

Defining the Economic and Environmental Values of Sea Bass

Blue Marine Foundation

Final Report

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Submitted by

MRAG



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Acronyms

AER	Annual Economic Report
CFP	Common Fisheries Policy
CPUE	Catch Per Unit Effort
DCF	Data Collection Framework
ETP	Endangered, Threatened or Protected
EU	European Union
EC	European Commission
FLAG	Fisheries Local Action Group
FTE	Full Time Equivalent
GDP	Gross Domestic Product
GVA	Gross Value Added
IFCA	Inshore Fisheries and Conservation Authority
ICES	International Council for the Exploration of the Sea
I-O	Input-Output
IUU	Illegal, Unreported and Unregulated
MLS	Minimum Landing Size
MMO	Marine Management Organisation
MSC	Marine Stewardship Council
MSY	Maximum Sustainable Yield
NFFO	National Federation of Fishermen's Organisations
NUTFA	New Under Ten Fishermen's Association
ONS	Office for National Statistics
PTE	Part Time Equivalent
SPA	Special Protection Areas
STECF	Scientific, Technical and Economic Committee for Fisheries
SWOT	Strengths, Weaknesses, Opportunities and Threats
TAC	Total Allowable Catch
UK	United Kingdom

1 Executive Summary

1.1 Background

Sea bass (*Dicentrarchus labrax*) is an important and valuable fish stock that is fished both commercially and recreationally in the UK and by other European Member States (e.g. France, Belgium, Netherlands, Spain and Portugal).

There is a considerable amount of fishing pressure from both commercial and recreational fishers on the bass stocks spanning the Irish Sea, Celtic Sea, English Channel, and southern North Sea.

Between 2010 and 2013, UK fisheries have been responsible for ~20% of sea bass landings from the bass stock in the Irish Sea, Celtic Sea, English Channel, and southern North Sea

It is widely acknowledged that the continued overfishing and downward trend in the health of the stock will have implications for the future viability of fishing activities (commercially and recreationally).

The new EU Common Fisheries Policy (CFP) introduces a legal requirement for EU Member States to fish all fish stocks at levels that will achieve Maximum Sustainable Yield (MSY) by 2015, where possible, and no later than 2020.

Management interventions are required at the EU level, nationally and/or locally to reduce the fishing pressure on bass and return the stocks to levels consistent with MSY.

The European Commission (EC) have recently proposed management measures for the commercial and recreational sectors.

It will be necessary to consider potential economic and social impacts of management decisions on both the commercial and recreational sectors and where there may be the greatest potential for economic benefits where maintaining some continued bass fishing.

1.2 Methods

Using a case study approach, this project aims to highlight the socio-economic values of bass, as well as the environmental impacts for various segments of the commercial and recreational fishing sectors targeting bass in the Sussex IFCA region of England.

The assessment of the economic value and environmental impacts of fishing activities targeting bass can help decision-makers identify appropriate management measures and assess likely benefits and impacts of constraining those fishing activities through the implementation of new management measures.

As a general approach, the study sought to provide a calculation of the economic value of recreational and commercial bass fisheries, in terms of economic output and employment, by utilising existing literature and by confirming information through stakeholder consultations. It should be noted that this is a rapid assessment designed to compare recreational and commercial fishing sectors catching bass in the Sussex IFCA district.

1.3 Results

Main results from this study are presented in (Table 1) and are summarised below.

- A total bass catch of 257.98–267.48 tonnes is estimated for commercial and recreational fisheries in Sussex during 2012.
- Recreational fishers in Sussex are estimated to have landed 17.2–31.2 tonnes of bass in 2012, of which 10.4–19.9 tonnes of bass are estimated to be retained. If a post hooking mortality is considered to be 20% then total removals of bass for recreational fishers increases to 11.76–22.16 tonnes;
- Commercial fisheries are reported to have landed 247.58 tonnes of bass in 2012;

- For commercial gears, drift and fixed nets are reported to have landed 149.64 tonnes of bass, ~60% of the total commercial catch;
- Final economic and employment impacts of recreational bass fisheries in Sussex during 2012 are estimated as £31.3 m and 353 Full Time Equivalent jobs (FTE);
- Final economic employment impacts of commercial bass fisheries in Sussex during 2012 are estimated as £9.25 m and 111.28 FTEs ;
- Per tonne of bass removed, recreational angling in Sussex is estimated to create £1.6–3.0 m in terms of final economic output and 18–34 FTEs.
- Per tonne of bass removed, commercial fishing in Sussex is estimated to create £0.04 m in terms of final economic output and 0.45 FTEs.

The economic output of recreational bass fisheries in Sussex is therefore estimated to be approximately 3.4 times higher than commercial bass fisheries. The employment generated by recreational bass fisheries is estimated to be approximately 3.2 times higher than commercial bass fisheries. However it is important to note both that bass may have an important role in the overall operation of some commercial fisheries, in particular because it is a non-quota species, and commercial fishing can represent an important indigenous industry.

The final economic output per tonne of bass retained in Sussex is almost 40–75 times higher for recreational bass fisheries than for commercial bass fisheries. The employment generated per tonne of bass retained is 39–75 times higher for the recreational bass fisheries than for the commercial fisheries.

It should be noted that the figures presented in this study are based on a number of assumptions that should be fully considered when interpreting these results. See section 3.7 of the report for details.

Recreational fisheries are widely regarded as having few environmental impacts apart from the direct removal of fish (fish that are kept by anglers) and those that die after being caught and released (post-hooking mortality). Commercial fisheries operating in Sussex have a range of potential environmental impacts, including bycatch and gear interactions with the seabed. Further evidence is required to classify the extent and significance of these impacts in the Sussex region. See Section 5.3 of the report for more details.

Table 1. Total Catch and Economic Outputs generated from sea bass fisheries in Sussex

	Recreational	Commercial					
	Angling	Gears Using Hooks	Pots and Traps	Drift and Fixed Nets	Demersal Trawl Seine	Beam Trawl	Commercial Total
Total Catch 2012 (t)	10.4–19.9*	33.5	0.6	149.64	63.7	0.2	247.58
Landings Value 2012 (£m)	-	0.30	0.02	0.87	0.39	0.01	1.57
Final Economic Output (£m)	31.3	1.78	0.02	5.14	2.29	0.01	9.25
Employment Generated (FTE)	353	21.47	0.26	61.89	27.52	0.14	111.28
Final Economic Output per tonne of bass retained (£m/t)	1.6–3.0	0.05	0.04	0.03	0.04	0.05	0.04
FTE Generated per tonne of bass retained (FTE/t)	17.7–33.9	0.64	0.47	0.41	0.43	0.55	0.45

*Total retained catch of bass by recreational anglers.

2 Introduction and Background

2.1 Project Context and Aims

2.1.1 Overview

Sea bass (*Dicentrarchus labrax*) is an important and valuable fish stock that is fished both commercially and recreationally in the UK and by other European Member States (e.g. France, Belgium, Netherlands, Spain and Portugal). However, there is a considerable amount of fishing pressure from both commercial and recreational fishers on the bass stock spanning the Irish Sea, Celtic Sea, English Channel, and southern North Sea. It is recognised that further management measures are required to conserve the stocks but exactly what those management measures should be is currently the subject of EU political debate.

The European Commission (EC) have recently proposed management measures (EC, 2014) for the commercial and recreational sectors (see Section 2.1.2.6). The proposed measures will be considered through the European Agriculture and Fisheries Council December 2014, where fishing opportunities for 2015 will be decided upon, along with any emergency stock conservation measures. It has also been proposed that a management plan should be developed for bass in the near future but it is thought that quick management action in the short-term will help limit damage to the health of the bass stocks.

Using a case study approach, this project aims to highlight the socio-economic values of bass, as well as the environmental impacts for various segments of the commercial and recreational fishing sectors targeting bass in the Sussex IFCA region of England. The Sussex IFCA region was selected by Blue Marine Foundation as a case study region because it plays host to a wide range of commercial fishing activities targeting bass (e.g. hook and line, drift/fixed netting, pair trawling activities as well as recreational sea angling activities).

Together, the assessment of the economic value and environmental impacts of fishing activities targeting bass can help decision-makers identify appropriate management measures and assess likely benefits and impacts of constraining those fishing activities through the implementation of new management measures.

It should be noted that this is a rapid assessment designed to compare recreational and commercial fishing sectors catching bass in the Sussex IFCA district. As a general approach, the study sought to provide a calculation of the economic value of recreational and commercial bass fisheries, in terms of economic output and employment, by utilising existing literature and by confirming information through stakeholder consultations.

2.1.2 Background and Scope: European Level

2.1.2.1 *Sea bass stocks*

The bass stock relevant to the Sussex region case study spans the Irish Sea, Celtic Sea, English Channel, and southern North Sea (ICES divisions VIIa, VIIf,g&h, VIId&e and IVb&c). It is prosecuted by a variety of European Union (EU) Member State countries (predominantly France, UK, Belgium, and Netherlands) both commercially and recreationally. The Sussex region sits within ICES area VIId (Eastern Channel) between the Southern North Sea (IVb&c) and Western Channel (VIIe).

There are other stocks of bass being exploited in the West of Ireland and Scotland (ICES divisions VIb, VIIg, VIIj), Bay of Biscay (ICES divisions VIIa,b) and in Spanish and Portuguese waters (ICES divisions VIIc, IXa). Although relevant from a European management perspective they are not considered within the scope of this report.

2.1.2.2 *Status of the sea bass stock in the Irish Sea, Celtic Sea, English Channel, and southern North Sea*

The International Council for the Exploration of the Sea (ICES) have advised that combined commercial and recreational fishing activities are inflicting fishing mortality well above the levels that are considered sustainable for the stock. Furthermore, recruitment of young fish into the population has been in decline since the mid-2000s and has been very poor since 2008. The declining recruitment and increasing

fishing mortality is causing a rapid decline in the size of the stock (biomass). For 2015, ICES have advised further reduced catch levels from previous years (ICES, 2014). It has been advised that landings of bass should not exceed 1,155 tonnes in 2015, although a Total Allowable Catch (TAC) is not in place for the stock.

2.1.2.3 *Estimated removals of sea bass in the Irish Sea, Celtic Sea, English Channel, and southern North Sea*

Commercial landings

In 2013, estimated landings of bass by the EU commercial fishing sector was 4,132 tonnes. This is similar to the average (2009–2013) total commercial fishery landings of 4,195 tonnes (Table 2). Commercial landings account for approximately 75% of reported commercial and recreational bass landings.

Unreported removals (discards, legal and illegal landings)

There is some uncertainty in estimating total removals of bass in commercial fisheries. One source of uncertainty is underestimation of total commercial removals due to discards. Estimated discards for sampled UK and French fleets in 2009–2013 was 235t in 2009, 211t in 2012, 35t in 2011, 157t in 2012 and 33t in 2013. Overall, the discard rate, by weight, for sampled UK and French fleets is only around 5%. The fleet metiers that are sampled represent around 70% of the total international landings and should be treated as an underestimate in terms of volumes discarded. Further coverage of other Member States and other fleet activities would improve estimates of discards. Most discards are fish below the Minimum Landing Size (MLS) of 36cm, and mostly from otter trawlers using 80-99mm mesh in areas such as inshore regions of the English Channel where juvenile bass are most common (Armstrong & Drogue, 2014).

Another source of bias is legal unreported landings associated with an allowance under Article 65(2) of the EU Control regulation (EU Regulation 1224/2009). This allows disposal of up to 30kg of fish for personal consumption without supplying sales slips. For small-scale, low-volume fisheries catching bass, this legal missing catch could be significant except in countries such as France where log-book schemes require reporting of all landings in under-10m fleets.

Finally, there may also be sources of illegal and unreported landings due to lucrative markets for bass, but evidence that such activities are occurring is either missing or anecdotal.

Recreational landings

Recent estimates of total recreational landings (retention) of bass for France, Netherlands, England and Belgium (various surveys 2009–2013) in ICES Subareas IV and VII amount to 1,300–1,500 tonnes (~25% of total reported commercial and recreational bass landings), (Armstrong & Drogue, 2014).

Capture-Release mortality

Assuming a 20% hooking mortality rate, an additional quantity of around 110–130 tonnes of bass releases will have died. The total annual recreational removals from the stock have therefore been estimated at 1,400–1,600 tonnes compared with total reported landings. It should be noted that recreational catch estimates (Table 2) exclude figures for Wales, Scotland and Northern Ireland (UK) and any other European Member State countries without surveys that could report bass catches (Armstrong & Drogue, 2014). Estimated total recreational removals of bass are therefore likely to be an underestimate.

Total removals by Member State

It is estimated that the average annual commercial and recreational landings (2010–2013) from the bass stock in the Irish Sea, Celtic Sea, English Channel, and southern North Sea, is around 5,600 tonnes. France is the largest remover of bass commercially and recreationally, responsible for 66% of landings, followed by UK (England & Wales) – 20%, Netherlands – 9%, Belgium – 4%, and the Channel Islands – 1%. It should be noted that Germany, Denmark have also landed a small amounts of bass commercially (≤ 6 tonnes between them) in recent years (ICES, 2014) but these are not included in Table 2.

French mid-water trawls are the largest commercial removers of bass, responsible for an estimated 25% of total bass removals. This is greater than the total estimated removals in the UK by commercial and recreational combined – 20%. The second largest removals of bass are from the French recreational sector – 17% and, third largest removals from French trawlers – 14%.

Table 2. Average commercial fishery landings by country and gear group (where available) over 2010 – 2013. Recreational landings estimates are given for surveys in the same time period.

Fishery	Landings (t)	Percentage (%)
France trawls	793	14
France mid-water trawls	1,408	25
France nets	139	3
France lines	305	5
France other	142	3
Recreational France 2009-2011	940	17
France Subtotal	3,727	66
UK (England & Wales) trawls	147	3
UK (England & Wales) mid-water trawls	57	1
UK (England & Wales) nets	361	6
UK (England & Wales) lines	175	3
UK (England & Wales) other	65	1
Recreational England 2012	335	6
UK (E&W) Subtotal	1,140	20
Netherland Commercial	384	7
Recreational Netherlands 2010-11	138	2
Netherlands Subtotal	522	9
Belgium Commercial	165	3
Recreational Belgium 2013	60	1
Belgium Subtotal	225	4
Channel Isles Commercial Subtotal	54	1
TOTAL	5,668	100

(Source: Adapted from STECF report (STECF 2014, Armstrong & Drogue 2014))

2.1.2.4 EU policy and expert advice considerations

It is widely acknowledged that the continued overfishing and downward trend in the health of the stock will have implications for the future viability of fishing activities and communities which are socially and economically reliant on bass.

The new EU Common Fisheries Policy (CFP) introduces a legal requirement for EU Member States to fish all fish stocks at levels that will achieve Maximum Sustainable Yield (MSY) by 2015, where possible, and no later than 2020.

It is widely accepted by European Member States that management interventions are required at the EU level, nationally and/or locally to reduce the fishing pressure on bass and return the stocks to levels consistent with MSY. However, exactly what these measures should be (e.g. introducing a TAC, other catch limits or technical measures) and how they should be implemented has been a source of expert and political debate over the past few years.

It has been concluded by STECF (2014) that whilst there are a number of regulations and management measures implemented by European Member States aimed at conserving bass, these measures have not been collectively effective in controlling catches, preventing an increase in fishing mortality and/or a decline in biomass of the bass stock. STECF note that if commercial effort and catches are maintained at the levels observed in 2013, the existing national measures are not likely to be effective in controlling fishing mortality or allowing the stock to recover to MSY levels over a 3-5 years' timescale. STECF also note that to reach MSY as advised by ICES (2014), would require a reduction of current levels of fishing mortality by around 60%.

ICES have advised that a European management plan is urgently needed to develop and implement further measures to substantially reduce fishing mortality throughout the range of the stock. It is considered unlikely that any one single measure will be sufficient to achieve the scale of reductions in fishing required. Therefore, it has been proposed amongst experts that a package of measures will be required across the main commercial and recreational fisheries. A suite of possible management measures and their relevance to targeted, non-target (bycatch fisheries) and recreational fishing activities have been considered by STECF (2014) and further discussions are ongoing between the Member States and the European Commission to determine what management steps and measures should be taken in the short-medium and medium/long term to protect the bass stock and bring fish back to levels consistent with achieving MSY.

The diversity of recreational and commercial bass fisheries means that any new management measures may have different and inequitable economic and social impacts in the short-medium term. It will be necessary to consider potential economic and social impacts of management decisions on both the commercial and recreational sectors and where there may be the greatest potential for social and economic benefits from continued bass fishing. It has been suggested by STECF that management of bass fisheries could take into account both biological (stock conservation) objectives and the impacts on the economic and social value of the commercial and recreational fisheries (STECF, 2014). In addition, the wider environmental impacts of bass fishing activities (e.g. bycatch, discards and impacts on habitats) are factors that could also be considered when making management decisions in the context of wider environmental conservation objectives.

Whilst a full economic, social and environmental evaluation of EU and UK fisheries could not be undertaken prior to political discussions in December 2014, a rapid assessment should give an indication of the nature of the benefits generated by commercial and recreational bass fisheries. The Sussex case study presented in this report aims to consider which segments of the commercial and recreational fisheries in this region of the UK provide the highest socio-economic value, as well as considering wider impacts, including environmental, of different bass fishing activities. It is hoped that the outputs will inform debate on management at the EU level and within the UK.

2.1.2.5 *Current EU and Member State national management measures*

Bass fisheries in Europe are not subject to EU TACs and quotas like many other commercial fish species and this can be an important point. There are currently a variety of management and market controls on commercial and recreational fisheries for bass stocks at EU, national and local levels. In summary, directed bass management measures include; EU basic Minimum Landing Size (MLS) and some more stringent national or local MLS's; bass licencing for commercial fisheries in France; weekly or monthly vessel catch limits in some commercial fisheries (France & UK); closures of nursery areas in England and Wales; closed seasons for some French fleets; and, a moratorium on commercial fishing for bass around Ireland (STECF, 2014; Armstrong & Drogue, 2014). However, these measures as a whole are considered by fisheries scientists advising on the health of the stocks to have been ineffective at reducing fishing pressure to the levels required to stop a continued decline in the stock (ICES, 2014; STECF, 2014). As such, further management action is required to recover stocks to sustainable levels, in line with the MSY objectives of the CFP.

Table 3 provides an overview of EU and Member State management measures currently in place or proposed nationally (i.e. Netherlands) for the bass stock in the Irish Sea, Celtic Sea, English Channel, and southern North Sea. New EU wide measures proposed by the European Commission for introduction in 2015, which will require the agreement by EU Fisheries Ministers at the December Fisheries Council, are presented in Section 2.1.2.6.

Table 3. Overview of EU and Member State management measures currently in place or proposed (Netherlands, 2014) for the sea bass stock in the Irish Sea, Celtic Sea, English Channel, and southern North Sea.

Country	Commercial Fisheries Management Measures	Recreational Angling Management Measures
EU (all Member States)	<p>The minimum landing size (MLS) of bass in the Northeast Atlantic is 36 cm in total length</p> <p>Commercial vessels catching bass within cod recovery zones (e.g. ICES division VIIId) are subject to days-at-sea limits according to gear type, mesh size and species composition. Note: There is effectively a ban on a range of enmeshing nets 70 - 89 mm (stretched mesh) in Regions 1 and 2 of Community waters.</p>	The MLS of bass in the Northeast Atlantic is 36 cm total length.
France	<p>A landings limit of 2.5 tonnes and 4.5 tonnes per vessel per week for French vessels (depending on season and gear).</p> <p>A licensing system from 2012 for commercial gears targeting bass.</p> <p>Voluntary closed season from February to mid-March for long-line and hand-line bass fisheries in Brittany, France.</p>	An MLS of 42 cm for French recreational anglers since 2013.
UK	<p>Landings limit of 5 tonnes per vessel per week.</p> <p>A regional MLS of 37.5 cm in Cornwall and South Wales IFCA regions</p> <p>Closure of 37 bass nursery areas (BNA) in England and Wales to specified fishing methods (Chichester Harbour is a significant bass nursery area and lies within the Sussex IFCA District. The Authority communicates and enforces the BNA and has successfully prosecuted under BNA legislation).</p> <p>A minimum gill net mesh size of 100 mm in South Wales.</p> <p>Ban on pair trawling within 12 nautical miles of the UK coast (applicable to UK vessels only) in ICES division VIIe to reduce cetacean bycatch (SI No. 3397, 2004).</p>	<p>A ban on recreational fishing from boats and a ban on the use of sandeel as bait in 37 bass nursery areas.</p> <p>A total ban on all fishing in the Heysham bass nursery area in Lancashire.</p>

Country	Commercial Fisheries Management Measures	Recreational Angling Management Measures
	The majority of IFCA's have a range of inshore netting byelaw management measures that offer some protection to bass stocks found within near shore locations, estuaries, natural harbours and river mouths.	
Belgium	No additional national management measures known at time of study.	No additional national management measures known at time of study.
Netherlands	<p>Proposed Measures in 2014:</p> <p>Phasing out pair trawling for bass. Fishing with bottom pair trawls will not be permitted in the Eastern Channel from September – December 2014.</p> <p>A monthly limit of bass landings of 5,000 kg per vessel (Non-transferable).</p> <p>The small-scale coastal fisheries in the North Sea have a 5 tonne limit per vessel per year. (Non-transferable).</p> <p>A limited to the number of professional handline fishermen for bass (from June 6, 2014).</p> <p>All catches including discards must be recorded.</p> <p>An MLS of 42 cm for commercial hand line fishermen.</p>	<p>Proposed Measures in 2014:</p> <p>A bag limit of 20 kg or 25 specimen of bass and cod for recreational anglers.</p> <p>An MLS of 42 cm for recreational anglers.</p>
Ireland	<p>A variety of control measures in Ireland that effectively ban commercial fishing for bass in Irish waters</p> <p>An MLS of 40 cm.</p>	Bag limits for recreational fishing (two bass per day)

(Source: MRAG Ltd. consultants via STECF report (Armstrong & Drogue, 2014).)

2.1.2.6 European Commissions proposed measures for 2015

Additional management measures at the EU level (i.e. for all Member States targeting bass commercially and recreationally) have been proposed by the European Commission for 2015 (EC, 2014). They are:

- Monthly catch limits (tonnes) and effort limits (days-at sea) between 1st January – 30th April for pelagic trawls with a track history of catching bass with a cod end mesh size greater than 80 mm in ICES division VIIe (Western Channel).

This would apply to all EU vessels with a track history of catching above a certain tonnage (still to be defined) in the area for the period from 1st January to 30th April 2014.

- Restrictions on access to ICES division VIIe for any pelagic trawl between 1st January – 30th April if the vessel has no previous track history of fishing in VIIe between 2009 and 2011.

Access may be granted to a vessel in the period if the Member States ensures that the equivalent capacity, measured in kilowatts, is prevented from fishing in the area. Conditionality's for the transfers of days at sea between vessels for this purpose are detailed in the proposed regulation.

- Bag limits for recreational fishermen. A bag limit of only one bass, per person, per day (Article 12). The limit will foreseeably apply to anglers and other recreational fishers e.g. nets and pots and to spearfishing.

It is worth noting that further management measures may yet be considered through the development of a bass management plan. However, developing and politically agreeing a management plan would likely need to happen over a longer timeframe than would be achievable in the short-term through emergency measures planned to be introduced at the 2014 December Fisheries Council. The longer timeframes required to introduce a management plan would mainly be due to the time required for Member States to develop and agree plan and for that plan to then be agreed through the EU ordinary legislative processes (European Parliament and Council co-decision procedure).

There is a risk that failing to introduce any emergency bass measures in December 2014 and then waiting for a management plan to be developed and politically agreed would allow more time for continued damage to the bass stock to take place. Conversely, poorly designed emergency measures could have unintended social and economic impacts for certain commercial and recreational fishers.

It is not the reports aim to comment on the appropriateness of EC proposed emergency management measures. It should, however, illustrate which segments of the commercial and recreational sectors are of highest socio-economic value in the Sussex region of the UK. This should help inform debate on the likely implications of short-term emergency management decisions by providing socio-economic evidence on the importance and reliance of bass fishing for certain segments of the UK fleet fishing out of the Sussex region.

2.1.3 Background and Scope: National and Local Level

In England fisheries rules and regulations are administered and managed nationally by Defra and the Marine Management Organisation (MMO). At the regional and local levels Inshore Fisheries Conservation Authorities (IFCAs) also manage inshore fisheries (0-6nm).

Social, economic and environmental evidence will be essential in helping decision-makers at all levels reach some consensus on the management objectives and measures that are appropriate and proportionate for the fisheries exploiting bass. This evidence will also be important for the IFCAs, who will likely have a key role in implementing management measures in their inshore fisheries, where bass are both prevalent and targeted by both commercial and recreational fishing sectors.

2.1.3.1 National sea bass landings, exports and imports

Bass make up only a relatively small proportion of total landings in the UK but bass can represent an important species due to a combination of high market value (reflecting market demand in the UK and on the continent), seasonal availability and non-quota nature of the stocks. National landings of bass are shown in the Table 4 below. This also shows that approximately half of the UK landings of bass were exported in 2013. The UK imports much more bass than it catches –this is mostly in the form of bass from aquaculture production.

Table 4. Breakdown of UK Commercial Catches, Exports and Imports of sea bass

	2010	2011	2012	2013
Sea bass Landings ('000 tonnes)	0.7	0.8	0.9	0.8
Sea bass Exports ('000 tonnes)	0.3	0.5	0.5	0.4
Sea bass Imports ('000 tonnes)	6.7	7.6	8.3	9.5

(Source: ICES, 2014; MMO, 2014.)

2.1.3.2 Background on the Sussex IFCA district sea bass fishery

The stock structure of bass in EU waters is currently uncertain and, therefore, ICES has pragmatically divided populations into four stocks (ICES, 2014). Bass exploited in the Sussex region belong to the stock occupying the North Sea, Channel, Celtic Sea and Irish Sea (ICES IVb,c & VIIa,d-h). Previous studies indicate that there are potentially two distinct bass stocks in the English Channel, an eastern and a western stock. The eastern stock is thought to migrate from waters off Devon to the Southern North Sea, and it is therefore this stock that is exploited in the Sussex region (Pawson, 1995). The start of the migration occurs in spring in the Western English Channel followed by spawning between the Isle of Wight and Beachy Head in Sussex (Pawson, 1995). The stock then moves east to feeding grounds in the Eastern English Channel and Southern North Sea (Pawson, 1995). They remain here until late autumn when the water temperature starts to decrease and they migrate south and west back to the winter pre-spawning areas in the western English Channel (Pawson, 1995). Juvenile bass do not migrate and instead exhibit small seasonal movements (Pawson, 1995).

Bass fishing occurs within the Sussex region on both a commercial and recreational scale. Pair trawlers target bass and also often catch them as bycatch while targeting bream. Small scale driftnets are also used to target bass, in both inshore and offshore areas (MRAG et al., 2014). Other commercial gears that are used to target bass include rod and line, static nets, bottling, long-lining and spear fishing. Recreational sea anglers also target bass, often on charter vessels where they are taken to areas where bass are known to be present¹.

Bass start to arrive in Sussex in late spring/early summer on their way to their feeding and breeding grounds. They are often caught as bycatch during this period in the bream pair trawl fishery, commonly in the area between Selsey and Littlehampton. They are most commonly found on harder grounds (such as the Royal Sovereign shoals of the coast of Eastbourne) or on inshore seabed features during

¹ Bass *Dicentrarchus labrax* – Sussex IFCA: http://www.sussex-ifca.gov.uk/index.php?option=com_content&view=article&id=62&Itemid=158

summer when they are targeted by static gear, commercial and recreational anglers. Some bass are also caught in keddle nets during these summer months, generally around Rye bay. From late summer to early autumn the bass start to return from their feeding grounds and are commonly caught during this period by driftnets (MRAG et al., 2014). This method of fishing is particularly effective at night or during the day after there has been a period of high wind activity causing the fish to come closer to the surface. The bass gradually move west and offshore to deeper water in late autumn and here they are targeted by stern trawlers. During the winter, few bass are caught in the Sussex region.

The IFCA has a duty under the Marine and Coastal Access Act 2009 (MaCAA, 2009) to manage both commercial and recreational fisheries sustainably, balancing the socio economic needs of the community with that of the marine environment. Since its establishment in 2010, the Sussex IFCA has undertaken a review of management measures and identified the need to prioritise recreational fisheries and develop management to support the sector whilst recognising the needs of commercial food supply fisheries. Management opportunities for development include putting in place further management measures to help support key recreational target species and as far as practically feasible maintain healthy fish populations. Examples of intended future management include:

- A review of existing static and drift net gear regulations and new byelaws reflecting the best evidence. (Sussex IFCA has well developed small fish surveys and habitat assessment work);
- Development and expansion of bass nursery management into the potential locations of Medmerry coastal realignment and Pagham Harbour;
- Consideration of appropriate bag limits to enable a 'reasonable take' whilst stopping excessive recreational exploitation and preventing unlicensed unregistered activities conducted at a commercial level.

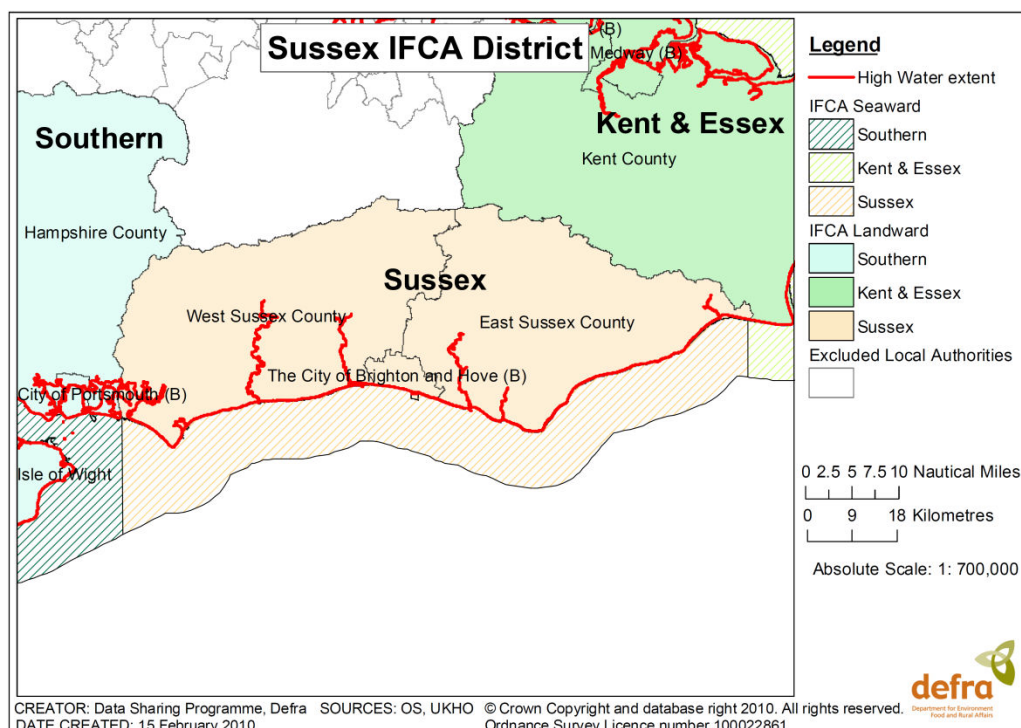


Figure 1. Map of the Sussex IFCA District (Source: Sussex IFCA, 2014.)

3 Methodology

The following methodology represents a rapid assessment designed to compare recreational and commercial fishing sectors catching bass in the Sussex IFCA region (Figure 1). As a general approach, the study sought to provide a calculation of the economic value of recreational and commercial bass fisheries, in terms of economic output and employment, by utilising existing literature and by confirming information through stakeholder consultations.

3.1 Literature Search

A literature review was conducted to collate publicly available economic and environmental information relating to recreational and commercial bass fisheries in Sussex. Literature reviewed included a range of quantitative and qualitative sources, such as the MMO catch statistics, Seafish fleet economic performance reports, Defra Sea Angling 2012 and results from the UK Inshore Fisheries Sustainability Project. During the initial review of data sources a stakeholder analysis was undertaken to identify the key gear groupings used to target bass and the key organisations/individuals to be consulted during the study. Knowledge gaps identified during the literature review stage were then used as key focal topics during stakeholder consultations.

3.2 Consultations

Semi-structured interviews were held with a number of fishers, fishmongers, wholesalers and fishery managers to verify information sourced from the literature and to fill identified knowledge gaps. To guide interviews, interview checklists of key questions for each stakeholder group were created following the literature review stage. To establish contact with individuals involved in recreational and bass fisheries in Sussex, existing contacts within fishery management organisations were asked to provide details for commercial and recreational bass fishers. Subsequent interviews were intended to cover all key organisations / individuals previously identified and fishers representing each of the key gear groupings. Interviews were conducted either in person or over the telephone.

3.3 SWOT Analysis

Using results from the stakeholder consultations, a SWOT analysis was utilised to present the strengths, weaknesses, opportunities and threats to bass management and each of the gear groupings identified during the literature review. SWOT analysis is a diagnostic strategy analysis tool that is widely used in strategy formulation which aims to provide a structured, comprehensive analysis that takes into account internal (strengths and weaknesses) and external (opportunities and threats) factors. A SWOT analysis structure was chosen for this study as it provides considerable advantage over other forms of analysis, enabling environmental, social and economic dimensions to be included in the analysis and considered at the same time.

3.4 Economic Output and Employment

A number of previous studies have evaluated the economic outputs of recreational and commercial fishery sectors. However, for the most part, previous studies consider these sectors in isolation and do not attempt to compare between the relative outputs of recreational and commercial fisheries. Methods employed by economic output studies on both sectors utilises Input-Output (I-O) analysis and economic multipliers.

The multiplier concept is simple to understand. It stipulates that an increase in the demand for the output of one sector will impact other sectors. This will cause an increased demand for intermediate inputs (such as wages, etc.) and increased consumption demand due to increased employment and household income. Intermediate demand can be referred to as indirect effects, whereas consumption demand can be referred to as induced effects. To determine the wider economic impacts of each sector, input-output tables are used to trace the effect of any spending through various supply chains to estimate indirect and induced income effects and derive economic multipliers of the value of expenditure. Multipliers presented commonly allow the determination of the sector's wider impacts in terms of economic output (£), employment (FTE) and impact on Gross Domestic Product (GDP) or Gross Value Added (GVA). Because of the differences in the nature of spending associated with commercial and recreational fishing these activities have different economic multipliers and the

numbers of jobs supported per £10,000 will also be different. To apply multipliers to recreational and commercial fisheries, studies on recreational fisheries apply multipliers to angler expenditure, whereas studies on commercial fisheries apply multipliers to landings values.

For the purpose of this study a number of economic analyses of recreational and commercial fisheries were reviewed in order to establish appropriate multipliers to apply to fisheries in Sussex. It was concluded that the most appropriate multipliers for recreational and fisheries were those applied in Armstrong et al. (2013) and that the most appropriate multipliers for commercial fisheries were those applied in Seafish (2007). These studies represent the most up-to-date estimates of economic multipliers and, in the case of the commercial fishing activities include both the value of landings and the expenditure associated with fishing activities. Applying the respective multipliers enabled the total economic output for the activity including direct, indirect and induced effects to be calculated. In addition to economic output, the number of people employed directly and indirectly by the fishing activities. To derive these, estimates of the employment supported was derived using estimates from Armstrong et al. (2013) and Seafish (2007) and reported as Full Time Equivalents (FTE): a measure that converts full and part time equivalents (PTE) to a common currency. Using results from surveys, information regarding angler spend per industry and industry employment data and information from the Seafish economic analysis of UK fleets (Seafish, 2007) were combined to calculate direct, indirect and induced employment impacts.

3.5 Recreational Angling

Data were available from the Sea Angling 2012 study specifically for the Sussex region but the low sample sizes at the scale of the Sussex IFCA made it difficult to make any robust inferences. For this reason, these data were not used as part of this study and the overall data for the whole of England were used as detailed below.

3.5.1 Estimation of Resident Sea Angler Population in Sussex

Determining the population of recreational anglers in a given region is challenging. Sea anglers are not required to hold a licence in order to participate in the sport and no register of anglers currently exists.

A number of previous reports have attempted to estimate the number of active anglers in England and Wales: Drew Associates (2004) used the Household Omnibus Survey to estimate that 5.02% of households and 1.45 million individuals participate in sea angling; Simpson and Mawle (2005) reported that 7% of the population participated in sea or freshwater angling over a two year period; and Nautilus (2000) estimated the population of anglers in the South West of England using methods presented in Drew Associates (2004). The most recent estimate of the sea angler population in England comes from Armstrong et al. (2013), which estimates the number of active anglers using the Office for National Statistics (ONS) household survey to determine participation rates in a sample population.

To estimate the number of recreational anglers present in Sussex, a sampling approach was beyond the scope of this study and it was therefore necessary to estimate angler numbers using available literature. Estimates were based on results from Armstrong et al. (2013), as this represents the most recent information available. Region specific results from the report indicate that 2.49% of the population currently living in the South East of England can be considered to be involved in angling (Hargreaves et al., 2013). Therefore, given recent population estimates for Sussex as 1.607 million (ONS, 2011) the total number of resident anglers was calculated as 40,014 individuals.

3.5.2 Non-resident Anglers

Non-resident tourist anglers can have a substantial impact on local economies, and this has been demonstrated in previous studies (e.g. Nautilus, 2000). While it is possible to identify the number of tourist visits to the Sussex region using publicly available tourism data, it was not possible to identify the proportion of these that were associated with sea angling or included sea angling.

Because it was not possible to derive a robust estimate of the number of non-resident anglers or non-resident angler spend, we chose instead to present only the analysis for resident anglers (see Section 4.1.1.2). This represents a conservative approach and it should be acknowledged that there will be additional economic impacts beyond the figures presented resulting from non-resident angler activity.

Based on previous studies (Nautilus, 2000), it could be expected that total angler expenditure could be increased by up to 50%.

It should be noted that figures reported in Section 4.1.1.2 also assume that the resident angler population spend the entirety of their angling related expenditure within Sussex and do not travel outside the county. However, as this study does not account for tourist anglers it is considered that the figures reported herein overall provide a conservative estimate of angler spend in the region.

3.5.3 Economic Impacts of Sea Angling: Expenditure, Economic Output and Employment

Previous studies estimating economic impacts of recreational fisheries can be separated into two groups: those that estimate direct effects (e.g. Drew Associates, 2004) and those that incorporate direct, indirect and induced impacts (Armstrong et al., 2013). Direct effects of sea angling are related to the expenditure of sea anglers. Sea Angling 2012 (Armstrong et al., 2013) used questionnaires to establish the amount individual anglers spent on angling related items and then scaled the estimates to a national level using the results of the ONS survey, giving a total spend of anglers in England of £1,232.7 million. Indirect effects of sea angling takes account of the impact direct spending has on the wider economy, as direct spending in one sector will generate knock on effects in other sector. To account for the indirect effects of expenditure, Sea Angling 2012 uses Input-Output (I-O) tables to estimate the multiplier impacts of sea angling expenditure at a national level. I-O methods have been widely used to study the economic impacts and flow-on effects between sectors and are therefore regarded as an appropriate methodology (Armstrong et al., 2013). Therefore, using the I-O framework, Defra calculates that the total economic output related to angler expenditure in England as £2,097.3 million.

Using information presented in Sea Angling 2012 relating to individual angler expenditure, economic output and employment, it was possible to scale these estimates to the Sussex district by using the population estimate calculated in Section 3.5.1.

Table 5. Expenditure, Economic Output and Employment generated by different numbers of Anglers

	Individual Angler	Sussex	England
No. of Anglers	1	40,014	884,304
Expenditure (£)	1394	55.8 m	1,232.7 m
Final Economic Output (£)	3,516.5	94.9 m	2,097.3 m
Employment (FTE)	0.03	1067.88	23,600

(Source: Armstrong et al., 2013)

3.5.4 Sea Bass Catches: Sea Bass Caught and Retained

Reporting requirements under the EU Data Collection Framework (DCF) require Member States to estimate recreational catches in specific areas. One of the main focuses of Defra Sea Angling 2012 was therefore to provide an estimate of total sea angling catches for bass in England.

To determine the total number of bass caught and retained, Defra utilised online and face-to-face surveys to establish daily catch rates and combined it with information collected on effort by shore, private boat and charter boat anglers.

Table 6. Annual Sea Angling catches of sea bass in England

	Shore	Private and Rented Boat	Charter Boat	Total
Sea bass Caught (t)	98–143	194–546	44	380–690
Sea bass Retained (t)	38–56	142–397	31	230–440

(Source: Armstrong et al., 2013)

To estimate bass catches in the Sussex district national catch ranges presented in Armstrong et al. (2013) were scaled to the proportion of angling effort represented by the district using the total number of anglers presented in Section 3.5.1 (results presented in Section 4.1).

It should be noted that additional deaths due to hooking-related mortality are not considered within the figures presented in

Table 6 and, therefore, the estimates of retained fish underestimate the true removals of fish of bass. Hooking mortality is dependent on a number of factors and the true value is unknown. However, previous bass stock assessments conducted by ICES have assumed a hooking mortality of 20% based on research into the striped bass fishery in the USA (ICES, 2013). Hooking mortality is not incorporated into the main analysis of this study presented in Table 8, but its impacts are discussed in Section 4.

3.5.5 Economic Impacts of Sea Angling attributed to Sea Bass

The economic impacts presented in 3.5.3 relate to employment and economic outputs generated from the entire recreational angling sector in the Sussex district. As one of the main goals of this study was to determine the economic impacts of bass angling to the district in order to compare them with the economic impacts of commercial fisheries, it would be misleading to accredit these benefits entirely to bass angling. However, it is difficult to distribute the economic impacts of recreational angling to individual species. This issue is further complicated if the reasons fishers participate in angling are considered.

To determine the proportion of the economic impacts of angling in Sussex that can be attributed to bass a proxy was adopted: the proportion of anglers that state bass as their primary target species has been estimated to be in the region of 20% for Sussex (pers. Comm. Cefas representative). However when fishers targeting bass as one of a number of target species are considered this rises to 33% based on surveys conducted as part of Sea Angling 2012 (Hargreaves et al., 2013).

Estimated economic impacts of the angling sector (Section 3.5.3) was therefore down-scaled to 33% to give the economic impacts of bass angling in Sussex. Further scaling of the estimated economic impacts to the estimated bass catches (Section 3.5.4) allowed the economic impact per tonne of bass retained to be calculated.

3.6 Commercial Fisheries

3.6.1 Landings Volume and Value

Landings volume and value of bass in the Sussex district were obtained from publicly available catch statistics (MMO, 2014)². Catches considered were those landed into ports located within Brighton and Hove, East Sussex and West Sussex. Catches of bass between 2009 and 2013 were extracted by gear type and are presented in Section 4.2.1. To facilitate comparison with values presented in Sea Angling 2012, data analysed for the commercial fisheries relates to 2012 landings volume and value.

3.6.2 Economic Impacts of Commercial Fisheries: Economic Output and Employment

To determine the economic impacts of commercial bass fisheries in Sussex it is important to consider more than just first point of sale values presented in national catch statistics. Similar to the impacts of recreational expenditure, the money generated through sea fishing is expected to have a number of knock-on impacts on other economic sectors.

A previous study by Seafish (2007) has quantified the wider economic impacts of sea fishing and fish processing sectors using an input-output (I-O) analysis. Similar to Defra Sea Angling 2012, the study derives economic multipliers, however, instead of being applied to the expenditure of individual anglers, multipliers can be applied to the value of fishery landings. This study represents the most up-to-date study that quantifies the wider economic impacts of UK sea fishing, although it must be noted that the study occurred several years ago and is based on economic information from 2002. Figures quoted therein are therefore now outdated, and the economic multipliers are likely to have changed. However, as calculating new economic multipliers was outside the scope of this study, and no update to the study is available, it has been necessary to use the information available within this report.

²It should be noted that the volumes and values considered to be caught in the Sussex district were equated to those landed into Sussex ports. The analysis in this study does therefore not account for sea bass that are caught within Sussex district waters and landed at ports outside of West and East Sussex.

The economic multipliers presented in Seafish (2007) are presented in Table 7. Multipliers are applied to £1m of landings value and are provided for economic output, employment and GDP. The study has also derived different multipliers depending on the type of fish landed: demersal, shellfish and pelagic.

Table 7. Economic Impact from £1m landings, UK Impact

	Output (£m)	Employment (FTEs)
Demersal	5.9	71
Shellfish	7.2	149
Pelagic	6.5	65

(Source: Seafish, 2007)

The economic impacts and the employment generated by bass landings in Sussex during 2012 were therefore calculated by applying the demersal multipliers (Table 7) presented in the Seafish (2007). These values were then scaled to the landings volume of bass to give the economic output and employment generated per tonne of bass landed.

3.7 Assumptions

To provide an estimation of the economic impacts of commercial and recreational fisheries a number of assumptions had to be made during the course of this study.

- Angling participation rates for the south east of England presented in Armstrong et al. (2013) are accurate and can be used to derive the number of resident anglers from a given area's population.
- Recreational bass catches in Sussex are proportional to national catches based on our estimation of angler numbers using angler participation rates presented in Armstrong et al. (2013).
- Estimated economic impacts of recreational fisheries does not include non-resident anglers.
- Expenditure of individual anglers in Sussex is identical to that reported in Armstrong et al. (2013). Expenditure of anglers was confirmed through consultations with a small number of anglers. However, determining specific average expenditure of anglers in the region was beyond the scope of this study.
- Bass angling accounts for 33% of the total expenditure and economic impacts of angling activity in Sussex.
- The economic multipliers presented in Seafish (2007) are still valid and can be applied to recent commercial fisheries landings.
- Bass catches reported for Sussex ports in the MMO catch statistics represent all commercial bass catches occurring in Sussex waters.

One of the main assumption made during this study relates to the use of economic multipliers which warrants further discussion. The estimation of economic multipliers can be challenging, and there are relatively few sources of fisheries-specific indicators the figures used for the purposes of this study for recreational fishing are not inconsistent with the wider literature (e.g. Fedler, 2009; Southwick, 2006) and while the commercial multipliers are higher than some estimates (e.g. Dyck & Sumaila 2010) this is a result of considering the economic impacts of both landings and fishing activity. In using the final values it is important to note that multipliers do not take account of changes that may occur in the nature of supply chain activity with changing levels of activity. For example, reductions in landings may reduce options for wholesale and lead to increased local sales. It is considered therefore that economic multipliers are likely to overstate the medium to longer run impacts (Poseidon, 2012).

4 Results: Sea Bass Exploitation within the Sussex District

Main results from this study are presented in (Table 8) and are summarised below. Subsequent sections detail results for each of the different gear groupings identified as exploiting bass in Sussex.

Landings

- A total bass catch of 257.98–267.48 tonnes is estimated for commercial and recreational fisheries in Sussex during 2012.
- Recreational fishers in Sussex are estimated to have landed 17.2–31.2 tonnes of bass in 2012, of which 10.4–19.9 tonnes of bass are estimated to be retained. If a post hooking mortality is considered to be 20% then total removals of bass for recreational fishers increases to 11.76–22.16 tonnes;
- Commercial fisheries are reported to have landed 247.58 tonnes of bass in 2012;
- For commercial gears, drift and fixed nets are reported to have landed 149.64 tonnes of bass, ~60% of the total commercial catch;

Economic Outputs

- Final economic and employment impacts of recreational bass fisheries in Sussex during 2012 are estimated as £31.3 m and 353 Full Time Equivalent jobs (FTE);
- Final economic employment impacts of commercial bass fisheries in Sussex during 2012 are estimated as £9.25 m and 111.28 FTEs ;
- Per tonne of bass removed, recreational angling in Sussex is estimated to create £1.6–3.0 m in terms of final economic output and 18–34 FTEs.
- Per tonne of bass removed, commercial fishing in Sussex is estimated to create £0.04 m in terms of final economic output and 0.45 FTEs.

Table 8. Total Catch and Economic Outputs generated from sea bass fisheries in Sussex

	Recreational	Commercial					
	Angling	Gears Using Hooks	Pots and Traps	Drift and Fixed Nets	Demersal Trawl Seine	Beam Trawl	Commercial Total
Total Catch 2012 (t)	10.4–19.9*	33.5	0.6	149.64	63.7	0.2	247.58
Landings Value 2012 (£m)	-	0.30	0.02	0.87	0.39	0.01	1.57
Final Economic Output (£m)	31.3	1.78	0.02	5.14	2.29	0.01	9.25
Employment Generated (FTE)	353	21.47	0.26	61.89	27.52	0.14	111.28
Final Economic Output per tonne of bass retained (£m/t)	1.6–3.0	0.05	0.04	0.03	0.04	0.05	0.04
FTE Generated per tonne of bass retained (FTE/t)	17.7–33.9	0.64	0.47	0.41	0.43	0.55	0.45

*Total retained catch of sea bass by recreational anglers.

4.1 Recreational Fisheries

4.1.1 Sea Angling

4.1.1.1 Overview

Recreational fishing is thought to be one of the sports with the highest levels of participation in England with an estimated ~884,000 people participating (Armstrong et al., 2013). Sea angling takes place from many towns along the Sussex coast. There are three main types of sea angling that take place: sea angling from charter vessels, shore angling and from private/rental vessels. Within these type of angling, there are also sub-types, in particular related to bass including fly-fishing, bait fishing and lure fishing. The main reason cited for targeting bass was the fact that it is a good sport fish in that they are fast and aggressive making it an exciting type of fishing (pers. comm. Sea anglers). The popularity of the Sussex region for sea angling may be in part due to its relative proximity to London where a large number of anglers are thought to live. Additionally, parts of the coast remain fairly accessible even in poor weather due to the shelter provided by the Isle of Wight so trips can be run consistently.

There are estimated to be 34 charter boats operating in the Sussex region (Sussex Angling Media, 2014). Guides and charter skippers reported that they would operate almost every day with good weather from April to the end of October (pers. comm. Angler 1; pers. comm. Angler 2). This equates to between 110-180 trips per year per vessel. Individual anglers going with these guides and skippers are thought to make between 4 and 20 trips per year. Many of these anglers will be coming from outside of Sussex. Other anglers who live locally are thought to make significantly more trips either by boat or shore angling (up to three trips per week).

The main fishing season is over the summer months from April until the end of October (pers. comm. Sea angler 1; pers. comm. Sea angler 2). Other species that anglers mentioned that they might target in addition to bass include mackerel (*Scomber scombrus*), cod (*Gadus morhua*), breem (*Spondylus cantharus*), pollock (*Pollachius pollachius*), dab (*Limanda limanda*) and plaice (*Pleuronectes platessa*) (pers. comm. Sea angler 1). Many anglers also travel abroad to target other sport fish including tuna and other bass species.

4.1.1.2 Economics and Employment Impact

Some types of sea angling (in particular fly fishing) can be expensive sports to participate in. Average annual expenditure is upwards of £1,300, one angler said that he spent up to £10,000 per year including foreign trips booked through his Sussex based guide (pers. comm. Sea angler 5). The gear used can range from £100 up to thousands of pounds depending on the quality and the regularity of upgrading (pers. comm. Sea angler 1; pers. comm. Sea angler 2). The cost of trips with a guide or charter skipper is around £200-450 total (which is split between the people renting the vessel and guide) (pers. comm. Sea angler 1; pers. comm. Sea angler 2). This takes into account the cost of fuel which has been increasing in price in recent years (pers. comm. Sea angler 1). Several anglers will travel down from London and other parts of the country and will stay in local hotels for several days spending £75-150 each per night (pers. comm. Sea angler 1; pers. comm. Sea angler 2, and pers. comm. Sea angler 6).

Analysis of the information presented in Defra Sea Angling 2012 allows estimations to be made regarding the recreational sea angling sector in Sussex and the economic impacts of recreational bass fishing.

The number of resident anglers in the Sussex district can be estimated as 40,014 (see Section 3.5.1). This estimate is approximately 20% lower than a previous estimate (50,000 anglers) given by the Sussex IFCA (Vause & Clark, 2011) based on figures in Drew Associates (2004). However, as the sea angling sector has reportedly changed since the publication of Drew Associates (2004) (Armstrong et al., 2013), it was considered appropriate to update this estimation of angling numbers using information reported in Armstrong et al. (2013). The final economic output of resident anglers is estimated to be £94.9 m which is based on an average spend per angler of £1,342/year and considers indirect and induced effects of angler expenditure. The average spend per angler is taken from Defra Sea Angling 2012 and was confirmed through consultations with anglers in the Sussex district: all anglers interviewed agreed that £1,342 was a reasonable estimate of individual angler annual expenditure. Employment generated by angling related expenditure is equivalent to 1069.7 FTE. The number of bass

landed in the Sussex district is estimated to range from 17.2–31.2 tonnes, with the proportion retained ranging from 10.4–19.9 tonnes.

Table 9. Direct Spend, Economic Output, FTE and Volume of sea bass landed in England and Sussex 2012

	England	Sussex
Total No. Of Anglers	884,304	40,014
Total Expenditure (£m)	1,232.6	55.8
Direct Spend (£m)	831.4	37.6
Final Economic Output	2,097.3	94.9
FTE Generated	23,619	1069.7
Bass Landed (t)	380–690	17.2–31.2
Bass Retained (t)	230–440	10.4–19.9

(Source: Armstrong et al., 2013)

The results presented above relate to employment and economic outputs generated from the entire recreational angling sector in the Sussex district. It would therefore be misleading to accredit these benefits entirely to bass angling. For the purpose of this study the economic output and FTE generated has therefore been scaled based on the estimate of the proportion of anglers who target bass (see Section 3.5.5). Targeting preference is used rather than catch compositions as fishers may be spending to catch bass but end up catching other species. However there will also be a number of fishers who are preferring to target other species (e.g. mackerel or sea bream) whose spending would be based on the tackle required to target these species. On this basis final estimated economic output and employment for anglers targeting bass was calculated (Table 10).

Table 10. Economic Output and FTE generated from bass fisheries in Sussex, assuming 33% of total angling expenditure can be attributed to bass

	Sussex
Final Economic Output (£m)	31.3
Employment Generated (FTE)	353
Final Economic Output/ tonne of bass retained (£m/t)	1.6–3
FTE Generated/ tonne of bass retained (FTE/t)	17.7–33.9

It should be noted that the proportion of anglers that state bass as a target changes depending on whether you consider anglers that state bass as a primary target species (20%) or those that state bass as one of many target species (33%). If economic output and FTE generated is scaled based on the proportion of anglers that state bass as a primary target species, alternative economic outputs can be generated for bass fisheries in Sussex can be calculated (Table 11).

Table 11. Economic Output and FTE generated from bass fisheries in Sussex, assuming 20% of total angling expenditure can be attributed to bass

	Sussex
Final Economic Output (£m)	20.9
Employment Generated (FTE)	235.3
Final Economic Output/ tonne of bass retained (£m/t)	1.0 – 2.0
FTE Generated/ tonne of bass retained (FTE/t)	11.8 – 22.6

The economic outputs presented table 11 have not been used in any further calculations or results presented within this report.

4.1.1.3 Environmental Impacts

The environmental impacts from recreational fishing are thought to be low as there is generally little interaction between the gear and the habitats. An angling guide estimated that 3–4 tonnes of bass had been caught on his vessel in a year of which around 500 fish area retained (pers. comm. Sea angler 1). Most recreational fishers reported that they return the majority of their catch (retention rates ranged from 1–20% of catch) and this often depends on the size of the fish caught – smaller fish are generally returned. All anglers consulted stated that any fish they retain are for personal consumption. These figures are consistent with other studies (e.g. Armstrong et al. 2013).

While there is a recognition amongst recreational fishers of the benefits of catch and release and the majority of fish appear to be released, it is accepted that there will be a level of mortality associated with the post capture release of bass. Mortality estimates have been estimated (e.g. Armstrong et al., 2013) and there remains some uncertainty about post release survival of bass, partly it may vary depending on the type of angling (Bartholomew & Bohnsack 2005). In studies conducted on striped bass in America, it was found that striped bass caught with live bait were more likely to be hooked deeper leading to greater mortality while few differences in mortality were found between artificial and natural baits for these species (Nelson, 1998; Diodati & Richards, 1996). The mortality rate of released fish will result in a higher mortality of bass in the population than just those that are removed. Given the context of the study of the need to reduce overall mortality of bass, for the purpose of this study we have adopted precautionary estimate of 20% (ICES, 2013).

4.1.1.4 SWOT Analysis

The main perceived strengths of the recreational sector include the fact that it makes important contributions to the economy overall and to the local economies in coastal locations. Importantly recreational fishing for bass can be an activity with relatively low costs of entry but also with the possibilities of considerable levels of spending depending on the type of fishing pursued. Furthermore, these benefits are gained at the expense of relatively low impact on bass stocks or to the wider environmental as the rate of retention tends to be low and there are few interactions between the gear and the seabed (pers. comm. Sea angler 1). Anglers consider these impacts to be significantly smaller than those of the commercial fleets (pers. comm. Sea anglers). There is thought to be a strong conservation ethic amongst anglers who are also seeking to organise and are pushing to increase the minimum landing size of bass in an attempt to allow the stocks to recover (pers. comm. Sea angler 3). Sea angling gives people an opportunity to access nature and natural resources (pers. comm. Sea angler 1).

A key weakness is that the benefits from recreational fishing appear to be related to perceptions of the status of the stocks. If people do not feel that they have much of a chance of catching a fish they are less likely to invest in the activity or will choose to fish in other locations. In this study respondents said that the perceived poor state of the bass stock is leading to anglers going elsewhere (often outside the UK) to fish or moving to other sports such as golf which are thought to be more reliable (pers. comm. Sea angler 1; pers. comm. Sea angler 4). There may be some environmental impacts from shore anglers leaving waste on the beach which can impact the marine or coastal environments (pers. comm.

Sea angler 2). While the environmental impacts are considered low and release rates high, anglers are thought to take fish for consumption that go unreported (pers. comm. Sea angler 3). This could contribute to the overall levels of fishing mortality of the stock.

Anglers believed that with effective management and policy in place, a thriving bass fishery could support increased levels of recreational participation and a viable commercial fishery (pers. comm. Sea angler 1). Having a sustainable fishery with fish perceived to be fairly abundant it could limit the number of anglers going elsewhere to fish (either elsewhere in England or abroad), potentially increasing the money coming into Sussex (pers. comm. Sea angler 1). Other opportunities to restore stocks and thereby the opportunity for recreational fishing include management measures aimed at increasing minimum landing sizes and the introduction of measures to protect nursery areas (pers. comm. Sea angler 1; pers. comm. Sea angler 5). Anglers also suggested the introduction of areas of angling excellence where anglers pay to fish and commercial angling is banned (pers. comm. Sea angler 3). Another opportunity mentioned for the sector was the provision of information on the fisheries or stock, for example posting signs similar to those used by the RSPB to indicate that an area is a nursery area for bass (pers. comm. Sea angler 1).

The main weakness of this sector was cited as the limited management and policing in the area and that it is difficult to manage or enforce any restrictions on the sector (pers. comm. Sea anglers). The minimum landing size is thought to have been set too low at 36cm which is lower than the size of maturity of bass (most female bass are sexually mature at 45cm) meaning that recruitment overfishing may be taking place (pers. comm. Sea angler 1). Threat to recreational fishing were viewed mainly in terms of impacts on the stock from commercial fishing, in particular from pair trawling and drift netting and the impacts on the seabed from these fishing techniques (pers. comm. Sea angler 1; pers. comm. Sea angler 2). There is also thought to be a lack of understanding of biological characteristics of bass such as fecundity and recruitment which has led to a lack of mature fish which has in turn led to decreasing levels of recruitment to the stock (pers. comm. Sea angler 1). The popularity of eating bass is also thought to be a threat as it is driving demand meaning that the species tends to be of high value so may be exploited more than it would be if prices were lower (pers. comm. Sea angler 1). This could also be leading to illegal fishing due to the price incentive of selling bass (pers. comm. Sea angler 1).

4.2 Commercial Fisheries

4.2.1 Commercial Sea Bass Fishing Methods in Sussex

Bass are caught within the Sussex district as both a target and bycatch species by a number of commercial fishing gears. Consultations with the region's fishers, alongside a review of the literature and available catch statistics, indicates that the majority of the district's recent commercial catches can be attributed to four main fishing gears: Stern trawling (demersal otter trawls); pair trawling; driftnetting (inshore and offshore) by vessels under 10 m; and rod and line fishing by vessels under 10 m (Vause & Clark, 2011; pers. comm. Sussex IFCA representative; pers. comm. MMO representative; MMO, 2014).

In terms of the district's catch volume of bass, available literature states that stern trawling and pair trawling are responsible for the majority of catches (Vause & Clark, 2011). However, publicly available catch statistics for Sussex ports (Table 12) indicates that, between 2009 and 2013, catches from drift and fixed nets are responsible for ~60% of the region's bass catch, demersal trawls/seines are responsible for ~27%, and gears using hooks are responsible for ~13%.

Table 12. Landings of bass from commercial fishing gears into Sussex ports by gear type and percentage contribution of each gear to total bass landings (2009–2013)

	2009		2010		2011		2012		2013	
Gear	Catch (t)	% of Total	Catch (t)	% of Total	Catch (t)	% of Total	Catch (t)	% of Total	Catch (t)	% of Total
Beam Trawl	0.76	0.6	0.72	0.5	0.47	0.3	0.25	0.1	0.3	0.1
Demersal Trawl/ Seine	35	26.7	35	24.7	54	31.0	63.7	25.7	71	28.9
Dredge	0.06	0.0	0.00	0.0	0.35	0.2	0.01	0.0	0.0	0.0
Drift and Fixed Nets	75	57.1	83	58.5	102	58.6	149.6	60.4	149	60.7
Gears Using Hooks	20	15.2	23	16.2	16	9.2	33.5	13.5	25	10.2
Pots and traps	0.37	0.3	0.81	0.6	0.93	0.5	0.56	0.2	0.24	0.1
Total	131.3	100	141.9	100	173.9	100	247.6	100	245.5	100

(Source: MMO, 2014)

The number of vessels catching bass using each of the four gears identified is difficult to discern due to the polyvalent nature of the district's vessels; the majority of active fishing vessels are under 10m and will change target species and gears multiple times throughout a year depending on a number of factors, such as including environmental conditions and the availability of quota for species. Information collected through consultations with the Sussex IFCA, MMO and fishers reveals that ~200 vessels are operating from ports in Sussex: 15 trawlers (beam and stern), five longliners, six pair trawlers, 10–12 commercial rod and line and ~160 vessels netting or potting. Further consultations with fishers indicate that, in terms of vessel numbers, driftnets and rod and line are the most commonly used gears to target bass commercially.

Consultations indicate that bass is an extremely important species in regards to the livelihoods of the district's fishers. However, the degree individual fishers depend on bass as a source of income varies considerably. For example, some of the commercial rod and line fishers operating in under 10m vessels are almost completely reliant on bass for their income, catching approximately 4–5 tonnes of bass annually (pers. comm. rod and line fisher). Conversely, fishers using stern trawls or fixed nets may only catch bass infrequently in small numbers while targeting other species. A comparison of bass landings and total landings (all species) in Sussex ports since 2009 indicates that bass constitutes between 1.1–2.4% (Table 13) of total commercial landings by volume; a further breakdown of the extent bass contributes to total landings by gear type is included in Table 13. A comparison of point of first sale

values since 2009 shows that bass annually constitutes 4.2–9.5% of the landings values for Sussex ports (Table 14); the relative importance of bass landings value to each gear type is presented in Table 14.

Table 13. Landings of sea bass compared to total landings (all species) into Sussex ports (2009-2013)

2009			2010			2011			2012			2013			
Gear	Catch bass (t)	Catch total (t)	% of Total	Catch bass (t)	Catch total (t)	% of Total	Catch bass (t)	Catch total (t)	% of Total	Catch bass (t)	Catch total (t)	% of Total	Catch bass (t)	Catch total (t)	% of Total
Beam Trawl	0.76	426	0.18	0.72	439	0.16	0.47	311	0.15	0.25	359	0.07	0.30	360	0.08
Demersal Trawl/ Seine	35	929	3.76	35	724	4.78	54	1,016	5	63.7	930	7	71	1 153	6.1
Dredge	0.06	5,534	0.00	0.00	8,535	0.00	0.35	7,744	0.00	0.01	6,285	0.00	0.00	3 671	0.00
Drift and Fixed Nets	75	1,524	4.95	83	1,091	7.62	102	1,217	8	149.6	935	16	149	962	15.5
Gears Using Hooks	20	29	68.26	23	27	82.38	16	19	83	33	37	89	25	30	84.9
Pots and traps	0.37	1,362	0.03	0.81	2,339	0.03	0.93	2,116	0.04	0.56	3,664	0.02	0.24	3 980	0.01
Total	131.27	9804.06	1.34	141.78	13154.51	1.08	173.99	12422.63	1.40	247.59	12210.09	2.03	245.36	10155.30	2.4

Table 14. Point of first sale value of sea bass landings compared to total landings value (all species) into Sussex ports (2009–2013).

2009			2010			2011			2012			2013			
Gear	Catch bass (£)	Catch total (£)	% of Total	Catch bass (£)	Catch total (£)	% of Total	Catch bass (£)	Catch total (£)	% of Total	Catch bass (£)	Catch total (£)	% of Total	Catch bass (£)	Catch total (£)	% of Total
Beam Trawl	5,287	1,464,058	0.4	5,612	1,484,862	0.4	3,691	1,128,678	0.3	1,908	1,167,778	0.2	2,125	1,040,134	0.2
Demersal Trawl/ Seine	221,529	2,000,495	11.1	231,258	1,563,225	14.8	364,435	2,674,002	13.6	387,570	2,168,164	17.9	464,501	2,592,494	17.9
Dredge	388	7,520,941	0.0	4	12,649,887	0.0	2,531	14,344,350	0.0	63	9,476,974	0.0	15	6,182,167	0.0
Drift and Fixed Nets	503,325	4,200,159	12.0	512,382	3,926,631	13.0	718,802	4,626,269	15.5	871,725	3,458,620	25.2	965,374	3,400,699	28.4
Gears Using Hooks	157,977	184,391	85.7	195,371	201,511	97.0	150,763	159,582	94.5	302,433	310,402	97.4	225,996	235,255	96.1
Pots and traps	2,292	1,451,059	0.2	6,546	2,646,169	0.2	6,595	2,497,519	0.3	3,712	3,823,013	0.1	1,730	4,005,483	0.0
Total	890,798	16,821,103	5.3	951,173	22,472,284	4.2	1,246,818	25,430,400	4.9	1,567,412	20,404,951	7.7	1,659,741	17,456,231	9.5

4.2.2 Driftnet Fishing

4.2.2.1 Overview

Driftnet fishing is commonly practiced along the Sussex coast and has long been associated with Sussex fishers. Two distinct driftnet fisheries are widely regarded to exist along the coast: a pelagic fishery for herring (*Clupea harengus*) and mackerel, and an inshore bass fishery. However, the recent evolution of an offshore driftnet fishery targeting bass means that the region's bass driftnet fisheries can be separated into two components: inshore and offshore.

In contrast, the inshore driftnet fishery is acknowledged to have existed for many years (40+ years), occurs all year round and within 3nm of the shore (pers. comm. Driftnet Fisher 1). Inshore driftnetting for bass occurs following periods of high wind (reduced water visibility) as bass move closer to the surface.

The offshore driftnet fishery for bass operates approximately 10 miles from shore and is primarily conducted at night by vessels under 10 metres in length between October and early January (pers. comm. Driftnet Fisher 1, 2, 3). During this period fish move offshore and form feeding aggregations where they prey on herring - it is when bass come to the surface to feed that they are targeted by driftnets (pers. comm. Driftnet Fisher 1, 2, 3). From January onwards bass are thought to migrate to spawning areas located in the south west and are considered to be out of range of most vessels operating from the ports and harbours of Sussex.

The offshore bass fishery is thought to have started in 2008, with the trigger for diversification into this fishery originating from the implementation of the registration of buyers and sellers legislation, and small quota allocations for cod, plaice and skates and rays. As bass is a non-quota species, it allowed fishers to supplement income lost from reduced catches of other species – primarily cod which was reduced to 50 kg/month/vessel in 2008 (pers. comm. Hastings Fisheries Protection Society representative).

Driftnetting for bass is therefore seen as extremely important to fisher livelihoods in the Sussex region as it is regarded, by all commercial fishers interviewed, that there is a lack of alternative species to target due to restricted quotas.

Fishing effort for the driftnet fishery varies substantially between the offshore and inshore component. Offshore driftnetters reportedly fish 1–3 days a week during the winter months (pers. comm. Driftnet Fishers), dependent on conditions. This equates to 12–36 days of fishing effort per vessel³. The polyvalent nature of vessels unfortunately made it difficult to establish how many vessels are actively driftnetting for bass in the region as many boats will change gear and target species multiple times a year.

4.2.2.2 Economic and Employment Impact

The results presented below represent the economic impacts derived from bass catches in drift and fixed net fisheries. It was not possible to allocate proportions of the catch to the specific net gears using publicly available catch statistics. The catches reported below therefore include the landings of the targeted driftnet fisheries and any bass bycatch that occurs in fixed net fisheries. Applying the economic multipliers presented in Seafish (2007) to a bass landings value £0.87 million leads to a final economic impact of £5.14 million and generated employment of 61.89 FTEs.

³ Assuming a winter fishing season for sea bass of 12 weeks.

Table 15. Economic and Employment Impact of Drift and Fixed Net Fisheries

	Drift and Fixed Nets
Total Catch 2012 (t)	149.64
Landings Value 2012 (£m)	0.87
Final Economic Output (£m)	5.14
Employment Generated (FTE)	61.89
Final Economic Output per tonne of bass retained (£m/t)	0.03
FTE Generated per tonne of bass retained (FTE/t)	0.41

4.2.2.3 Environmental Impacts

The environmental impacts of driftnets are debated and considered to vary significantly between fisheries (as reported in Master, 2014). For example, large scale driftnet fisheries in the Mediterranean are considered to have substantial bycatch of marine mammals and other endangered and threatened species (Silvani et al., 1999; EJJ, 2007). Whereas small-scale driftnet fisheries operating from the UK using small mesh sizes have been previously reported as having minimal environmental impacts; herring driftnet fisheries operating from Hastings are reported to have limited interactions with Endangered, Threatened or Protected (ETP) species (Hough et al., 2009).

No comprehensive evidence documenting the environmental impacts of the driftnet fisheries in Sussex exist, although it has been previously noted that bass driftnets operating with a mesh size of 90–100 mm may result in incidental catch of Allis shad (*Alosa alosa*) and Twaite shad (*Alosa fallax*): a UK biodiversity action plan species (Carleton et al., 2009a). Furthermore, consultations with stakeholders reveals conflicting anecdotal evidence regarding the environmental impacts of this fishery: a number of stakeholders indicate that there are no significant bycatch issues, whereas others indicate that there may be issues relating to cetacean bycatch. It is recommended that this issue is further investigated to determine the extent of environmental impacts associated with these fisheries.

4.2.2.4 SWOT Analysis

The main strength of the driftnetting sector targeting bass was that this fishery provides a fishing opportunity where there are no other species available to catch as they are under quota (pers. comm. Driftnet fishers). Additionally, the fact that bass prices can be high was a further strength identified (pers. comm. Driftnet fisher 1). Environmentally, some fishers and the IFCA reported that the level of bycatch caught by driftnets is low (pers. comm. Driftnet fisher 2, pers. comm. IFCA representative).

The main weaknesses identified related to offshore driftnetting. The extent of fishing in the winter months is thought to lead to a large amount of bass flooding markets and prices being driven down (pers. comm. Driftnet fisher 1). In addition, driftnetting is regarded to be a dangerous method of fishing as it occurs at night and within a busy shipping lane. Fishers also reported that there is a perception that net limits on driftnets were not enforced due to inadequate policing and that the existing conservation measures may be inadequate (pers. comm. Driftnet fisher 3).

Fishers suggested that there is an opportunity to maintain a sustainable driftnet fishery if groups from the various segments could cooperate to agree on restrictions to the fishery and to establish enforcement mechanisms across the board (pers. comm. Driftnet fishers 1, 2, 3). They believe that these would be better accepted by all groups if they were able to cooperate on these changes (pers. comm. Driftnet fishers 1, 2, 3). The Sussex IFCA recognises that there is an opportunity to amend and extend existing bass nursery legislation into other locations in the District, including a new large scale coastal management realignment scheme and an existing marine Special Protection Area (SPA).

Many of the threats to the fishery identified by fishers relate to restrictions that fishers felt were not proportionate to the fishing impacts from driftnets but they felt that failure to regulate the fishery is also a threat (pers. comm. Driftnet fishers; pers. comm. Driftnet fisher 1). Fishers want other segments to be better regulated, including recreational fishing which remains unregulated and the French pair trawlers who they consider to be overexploiting the stocks (pers. comm. Driftnet fishers). Fishers agreed that

there is a lack of opportunity to diversify into other fisheries from the driftnet sector due to the lack of quota (pers. comm. Driftnet fishers).

4.2.3 Commercial Rod and Line

4.2.3.1 Overview

Commercial rod and line fishing is regarded as a popular fishing method in the Sussex district, with involved fishers targeting bass, cod, pollock and ling (*Molva molva*) (Vause & Clark, 2011). Fishers targeting bass reportedly use fast under 10 m vessels and fish a variety of inshore and offshore areas, actively seeking prime fishing locations (pers. comm. Commercial Rod and Line Fisher 1). The fishing season for rod and line fishers targeting bass is primarily during the summer months, starting in April and extending to October.

Estimations of vessel numbers from fishers and fishery managers corroborate that ~10–12 vessels were actively using rod and line to target bass commercially in 2014 (pers. comm. Rod and line fisher 3; pers. comm. MMO representative). Each of these vessels is estimated to have been active between 12 and 24 days per month for a period of seven months, equalling 288–672 fishing days annually per active vessel or 2,880–8,064 fishing days for the sector.

Consultations indicate that bass are an extremely important species to commercial rod and line fishers: all commercial rod and line fishers consulted declared that they were dependent on bass for the majority of their income. Annual catch rates reported by each of the fishers interviewed ranged between 3–5 tonnes of bass annually. The importance of bass to this group can be further illustrated by comparing total catches and bass catches of gears using hooks (Table 16). Catch statistics indicate that bass constitute 81.7% of total catches by volume.

Table 16. Total catches and catches of sea bass in the Sussex district from fishing gears using hooks (2009–2013)

Year	Total Catch (t)	Bass Catch (t)	% of Total Catch
2013	29.9	25.3	84.6
2012	37.5	33.5	89.3
2011	19.9	16.3	82.0
2010	27.7	22.6	81.8
2009	29.3	20.1	68.5
Total	144.2	117.8	81.7

(Source: MMO, 2014)

4.2.3.2 Economic and Employment Impacts

The results presented below represent catches and economic impacts derived from bass catches from gears using hooks. Applying the economic multipliers presented in Seafish (2007) bass landings volume of landings value £0.30 million leads to a final economic impact of £1.78 million and generated employment of 21.47 FTEs.

Table 17. Economic and Employment Impact of sea bass catches in Sussex from Drift and Fixed Nets

	Gears Using Hooks
Total Catch 2012 (t)	33.5
Landings Value 2012 (£m)	0.30
Final Economic Output (£m)	1.78
Employment Generated (FTE)	21.47
Final Economic Output per tonne of bass retained (£m/t)	0.05
FTE Generated per tonne of bass retained (FTE/t)	0.64

(Source: MMO, 2014)

4.2.3.3 Environmental Impacts

Rod and line fisheries are generally viewed as extremely selective and as having few associated environmental impacts, apart from the direct removal of fish and post-hooking mortality of undersized fish that are returned. Rod and line fishers consulted confirm this point as they estimated that ~95% of their catches were composed of their target species (bass) and stated that bycatch was minimal (pers. comm. Commercial Rod and Line Fisher 1, 2, 3). Furthermore, a review of the UK inshore fisheries sustainability project (Carleton et al., 2009a) reveals that no major environmental concerns have been previously highlighted for the rod and line fishery for bass in the Sussex district. However the study also notes that there are currently no formal records quantifying or describing the type and frequency of interactions with ETP species.

4.2.3.4 SWOT Analysis

The main identified strength of the rod and line fishery is that it is a selective fishery delivering a high value product in the summer months (pers. comm. Rod and line fisher 1). This is due to the large size and good condition of fish caught by this method.

The weaknesses identified by rod and line fishers included the fact that there are high overheads on rod and line fishing as a lot of money is spent on fuel (pers. comm. Rod and line fisher 1) and it is less efficient than other commercial methods (pers. comm. Rod and line fisher 2).

The IFCA believe that there is potential to expand this fishery through increased marketing of rod and line caught bass as they are higher quality and larger fish (pers. comm. IFCA representative). IFCAs suggested that inshore nursery areas could be protected from all types of fishing to help to protect the stock (pers. comm. IFCA representative).

External threats to the fishery identified by fishers included the failure to regulate this sector as well as others. In particular it was highlighted that the angling sector remains unregulated and that they catch and retain significant quantities of bass (pers. comm. Rod and line fishers). French pair trawlers are seen to be impacting bass stocks and stocks of bait fish used by the rod and line fishers are also caught by pelagic trawlers operating in the channel (pers. comm. Rod and line fisher 1). Fishers suggested that the fishery is poorly managed and regulations are not enforced. One fisher said that he had not been boarded for inspection for three years, suggesting that illegal activity may not be detected or reported (pers. comm. Rod and line fisher 2).

4.2.4 Trawling

4.2.4.1 Overview

Pair Trawling

Pair trawlers operating in the Sussex district target black sea bream (*Spondyliosoma cantharus*) and catch bass as a high value bycatch species (Vause et al., 2011; pers. comm. Driftnet fisher and former pair-trawl fisher; pers. comm. MMO representative). Pair trawling activity in the district is regarded to be highly seasonal and geographically restricted, occurring during spring months between Selsey Bill and Shoreham-by-sea (Vause et al., 2011). Consultations with fishers and fishery managers in the region indicates that the activity of pair trawlers operating from Sussex ports during 2014 is limited to approximately two or three pairs of vessels (pers. comm. MMO Representative; pers. comm. Sussex IFCA representative). Pair trawl vessels are regarded to operate from the ports of Newhaven and Shoreham (pers. comm. MMO Representative; pers. comm. IFCA Representative).

Outside of the main pair trawl season for black sea bream, pair trawl fishers are understood to switch to other fishing methods such as stern trawling (pers. comm. MMO Representative).

Stern Trawling

Stern trawling activity off the coast of Sussex can be separated into two different types of gear: rock hopper otter trawl and small footrope otter trawl. Rock hopper otter trawls reportedly target cod, whiting, lemon sole and bass, whereas small footrope otter trawl target plaice, sole, codling and cuttlefish (Vause & Clark, 2011). To the contrary of what is presented in Vause & Clark (2011), consultations with

fishery managers indicate that bass are not targeted by stern trawlers but can be caught as a bycatch species (pers. comm. MMO representative; pers. comm. Sussex IFCA Representative).

Otter trawling

Otter trawling activity is thought to occur over a significant proportion of the Sussex IFCA district within six nautical miles of shore with particularly high concentrated levels of activity in the central area of the district south of Beachy Head, in the east from Hastings to Rye Bay and within Chichester Harbour, between Littlehampton to Eastbourne and from Hastings to Rye (pers. comm. Sussex IFCA representatives). Relative fishing effort maps developed by the Sussex IFCA/SFC since 2014 describe the observed spatial distribution of fishing activity and fishing methods within the District. Fishery managers consulted estimate that up to 15 vessels operating from Sussex ports are actively stern/beam trawling (pers. comm. IFCA Representative).

Publicly available catch statistics do not provide the resolution required to discern the current volume of bass caught and landed by pair trawlers or stern trawlers. This is due to catches from both stern trawlers and pair trawlers being aggregated under the demersal trawl/seine category in the MMO catch statistics. The results presented below therefore represent catches and economic impacts derived from bass catches from stern trawlers and pairtrawlers combined. Applying the economic multipliers presented in Seafish (2007) bass landings volume of landings value £0.39 million leads to a final economic impact of £2.29 million and generated employment of 27.52 FTEs.

Table 18. Economic and Employment Impact of sea bass catches in Sussex from Demersal Trawls and Seines

	Demersal Trawl Seine
Total Catch 2012 (t)	63.7
Landings Value 2012 (£m)	0.39
Final Economic Output (£m)	2.29
Employment Generated (FTE)	27.52
Final Economic Output per tonne of bass retained (£m/t)	0.04
FTE Generated per tonne of bass retained (FTE/t)	0.43

(Source: MMO, 2014)

4.2.4.2 Environmental Impacts

Pair Trawling

The environmental impacts of pair trawlers operating in European waters has been well documented in recent years. Significant levels of cetacean bycatch has been reported from UK pair trawlers targeting bass in ICES area VIId, with an estimated average of ~180 dolphins bycaught annually between 2001-2006 (Northridge, 2006). However, this relatively high rate of dolphin bycatch has been considered to be attributed to circumstances restricted to area VIId: during winter months dolphins move from their summer offshore habitats to aggregate in this area and, concurrently, pair trawler activity increased in this area as they target winter of spawning aggregations of bass (de Boer, 2012).

The environmental impacts of the pair-trawl fishery operating in the Sussex district is not as well studied, but it has been recently examined as part of the UK Inshore Fisheries Sustainability Project (Dapling et al., 2010). Conclusions from the study indicate that there is insufficient information available on the extent and composition of discards and bycatch from this fishery. To support selectivity of pair trawlers, byelaw regulation (Fishing Instrument Byelaw, 2011) defines spatial and temporal requirements for a minimum 95 mm mesh size for a pair trawl cod end. Further provisions to reduce discards from pair trawlers remain undeveloped. The study also states that further work is required to demonstrate/mitigate the impact of shallow-water pair on the seabed. The environmental impacts of pair trawlers capturing bass in the region are therefore uncertain.

Stern Trawling

Demersal otter trawls are designed for catching demersal species located on, or just above, the seabed (FAO, 2008). An otter trawl net consists of a cone shaped body and a cod end which retains the catch. Otter boards – large rectangular boards constructed of timber or steel – are positioned at the net opening and function to keep the gear in contact with the ground and maintain the net opening. As the trawl is towed along the seabed the gear disturbs the sediment, driving species into the net. The environmental impact of demersal trawling has been well documented by a number of studies, and it is commonly acknowledged that trawling can alter species composition and structure of benthic communities (Jennings et al., 2001). Concerns regarding impacts of trawl fisheries in the Sussex region have been previously highlighted by Carleton et al. (2009b).

4.2.4.3 SWOT Analysis

The potential strengths of the pair trawling sector include the efficiency of using this gear – high fishery yields.

The IFCA suggested that the main weakness of the pair trawling sector is that it has the highest 'carbon footprint' as the vessels use a lot of fuel and there is environmental damage caused by contact between the gears and the seabed. There is thought to be bycatch (apart from bass) associated with these fisheries including interactions with dolphins. Work has been conducted on mitigation measures for bycatch (particularly of dolphins) in pair trawls around the UK. These include the use of acoustic deterrents, escape panels and exclusion devices (Northridge, 2006). Some of the fisheries are highly seasonal and can only operate in a narrow geographical area.

4.2.5 Other Gears

4.2.5.1 Overview

From the MMO landing statistics it was evident that a relatively small volume of bass landings in Sussex can be attributed to pots and traps, and beam trawls. Furthermore, these gears were not identified during the literature review or stakeholder consultations as contributing significantly to bass catches in the region. Therefore the economic and environmental impacts have not been extensively considered in our discussion or a SWOT analysis conducted for either of these gears.

4.2.5.2 Economic and Employment Impacts

Table 19. Economic and Employment Impact of sea bass catches in Sussex from Pots and Traps and Beam Trawls

	Pots and Traps	Beam Trawl
Total Catch 2012 (t)	0.6	0.2
Final Economic Output (£m)	0.004	0.002
Employment Generated (FTE)	0.26	0.14
Final Economic Output per tonne of bass retained (£m/t)	0.04	0.05
FTE Generated per tonne of bass retained (FTE/t)	0.47	0.55

4.3 Markets

There are several wholesalers operating in the Sussex region. One of the key wholesalers has approximately 30 boats bring their catches to seller to sell on the behalf of the fishers. The majority of the fishers come from Eastbourne while the rest come from Newhaven. The market for bass is seasonal based on the changing distribution of bass and the fisheries targeting them.

During the summer, bass comes into the wholesaler from rod and line fishers but over the winter months significantly more bass comes from the driftnet fishers who target larger bass by using 6" mesh nets.

During this winter driftnet season, a typical catch brought into the wholesaler from one vessel would be approximately 190kg of 2-3kg fish and 150kg of 1.5-2kg. Bass are sold at different prices per kilogram depending on the size of the fish. The 1.5-2kg fish tend to be sold for around £6/kg, the 2-3kg fish are sold for between £9 and £12.50/kg and any fish over 3kg are sold for £11-12/kg. The wholesaler takes a commission of 9% of the price of the fish so fishers would receive approximately £5.50/kg for 1.5-2kg fish (a total of £691 based on approximately 126 fish), £9/kg for 2-3kg fish (a total of £545 based on approximately 60 fish) and £10.50/kg for 3kg+ fish. Fishers would therefore receive around £1,235 per trip based on the average catches and prices. Not all of the fish from these vessels are always taken to this wholesaler, they may be taken elsewhere, either to other wholesalers or to other parts of the country if the fishers feel that there is too much for the wholesaler to handle.

This wholesaler tends to sell to other wholesalers and suggested that not much of the fish stays in the UK as it is expensive. Between a third and a half of fish he sells goes to foreign markets, mainly in France and Belgium.

In addition to the legitimate markets identified, the combination of high demand for bass (and high prices) together with opportunities to sell directly to consumers mean that there are opportunities for bass to be sold illegally. Anecdotal evidence from both commercial and recreational fishers suggest that this is happening but the scale and extent of this issue is unknown and its potential to contribute to the regions bass removals and local economy cannot be estimated.

It should also be noted that there are potentially existing markets that would permit bass landings to go unrecorded. Article 65(2) of the EU Control regulation (EU Regulation 1224/2009) allows the disposal of up to 30kg of fish for personal consumption without supplying sales slips. This could result in significant volumes of unreported catches depending on the extent of this activity in the region. The registration of buyers and sellers legislation (2005) in the UK also permits unregistered buyers to buy up to 30kg of fish on a given day if they are for private consumption. Some of the stakeholders consulted as part of this study indicate that this activity may be widespread (pers. comm. Angling Trust Representative).

5 Discussion

5.1 Sea Bass Removals

Comparing estimated recreational fishery catches (Section 3.5.4) and commercial fishery catches reported in the MMO catch statistics allows conclusions to be drawn regarding the varying degree of exploitation between the two sectors. A total catch of 257.98–267.48 tonnes is estimated: commercial fisheries in Sussex reportedly landed 247.58 tonnes, whereas recreational fisheries are estimated to have landed 17.2–31.2 tonnes. Of the recreational catch, 10.4–19.9 tonnes of bass are estimated to be retained (6.8–11.3 tonnes caught and released). Recreational fishery removals can be further modified by taking account of post hooking mortality (bass which are caught and released by anglers but subsequently die due to the trauma of being landed). If this is assumed to be 20% (as used in ICES, 2013; Armstrong & Drogue, 2014), total numbers of removed bass for both sectors increases to 265–275.36 tonnes, whereas recreational removals increases to 11.76–22.16 tonnes. From this analysis it can be estimated that commercial fisheries across Sussex are responsible for approximately 11–24 times the removals of bass by recreational fisheries. However, it must be noted that the actual rate of removals of bass by recreational fisheries in the Sussex region is unknown and these figures are estimations based on national removals presented in Armstrong et al. (2013).

5.2 Economic Impacts

The economic analysis presented in Section 4 provides an estimation of the wider economic impacts stemming from expenditure related to commercial and recreational bass fisheries in Sussex. A comparison between these two sectors shows that the recreational bass fisheries have a higher economic output than commercial fisheries, generating £31.3 million of economic output and 353 FTE (when indirect and induced effects are considered). Analysis of commercial fisheries by the five gear groupings indicates that the economic impacts range from £0.01–5.14 million, and 0.14 and 61.89 FTE (when indirect and induced effects are considered). When commercial fisheries are grouped, the total economic impact is estimated at £9.25 million and 111.28 FTE. From the analysis performed in this study it can therefore be inferred that recreational bass fisheries in Sussex have 3.4 times the economic impact in terms of financial outputs to the economy and 3.2 times the economic impact in terms of Employment (FTE).

This study therefore concludes that recreational bass fishing in Sussex has a higher overall economic impact than commercial bass fisheries. These findings are consistent with other studies that state that the value of recreational fisheries often outweighs that of commercial fisheries (e.g. Cooke & Cowx, 2006), and findings from previous studies that have sought to compare the economic impacts of these two sectors (Southwark Associates, 2006). For example, a study conducted by Southwark Associates (2006) on US Fisheries indicates that the economic impact of recreational fisheries is approximately 3.5 times that of commercial fisheries; a rate comparable to the rate presented by this study.

5.3 Environmental Impacts

Recreational fisheries are widely regarded as having few environmental impacts apart from the direct removal of fish (fish that are kept by anglers) and those that die after being caught and released (post hooking mortality). However, this does not necessarily mean the environmental impacts of angling are minimal. The scale of participation means that recreational fishers can be responsible for significant landings which have the potential to contribute to fishery declines (Cooke & Cowx, 2004). Armstrong et al. (2013) estimates that recreational angling in England was responsible for between 230–440 tonnes of retained bass in 2012. When compared to commercial landings of 897 tonnes for the UK in 2012 (Armstrong et al., 2013), recreational fishing in England alone was responsible for 20.4–32.9 % of total bass catches in the UK. In Sussex, the contribution recreational fisheries to total removals of bass was estimated as ~4–7 %. This is much lower than the national contribution of recreational fisheries, and can be partly explained by the relatively high volume of commercial bass landings in Sussex compared to the national total.

Commercial fisheries operating in Sussex have a range of potential environmental impacts. In the first instance, commercial bass fisheries in the UK are estimated to remove around 2–4 times that the volume of recreational fisheries. However, removals of commercial fisheries in the UK must also be

considered in the wider context of European fisheries: commercial UK fisheries are responsible for approximately 14% of total bass landings from the focal stock, whereas commercial French fisheries are responsible for approximately 49% (Table 2). Apart from the direct removal of fish biomass, other potential environmental issues can vary depending upon factors such as the gear used, the time of year, and location. For commercial rod and line fishers, no significant environmental issues are thought to exist apart from the direct removal of fish and post-hooking mortality of fish that are returned to the sea (predominately due to fish being under the MLS); this was corroborated through stakeholder interviews and recent reviews of the fishery conducted by Dapling et al. (2010). For driftnet fisheries the environmental impacts are more uncertain; conflicting opinion exists amongst stakeholders regarding environmental issues. However, this evidence is anecdotal and further work is required to establish the potential impacts. The environmental impacts of trawl fisheries are well documented in other regions. Pair trawl fisheries targeting bass in other regions have been associated with high cetacean bycatch (Northridge, 2006), although this does not seem to be a recorded issue with pair trawl fisheries operating in the South East. Dapling et al. (2010) notes that information is insufficient to determine if environmental issues exist with the Sussex pair trawl fishery and that no measures have been implemented to mitigate potential issues. Demersal trawl fisheries (stern trawl fisheries) are known to have significant impacts on benthic environments as the gear interacts with the sea floor. These issues are well documented in a number of studies (See Section 4.2.4.2).

It should be noted that additional removals of bass may be occurring due to legal and illegal unreported landings. As discussed in section 4.3 legal unreported landings will occur due to allowances in EU Control Regulation and UK legislation (Registration of Buyers and Sellers, 2005). Consultations with commercial and recreational fishers provides anecdotal evidence that unlicensed fishing and selling of bass may be occurring, with fishers selling their catch directly to consumers, restaurants and/or hotels. Despite suggestions from a number of different groups and individuals that this unlicensed commercial fishery exists, it must be stressed that only anecdotal evidence exists on this issue. The scale and extent of this issue is unknown and its potential to contribute to the regions bass removals and local economy cannot be estimated.

5.4 Strengths, Weaknesses, Opportunities and Threats

Consultations with fishers and fishery managers in Sussex identified a range of strengths, weaknesses, opportunities and threats associated with the bass fisheries in the region. A number of common points emerged during the analysis. These points are synthesised below.

Strengths

Low environmental impacts was commonly suggested as a strength of not only the recreational fishery but also the commercial rod and line and driftnet fisheries. They are viewed as highly selective efficient fishing methods when compared to other gears such as trawls.

For commercial fisheries, the main strength highlighted was the fishing opportunity bass provides in the absence of quota for other species. Consultations therefore indicate that bass are integral to the livelihoods of a significant number of commercial fishers in Sussex. Although the polyvalent nature of the fishers and the small scope of this study meant it was not possible to determine the overall degree of dependence.

Weaknesses

Key weaknesses that emerged were around the organisation of the fisheries and the ability to agree measures to improve stock health. In part this reflected wider threats to the fisheries (see below). The unrestricted access to bass as a displacement stock could be considered to be a weakness as this will have long term implications for the sustainability and management of the bass fisheries in Sussex.

Opportunities

The high market demand for bass and its value as a sport fish mean that there are opportunities for healthy stocks to support both commercial and recreational fisheries. Recreational anglers agreed that there are a number of possible opportunities to effectively manage bass stocks in order to promote stock recovery and increase the derived societal benefits. Two of the most commonly suggested opportunities were: the protection of nursery areas; and the limitation of commercial effort. Anglers believe that if these measures are implemented then bass abundance would increase, angling

opportunities would increase, and there would be increased economic benefits to the region associated with increased angling activity. When asked about the implementation of effort restrictions on anglers, the majority of anglers were not opposed to some form of restriction, although the majority did agree that a 1 fish/day bag limit (as proposed by the EU) would be too stringent and could have significant, negative consequences on the angling sector. However, Sussex IFCA management are very concerned at the introduction of a maximum bag limit which could be considered excessively restrictive and disproportionate in respect to other non-recreational management measures defined at EU level. Excessive measures may cause significant economic impact and negative consequences on an economically valuable recreational sector. In particular the consequence on the incomes of the angling charter vessels and businesses that operate from the Sussex IFCA District could be significant. The principle of a bag limit was recognised by the IFCA management as good management tool if applied correctly. It was suggested a figure significantly higher than 1 fish (perhaps in the order of 5 fish) might not result in significant socio economic consequences. In the absence of an EU regulatory bag limit, the opportunity exists for a bag limit to be defined locally under IFCA byelaw regulations in consultation with the local fishing community.

Commercial fishers agreed that there is the opportunity to improve the status of bass stocks by reducing overall fishing effort and imposing restrictions on bass fisheries. All commercial fishers suggested that restrictions should not be targeted at one gear, and appropriate restrictions should be applied to all gears targeting bass, including recreational fisheries. Fishers suggest that applying restrictions to all gears would increase acceptance and cooperation between fishers using different gears. Identical to recreational fisheries, fishery managers suggested that protecting inshore nursery areas presents a major opportunity to improve bass management.

Threats

Across all consultations the most commonly suggested threat to bass stocks and dependent fisheries was a *status quo* situation. Recreational and commercial fishers consulted both suggest that bass stocks are in decline and that management interventions are required.

For recreational fishers, additional perceived threats commonly suggested included:

- The overexploitation of bass by commercial fisheries, both foreign and domestic;
- The removal of immature bass by commercial fisheries due to small minimum landing size; and,
- An illegal fishery for bass of unknown scale.

For commercial fishers, additional perceived threats commonly suggested included:

- The overexploitation of bass by French pair trawlers;
- Unregulated exploitation of bass by recreational fishers;
- An illegal fishery for bass of unknown scale; and,
- Disproportionate implementation of regulations targeted at specific gears (commercial fishers suggest that all fisheries and gears used to target bass should be subject to restrictions).

5.5 Wider Benefits to Society

The study has focused mainly on the economic and employment benefits generated by fishing for bass. However there are other benefits to society from fishing activities, both recreational and commercial, that should also be considered. A number of studies around the world have examined commercial and recreational fishing and these studies highlight social benefits that can be derived to individual and collective wellbeing (e.g. Armstrong et al., 2013; Brown et al., 2011; Pollnac & Poggie 2008). From an individual perspective recreational fishing is reported to provide relaxation and improve both mental and physical health (e.g. Armstrong et al., 2013; Brown et al. 2011). Collectively recreational fishing is identified as a socially inclusive activity with low costs of entry and an avenue for social interaction that can increase social engagement and strengthen family and wider relationships and even reduce anti-social behaviour (e.g. Armstrong et al., 2013; Brown et al. 2011).

Furthermore, when discussing the wider benefits of commercial fisheries, it is important to note that other studies (e.g. MRAG et al., 2011) have highlighted the positive contributions that commercial fisheries can make to coastal communities and the important role that they can have as an 'indigenous industry' in contrast to other sectors. Commercial fishing activities are also perceived to provide

important benefits beyond the economic. The European Parliament Resolution in 2006 on inshore fishing for example highlights the importance of the cultural traditions of inshore fishing and contributions to the social fabric of coastal communities (European Parliament, 2006). Fishing can be an important element of individual and collective identity and studies indicate that fishers have strong attachments to their work and can derive considerable job satisfaction from fishing (e.g. Pollnac & Poggie, 2008). Bass was identified as being important to particular segments of the commercial fishers. In particular bass was identified as important in the annual activities of commercial rod and line fishers and drift net operators. Bass represents an important species for these fishers because of a combination of the high market value, seasonality, small quota allocation for other species (e.g. cod and plaice) and non-quota nature of bass. For these fishers bass can play a role in overall fishing operations that it was considered would be difficult to replace. On the other hand, stern trawlers are much less dependent on bass, catching them infrequently in and in small numbers while targeting other species.

Fishing also produces a high quality food. However in the context of bass the quantity produced in Sussex (247.5 tonnes in 2012 representing ~30% of bass landings in England and Wales) is low compared to the 7,139 tonnes of bass imported in 2011 and in the context of total finfish landings in England and Wales by UK vessels of approximately 40,000 tonnes. The overall contribution to food supply is therefore relatively low. The supply could be important locally, and may be so to a degree, but respondents indicated that the vast majority of fish is sold to wholesalers and much of it is exported.

6 References

- Armstrong, M., Brown, A., Hargreaves, J., Hyder, K., Pilgrim-Morrison, S., Munday, M., Proctor, S., Roberts, A. and Williamson, K. 2013. Sea Angling 2012 – a survey of recreational sea angling activity and economic value in England. Available: http://randd.defra.gov.uk/Document.aspx?Document=12025_SeaAngling2012synthesisreportFINAL.pdf [Accessed 21/11/2014].
- Armstrong M & Drogou M, 2014. Request for Services - Sea bass. Commitment No. SI2.680348. Sea bass fisheries in Europe and their management, Paper for STECF, July 2014. STECF 2014. Request for Services - Sea bass. Commitment No. SI2.680348. Paper for STECF July. Available: <https://stecf.jrc.ec.europa.eu/plen1402>. [Accessed: 21/11/2014].
- Brown, A., Djohari, N. and Stolk, P. 2011. Making the most of community waters: localism, health and angling. Report from the Social and Community Benefits of Angling Research Project.
- Carleton, C., Medley, P., Southhall, T., Nimmo, F., Tarrant, D., Gill. M., 2009a. 'Navigating the Future'. Developing Sustainable Inshore Fisheries. The UK Inshore Fisheries Sustainability Project Stage 2 Report. Food Certification International in collaboration with Nautilus Consultants.
- Carleton, C., Medley, P., Southhall, T., Nimmo, F., Tarrant, D., Gill. M., 2009b. 'Navigating the Future'. Developing Sustainable Inshore Fisheries. The UK Inshore Fisheries Sustainability Project Stage 3 Report. Food Certification International in collaboration with Nautilus Consultants.
- Cooke, S. J., & Cowx, I. G. 2004. The role of recreational fishing in global fish crises. *BioScience*, 54(9), 857-859.
- Cooke, S. J., & Cowx, I. G. 2006. Contrasting recreational and commercial fishing: searching for common issues to promote unified conservation of fisheries resources and aquatic environments. *Biological conservation*, 128(1), 93-108.
- Dapling T.M., Clark R.W.E., & Vause B.J., Medley, P., Carleton, C.R.C. 2010. 'Navigating the Future'. Developing Sustainable Inshore Fisheries. The UK Inshore Fisheries Sustainability Project Summary Report. Sussex Sea Fisheries Committee, Shoreham-by-Sea. Sussex.
- de Boer, M. N., Saulino, J. T., Leopold, M. F., Reijnders, P. J., & Simmonds, M. P. 2012. Interactions between short-beaked common dolphin (*Delphinus delphis*) and the winter pelagic pair-trawl fishery off Southwest England (UK). *International Journal of Biodiversity and Conservation*, 4(13), 481-499.
- DEFRA, 2009. A review of the effectiveness of the Economic Link. Available: <http://archive.defra.gov.uk/foodfarm/fisheries/documents/policy/saif-econlinkreview.pdf> [Accessed 21/11/2014].
- Diodati, P.J. and Richards, R.A. 1996. Mortality of Striped Bass hooked and released in salt water. *Trans. Am. Fish. Soc.* 125, 300–307.
- Drew Associates, 2004. Research into the economic contribution of Sea Angling, Drew Associates.
- Dyck, A.J. and U.R. Sumaila. 2010. Economic impact of ocean fish populations in the global fishery. *Journal of Bioeconomics* 12: 227-243.
- EJF, 2007, *Illegal Drift netting in the Mediterranean*, Environmental Justice Foundation, London, UK.
- European Commission (EC) - 2014, (COM 2014, 670 Final) - Proposal for a Council Regulation fixing for 2015 the fishing opportunities for certain fish stocks and groups of fish stocks, applicable in Union waters and, for Union vessels, in certain non-Union waters and repealing Council Regulation (EU) No 779/2014. Available: http://ec.europa.eu/fisheries/cfp/fishing_rules/tacs/info/com_2014_670_en.pdf [Accessed: 21/11/2014].
- European Commission (EC) - 2014, (COM 2014, 670 Final) - ANNEXES (2-8) to the Proposal for a Council Regulation fixing for 2015 the fishing opportunities for certain fish stocks and groups of fish stocks, applicable in Union waters and, for Union vessels, in certain non-Union waters and repealing Council Regulation (EU) No 779/2014.

European Parliament, 2006. European Parliament resolution of 15 June 2006 on inshore fishing and the problems encountered by inshore fishing communities (p6_TA (2006)0276).

FAO, 2008. Fishing gears and methods. Topics Fact Sheets. Available: <http://www.fao.org/fishery/topic/1617#container> [Accessed: 21/11/2014].

Fedler, T. 2009. The Economic Impact of Recreational Fishing in the Everglades Regio. Report prepared for the Bonefish and Tarpon Trust.

Hargreaves, J., Pilgrim-Morrison, S., Williamson, K., Brown, A., Armstrong, M. and Hyder, K., 2013. Sea Angling 2012 – A Survey of Recreational Sea Angling Activity and Economic Value in England. Annex 1

Hough, A., Andrews, J. and Nichols, J. 2009. Moody Marine. Public Certification Report for Hastings Fleet: Dover Sole Gill Net and Trawl Fisheries Client: Hastings Borough Council and the Hastings Fisheries Management Group July 2009.

ICES. 2013b. Report of the Working Group for Celtic Seas Ecoregion (WGCSE). ICES CM 2013/ACOM: 12

ICES, 2014. ICES Advice 2014, Book 5. European sea bass in Divisions IVbc, VIIa, and VII-d (Irish Sea, Celtic Sea, English Channel and southern North Sea), Available: <http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2014/2014/bss-47.pdf> [Accessed: 21/11/2014].

ICES, 2014. ICES Advice 2014, Book 9. Red (=blackspot) seabream (*Pagellus bogaraveo*) in Subareas VI, VII and VIII. Available: <http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2014/2014/sbr-678.pdf> [Accessed: 21/11/2014].

Jennings, S., Dinmore, T.A., Duplisea, D.E., Warr, K.J. and Lancaster, J.E., 2001. Trawling disturbance can modify benthic production processes. *Journal of Animal Ecology*, 70: 459-475.

Marine and Coastal Access Act 2009. Available: http://www.legislation.gov.uk/ukpga/2009/23/pdfs/ukpga_20090023_en.pdf

Marine Management Organisation, 2014. Fisheries Statistics. Available: <https://www.gov.uk/government/organisations/marine-management-organisation>. Accessed 05 November 2014 [Accessed: 21/11/2014].

Masters, J. 2014. Report on the current state of driftnet fisheries in the UK. Sea Fish, SR673, 100pp.

MRAG et al., 2011 Regional social and economic impacts of change in fisheries-dependent communities. Report prepared under Lot 4: Impact Assessment Studies related to the CFP, Fish/2006/06

MRAG et al., 2014. Study in support of the review of the EU regime on the small-scale driftnet fisheries. Final Report for DG-MARE: http://ec.europa.eu/fisheries/documentation/studies/small-scale-driftnet/index_en.htm [Accessed: 21/11/2014].

Nautilus Consultants, 2000. Study into Inland and Sea fisheries in Wales.

Nelson, K.L. 1998. Catch-and-release mortality of striped bass in the Roanoke River, North Carolina. *N. Am. J. Fish. Manage.* 18, 25–30.

Nichols, J., Hunnington, T., Hough, A. 2005. Public Certification Report for the Hastings Fleet Pelagic Fishery. Moody Marine Ltd: http://www.msc.org/track-a-fishery/fisheries-in-the-program/certified/north-east-atlantic/hastings-fleet-pelagic-herring-and-mackerel/assessment-downloads-1/PubCertRep_Pelagic.pdf [Accessed: 21/11/2014].

Northridge, S. 2006. Dolphin bycatch: observations and mitigation work in the UK bass pair trawl fishery 2005-2006 season. Occasional Report to DEFRA. Available from DEFRA website, accessed on 7 February 2010. http://randd.defra.gov.uk/Document.aspx?Document=MF0736_4194_OTH.pdf [Accessed: 21/11/2014].

ONS, 2011. 2011 Census for England and Wales. Available: http://www.ons.gov.uk/ons/guide-method/census/2011/index.html?utm_source=twitterfeed&utm_medium=twitter [Accessed: 21/11/2014].

Pawson, M., G. 1995. Biogeographical identification of English Channel fish and shellfish stocks. Fisheries Research Technical Report (number 99), MAFF Direct Fisheries Research Lowestoft, England.

Pollnac, R.B. and Poggie, J.J. 2008. Happiness, well-being and psychocultural adaptation to the stresses associated with marine fishing Human Ecology Review 15(2): 194-200.

Poseidon, 2012. Best practice guidance for fishing industry financial and economic impact assessments: guidelines based on outputs from a technical workshop organised by the UK Fisheries Economists Network. Report for Seafish & UK FEN.

Radford, A., Riddington, G. and Gibson, H., 2009. Economic Impact of Recreational Sea Angling in Scotland. Prepared for Scottish Government.

Scientific, Technical and Economic Committee for Fisheries (STECF), 2014. Review of scientific advice for 2015 – part 2 (STECF-14-11). 2014. Publications Office of the European Union, Luxembourg, EUR XXXX EN, JRC XXXX, XXX. P115-117 Available: http://stecf.jrc.ec.europa.eu/c/document_library/get_file?uuid=943efb80-4405-4a0f-8ac6-a4dd2cf02c7b&groupId=43805 [Accessed: 21/11/2014].

Scientific, Technical and Economic Committee for Fisheries (STECF), 2014. 46th Plenary Meeting Report (PLEN-14-02). 2014. Publications Office of the European Union, Luxembourg, EURXXXX EN, JRC XXXXXX, XX. P51-59. Available: http://stecf.jrc.ec.europa.eu/documents/43805/812327/2014-07_STECF+PLEN+14-02_Final+Report_JRC91540.pdf [Accessed: 21/11/2014].

Seafish. 2007. The economic impacts of the UK sea fishing and fish processing sectors: an input-output analysis. Hull, Seafish Industry Authority.

Silvani, L., Gazo, M., & Aguilar, A. 1999. Spanish driftnet fishing and incidental catches in the western Mediterranean. Biological Conservation, 90(1), 79-85.

Simpson D and Mawle G.S. 2005. Public Attitudes to Angling 2005.

Spurgeon and Lawrence, 2007. Economic evaluation of inland fisheries, Managers report from science project SC050026/SR2.

Southwark Associates. 2006. The Relative Economic Contributions of U.S. Recreational and Commercial Fisheries. Report prepared for the Theodore Roosevelt Conservation Partnership

Southwick, 2006. The Relative Economic Contributions of U.S. Recreational and Commercial Fisheries. Report prepared for the Theodore Roosevelt Conservation Partnership.

Sussex Angling Media, 2014. Sussex Charter Boats list. Available: <http://www.sussexanglingmedia.co.uk/#/sussex-charter-boats/4553929600>

UK Registration of Fish Buyers and Sellers and Designation of Fish Auction Sites Regulations 2005.

Vause, B. J and Clark, R. W. E., 2011. Sussex Inshore Fisheries and Conservation Authority Baseline Fisheries Information. 103pp. First published October 2011. Available: www.sussex-ifca.gov.uk.

Annex 1 – List of organisations contacted during consultations

Organisation	Organisation type	Sector	Assistance provided
Marine Management Organisation	Management and enforcement	Commercial and recreational sectors	Advice for data sourcing, information on trawling in Sussex
Sussex Inshore Fisheries and Conservation Authority	Management and enforcement	Commercial and recreational sectors	Information on commercial and recreational fleets
CEFAS	Research institute	Recreational	Recreational data
Hastings Fishermen's protection society	Producer organisation	Commercial	Commercial information
National Under Ten Fishermen's Association	Producer organisation	Commercial	Commercial information
n/a	Driftnet fishers	Commercial	Commercial information
n/a	Hook and line fishers	Commercial	Commercial information
Angling Trust	Angling group	Recreational	Recreational information and provision of contacts
Angling Trust Sussex	Angling group	Recreational	Recreational information and provision of contacts
Bass Anglers Sport fishing society	Angling group	Recreational	Recreational information
Substance	Research institute	Recreational	Information on economic analysis of recreational sector
UK bass	Angling group	Recreational	Recreational information
Sussex County Angling Action group	Angling group	Recreational	Recreational information
n/a	Fly fishing guide	Recreational	Recreational information
n/a	Charter boat skipper	Recreational	Recreational information
n/a	Fly fishers	Recreational	Recreational information
n/a	Bait fishers	Recreational	Recreational information
n/a	Tackle shop	Recreational	Recreational information
n/a	Fishmongers	Commercial	Information on prices, source and destination of bass catches
n/a	Wholesalers	Commercial	Information on prices, source and destination of bass catches
n/a	Restaurants	Commercial	Information on prices and source of sea bass served

Annex 2 – Main data sources

Literature was searched for key quantitative information and data for the calculations performed and presented in this report. References can be found throughout the report and a list of references are presented in Section 6. Below are a short list of major data sources with regards to the commercial fisheries and recreational sectors.

1) *MMO fisheries statistics:*

Marine Management Organization, 2014. Fisheries Statistics. Available: <https://www.gov.uk/government/organisations/marine-management-organisation>. Accessed 05 November 2014 [Accessed: 21/11/2014].

2) *Sea Angling 2012 Report:*

Armstrong, M., Brown, A., Hargreaves, J., Hyder, K., Pilgrim-Morrison, S., Munday, M., Proctor, S., Roberts, A. and Williamson, K. 2013. Sea Angling 2012 – a survey of recreational sea angling activity and economic value in England. Available: http://randd.defra.gov.uk/Document.aspx?Document=12025_SeaAngling2012synthesisreportFINAL.pdf [Accessed: 21/11/2014].

3) *Seafish Economic analysis:*

Seafish. 2007. The economic impacts of the UK sea fishing and fish processing sectors: an input-output analysis. Hull, Sea Fish Industry Authority.