the fleet (Figure 22).

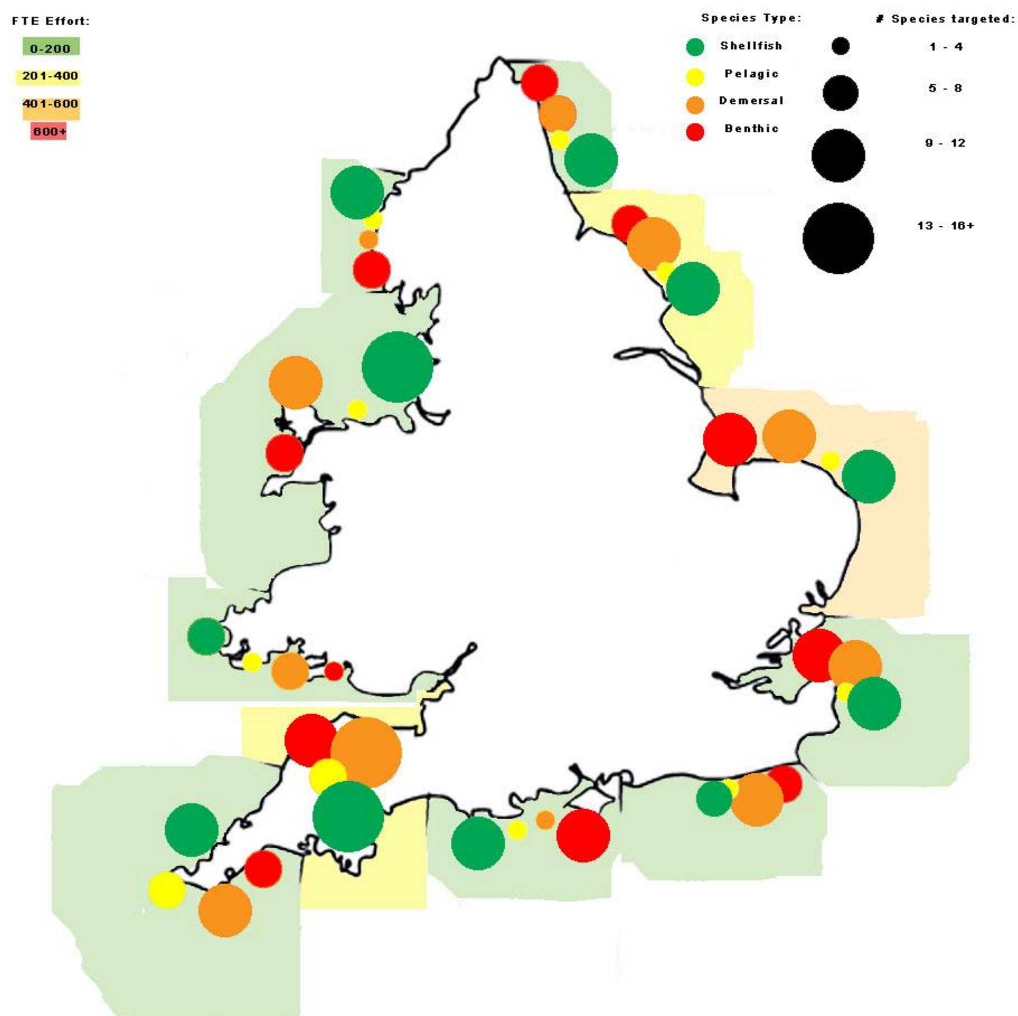

Figure 22: The spatial representation of fleet FTE effort and Species targeted as reported in 2002.

In the 2007 report, fleet FTE effort had reduced further, the fleet was smaller in terms of number but its impact upon the food web showed a marked difference from the early 1980s, with more species being targeted (Figure 23).

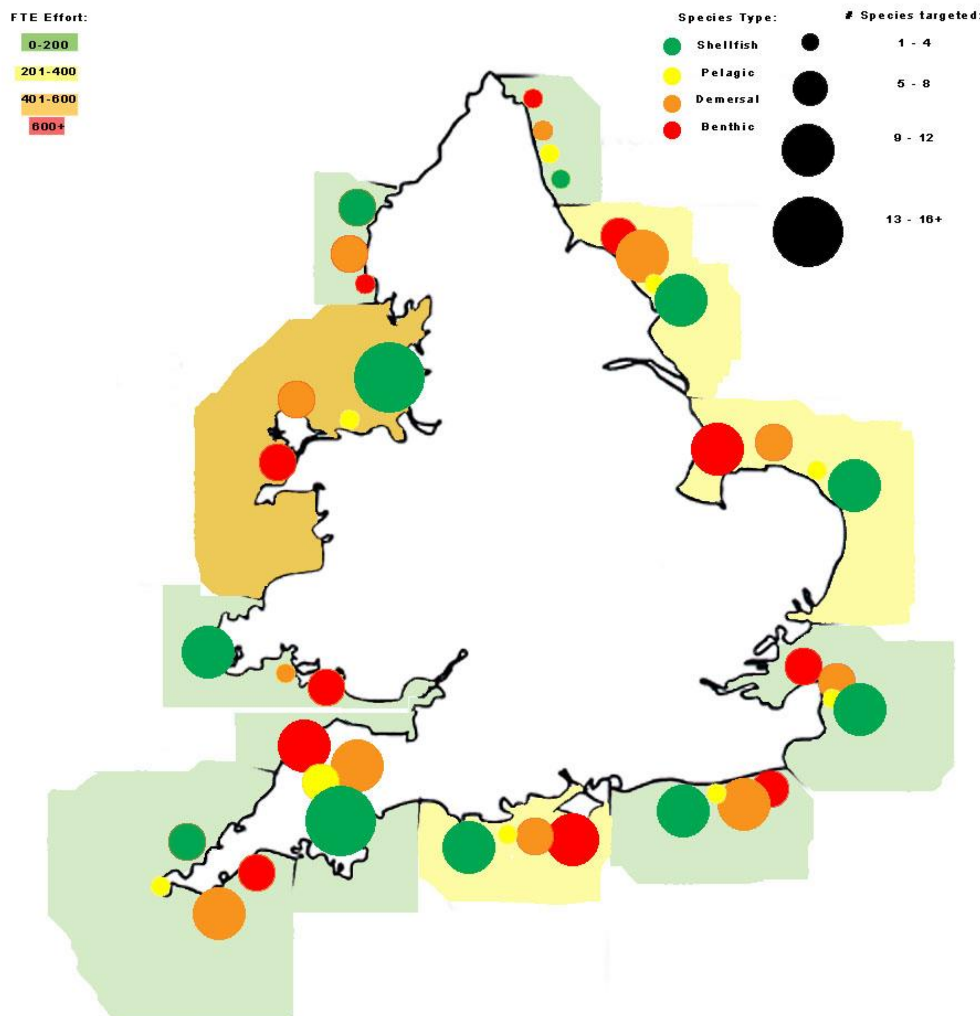

Figure 23: The spatial representation of fleet FTE effort and Species targeted as reported in 2007.

Figure 24 shows the top gear types fished (in terms of reported FTE effort cumulatively across all the reports) and the differences between districts. The districts that border the English Channel and the Celtic Sea (Southern – South Wales) show pot gear to be their most fished gear. Net gears do not feature heavily despite there being the greatest diversity of gears with this gear type. Of note are the line anglers of the North Eastern district, which constituted a major part of the fleet and the Eastern district showed many fishers gathered lugworms as bait.

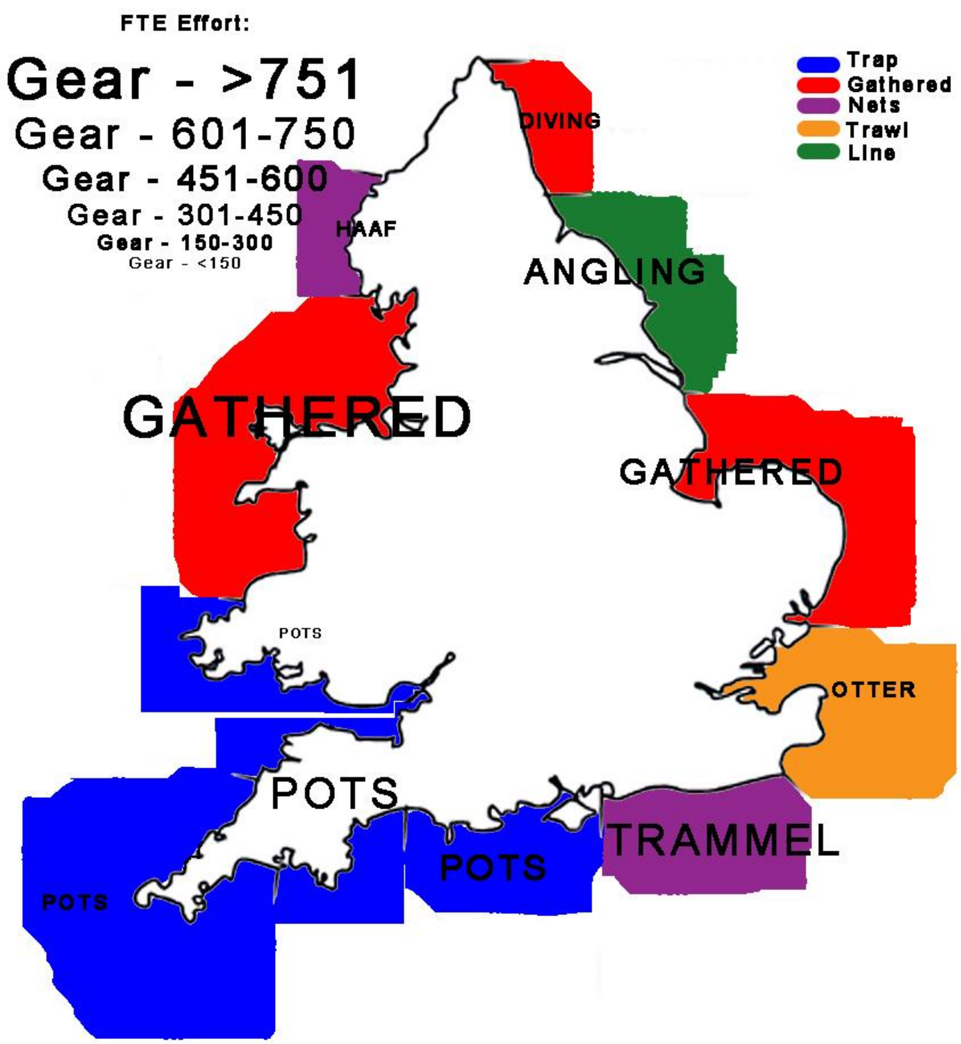

Figure 24: Cumulative representation of the predominant gear types fished by FTE effort, by district, across all reports.

Figure 25 shows the top species fished (in terms of reported FTE effort cumulatively across all the reports). There is a clear distinction in the species targeted, with Cod being the most targeted species for the North Sea districts (with the exception of Northumberland) as well as for the Sussex district. Not a single Benthic species is present in the top species targeted whilst the Brown Crab was also heavily targeted, along with Salmon.

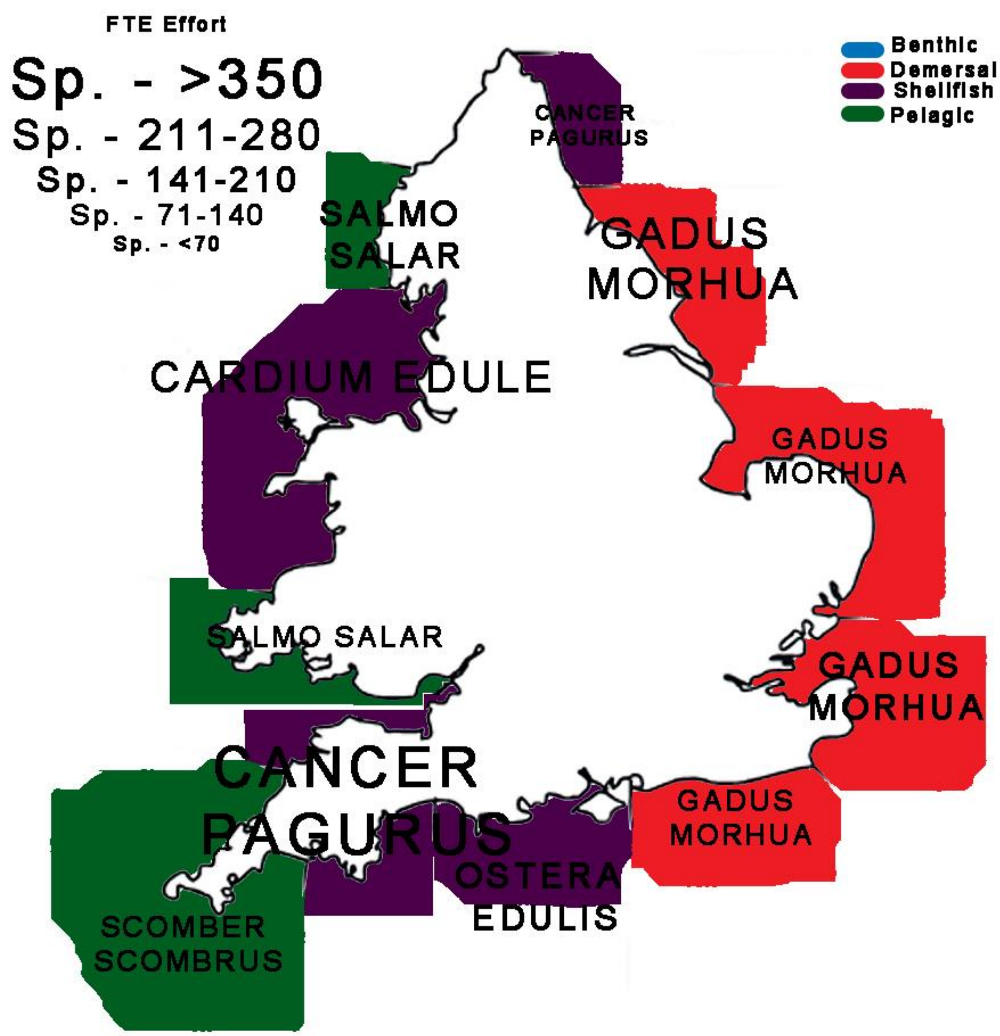

Figure 25: Cumulative representation of the predominant species fished by FTE effort, by district, across all reports.

Discussion

It is clear that the coastal fisheries of England and Wales, much like those of Europe & the rest of the world, have changed drastically since the 1980s. The versatility of the coastal fleet has been its key strength, in the face of fish quota restrictions and declining fish stocks, coastal fishers have been able to adapt and continue fishing, exploiting new resources, species and markets. However, this versatility is not without consequence, as the coastal fleet is impacting even more of the coastal ecosystem.

This study looked to address 5 key points, which concerned the recent history of the coastal fisheries of England & Wales, in terms of fleet development, gear capacity and ecological impact as well as commenting upon what value the SFCs provided in coastal fisheries management before finally addressing the future of the inshore resource management with the newly minted IFCAs.

- ***The relationship between fleet size and fleet effort***

  At a national level between the 1983 and 2007 reports, the coastal fleet was reduced in vessel numbers by 64%, fisher numbers by 81% which resulted in a 63% reduction in FTE effort. However the reduction was not uniform across all SFCs (Table 10).

Table 10: Expressing the fleet reported in 2007 as a % of the 1983 fleet.

District	**% of 1983 fleet**		
	Vessel Numbers	**Fisher Numbers**	**FTE effort**
N	14	0	10
NE	38	6	38
E	42	14	27
KE	25	2	18
SX	18	0	10
S	19	39	45
D	60	18	32
CS	66	1	40
SW	59	55	86
NWNW	94	81	95
C	38	0	31
National	**36**	**19**	**37**

These differences could be a consequence of the types of fisheries that were exploited in each district and the nature of how the fleet operated. The districts that have shown a lower reduction in both numbers and effort are ones that had very strong non quota species fisheries and/or had fishers that operated on a very seasonal basis, targeting multiple species throughout the year.

Fleet numbers and effort are intrinsically linked, more fishers give rise to more effort being exerted by the fleet, however there are many factors involved to how fishers translate into fleet effort, such as working schedule (full/part time, seasonal) gears used (e.g. labour intensive result in a lot of hours preparing the gear but low fleet effort) and even species targeted (ease of target capture and availability of targets, unsuccessful catches are unrecorded and deemed effortless). There is no explanation for the increase in the fleet reported in 1989, high unemployment and the ease of access into coastal fisheries are possible factors (Symes & Phillipson, 2001).

The discrepancy between the number of reported vessels and those with effort and gears is likely the combination of 2 factors; error in the data collection and "slipper skippers". Slipper skippers are non-fishing fishers who own vessels, historical fishing rights and consequently can be allocated quota. The usual practice is that their quota is sold to the highest bidder, securing a guaranteed income (Gray *et al.*, 2011). There is a decrease in the number of effortless vessels reported in later reports, which suggests that there was less error during subsequent data collection or that slipper skippers became active or left the fishery, or a combination of these factors. Gray *et al.*, (2011) suggest that quota leasing is a fundamental part of modern fishing, offering one reason as to why effortless vessels persist within the fleet.

Overall the capabilities of the fleet have been restricted, with the fleet being reduced to a third of its former size in vessel numbers, the average coastal vessel length decreased by almost 2 metres and vessels operated on average with one less crew member. The fleet ended up being comprised of predominantly full time fishers, with the majority of vessels of 10 m of less (Figure 13). Given the recent legislative practices and economic climate, it is too difficult to fish on a part time or seasonal basis and compete with other fishers for a profit.

National and international legislation drove a reduction in the fleet size, in a bid to reduce fishing pressure (Crean, 2000; Holden, 2004). The CFP was instrumental at an international level in the reduction of member state fishing fleet size since the early 1980s (Holden, 2004; Symes & Philipson 2009), and through the European Fisheries Fund (EFF, and its predecessor the Financial instrument for Fisheries Guidance, FIFG) implemented the decommissioning of larger vessels in the fleet. The EFF also funded modernisation and renewal of the fleet, effectively allowing fishers to decommission their old larger vessel and be granted money for buying a smaller, compliant, more efficient vessel. Since 2005, the EFF has only allowed funded grants that will ultimately result in a reduction in fleet numbers (Idda *et al.*, 2009).

At a national level, the M&FA introduced vessel licences in 1977, these were initially aimed at vessels over 12 metres in length (the standard European measure for offshore vessels) The licenses were for fish stocks designated “pressure” stocks, and used to enforce restrictive fishing against those species (Hatcher *et al.*, 2002). In 1990, the licenses of vessels was applied to all vessels >10 m in length, by 1993, the licensing measures were introduced to the <10 m vessels (MMO 2010), with specific focus upon reducing the effort of the “super under 10” / high tech / fast working members of the fleet (Gray *et al.*, 2011).

The relationship between fleet size and effort is one of continual change and the restrictive measures imposed at a national/international level do not always account for the ultimate impact upon the fishers and their livelihoods (Judd, 1988). It is incredibly important to be able to appropriately manage the coastal fisheries for their sustainable fishing, but this must also go hand in hand with enabling the workers of the fisheries to sustain their living, tighter restrictions upon a vessel type, use of a particular gear or targeting of particular species will simply encourage landing of non-quota species with unregulated gears so that fishers can sustain themselves. However it is not simply a case of the number of sea going vessels and capable hands that determine the effort of the fleet, consideration of vessel and gear technology (Parente, 2004) as well as species targets must also be made.

- ***The role of technology in coastal fisheries***

Whilst the notion of limiting fleet size to limit fleet effort is an obvious management measure, it does not consider the technological capacity of the fleet (Marchal, 2006; Thorson & Berkson, 2010); as seen in Figure 17 there was no pattern in the number of gears being fished and fleet FTE effort. This is possibly a consequence of the different fishing capacities of each gear. Pot gears for example require a low amount of effort to fish for a long time, where was line fishing is very labour intensive and demands a higher amount of effort and are fished for much shorter periods of time than pot gears.

The data suggests that there was no correlation in the amount of gear fished regardless of vessel size, and once consideration of gear regulations and physical space available upon vessels is taken into account, it would suggest that habitat space is the most likely limiting factor in determining the amount of gear used. Although there was no correlation found between the number of gears fished and the number of vessels active (Figure 14), increases in number of gears being fished could be associated with legislative avoidance, development of novel gears, targeting of non-quota species, reducing costs, improving catch efficiency or in response to competition with other local fishers. Novel gears are adopted when they fulfil a need, if they prove some advantage over the existing repertoire (Acheson & Reidman, 1982).

Net and trawl gears were the most numerous and diverse used by the fleet, but line and trap gears increased in usage by the fleet. The decline in trawl gear usage was likely to be a result of several factors, such as the scarcity of traditional species targets, quota and gear restrictions and the development of non-quota species fisheries. The most significant gear type used by the fleet were "unspecified", this is likely an artefact of data collection or another recording error, as in later reports unspecified gears are much less common.

With a positive correlation between the number of gear types fished and the number of species targeted (Figure 16), the data indicates that gears were designed for fishing specific species targets. If a new species is targeted, then it is likely a new gear is used.

Multi-gearing decreased across the fleet, however given the versatility of net gears with their high catching efficiency, general species targeting and lesser labour requirements they are an optimal gear to supplement a fisher's main activities. Neis *et al,*. (1999) suggest that catch rates are maintained by increasing effort and/or the amount of gear fished. There were incidental comments throughout the reports that the fleet is fishing grounds further away from the coast and with more gear, a trend seen in lobster fisheries in the United States of America (Judd, 1988). A technique which the coastal fleet may have adopted to maintain catch yields.

Clearly the catch efficiency of individual gears does impact greatly upon the overall fishing effort of the fleet, net and pot gears can be maintained and set up with lesser efforts than other fishing gears and fish for as long as they are in the water, indiscriminately fishing any species that encounters them, whereas line gears are much more labour intensive to maintain and prepare and much more specific in the species targeted (even time of day and direction of line set can affect gear efficiency, Løkkeborg & Pina, 1997). However gear efficiencies are not a static concept and are constantly responding to a multitude of factors, Angelsen & Olsen (1987) note that catching efficiencies of static gears show a negative relationship to fish density as well as gear density.

- ***The interactions of coastal fisheries upon the inshore ecosystem***

Symes & Phillipson (2001) observed that UK fisheries were based largely upon shellfisheries and over the period of 1989 – 1998 the volume landed increased by 35% (and 66% in value). The coastal fleet was fishing harder for shellfish species than ever before, shellfish species were being targeted at a level similar to the early 1980s, despite the overall reduction of fleet numbers and effort. New species targets such as *N. puber* and increased amounts of trap gear contributed to the sustained fleet effort exerted in the shellfisheries.

As the composition of the fleet changed through legislation and restrictive policies, the species targeted by the coastal fleet has changed too, with less effort spent targeting traditional species such as *gadoids* and *salmonids*, in response to falling stock levels and increased regulations (Potter *et al.*, 2003; Tingley *et al.*, 2010). The new fisheries that have arisen since the early 1980s are closely tied to non-quota and shellfish species, providing more reliable catches for coastal fishers, helping to sustain the fleet in those areas of England & Wales were these species predominate (Symes & Phillipson, 2001). As these fisheries became established and their markets developed, more effort by the fleet has been invested into them. The *N. puber* fishery in the early 1980s was typical of south coast districts, those closest to France and the rest of Europe where markets existed. As infrastructure has developed, all districts of England and Wales could target *N. puber* and ship the catch live to the European markets. Shellfish species also saw more effort as gathered gears are relatively cheap and enable fishers to exploit a wide range of species, such as mussels, cockles, whelks, periwinkles and clams.

There is no evidence that the fleet has been progressively fishing species further down the food web, however given the general decline of whitefish species such as *G. morhua and H. hippoglossus*, and with more abundant (and non-quota) species targeted as alternatives, the data and analyses may not be sufficient to validate a trend Pauly *et al.* (1998) have identified in global fisheries. However different districts are targeting species of different trophic levels, Northumberland targets species of a significantly lower trophic value, whilst North Eastern targets species which were significantly higher in trophic value (Table 8). As Northumberland and North Eastern districts border each other, it is highly likely that the ecosystem in this area is under huge fishing pressure, and has been for some time.

The NWNW district targeted predominately Demersal and Shellfish species (a total of 34 reported in 2007) with the largest effort being placed upon Bass and Cockles. The NWNW district byelaws that managed cockle fishing effort required each fisher to obtained a permit to fish (for >5 kg of cockles), permits were issued annually and need to be reapplied each year. The NWNWSFC also capped the number of new permit holders. This allowed the fishery to be strictly managed, but also provided the opportunity for new entrants into the fishery. Fishing for cockles was only allowed by hand, or an approved tool/dredge gear which was stipulated by the NWNWSFC scientists. The cockles fished were also subject to a 20mm minimum landing size. The fishery was subject to seasonal closures for part or the whole year (depending upon the advice of the NWNWSFC scientists). Whilst the international and national policies focused on restricting vessel numbers and the targeting of quota species, the cockle fishery within the NWNW district is an excellent example of how these policies would have been ineffective at managing this fishery (since the majority of fishers involved in the cockle fishery were land based, fishing by hand or hand tools) and how the NWNWSFC developed management tools tailored for this fishery.

Restrictions upon quota species, enforcement of total allowable catches and fluctuations in market prices have impacted upon the profitability of fishing, coastal fishers have utilised their versatility and switched to more seasonal fishing, targeting more abundant, non-quota species (Symes, 2002). Coulthard (2008) suggests there are two main categories for sustaining livelihoods in coastal fishing communities, diversification for accumulation and the diversification for survival, the data would indicate that coastal fisheries of the UK have progressed from accumulation (and reliance upon certain key species) to survival, showing less specialisation and the ability to adapt to harvest a multitude of marine resources.

Fisheries of any size will have an impact upon the ecosystem which they fish, given the nature and diversity of coastal fisheries, it is likely that all elements of the ecosystem are impacted upon, whether directly or indirectly through fishers actions (Botsford et al., 1997). Pauly *et al.*, (1998) suggest that a move down each trophic level will see biological production increase by a factor of around 10. Many of the non-quota species of the UK waters could be 10 times more abundant than the quota species, which may provide a significant driver for coastal fishers to target these species. However, Pinsky *et al.*, (2011) present data that indicates fast growing/short lived and basal food web species are as susceptible to the impacts of fisheries as the slower growing/long lived, higher in the food web counterparts.

As a result of the SFCs data on coastal fisheries, this study has been able to discern detailed changes that have been taking place within the fleet and to the ecology of the fisheries too. Hopefully this will provide a benchmark for future studies to examine these data and look greater at the history of the coastal fisheries from over the last 120 years.

- ***Analysis of the SFCs as a coastal fisheries management model***

In the entire 120 years the SFCs have changed little (Winterbottom, 2008), arguably both a blessing and a curse, the SFCs carried out their duties well enough that little needed to change, however the SFCs were not without their shortcomings and in the face of ever growing environmental concerns and additional responsibilities the SFCs model had to be innovated. While there is no universal model of alternative fisheries management that can be ubiquitously applied across all coastal (or small scale) fisheries as there are so many permutations across the entire spectrum, it would be impossible to develop a single set of principles (Hauck & Sowman, 2001), there is merit in considering the SFCs as a coastal fisheries management model in reference to other models, it is possible to define a set characteristics that contribute to a successful alternative model.

Stakeholder involvement;

The SFCs were built around numerous stakeholders, balanced to comprise members of all interested parties who provided a wealth of experience and knowledge about the local fisheries and would make effective decisions for the sustainable management of the fisheries (Symes & Phillipson, 1997). Identified as crucial for the success of other alternative management models (Hutton & Pitcher, 1998; Mulekom, 1999; Berkes, 2010; Lee *et al.*, 2006; Pomeroy, 1995).

A flaw with the SFCs was that members might remain on the committee (almost indefinitely) and the status quo adopted as the best course of action, given the lack of fresh input into the committee. As with all models, there is all the potential that stakeholders with conflicted interests might well use their position to further a corporate/political or personal agenda.

Proactive & adaptive regulation;

The SFCs had the ability to create and enforce local byelaws, both on a temporary (emergency; lasting no longer than 12 months) and a permanent basis. The SFCs were proactive and able to develop highly specialised regulations (Symes & Philips, 1997; Winterbottom, 2008). Through these regulator powers, the SFCs mediated conflicts over gear and area directly. Conflict resolution identified in alternative models (Hauck & Sowman, 2001; Pomeroy, 1995; Lee *et al.*, 2006) also highlights the need for impartiality in the management of a fisheries.

Differences in SFCs regulations (between districts) provided loopholes that fishers exploited. Foreign fishers landed “no take” species, or fishers use gear that they are allowed in their district but not in the one they fish, fishers land brown crab larger in size than may be allowed by their SFC byelaws, however the fisher may claim to have captured them outside the district’s waters, where the taking of larger animals may be permitted.

Suitable district size;

The SFCs size were dictated by the number of local authorities that had coastal interests. District size is of vital importance, the district needs to be large enough for policies to be effective for fish stocks and habitats within them, to have enough resources invested in them from local government & other stakeholders and small enough that they can be easily regulated. Whilst district size is important for managing static coastal resources, size is irrelevant for resources that cannot entirely be managed within the SFC district, such as fish stocks that migrate or offshore breeding grounds (Willmann & Insull, 1993).

Funding;

Fisheries management has a cost, for the SFCs financing is shared across all potential resource users (and somewhat subsidised by offending fishers). Given the precarious nature that the SFCs are funded, the larger SFCs benefitted from having more financial resources (Symes & Phillipson, 1997), which impacted greatly upon the SFCs functionality in terms of essential and advantageous operations. These optional functions were projects usually to investigate a particular species of concern, elucidating the multiple factors affecting a species stock or developing new monitoring techniques that might improve the enforcement work carried out.

The financial constraints of the SFCs meant that valuable long term research was considered optional, and in some cases was never carried out. It is difficult to resolve the financial constraints of any fisheries management model, because the management ideally should not be for a return on investment (i.e. x amount of offenders prosecuted) but maintaining and developing the coastal fisheries so that the value of coastal resources will increase over time. As with many natural resources, it is difficult to ascribe a monetary value to them. What is more important is the knowledge that the loss of these resources would be far greater (even from a financial perspective) than the cost of managing them.

Symes & Philipson (1997) highlighted the value for money that the SFCs represent, as the cost to manage the coastal fisheries was a fraction of the money compared to what was generated through coastal fisheries activities. Crucial for the SFCs (and all models alike) is the ability to enforce their fisheries effectively through financial backing and resources, smaller SFCs were limited in this capacity for exactly the same reason.

Funding is crucial to any management model, and there are different ways in which the funding can be acquired, either through private investment (Hauck & Sowman 2001) or from government (Lee *et al.*, 2006).

Data;

It is clear that there has been a vast accumulation of data through the activities of the SFCs and that these data can contribute to a richer understanding of the management of coastal fisheries. The strength of SFCs management was reliant upon the quality of data it generated. The SFCs continually collected data, which allowed for concise and well informed decisions to be made by the committee (Symes & Philipson, 1997; Winterbottom, 2008). Data collection about fish stock health, fleet effort, landings were all essential for appropriate fisheries management, the better quality the data collected, the more accurate a picture that the committee had when managing the fisheries.

The wealth of data available from the SFCs is immense and although inconsistent in how it was recorded (between SFCs) it is the best (and only) source of long term coastal fisheries data. Collectively the SFCs data details the changes of the coastal fleet and highlights the importance of fishers' knowledge & regionally tailored management in maintaining the quality and diversity of the coastal fisheries (Branch *et al*., 2006; Grant & Berkes, 2007).

There was a time when scientists (and fishers) believed that the only reliable fisheries data was could be found from offshore fisheries (Gray *et al.*, 2011), however, utilisation of the SFCs data would allow coastal fisheries to have much better representation at a national & international level and contribute greatly to more appropriate management plans. The SFCs advantage over alternative possible data sources are firstly that as the closest agents to the coastal fleet, they understood best how it responded to change, whether biological, social or economic (Symes & Phillipson, 1997; Winterbottom, 2008), and secondly there is no other data source available that is as complete and comprehensive as the data the SFCs collected.

The individual SFCs can be considered variants of the same alternative management model; financed by central/local government and administered to best match national & international policies within the regional context of the fisheries they managed (Hoss *et al.*, 1999, describe a similar model). Each SFC aimed to manage its fisheries primarily through limiting access to resources and enforcing effort restrictions. Alternative fisheries management models around the world range in being driven by the authorities, the fishers or any combination of both with additional stakeholders choosing how to limit effort (Ruddle, 1998; Berkes, 2010; Nauschon & Charles, 2010; Kuperan & Abdullah, 1994; Pomeroy, 1995; Hauck & Sowman, 2001).

However there are innovative alternative models also in practice, where the focus of management is environmental protection, regeneration and improvement of the coastal resources, with effort regulation and enforcement being a secondary objective (Bruckmeier & Höj Larson, 2008; Garcia & Hayashi, 2000; Russ, 2006; Kearney *et al.,* 1996; Morales-Nin *et al*. 2010).

Regardless of the model used, there are important factors that need to be considered, such as the ease of management and/or enforcement of the regulations, the ability for cheaters to exploit the system, the health of the fish stocks and their associated environments, the education that is invested in the community and for resource users (education being more likely to promote compliance with the model and so ultimately contribute to the overall successful management of the resources) and participation. Above all, a successful management model must ensure the needs of the coastal communities are met and balanced with the environmental need to protect, conserve and use the coastal resources sustainably (Kronen et al., 2010).

As Nauschon & Charles (2010) and others (Pomeroy, 1995; Hauck & Sowman, 2001) have observed, the success of alternative fisheries management models are dependent upon the support systems needed to facilitate them. Without appropriate national & international support for alternative models coastal fisheries will be hugely constrained and severely limited in the possibility of developing truly sustainable fisheries.

The close relationship between the SFCs and the fishers, is perhaps the reason why SFC data tends to be disregarded by many of the scientific community (Johnannes *et al.*, 2000; Mackinson & Nøttestad 1998; McGuire, 1999). However, the relationship is something that should be aspired to in all fisheries management (McGuire, 1999), it is undoubtedly the reason why successful fisheries management agencies are able to perform the considered and careful management that they do (Johnannes *et al.*, 2000; McGuire, 1999; Hilborn, 2007). The management of the coastal fisheries by the SFCs allowed fisheries to continue on a scale appropriate for the health of the stock, contributed to diversity of the fisheries exploited by the fleet and allowed various shellfish stocks to be fished at an appropriate level or closed in order to allow regeneration of over exploited stocks (Atkinson *et al.*, 2003).

By design the SFCs were not concerned with defining the coastal and offshore fleets, but with managing the efforts within their district. The SFCs managed a specific range of the coastal waters (shore to 6 nautical miles), which consequently benefitted the coastal fishers by effectively preventing competition with the offshore vessels and limited over exploitation of coastal resources. The SFCs can be considered successful in their goal of coastal fisheries management, England & Wales still have coastal fleets that are actively fishing, and ministers of the EU consider "coastal fisheries" the most sustainable and secure fisheries for the future (Winterbottom, 2008; CEC, 2009; Johannes *et al*., 2000).

The SFCs collectively developed a plethora of management practices specifically for the coastal fleet and the coastal ecology (Winterbottom, 2008). The ability to discuss, exchange ideas and experiences meant that SFCs management was organic, with new practices being adopted by other SFCs where appropriate and if they had significant benefit over current practices in that region and had been seen as successful in other SFCs.

- ***A comprehensive coastal resource management model, the IFCAs***

Whilst the SFCs possessed positive attributes that have been identified in other alternative management models around the world, they were flawed for the task of complete comprehensive coastal resource management. At the time of their inception, the focus for the SFCs was in managing the fisheries within their districts. However within the last 50 years of their existence, there was a significant shift in thinking, with a greater appreciation for the importance of marine habitats, ecosystems, and the wider coastal resources which saw the SFCs gain additional responsibilities, specifically relating to environmental conservation. As the SFCs environmental obligations grew, it became apparent that they could not provide 21st century fisheries management and environmental conservation in their current form (Winterbottom, 2008).

In April 2011, the SFCs (along with several other government agencies with coastal responsibilities) were innovated and reinvented as Inshore Fisheries Conservation Authorities (IFCAs), the result of SFCs lobbying and the Marine & Coastal Access bill, with the purpose of modernising the management of the inshore fisheries and coastal resources. The IFCAs are intended as a "one stop shop" a vast improvement upon the previous systems where there were several bodies all with different powers and objectives. IFCAs are now the primary agents for pro-active conservation (Appleby, 2009) and management of all coastal resources within English coastal waters.

One significant innovation that has been introduced with this change is the creation of a central body, the MMO. Acting as the cohesion between the different IFCAs and with the power to implement technical standards across the board, the discrepancies that existed in data collection and records are likely to be a thing of the past.

The IFCAs have been created with the tools and mind set of long term and complete coastal resource management, that aims to understand the intricate relationship of all coastal resources as well as balancing the social economic and environmental needs for sustainable resource utilisation.

The coastal fisheries of England & Wales contribute to the fabric and identity of coastal regions, they are vital for over 179,000 people in coastal communities for their livelihoods and way of life (Phillipson & Symes, 2010; Branch *et al.*, 2011). There are huge challenges facing coastal fisheries; unreliable catches, increasing costs, reduction and unbalanced total allowable catch (TAC) quotas, increased decommissioning (Stead, 2005) all of which the IFCAs must tackle as well as ensuring that the biology and ecology of the coastal resources are protected and developed for the future. It is the opinion of the author that IFCAs have the best opportunity to be able to do, as a result of their legacy and the tools that they have at their disposal.

This study has demonstrated that there is a wealth of data available (spanning 120 years, probably one of the best long term data sets on coastal fisheries around the world) on the coastal fisheries of England & Wales and that it can be utilised for analysis of historical trends as well as feeding into future management plans. Data is crucial for the successful implementation and operation of any coastal resources management plan, and while there were inconsistencies in the data, the SFCs data should be valued for what it can provide fisheries managers over what the next best alternative can (in this case, the next best alternative is very little).

The relationships between regulation, enforcement and persecution are something that will help explain some of the behaviour patterns in fisheries and will undoubtedly contribute to refining management models for the future. Contrary to opinion (Kuperan & Abdullah, 1994) fishers are not obsessed with immediate rewards and short term benefit, the fact that alternative fisheries models are continuing to grow in favour over traditional models and that most are centred around co-operative and stakeholder involvements clearly shows how much fishers want sustainable fisheries and have a long term vested interest in the protection of coastal resources.

The positive attributes of the coastal fisheries of England and Wales should indicate what is possible with appropriate resource management, stakeholder involvement and a proactive approach to marine conservation. The SFCs although now retired, did serve as an exemplary model of coastal fisheries management. It is with the broader scope of complete coastal resource management that brought the IFCAs into existence, with many of the core attributes of the SFCs still fundamental to their vision, a testament to the SFCs legacy and value. The IFCAs are a great model for the future of coastal fisheries and resource management.

Literature

Acheson, J. M. and Reidman, R. (1982), Technical innovation in the New England fin-fishing industry: an examination of the downs and more hypotheses. *American Ethnologist*, 9, pp.538–558.

Allison, E., (2001). Big laws, Small catches: Global Ocean governance and the fisheries crisis. *Journal of International development.* 13, pp.933-950.

Angelsen, K. K., & Olsen, S. (1987). Impact of fish density and effort level on catching efficiency of fishing gear. Fisheries research 5(2-3), pp.271-278

Appleby, T., (2009). The Marine Bill: An overview and some thoughts. *Liverpool Law Rev.* 30, pp.101-113.

Atkinson, P.A, Clark, N.A, Bell, M.C, Dare, P.J, Clark, J.A, Ireland, P.l. (2003) Changes in commercially fished shellfish stocks and shorebird populations in the wash, England. *Biological Conservation*, 114:1, pp.127-141.

Beem, B. (2006). Planning to learn: Blue Crab Policymaking in the Chesapeake Bay. *Coastal Management*, 34, pp.167-182.

Bene, C., Mindjimba, K., Belal, E., Jolley, T. (2000). Evaluating livelihood strategies and the role of inland fisheries in rural development and poverty alleviation: the case of the yaere floodplain in North Cameroon. *In: Proceedings of the 10th international conference of the institute of fisheries economics and trade, Corvallis, Oregon, July 9–14, 2000*. Available online: /http://osu.orst.edu/dept/iifet/2000/papers/bene.pdf

Berkes, F. (1986). Local-level management and the commons problem: A comparative study of Turkish coastal fisheries. *Marine Policy*, 10:3, pp.215-229.

Benjamin, D.K. (2001). Fisheries are classic example of the “Tragedy of the commons”. *PERC Report*, 19:1, pp.15-16.

Bernard, R.H. (1996). Qualitative data, quantitative analysis. *The Cultural Anthropology Methods Journal*, 8:1, pp.9-11.

Botsford, L. W., Castilla, J. C., Peterson, C. H. (1997) The management of fisheries and marine ecosystems, *Science* 277 pp.509-515.

Branch, T.A., Hilborn, R., Haynie, A.C. (2006). Fleet dynamics and fishermen behaviour: lessons for fisheries managers. *Canadian Journal of Fisheries and Aquatic Sciences*. 63, pp.1647-1668.

Branch, T. A., Jensen, O.P., Ricard, D., Ye, Y. & Hilborn, R., (2011). Contrasting Global Trends in Marine Fishery Status Obtained from Catches and from Stock Assessments. *Conservation Biology*, 25(4) pp. 777-786

Bruckmeier, K. & Hoj Larsen, C., (2008). Swedish Coastal fisheries – From conflict mitigation to participatory management. *Marine Policy*. 32, pp.201-211.

Catchpole, T.L., Frid, C.L.J, Gray, T.S. (2005). Discards in North Sea Fisheries: Causes, Consequences and Solutions. *Marine Policy*. 29, pp.421-430.

Chuenpagdee, R., Liguori, L., Palomares, M., and Pauly, D. (2006). Bottom-up, global estimates of small-scale marine fisheries catches. *Research reports*, 14:8, 110pp. http://www.fisheries.ubc.ca/publications/reports/report14_8.php (First accessed 12th October 2010). Fisheries Centre, University of British Columbia, Vancouver.

Commission of the European Communities (CEC) (2009). Green paper: Reform of the Common Fisheries Policy. COM 163, Brussels. 28pp. available online at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0163:FIN:EN:PDF (accessed 14th July 2010).

Coulthard, S. (2008). Adapting to environmental change in artisanal fisheries – Insights from a South Indian lagoon. *Global environmental change*, 18, pp.479-489. (The Management of the European Seas).

Crean, K. (2000). The influence of boundaries on the management of fisheries resources in the European Union: Case studies from the UK. *Geoforum* 31:3 pp.315-328.

Department for Environment, Food & Rural Affairs (DEFRA) (2002) Safeguarding our seas; a strategy for the conservation and sustainable development of our marine environment. Department for Environment, Food & Rural Affairs Publications, London. 82pp. Available online at http://archive.defra.gov.uk/environment/marine/documents/marine_stewardship.pdf (First accessed 5th May, 2009)

Department for Environment, Food & Rural Affairs (DEFRA) (2007) A sea change; A marine bill white paper. Department for Environment, Food & Rural Affairs Publications, London. 176pp. Available online at http://www.official-documents.gov.uk/document/cm70/7047/7047.pdf (First accessed 21st June 2009).

Daw, T. & Gray, T. (2005). Fisheries science and sustainability in international policy: a study of failure in the European Union's Common Fisheries Policy. *Marine Policy* 29 pp.189-197.

Farrugio, H., Oliver, P., Biagi, F., (1993). An overview of the history, knowledge, recent and future trends in Mediterranean fisheries. *Scientia Marina* 57 pp105-119.

Food and Agriculture Organization of the United Nations (FAO)(2001) Case studies in fisheries self-governance. *FAO Fisheries Technical Paper.* No. 504. Rome, FAO. 465p.

Food and Agriculture Organization of the United Nations (FAO) (2010a), FAO Yearbook. Fishery and Aquaculture Statistics 2008. Rome. 100pp. Available online at http://www.fao.org/docrep/013/i1890t/i1890t.pdf (First accessed 11th August 2009).

Food and Agriculture Organization of the United Nations (FAO) (2010b), FAO State of the World Fisheries and Aquaculture 2010, Rome. 218pp. Available online at http://www.fao.org/docrep/013/i1820e/i1820e.pdf (First accessed 12th February 2011)

Froese, R. and Pauly, D. (editors). (2000). Fishbase 2000: Concepts, design and data sources. *ICLARM*, Los Baños, Laguna, Philippines. 344 p.

Garcia, S. M. & Hayashi, M. (2000). Division of the oceans and ecosystem management: A contrastive spatial evolution of marine fisheries governance. *Ocean & Coastal Management*. 43, pp.445-474.

Goncuoglu, H., Unal, V. (2011). Fisherwomen in the Turkish Fishery, Southern Aegean Sea. *Journal of Applied Ichthyology*. 27:4, pp.1-6.

Grant, S., Berkes, F. (2007). Fisher knowledge as expert system: A case from the longline fishery of Grenada, the Eastern Caribbean. *Fisheries research*. 84, pp.162-170.

Gray, M.J,(1995). The coastal fisheries of England and Wales, Part III: A review of their status 1992-1994. *Fish. Res. Tech. Rep., MAFF direct. Fish. Res*., Lowestoft, 100. 99pp.

Gray, T. and Hatchard, J. (2003). The 2002 reform of the Common Fisheries Policy's system of governance--rhetoric or reality? *Marine Policy*, 27:6, pp.545-554.

Gray, T., Korda, R.C., Stead, S., Jones, E. (2011) Quota discarding and distributive justice: The case of the under-10 m fishing fleet in Sussex, England, *Marine Policy*. 35:2 pp.122-129

Grieve, C. (2001). Reviewing the Common Fisheries Policy – EU fisheries management for The 21th century", London: Institute for European Environmental Policy. Available at http://www.ieep.org.uk/pdffiles/publications/reviewing_the _cfp.pdf (accessed 12th November 2010)

Griffin, L. (2009) The limits to good governance and the state of exception: A case study of North Sea Fisheries. *Geoforum*. 41 pp.282-292

Hart, P.J.B. and Reynolds, J.D. (2002a). The handbook of fish biology and fisheries; Volume 1. Wiley-Blackwell, Oxford. 420pp.

Hart, P.J.B. and Reynolds, J.D. (2002b). The handbook of fish biology and fisheries; Volume 2. Wiley-Blackwell, Oxford. 421pp.

Hatcher, A., Frere, J., Pascoe, S., Robinson, K. (2002). 'Quota-hopping' and the foreign ownership of UK fishing vessels. *Marine Policy*, 26:1, pp.1-11.

Hauck, M. & Sowman, M. (2001). Coastal and fisheries co-management in South Africa: an overview and analysis. *Marine Policy*, 25, pp.173-185.

Hilborn, R. (2007). Managing fisheries is managing people: what has been learned? *Fish and Fisheries*. 8, pp.285-296.

Hiscock, K., (1998). Marine Nature Conservation Review. Benthic marine ecosystems of Great Britain and the north-east Atlantic. *Joint Nature Conservation Committee*. (Coasts and seas of the United Kingdom. MNCR series.) Peterborough

Holden, M. (1994). The Common Fisheries Policy: Origin, evaluation, future, *Fishing News Books*, Oxford. 274pp.

Honey, K.T., Moxley, J.H., Fujita, R.M. (2010). From Rags to Fishes: Data-Poor Methods for Fishery Managers. *Managing Data-Poor Fisheries: Case Studies, Models & Solutions*, 1, pp.159–184.

Hoss, D.E., Bath, G.E., Cross, F.A. & Merriner, J.V. (1999). U.S. Atlantic coastal fisheries – How effective have management plans been in maintaining "sustainable fisheries"? *Limnologica*, 29, pp.227–232.

Hutton, T. & Pitcher, T. (1998). Current directions in fisheries management policy: a perspective on co-management and its application to South African fisheries. *South African journal of marine sciences*, 19, pp.471-86.

Huxley, T.H. (1884). Inaugural address. *Fisheries exhibition literature*, 4, pp.1–22.

Idda, l., Madau, F.A., Pulina, P. (2009). Capacity and economic efficiency in small-scale fisheries: evidence from the Mediterranean Sea. *Marine Policy*, 33:5, p.860-867.

Jacquet, J. & Pauly, D. (2008). Funding priorities: Big barriers to small-scale fisheries. *Conversation & Policy*, 22:4, pp.832-835.

Jensen, C.l., (2002). Reduction of the fishing capacity in 'common pool' fisheries. *Marine Policy*. 26:3, p.155-158.

Jentoft S, McCay B, Wilson DC (1998). Social theory and fisheries comanagement. *Marine Policy*, 22(4–5)pp423–36.

Johannes, R.E., Freeman, M.M.R., Hamilton, R.J., (2000). Ignore fishers' knowledge and miss the boat. *Fish and Fisheries*, 1, pp.257-271.

Judd, R.W. (1988). Saving the fishermen as well as the fish: Conservation and commercial rivalry in Maine's lobster industry, 1872 – 1933. *Business history review*, 62:4, p.596.

Kearney, R. E., Andrew, N. L. & West, R. J. (1996). Some issues in the management of Australia's marine and coastal fisheries resources. *Ocean & coastal management,* 33:1-3, pp.133-146.

Kronen, M., Vunisea, A., Magron, F., McArdle, B. (2010). Socio-economic drivers and indicators for artisanal coastal fisheries in Pacific islands countries and territories and their use for fisheries management strategies. *Marine Policy,* 34, pp.1135-1143.

Kuperan, K & Abdullah, N.M.R. (1994). Small scale coastal fisheries and co-management. *Marine Policy* 18(4), pp.306–313.

O'Leary, B., Smart, J.C.R., Neale, F.C., Hawkins, J.P., Newman, S., Milman, A.C., Roberts, C.M. (2011). Fisheries mismanagement. *Marine Pollution Bulletin*, 62 pp.2642-2648.

Lankester, E.R. (1884). The scientific results of the exhibition. *Fisheries exhibition literature* 4, pp.405–445.

Laxe, F.G. (2010). Dysfunction in common fishing regulations. *Marine Policy*, 34 pp.182-188.

Lee, K.N., Gates, J.M., Lee, J (2006). Recent developments in Korean fisheries management. *Ocean & Coastal management*, 49 pp.355-366.

Løkkeborg, S. & Pina, T. (1997). Effects of setting time, setting direction and soak time on longline catch rates. *Fisheries research*, 32(3) pp.213-222

Lindebo, E., Frost, H. and Løkkegaard, J. (2002). Common Fisheries Policy reform—A new capacity policy. Fødevareøkonomisk Institut Report No. 141. Copenhagen, Denmark. 46pp.

Mackinson, S. and Nøttestad, l. (1998). Combining local and scientific knowledge. *Reviews in Fish biology and Fisheries*, 8, pp.481-490.

Makino, M., Matsuda, H. (2005). Co-management in Japanese coastal fisheries: institutional features and transaction costs. *Marine Policy*, 29, pp.441-450.

Maliao, R.J., Pomeroy, R.S., Turingan R.G. (2009). Performance of community-based coastal resource management (CBCRM) programs in the Philippines: A meta-analysis. *Marine Policy*, 33, pp.818-825.

Marchal, P., (2006). Technological developments and tactical adaptations of important EU fleets (tectac, n° qlk5-2001-01291). Final report, 651 pp.

Marin, A., Berkes, F. (2010). Network approach for understanding small-scale fisheries governance: The case of the Chilean coastal co-management system. *Marine Policy*, 34, pp.851-858.

Marine Maritime Organisation (MMO) 2010, UK Fisheries Statistic 2009, National Statistics Publication, London. Available online at http://marinemanagement.org.uk/fisheries/statistics/documents/ukseafish/2009/final.pdf (First accessed 9th October 2010)

Marine Maritime Organisation (MMO) 2011, UK Fisheries Statistic 2009, National Statistics Publication, London. Available online at http://marinemanagement.org.uk/fisheries/statistics/documents/ukseafish/2009/final.pdf (First accessed 9th November 2011)

Mcguire, T. R. (1999). Folk management in the world's fisheries: lessons for modern fisheries management. *Culture & agriculture*, 21. pp.49–51.

Meredith, D. (1999). The strategic importance of the fishing sector to rural communities and Ireland: a case study of the Rossaveal Region, Co. Galway. *Irish Fisheries Investigations (New Series)*, 4. 49pp.

Miller, R.B. and Anderson M.J., (2004). Remedies for pseudoreplication. *Fisheries research*, 70. pp.391-404.

Morales-Nin, B., Grau, A.M., Palmer, M. (2010). Managing coastal zone fisheries: A Mediterranean case study. *Ocean & Coastal management*, 53. pp.99-106.

Mulekom, L.V. (1999). An institutional development process in community based coastal resource management: building the capacity and opportunity for community based co-management in a small scale fisheries community. *Ocean & Coastal Management*, 42. pp.439-456.

Munro, J. L. (1979). Stock assessment models: Applicability and utility in tropical small-scale fisheries. pp.35–47. (Saila and Roedel, Stock assessment for tropical small-scale fisheries). International Centre for Marine Resource Development, University of Rhode Island, Kingston.

Nasuchon, N. & Charles, A. (2010). Community involvement in fisheries management: Experiences in the Gulf of Thailand countries. *Marine Policy* 34, pp.163-169.

Neis B, Schneider D.C., Felt L., Haedrich R.L., Fischer J., Hutchings J.A. (1999). Fisheries assessment: what can be learned from interviewing resource users? *Can. J. Fish. Aquat. Sci.* 56:10, pp.1949-1963.

Nielsen, J.R., Degnbol, P., Kuperan Viswanathan. K., Ahmed, M., Hara, M., Abdullah, N.M.R (2004). Fisheries co-management – An institutional innovation? Lessons from South East Asia and Southern Africa *Marine Policy* 28, pp.151-160.

Northern Ireland Assembly (NIA), (2001). The Common Fisheries Policy: Issues, impact and future of the CFP. Research and Library Services, Research paper 37/01, 22 p. Http://www.niassembly.gov.uk/io/research/3701.pdf (First accessed on 21st October, 2010).

Parente, J. (2004) Predictors of CPUE and standardisation of fishing effort for the Portuguese coastal seine fleet. *Fisheries research* 69(3) pp.38-387

Pauly, D., Christensen, V., Dalsgaard, J., Froese, R., Torres Jr., F. (1998). Fishing down marine food webs. *Science,* 279(5352), pp.860-863.

Pauly, D. and Watson, R. (2005). Background and interpretation of the 'Marine Trophic Index' as a measure of biodiversity. *Philosophical transactions of the royal society: biological sciences,* 360, pp.415-423.

Pawson, M.G. and Benford, T.E., (1983). The coastal fisheries of England and Wales, Part I: A review of their status in 1981. *Internal rep., MAFF direct. Fish. Res.*, *Lowestoft*, 9, 76pp.

Pawson, M.G., Pickett, G.D. and Walker, P. 2002. The coastal fisheries of England and Wales, Part IV: A review of their status 1999-2001. *Sci. Ser. Tech rep., CEFAS Lowestoft*, 116. 83pp.

Pawson, M.G. and Rogers, S.I., (1989). The coastal fisheries of England and Wales, Part II: A review of their status in 1988. *Internal rep., MAFF direct. Fish. Res.*, Lowestoft, 19. 76pp.

Penas, E., (2007). The fishery conservation policy of the European Union after 2002: Towards long-term sustainability. *ICES Journal of Marine Science*, 64, pp.588–595.

Phillipson, J. (2000), *Delimiting fisheries dependent regions: the problem of inadequate data* D. Symes (Ed.), Fisheries Dependent Regions, Blackwell Science, Oxford

Phillipson, J. & Symes, D. (2010). Recontextualising inshore fisheries: The changing face of British inshore fisheries management. *Marine Policy*, 34:6 pp.1207-1214.

Pinsky, M. Jensen, O.P., Ricard, D. & Palumbi, S.R., (2011). Unexpected patterns of fisheries collapse in the world's oceans. *Pro. Nat. Aca. Sci.*, *In press*.

Pomeroy, R.S. (1995). Community based and co-management institutions for sustainable coastal fisheries management in South East Asia. *Ocean & Coastal Management*. 27:3, p.143-162.

Potter, E.C.E., Maclean, J. C., Wyatt, R.J., Campbell, R.N.B. (2003). Managing the exploitation of migratory Salmonids. *Fisheries research*. 62:2, p.127-142 (The Scientific basis for management of Salmonid stocks in the British isles).

Prime, M. & Johnson, M. (2009) Smalls have their say. *Samudra*, 54 pp.34-38.

Ramsay, K., Kaiser, M.J., Moore, P.G., Hughes, R.N. (1997) Consumption of fisheries discards by benthic scavengers: utilisation of energy subsidies in different marine environments. *Journal of Animal Ecology*. 66, p.884-896.

Robinson, R. (2009). The sea fisheries of the NorthWest European continental shelf, 1100-1850, in Starkey, D.J., Thor, J. and Heidbrink, I. (eds), A history of the North Atlantic Fisheries, Vol. 1: From early times to present day. German maritime museum, Bremerhaven. pp.121-144.

Ruddle, K. (1998) Traditional community-based coastal marine fisheries management in Viet Nam. *Ocean & Coastal Management*. 40, pp.1-22.

Russ GR. (2006) Yet another review of marine reserves as reef fishery management tools. *In: Sale PF, editor. Coral reef fishes: dynamics and diversity in a complex ecosystem. San Diego, CA, USA: Academic Press*; pp. 421–43.

Sahrhage, D. and Lundbeck, J. (1992) A history of fishing. Berlin. Springer-Verlag. 352pp.

Sea Around Us Project; UK Marine Trophic Index. University of British Columbia & the Pew Environment Group. Http://www.seaaroundus.org/eez/826/200.aspx# (First accessed 12th May 2010).

Siry, H.Y., (2011). In search of appropriate approaches to coastal zone management in Indonesia. *Ocean & Coastal management*, 54 pp.469-477.

Stead, S.M., (2005). Changes in Scottish coastal fishing communities--Understanding socio-economic dynamics to aid management, planning and policy. *Ocean & Coastal Management*. 48:9-10, pp670-692.

Stein, N.A & Edwards, V.M., (1997). Institutional analysis of UK coastal fisheries: implications of overlapping regulations for fisheries management. *Marine Policy*. 21:6, pp.535-544.

Stobart, B., Warwick, R., González, C., Mallo, S., Díaz, D., Reñones, O., Goñi, R., (2009). Long-term and spillover effects of a marine protected area on an exploited fish community. *Marine Ecology Progress Series* 384, pp47-60.

Strauss, A. L., & Corbin, J. (1997). *Grounded Theory in Practice*. London: Sage 280pp.

Suarez de Vivero, J. L., Frieyo de Lara, M., Estevez, J.J. (1997). Decentralization, regionalization and co-management. *Marine Policy*, 21:3 pp.197-206.

Sumaila, U. R., (2007). Running on empty: eliminate fuel subsidies to reduce destructive bottom trawling on the high seas. *Conservation,* 8, pp.6–7.

Symes, D. (1992). The Common Fisheries Policy and UK quota management. *Ocean & Coastal Management*. 18:2-4, pp.319-338 (The management of the European seas).

Symes, D. (2009). Reform of the European Union's Common Fisheries Policy: Making Fisheries Management Work. *Fisheries Research*. 100, pp.99-102.

Symes, D. and Phillipson, J., (1997). Inshore fisheries management in the UK: Sea Fisheries Committees and the challenge of marine environmental management. *Marine Policy*, 21:3, pp.207-224.

Symes, D. and Phillipson, J., (2001). Inshore fisheries management, pp. 3-23, Kluwer academic publishers. 336pp.

Symes, D. and Phillipson, J., (2009). Whatever became of social objectives in fisheries policy?, *Fisheries Research*, 95:1, pp.1-5.

Symonds, D.J., Rogers, S.I., (1995). The influence of spawning and nursery grounds on the distribution of sole Solea solea (L.) in the Irish Sea, Bristol Channel and adjacent areas. *Journal of Experimental Marine Biology & Ecology* 190, pp243-261.

Thorson, J.T. and Berkson, J., (2010). Evaluating single- and multi-species procedures to estimate time-varying catchability functional parameters. *Fisheries Research*, 101:1-2, pp38-49.

Tingley, D., Asmundsson, J., Borodzicz, E., Conides, A., Drakeford, B., Eethvarethsson, I.R., Holm, D., Kapiris, K., Kuikka, S., Mortensen, B., (2010). Risk identification and perception in the fisheries sector: Comparisons between the Faroes, Greece, Iceland and UK, *Marine Policy*. 34:6, p.1249-1260.

Wakefield, J. (2010). Undermining the Integrated Maritime Policy. *Marine Pollution Bulletin*, 60 pp.323-333.

Walmsley, S.A. and Pawson, M.G., (2007). The coastal fisheries of England and Wales, Part V: A review of their status 2005–6. *Sci. Ser. Tech rep., CEFAS* Lowestoft, 140. 83pp.

Watson, R. and Pauly, D., (2001). Systematic distortions in world fisheries catch trends. Nature, 414, pp.534-536.

Willmann, R. & Insull, D. (1993). Integrated coastal fisheries management. *Ocean & Coastal management*, 21, pp.285-302.

Winterbottom, P., (2008). Management of English and Welsh inshore waters and the marine bill. *Water law*, 19, pp.145-149.

Witbooi, E., (2008). The infusion of sustainability into bilateral fisheries agreements with developing countries: The European Union example. *Marine Policy*, 32, pp.669-679.

Young, F.W., (1981). Quantitative analysis of qualitative data. *Psychometrika*, 46:4, pp.357-388.

Appendix I

Table A1: Backwards elimination stepwise regression for FTE scores.

Step	1	2
Constant	-117.6	-118.3
Year	0.059	0.059
t-value	2.13	2.15
p-value	<0.05	<0.05
District	0.047	
t-value	0.63	
p-value	0.528	
VF	1.0156	1.0151
t-value	103.81	104.19
p-value	<0.001	<0.001
VP	0.43	0.429
t-value	26.79	26.81
p-value	<0.001	<0.001
VS	1.015	1.016
t-value	79.41	79.55
p-value	<0.001	<0.001
FN	0.9442	0.9443
t-value	174.86	175.2
p-value	<0.001	<0.001
S	5.08	5.07
R-Sq	99.1	99.1
R-Sq (adj)	99.09	99.09
Mallows Cp	7	5.4
PRESS	15222.7	15107.6
R-Sq (pred)	98.92	98.93

Predictor	Coef	SE Coef	T	P
Year	0.00007	0.000148	0.499	0.618
VF	1.0123	0.00969	104.475	<0.001
VP	0.42306	0.015808	26.763	<0.001
VS	1.01308	0.012754	79.432	<0.001
FN	0.94237	0.00533	176.812	<0.001

Appendix II

Fish species data references:

<table>
<tr><th>Scientific Name</th><th>Fishbase Reference</th></tr>
<tr><td>*Dicentrarchus labrax*</td><td>Costa, M.J. 1988 Écologie alimentaire des poissons de l'estuarie du Tage. Cybium 12(4):301-320.</td></tr>
<tr><td>*Pagellus spp.*</td><td>Bauchot, M.-L. and J.-C. Hureau 1990 Sparidae. p. 790-812. In J.C. Quero, J.C. Hureau, C. Karrer, A. Post and L. Saldanha (eds.) Check-list of the fishes of the eastern tropical Atlantic (CLOFETA). JNICT, Lisbon; SEI, Paris; and UNESCO, Paris. Vol. 2.</td></tr>
<tr><td>*Scophthalmus rhombus*</td><td>Bauchot, M.-L. 1987 Poissons osseux. p. 891-1421. In W. Fischer, M.L. Bauchot and M. Schneider (eds.) Fiches FAO d'identification pour les besoins de la pêche. (rev. 1). Méditerranée et mer Noire. Zone de pêche 37. Vol. II. Commission des Communautés Européennes and FAO, Rome.</td></tr>
<tr><td>*Cancer pagurus*</td><td rowspan="2">*SEA AROUND US (Froese, R. and D. Pauly, Editors. 2000. FishBase 2000: concepts, design and data sources. ICLARM, Los Baños, Laguna, Philippines. 344 p.)*</td></tr>
<tr><td>*Crangon vulgaris*</td></tr>
<tr><td>*Anarhichas lupus*</td><td>Bowman, R.E., C.E. Stillwell, W.L. Michaels and M.D. Grosslein 2000 Food of northwest Atlantic fishes and two common species of squid. NOAA Tech. Memo. NMFS-NE 155, 138 p.</td></tr>
<tr><td>*Mercenaria mercenaria*</td><td rowspan="2">*SEA AROUND US (Froese, R. and D. Pauly, Editors. 2000. FishBase 2000: concepts, design and data sources. ICLARM, Los Baños, Laguna, Philippines. 344 p.)*</td></tr>
<tr><td>*Cardium edule*</td></tr>
<tr><td>*Gadus morhua*</td><td>dos Santos, J. and S. Falk-Petersen 1989 Feeding ecology of cod (*Gadus morhua* L..) in Balfjord and Ullsfjord, northern Norway, 1982-1983. J. Cons. Int. Explor. Mer. 45:190-199.</td></tr>
<tr><td>*Conger conger*</td><td>Olaso, I. and E. Rodriguez-Marin 1995 Alimentación de veinte especies de peces demersales pertenecientes a la división VIIIc del ICES. Otoño 1991. Informes Técnicos, Centro Oceanográfico de Santander, Instituto Español de Oceanografía, 56p.</td></tr>
</table>

Palinurus elephas	*SEA AROUND US (Froese, R. and D. Pauly, Editors. 2000. FishBase 2000: concepts, design and data sources. ICLARM, Los Baños, Laguna, Philippines. 344 p.)*
Sepia officinalis	
Limanda limanda	Gibson, R.N. and I.A. Ezzi 1987 Feeding relationships of a demersal fish assemblage on the west coast of Scotland. J. Fish Biol. 31:55-69.
Dogfish, unspecified	Ellis, J.R., M.G. Pawson and S.E. Shackley 1996 The comparative feeding ecology of six species of shark and four species of ray (Elasmobranchii) in the north-east Atlantic. J. Mar. Biol. Assoc. U.K. 76(1):89-106.
Anguilla angullia	Costa, J.L., C.A. Assis, P.R. Almeida, F.M. Moreira and M.J. Costa 1992 On the food of the European eel, *Anguilla anguilla* (L.), in the the upper zone of the Tagus estuary, Portugal. J. Fish Biol. 41:841-850.
Palaemon (leander) serratus	*SEA AROUND US (Froese, R. and D. Pauly, Editors. 2000. FishBase 2000: concepts, design and data sources. ICLARM, Los Baños, Laguna, Philippines. 344 p.)*
Platichthys flesus	Costa, M.J. 1988 Écologie alimentaire des poissons de l'estuarie du Tage. Cybium 12(4):301-320.
Carcinus maenas	*SEA AROUND US (Froese, R. and D. Pauly, Editors. 2000. FishBase 2000: concepts, design and data sources. ICLARM, Los Baños, Laguna, Philippines. 344 p.)*
Triglidae spp.	Macpherson, E. 1979 Relations trophiques des poisons dans la Méditerranée occidentale. Rapp. Comm. Int. Explor. Sci. Mer Méditerr. 25/26, 49-58.
Melanogrammus aeglefinus	Daan, N. 1989 Data base report of the stomach sampling project 1981. Cooperative Research Report No. 164, International Council for the Exploration of the Sea Palægade 2-4, 1261 Copenhagen K, Denmark.
Merluccius merluccius	Bozzano, A., L. Recasens and P. Sartor 1997 Diet of the European hake *Merluccius merluccius* (Pisces: Merlucciidae) in the western Mediterranean (Gulf of Lions). Sci. Mar. 61, 1-8.
Clupea harengus	Bowman, R.E., C.E. Stillwell, W.L. Michaels and M.D. Grosslein 2000 Food of northwest

	Atlantic fishes and two common species of squid. NOAA Tech. Memo. NMFS-NE 155, 138 p.
Trachurus trachurus	Olaso, I., O. Cendrero and P. Abaunza 1998 The diet of the horse mackerel, <>Trachurus trachurus (Linnaeus1758), in the Cantabrian Sea (north of Spain). J. Appl. Ichthyol. 15(6):193-198.
Microstomus kitt	Rae, B.B. 1965 The lemon sole. Fishing News (Books) Ltd., London. 106 p.
Molva molva	Greenstreet, S.P.R. 1996 Estimation of the daily consumption of food by fish in the North Sea in each quarter of the year. Scottish Fish. Res. Rep. No. 55.
Homarus vulgaris	*SEA AROUND US (Froese, R. and D. Pauly, Editors. 2000. FishBase 2000: concepts, design and data sources. ICLARM, Los Baños, Laguna, Philippines. 344 p.)*
Scomber scombrus	Daan, N. 1989 Data base report of the stomach sampling project 1981. Cooperative Research Report No. 164, International Council for the Exploration of the Sea Palægade 2-4, 1261 Copenhagen K, Denmark.
Lepidorhombus whiffiagonis	Morte, S., M.J. Redon and A. Sanz-Brau 1999 Feeding ecology of two megrims *Lepidorhombus boscii* and *Lepidorhombus whiffiagonis* in the western Mediterranean (Gulf of Valencia, Spain). J. Mar. Biol. Assoc. U.K. 79:161-169.
Lophius piscatorius	Tsimenides, N. 1980 Contribution to the study of the anglerfishes *Lophius budegassa* Spinola 1807 and *L. piscatorius* L. 1758 in Greek seas. PhD. Thesis, University of Patras. (In Hellenic with English abstract).
Liza ramada, Liza aurata, Chelo labrosus	Blanco, S., S. Romo, M.-J. Villena and S. Martínez 2003 Fish communities and food web interactions in some shallow Mediterranean lakes. Hydrobiologia 506-509:473-480.
Mullus surmuletus	Golani, D. 1994 Niche separation between colonizing and indigenous goatfish (Mullidae) along the Mediterranean Coast of Israel. J. Fish Biol. 45, 503-513.
Mytilus edulis	

Ostera edulis	*SEA AROUND US (Froese, R. and D. Pauly, Editors. 2000. FishBase 2000: concepts, design and data sources. ICLARM, Los Baños, Laguna, Philippines. 344 p.)*
Nephrops norvegicus	
Octopus vulgaris	
Crassostera gigas	
Littorina littorea	
Sardina pilchardus	Sever, T.M., B. Bayhan and E. Taskavak 2005 A preliminary study on the feeding regime of European pilchard (*Sardina pilchardus Walbaum 1792*) in Izmir Bay, Turkey, Eastern Aegean Sea. NAGA, WorldFish Center Quarterly, Vol. 28, No. 3 & 4, Jul-Dec 2005.
Pandalus montagui	*SEA AROUND US (Froese, R. and D. Pauly, Editors. 2000. FishBase 2000: concepts, design and data sources. ICLARM, Los Baños, Laguna, Philippines. 344 p.)*
Pleuronectes platessa	Gibson, R.N. and L. Robb 1996 Piscine predation on juvenile fishes on a Scottish sandy beach. J. Fish Biol. 49 :120-138.
Pollachius pollachius	Bergstad, O.A. 1991 Distribution and trophic ecology of some gadoid fish of the Norwegian Deep. 1. Accounts of individual species. Sarsia 75:269-313.
Pandulus borealis	*SEA AROUND US (Froese, R. and D. Pauly, Editors. 2000. FishBase 2000: concepts, design and data sources. ICLARM, Los Baños, Laguna, Philippines. 344 p.)*
Chlamys opercularis	
Pollachius virens	Daan, N. 1989 Data base report of the stomach sampling project 1981. Cooperative Research Report No. 164, International Council for the Exploration of the Sea Palægade 2-4, 1261 Copenhagen K, Denmark.
Salmo salar	Bowman, R.E., C.E. Stillwell, W.L. Michaels and M.D. Grosslein 2000 Food of northwest Atlantic fishes and two common species of squid. NOAA Tech. Memo. NMFS-NE 155, 138 p.
Ammodytes tobianus	Bogorov, V.G., B.P. Manteifel and A.E. Pavlova 1939 Nutrition of the small sand-eel *Ammodytes tobianus* in Murman waters.

	Trans. Inst. Mar. Fish. Oceanogr. USSR 4:355-366.
Pecten maximus	*SEA AROUND US (Froese, R. and D. Pauly, Editors. 2000. FishBase 2000: concepts, design and data sources. ICLARM, Los Baños, Laguna, Philippines. 344 p.)*
Salmo trutta	Nilsson, N.-A. 1957 On the feeding habits of trout in a stream of Northern Sweden. Inst. Freshwat Res. Rep. (38):154-166.
Sharks, unspecified	*SEA AROUND US (Froese, R. and D. Pauly, Editors. 2000. FishBase 2000: concepts, design and data sources. ICLARM, Los Baños, Laguna, Philippines. 344 p.)*
Shrimps, unspecified	
Osmerus eperlanus	Nosova, I.A. 1962 Feeding of some planktivorous fishes (European smelt, zope and vendace) of Rybinsk reservoir. Trudy Vsesoyuznogo Gidrobiologicheskogo Obshchestva 12:214-234.
Raja spp.	Stehmann, M. and D.L. Bürkel 1984 Rajidae. p. 163-196. In P.J.P. Whitehead, M.-L. Bauchot, J.-C. Hureau, J. Nielsen and E. Tortonese (eds.) Fishes of the north-eastern Atlantic and Mediterranean. UNESCO, Paris. vol. 1.
Solea solea	Costa, M.J. 1988 Écologie alimentaire des poissons de l'estuarie du Tage. Cybium 12(4):301-320.
Maja squinado	*SEA AROUND US (Froese, R. and D. Pauly, Editors. 2000. FishBase 2000: concepts, design and data sources. ICLARM, Los Baños, Laguna, Philippines. 344 p.)*
Sprattus sprattus	Oven, L.S., N.F. Shevchenko and V.E. Giragosov 1997 Size-age composition, feeding, and reproduction of *Sprattus sprattus phalericus* (Clupeidae) in different sites of the Black Sea. J. Ichthyol. 37(9):769-778.
Loligo spp.	*SEA AROUND US (Froese, R. and D. Pauly, Editors. 2000. FishBase 2000: concepts, design and data sources. ICLARM, Los Baños, Laguna, Philippines. 344 p.)*
Galeorhinus galeus	Cortés, E. 1999 Standardized diet compositions and trophic levels of sharks. ICES J. Mar. Sci. 56:707-717.

Thunnus thynnus	Pinkas, L. 1962 Bluefin tuna food habits. p.47-63. In L. Pinkas, M. S. Oliphant, and I. L. K. Iverson (eds.) Food habits of Albacore, Bluefin tuna, and Bonito in California waters. Fish. Bull. 152.
Scophthalmus maximus	Fischer, W., M.-L. Bauchot and M. Schneider (eds.) 1987 Fiches FAO d'identification des espèces pour les besoins de la pêche. (Révision 1). Méditerranée et mer Noire. Zone de Pêche 37. FAO, Rome. 1529 p.
Liocarcinus puber	*SEA AROUND US (Froese, R. and D. Pauly, Editors. 2000. FishBase 2000: concepts, design and data sources. ICLARM, Los Baños, Laguna, Philippines. 344 p.)*
Buccimium undatum	
Merlangius merlangus	Daan, N. 1989 Data base report of the stomach sampling project 1981. Cooperative Research Report No. 164, International Council for the Exploration of the Sea Palægade 2-4, 1261 Copenhagen K, Denmark.
Trisopterus luscus	Armstrong, M J. 1982 The predator-prey relationships of Irish Sea poor-cod (*Trisopterus minutus* L.), pouting (*Trisopterus luscus* L), and cod (*Gadus morhua* L.). J. Cons. Int. Explor. Mer. 40(2):135-152.
Glyptocephalus cynoglossus	Bowman, R.E., C.E. Stillwell, W.L. Michaels and M.D. Grosslein 2000 Food of northwest Atlantic fishes and two common species of squid. NOAA Tech. Memo. NMFS-NE 155, 138 p.
Labrus spp.	Deady, S. and J.M. Fives 1995 Diet of ballan wrasse, *Labrus bergylta*, and some comparisons with the diet of corkwing wrasse, *Crenilabrus melops*. J. Mar. Biol. Assoc. U.K. 75(3):651-665.