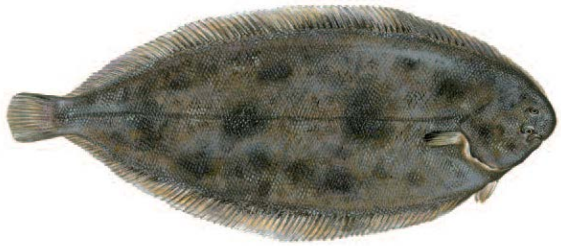
Responsible Sourcing Guide:

Dover sole

Version 7 – May 2013



Solea solea Image © Scandinavian Fishing Year Book

Dover sole (*Solea solea*) is an important commercial species in the North East Atlantic. In 2011, 2,000 tonnes (t) of sole was landed in the UK with a first sale value of £25.7 million (1). UK consumption in 2012 (2) was approximately 2,003 t of sole and sole products, valued at £27 million. Because of its high market value, many fisheries use specific gears to target sole.

Sole belong to the family Soleidae (true soles) and are found throughout shelf waters of the North East Atlantic from Iceland and Norway to the northeast coast of Africa, and throughout most of the Mediterranean. Although they undergo seasonal migrations between spawning and feeding grounds, sole tend not to move over great distances and, once recruited to a spawning ground, appear to continue to spawn on that ground (3).

The main fisheries for sole occur in the North Sea, English Channel, Bristol Channel, Irish Sea and northern Bay of Biscay. Sole have a long history of commercial exploitation and have been taken in mixed demersal fisheries since at least the mid-19th century. Large-scale, targeted fishing for sole began with the development of the modern heavy beam trawl in the early 1960s (4), which led to a steady rise in exploitation levels. Sole has shown substantial variations in abundance over the last 50 years, largely as a result of fishing activity and variability in breeding success. In more northerly regions, natural fluctuations in abundance have also occurred due to severe mortality during very cold winters, such as in 1963.

Nearly all of the major stocks of sole are currently considered to be fished sustainably, though sole in the Irish Sea are overfished and ICES recommends that directed fisheries should be avoided. Four fisheries landing sole from the North Sea and Eastern English Channel are currently MSC certified (6).

The purpose of this guide is to outline the status of Dover sole stocks and describe some of the measures being taken to protect them.

BUYERS' TOP TIPS

Know the species

There is only one species, *Solea solea*, sometimes called common sole, which may be marketed as Dover sole on UK markets (5). Sand sole, *Pegusa lascaris*, are similar in size and shape to Dover sole, but have a lighter skin colour with irregular dark spots and freckles on the eyed side. In the north Pacific, *Microstomus pacificus* is sometimes referred to as Dover sole, but this species belongs to the flounder family and is not found in the Eastern Atlantic.

Know your source of supply and stock status

Sole populations are allocated to management areas, comprising one or more ICES divisions. Find out the management stock from which the fish has been caught.

Seafish Responsible Sourcing Service

This is one of a series of Responsible Sourcing Guides produced by Seafish to give information on sustainability issues. This links to other sources of information and the Responsible Fishing Scheme (BSi: PAS 72:2006), aimed at ensuring best quality and environmental practice onboard vessels.

For further guides and information see:
http://tinyurl.com/seafishrsg

Status of Dover solestocks: March 2013

Biology

Dover sole is common throughout the coastal waters of the North East Atlantic, inhabiting sandy and muddy areas in waters down to 150m depth. It tends to be inactive during daylight, when it may be partially buried in the seabed, but feeds actively at night on marine worms and small bivalve molluscs and crustaceans (3).

Sole have been known to live for up to 40 years, but today are rarely caught above 15 years of age. Females grow to a larger size than males, reaching lengths of 50–60cm. They are sexually mature at age two to three, but do not achieve their full reproductive potential until age four or five (3). They migrate offshore in winter, but return to shallower water in spring, when the adults will move to distinct spawning grounds in inshore waters or on offshore banks. Spawning activity peaks in April–May. The planktonic larvae move inshore and settle onto the sea bed in estuaries, tidal inlets and sandy bays (3). At about 15–18mm in length, the left eye moves to the right side of head. The juveniles remain in these nursery areas for around two years before moving to deeper water to join the adult stock.

Assessment

The International Council for Exploration of the Seas (ICES) conducts annual assessments on seven of the nine sole stocks. The assessment models use information on the number of sole at each age in the catch of the commercial fishery, together with data collected by fishery-independent trawl surveys. In addition, a number of collaborative Fishery Science Partnership surveys (7) have recently been conducted. Where an analytical assessment is not possible, ICES provides advice based on the data-limited framework (9) where feasible.

Research

Scientists have started to use egg surveys to make independent estimates of sole spawning stock biomass (SSB)– the total weight of mature sole in the stock. Research surveys are used to estimate the numbers of planktonic eggs produced over the whole of the spawning area throughout the spawning season. This is related to the number of eggs produced per kg of spawning fish, to estimate the SSB. Only a few such assessments have been conducted. This method is not yet being used to give management advice on sole stocks (although this method has been used for assessment and management of mackerel stocks for 30 years).

Maximum Sustainable Yield (MSY) and the Precautionary Approach (PA)

Current ICES advice on cod stocks is given on the basis of MSY and the precautionary approach (6). MSY means fishing at a level that takes the maximum catch (yield) that can safely be removed from a fish stock, on a continuous basis, whilst maintaining its long-term productive capacity, and is achieved by keeping the Spawning Stock Biomas (SSB) above the biomass action point **$MSY_{Btrigger}$**. The precautionary approach aims to limit fishing mortality (F) and catches to levels that avoid depleting the stock's reproductive

capacity, keeping its SSB above its biomass reference level (defined as $\mathbf{B_{pa:}}$ see Fig. 3).

These concepts are illustrated in the schematic (Fig. 1). This shows how catches from an unfished stock would increase in line with exploitation (or fishing mortality, F), up to a point where the total mortality on the stock causes so many fish to be caught at a relatively small size (and discarded or landed) that the potential production of the stock, based on growth of individual fish, is not realised ('growth overfishing'). The peak of this curve represents MSY and indicates where $\mathbf{F_{MSY}}$ lies.

However, providing sufficient fish survive to become adults and spawn, they may still have the reproductive capacity to replace themselves. Stock collapse can occur when fishing mortality reaches a level ($\mathbf{F_{lim}}$) where removals from a stock are so high, and its spawning capacity is so diminished, that fewer and fewer juveniles are produced. So, not only is the size of the stock being reduced by too high a level of exploitation, but there are fewer juvenile fish to replace those that are caught, and stock levels are likely to fall even lower ('recruit overfishing'). The yellow area between the green (inside safe limits) and red (outside safe limits) zones in the schematic and stock trajectories (North Sea example at Fig 2 & 3) represents levels of F or SSB that management should seek to avoid to ensure that the stock has a high probability of remaining sustainable.

Scientific advice given under the twin MSY/precautionary approach strategy will aim to either achieve catches consistent with fishing levels that would result in $\mathbf{F_{MSY}}$, or reduce fishing mortality to return the stock to within safe biological limits (>$\mathbf{B_{pa}}$). For many fish stocks, including sole fisheries in the North Sea, Bay of Biscay and western English Channel, parties exploiting the stock have management plans, and ICES also provides advice on catches compatible with such plans. Where there is insufficient information to evaluate the status of the stock, ICES advice is given on its approach for data-limited stocks (9) This uses abundance indices from research surveys and catches to set a TAC based on trends. Included in the method are precautionary measures where there is uncertainty.

Figure 1: Schematic of ICES' MSY and PA reference points in relation to fishing mortality and Yield

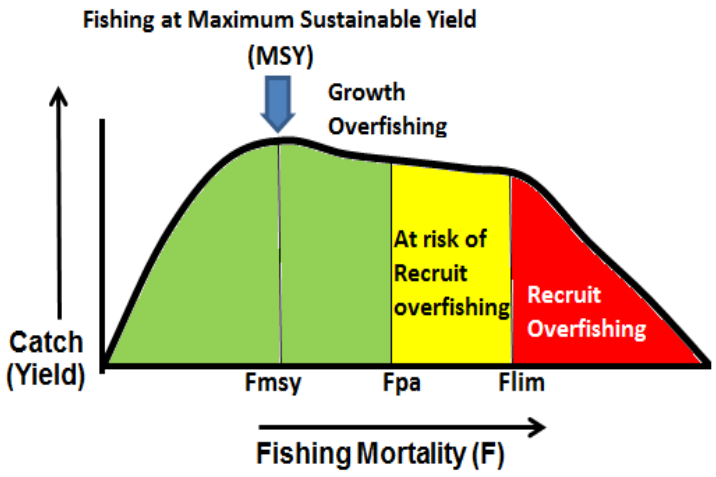
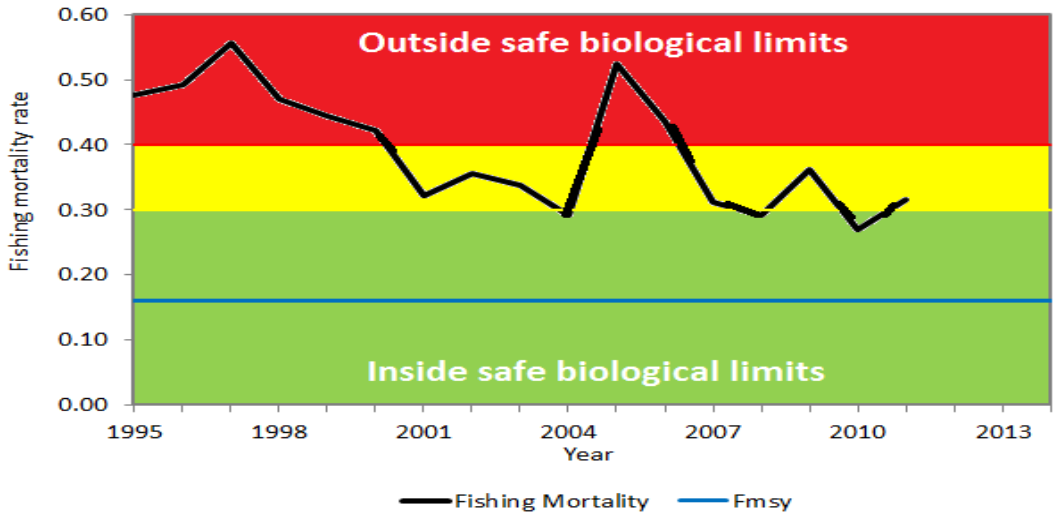


Table 1: Management Stock (colour keyed to Figure 1 and Figure 4 map on page 6)	**Agreed TAC 2013 (t) (11)**	**Adv'sy TAC 2013 (t)**	**Scientific advice and management (June 2012 ICES advice) (10)**
NORTH EAST ATLANTIC DOVER SOLE STOCKS (*Solea solea*) www.ices.dk			
Inside safe biological limits			
North Sea: ICES Sub-area IV	13,945	14,000 Mg'ment plan (12)	SSB has fluctuated around the precautionary level since 1998 and is estimated to be above B_{pa} and $MSY_{Btrigger}$ in 2012. Fishing mortality has shown a declining trend since 1995 and is estimated to have been below the precautionary level since 2008, but above F_{MSY}. A long-term plan for improving the status of sole and plaice stocks in the North Sea (12) has been accompanied by a substantial reduction in beam trawling effort since 1995. ICES concluded that the management plan is precautionary and, since both North Sea sole and plaice have now been within safe biological limits for two consecutive years, that a transition to the second stage of the plan should be implemented. ICES' advice is given on this basis.
Bay of Biscay: ICES Divs VIII a and b	4,100	3,500	Following low recruitment since 2002, the 2007 year class was the highest since 1993, and SSB increased above $MSY_{Btrigger}$ and B_{pa} in 2011 and 2012. Fishing mortality since 2004 has been around the precautionary level (F_{pa}), though above F_{MSY}. This stock has benefited from a multiannual plan agreed by EU in 2006 (13), and ICES' advice is based on the transition to the MSY approach. The European Council has opted for middle ground between MSY and the Precautionary Approach in setting the TAC.
Celtic Sea, Bristol Channel: ICES DivsVIIf&VIIg	1,100	1,100	Recent recruitment has been largely stable (though the 2009 year class is the lowest of the time series) and the SSB has been above $MSY_{Btrigger}$ since 2001. Fishing mortality has decreased to the lowest level in the time series and is now below F_{MSY}. ICES advice is based on the MSY approach.
Western English Channel: ICES Division VIIe	894	960	Recruitment has been fluctuating around average without trend, and SSB has been around $MSY_{Btrigger}$ for about two decades, with an increase since 2009. Fishing mortality was above F_{MSY} until 2009, when a significant reduction of fishing mortality to below F_{MSY} accompanied a reduction in fishing effort. ICES' advice is given on the basis of the MSY framework. This stock is subject to a management plan (14), which has not been evaluated by ICES.
Eastern English Channel: ICES Division VIId	5,900	5,900	The 2008, 2009 and 2010 year classes were above average and SSB has increased since 2001 to be well above $MSY_{Btrigger}$ in 2012. Fishing mortality has been above the precautionary level (and F_{MSY}) since 2005. ICES' advice is given on the basis of the transition to MSY by 2015. The Hastings sole trammel net and Dutch sole gill net and otter-trawl fisheries are MSC certified (4).

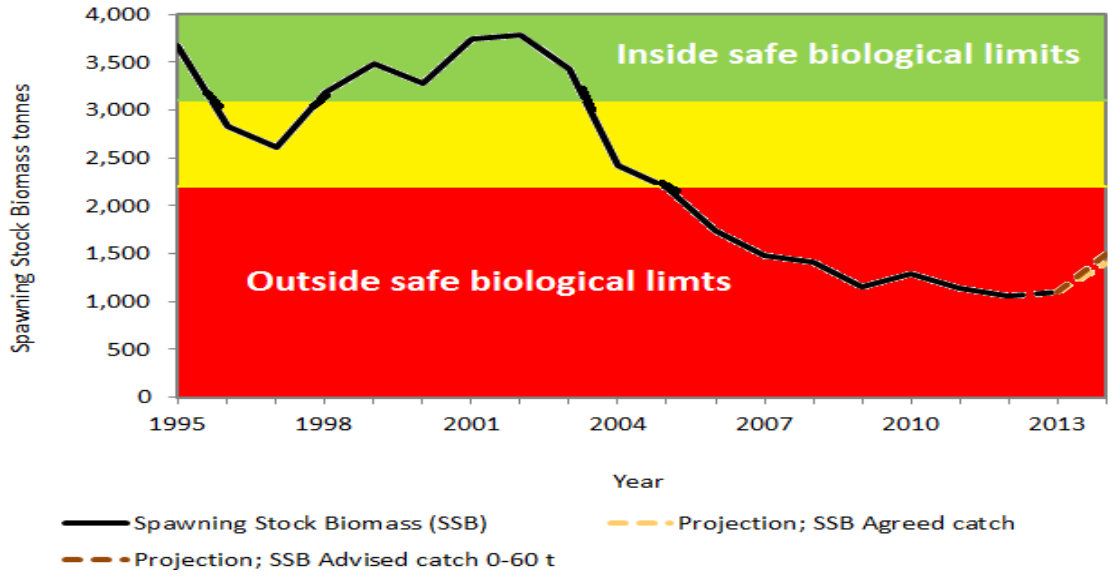
Table 1: Management Stock (colour keyed to Figure 1 and Figure 4 map on page 6)	**Agreed TAC 2013 (t) (11)**	**Adv'sy TAC 2013 (t)**	**Scientific advice and management (June 2012 ICES advice) (10)**
Stocks at risk of being outside safe biological limits and below biomass action point $MSY_{Btrigger}$			
Skagerrak and Kattegat:ICES Division IIIa Sub divisions 22-24 Western Baltic	560	560	There have been no strong year classes since 2000, and SSB has decreased since 2005, and is now below $MSY_{Btrigger}$. Fishing mortality has been stable around F_{MSY} since 2005, ICES' advice is based on the MSY approach, and applies to Division IIIa and Sub-divisions 22–24 to better reflect the management regime that sets a TAC for the entire area of Division IIIa and the Baltic Sea.
Stock outside safe biological limits			
Irish Sea: ICES Division VIIa	140	60 No directed fishery	Recent recruitment levels have been consistently low, and SSB has declined continuously since 2001, dropping below B_{lim} in 2006 to the historic lowest level. The fishing mortality has shown a declining trend since the mid-1980s to stabilise around the precautionary level in recent years, but well above F_{MSY} (Fig. 2). ICES' advice is given on the basis of the MSY approach; a zero catch would be compatible with the MSY framework (see Fig.3).
Reference points not defined			
West of Ireland: ICES VIIb& c	42	30	There is insufficient information to evaluate the status of the stock and ICES advice is given on its approach for data-limited stocks. ICES advises that catches should decrease by 20% in relation to the average landings of the last three years.
Southwest of Ireland: ICES Divisions VIIh-k	402	200	There is insufficient information to evaluate the status of the stock and ICES advice is given on its approach for data-limited stocks. ICES advises that catches should decrease by 20% in relation to the average landings of the last three years. However, the Council opted for a 5% TAC decrease on 2012 in 2013.

Figure 2: Fishing mortality trajectory for Irish Sea Dover sole (ICES Div. VIIa). ICES 2012 assessment.



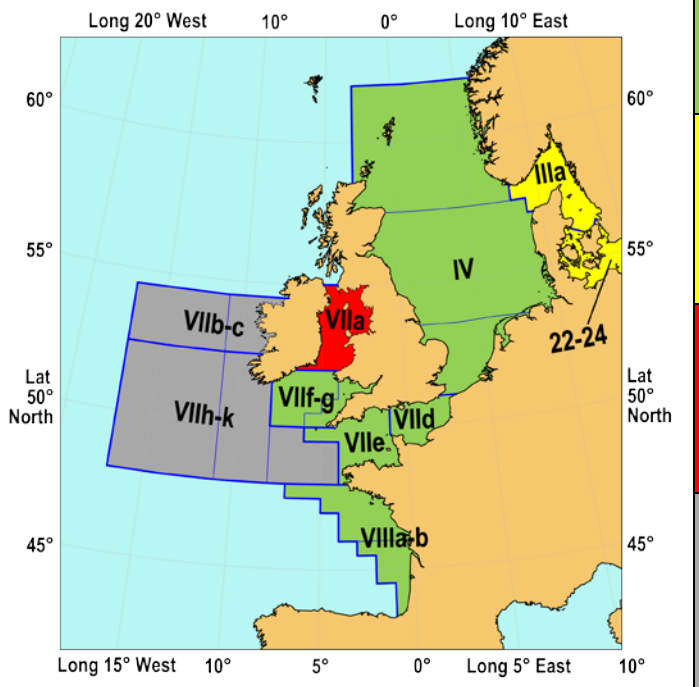
The fishing mortality rate has shown a declining trend and is now close to precautionary levels. Though this indicates a probability of around 5-10% of fishing mortality being outside safe biological limits, fishing this stock at Maximum Sustainable Yield (F_{MSY}) would imply a lower fishing mortality of 0.16 (blue line).

Figure 3 Spawning Stock Biomass (SSB) trajectory Irish Sea Dover sole (ICES VIIa), ICES 2012 assessment.



$MSY_{Btrigger}$ and B_{pa} are at 3,100 t and safe biological limits (B_{lim}) is at 2200 t. The stock has been outside safe biological limits since 2005. Two projections (dotted) beyond 2012 are shown. The brown line represents the effect of the advised (0- 60 t) catch in 2013. The agreed catch (orange line) of 140 t would result in a lower SSB in 2014 and was not considered by ICES to be compatible with the MSY approach, although both projections indicate an increase in spawning stock in 2014.

Figure 4: Management areas for Dover sole stocks (colour keyed to Table 1)



Inside safe biological limits

At risk of being outside safe biological limits

Outside safe biological limits

Reference points not defined

Organisation key

ICES: International Council for the Exploration of the Sea. Responsible for providing scientific advice for North East Atlantic fishery management.

EU: The European Union manages fisheries within the Exclusive Economic Zone.

MSC: The Marine Stewardship Council is an independent non-profit organisation that promotes responsible fishing practices though a certification scheme.

Management and conservation measures

Sole fisheries are managed through a combination of TACs, limits on the number of days which the boats can spend at sea, and technical measures. The TAC and effort limitations are intended to limit the catch of sole in each area, whilst the technical measures are aimed at managing the species composition, and the size of fish in the catch, through mesh size controls and net configuration. The main issues affecting management of sole fisheries are:

Multi-species fisheries

Sole are mainly caught by beam trawls in the southern North Sea, English Channel and Irish Sea, but are also caught by otter trawls and trammel, gill and tangle-net gears in directed inshore fisheries. Sole is the main target species in many beam-trawl fisheries, but these also take important catches of plaice in the North Sea and of cuttlefish, plaice, monkfish and lemon sole in western waters. Whilst discarding of undersized sole (<24cm) is generally low, as their body shape and flexibility allow the smaller fish to escape from the minimum mesh size used for most gears targeting sole (≥80mm), there are different requirements for gear selectivity of other species. In some fisheries, for example, large numbers of undersize plaice are

caught, which can result in very high discard rates. However, an increase in mesh size to reduce the by catch of undersized plaice would result in a significant reduction in the catch of marketable sole.

Management plans

There are management plans for the sole fisheries in the North Sea (12), Bay of Biscay (13) and western English Channel (14). These plans are intended to reduce the fishing mortality on these stocks through effort restrictions and gradual year-on-year reductions in TACs. Ultimately, the plans aim to achieve larger and more stable stocks and catches, and more profitable fisheries fished at MSY.

Environmental impacts

Beam trawling is the main method used for catching sole. Disturbance of the sea bed by beam trawls can have ecological effects and, a combination of high fuel prices, pressure from environmental Non-Governmental Organisations (NGOs) and consumers, is encouraging the development and use of low impact gears.

One option to reduce these effects is by using pulsed electric fields instead of heavy tickler chains, to stimulate the fish to swim out of the seabed in the path of the trawl. The EU has permitted limited (to 5% of each nations' fleet) use of electrified beam trawls (with restrictions on power and voltage) in the southern North Sea (15,16) and this technology has become highly developed, particularly when combined with the 'Sumwing' design of beam trawl which is designed to reduce mechanical impacts on sea bed habitats.

There are, however, uncertainties about the effects of pulsed electric fishing, particularly on escaping fish. This is being investigated by ICES (17) and will be discussed when considering any addition to the number of vessels permitted to use the gear.

An alternative approach for beam trawlers is to tow single-warp otter trawls from each of the booms or 'outriggers' which is associated with a large reduction in fuel costs – up to 70%. This gear is being used by Dutch, Belgian and UK vessels (18) and still catches sole, but other species such as plaice, brill, turbot and John dory make up a higher proportion of the catches (19).

CEFAS has been developing modified cod-end mesh configurations in collaboration with the English beam trawling fishery, to reduce the quantity of undersized roundfish caught in sole-directed fisheries. Release panels can be employed to release the benthic (seabed-living species) retained (20, 21). These concepts have been extended successfully to twin-rig otter trawling for sole (22).

Figure 2 Sum wing pulse trawl

Product characteristics and seasonal cycles

Dover sole has a medium brown to dark brown skin colouration with irregular dusky patches on the eyed side; the blind side is creamy-white. Sole are usually presented whole and gutted, or are used as fillets.

	J	F	M	A	M	J	J	A	S	O	N	D
North Sea, Skagerrak & Kattegat												
Irish coast												
Southern England &Wales												
Bay of Biscay												
Mediterranean												
		Spawning										

Supply chain standards

Responsible practice in the chilledand frozen supply chain depends on correct catching, gutting, washing,chilling or freezing, processing and handling practices throughout the chain. There are standards which cover these aspects from capture to retailer:

• **Seafish Responsible Fishing Scheme.** Sets best practice standards for fishing vessels, based on British Standards Institution specifications (BSi: PAS 72:2006) (23);

• **British Retail Consortium (BRC) Global Standard & Safe & Local Supplier Approval (SALSA) certification.** Designed to raise standards in the seafood processing and wholesaling sectors.

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For further guides see: http://tinyurl.com/seafishrsg

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*European legislation available on: http://europa.eu/

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