DOVER SOLE – ATLANTIC OCEAN

Solea solea

Sometimes known as Tong, Black Sole, Common Sole, River Sole, Sea Partridge, Slip, Sole, Tounge, True Sole, and Southport Sole

SUMMARY

Dover Sole are a fast growing species of bottom fish, reaching a size of 70 cm and living up to 40 years. They are found from the North Sea south to northwest Africa and into the Mediterranean Sea. Dover Sole have a medium abundance overall, though population size varies between regions. They are caught by a variety of fishing gears including bottom trawls and gillnets. Although bottom trawling is generally damaging to the seafloor, most Dover Sole, particularly around the UK, are caught in mud and sand habitats, which are relatively resilient to any damage. Bycatch from Dover Sole fisheries typically includes other fish that live on or near the seafloor like cod, gurnards and flounders.

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LIFE HISTORY

Core Points (only one selection allowed)

If a value for intrinsic rate of increase (‘r’) is known, assign the score below based on this value. If no r-value is available, assign the score below for the correct age at 50% maturity for females if specified, or for the correct value of growth rate (‘k’). If no estimates of r, age at 50% maturity, or k are available, assign the score below based on maximum age.

1.00  Intrinsic rate of increase <0.05; OR age at 50% maturity >10 years; OR growth rate <0.15; OR maximum age >30 years.

2.00  Intrinsic rate of increase = 0.05-0.15; OR age at 50% maturity = 5-10 years; OR a growth rate = 0.16–0.30; OR maximum age = 11-30 years.

3.00  Intrinsic rate of increase >0.16; OR age at 50% maturity = 1-5 years; OR growth rate >0.30; OR maximum age <11 years.

Dover Sole can live for 40 years (ICES 2011) and reach a length of 70 cm (Miller and Loates 1997). Sexual maturity is reached around 25 to 35 cm and 4 years, with males maturing slightly smaller and younger than females (Perry et al. 2005; ICES 2011). Growth rates vary between locations, being around 0.363 in the North Sea (Perry et al. 2005) and 0.22 in Portuguese waters (Teixeira and Cabral, 2010). Although Dover Sole can live for 40 years, they mature quickly and grow fast so a core point of 3 was awarded.

Points of Adjustment (multiple selections allowed)

-0.25  Species has special behaviors that make it especially vulnerable to fishing pressure (e.g., spawning aggregations; site fidelity; segregation by sex; migratory bottlenecks; unusual attraction to gear; etc.).

Dover Sole tend to aggregate during very cold weather, making them easier to catch by offshore beam trawlers (ICES 2003). In addition, inshore gillnet fisheries target spawning Dover Sole in the North Sea region (ICES 2011). Juvenile Dover Sole also have high site fidelity (Vinagre et al. 2008).

-0.25  Species has a strategy for sexual development that makes it especially vulnerable to fishing pressure (e.g., age at 50% maturity >20 years; sequential hermaphrodites; extremely low fecundity).

-0.25  Species has a small or restricted range (e.g., endemism; numerous evolutionarily significant units; restricted to one coastline; e.g., American lobster; striped bass; endemic reef fishes).
Species exhibits high natural population variability driven by broad-scale environmental change (e.g. El Nino; decadal oscillations).

There is some indication that Dover Sole populations are affected by broad-scale environmental changes. For example, research showed that Dover Sole moved southward in the North Sea between 1962 and 2001, although the cleanup of the Thames estuary, which made it a major nursery ground, may have impacted this movement (Perry et al. 2005). In addition, cold water mortality during 1962/63 reduced the abundance of Dover Sole by half in the North Sea (Millner and Whiting 1996). In the Bay of Biscay, juvenile Dover Sole appear to deal with short term environmental changes by migrating offshore to deeper more stable waters (Koutsikopoulos et al. 1989). Recruitment of larvae and juvenile Dover Sole is highly correlated to the magnitude of river plumes, which are influenced by precipitation patterns that can change due to global climate changes (Vinagre et al. 2007). However, because research does not clearly show that abundance of Dover Sole varies greatly due to broad-scale environmental change, no points are subtracted.

Species does not have special behaviors that increase ease or population consequences of capture OR has special behaviors that make it less vulnerable to fishing pressure (e.g., species is widely dispersed during spawning).

Species has a strategy for sexual development that makes it especially resilient to fishing pressure (e.g., age at 50% maturity <1 year; extremely high fecundity).

Dover Sole spawn from late winter through the spring after migrating inshore from over-wintering grounds (ICES 1986) and tagging work suggests they return to the same spawning ground to spawn (ICES 2011). The main spawning areas have been identified as the German and Danish Bight of the North Sea, off Texel, the Thames estuary, off the Belgian Coast, off the Bay of Somme and off the English south coast (Dungeness to Selsey Bill) (ICES 1986) and the Bay of Biscay serves as an essential nursery habitat (Guinand et al. 2008). Dover Sole typically spawn in waters shallower than 40 m and particularly within shallow, gently shelving sediment near coastal nursery areas in the north-east Irish Sea (Symonds and Rogers 1995). In the Bristol Channel, spawning grounds are in deeper waters of 40-75 m (Symonds and Rogers 1995). The success of spawning in these two areas is related to the presence of suitably hydrographic conditions, which aid in the transportation of eggs and larvae to nursery grounds (Symonds and Rogers 1995). In the Vilaine estuary (France) spawning Dover Sole begin migrating inshore to spawn in early to late April, with the exact time depending on hydroclimatic conditions, specifically a salinity value between 35 and 30 S and water temperature up to 11°C (Marchand 1991). Peak spawning occurs in the Bay of Biscay during March and in the North Sea in late May (Horwood 2001).

Fecundity appears to vary by region, with the lowest fecundity (500 eggs/g of female body weight) in the south-west region and almost twice as many eggs are produced in the eastern North Sea (Witthames et al. 1995). Fecundity can also vary by year (Millner et al. 1996).
1991). Other estimates of fecundity range from 205,000 to 440,000 eggs for a female 35 cm long (Witthames et al. 1995). This is a medium fecundity rate so no points are added.

+0.25 **Species is distributed over a very wide range (e.g., throughout an entire hemisphere or ocean basin; e.g., swordfish; tuna; Patagonian toothfish).**

Dover Sole are found from the North Sea and Irish Sea south to northwest Africa and into the Mediterranean Sea (Wheeler 1969). There is genetic evidence that the Mediterranean and Atlantic populations are different and that the entire Atlantic population is a single unit (Rolland et al. 2007). As juveniles, Dover Sole make large migrations but as adults their movement is much less (Pawson 1995). Dover Sole are found in large abundances in the north-east Irish Sea and Bristol Channel off of west England and Wales (Symonds and Rogers 1995). This is considered a medium range so no points are added.

+0.25 **Species does not exhibit high natural population variability driven by broad-scale environmental change (e.g., El Nino; decadal oscillations).**

### 2.75 Points for Life History

**ABUNDANCE**

**Core Points (only one selection allowed)**

Compared to natural or un-fished level, the species population is:

1.00 **Low:** Abundance or biomass is <75% of BMSY or similar proxy (e.g., spawning potential ratio).

2.00 **Medium:** Abundance or biomass is 75-125% of BMSY or similar proxy; OR population is approaching or recovering from an overfished condition; OR adequate information on abundance or biomass is not available.

The abundance of Dover Sole varies by region and is unknown in some areas, like western Ireland (ICES 2010a). While the status of Dover Sole populations west of Scotland is also not well understood, it appears that fishing mortality is below target levels, which is a promising result (ICES 2010b). In the Celtic Sea, the Dover Sole population has been above target levels since 2001 and fishing mortality has declined since 2003, to the lowest levels in the time series (ICES 2010c). In the Bay of Biscay and western Iberian Seas, the Dover Sole population size is close to the target level and fishing mortality rates are below target levels (ICES 2010d). In the eastern region of the North Sea, the population has been above target levels since 2002, but fishing mortality...
has increased over the last several years and is currently above target levels (ICES 2010e). In the western region of the North Sea, both fishing mortality and population size are below target levels (ICES 2010F). In the Irish Sea, Dover Sole populations are also below target levels, declining since 2001, and reaching the lowest levels in 2008 and fishing mortality is above target levels (ICES 2010g). In Skagerrak, Kattegat and the Belts (North Sea), fishing mortality is below the target level, while the population size is above target points, despite decreasing since 2005 (ICES 2010h). In the North Sea, fishing mortality is above target levels and the population size is below target levels (ICES 2010i). We have awarded a middle score to account for the differences in population size throughout their assessed range.

3.00 High: Abundance or biomass is >125% of BMSY or similar proxy.

Points of Adjustment (multiple selections allowed)

-0.25 The population is declining over a generational time scale (as indicated by biomass estimates or standardized CPUE).

-0.25 Age, size or sex distribution is skewed relative to the natural condition (e.g., truncated size/age structure or anomalous sex distribution).

During the 1960’s there was an increase in the size at age for Dover Sole in the North Sea, which reached a peak in the early 1970’s (Rijnsdorp et al. 2004). This peak was followed by a steady decline in growth rates (Rijnsdorp et al. 2004). It was hypothesized that these changes were due to an increase, followed by a decrease, of nutrient input from river runoff in the southeastern North Sea (Rijnsdorp et al. 2004). There have also been changes in the proportion of mature fish at age over time, but no real trend is evident (ICES 2011). Historically it was also common to capture Dover Sole over 20 years old but now it is difficult to catch fish over 10 years old and landings are dominated by 2-4 year old fish (ICES 2011). For example, in the Skagerrak/Kattegat area, the catch of Dover Sole is dominated by 2 year old fish of 22 cm size (ICES 2011). In addition, in the Bay of Biscay, a change in the fishery from Belgian beam trawlers to the French fixed net fishery has resulted in more older fish being caught (ICES 2010d).

-0.25 Species is listed as "overfished" OR species is listed as "depleted", "endangered", or "threatened" by recognized national or international bodies.

-0.25 Current levels of abundance are likely to jeopardize the availability of food for other species or cause substantial change in the structure of the associated food web.

+0.25 The population is increasing over a generational time scale (as indicated by biomass estimates or standardized CPUE).

In the Celtic Sea, the population size of Dover Sole has been increasing since lows in the late 1990’s (ICES 2010c) and in the North Sea, eastern channel, the population of Dover
Sole has been increasing since lows in the early 2000’s (ICES 2010e). However, in the western channel of the North Sea, the population declined in the 1990’s from highs in the 1980’s, remained stable and since 2004 has begun to decline again (ICES 2010f). In the Irish Sea, the Dover Sole population has been declining since 2001 (ICES 2010g). In Portuguese waters, sole abundances, which include Dover Sole, have shown a decreasing trend between 1992 and 2005 (Teixeira and Cabral 2009). We have not awarded points because of the differences between regions.

+0.25 Age, size or sex distribution is functionally normal.
+0.25 Species is close to virgin biomass.
+0.25 Current levels of abundance provide adequate food for other predators or are not known to affect the structure of the associated food web.

Dover Sole feed on small invertebrates like worms, bivalves and crustaceans (Teixeira and Cabral 2010), with prey size increasing with age (Cabral 2005). Predators include other fish, rays and the occasional seal or sea lion (Fishbase 2011). Current abundance levels are probably sufficiently high enough not to affect the food web.

2.00 Points for Abundance

HABITAT QUALITY AND FISHING GEAR IMPACTS

Core Points (only one selection allowed)

Select the option that most accurately describes the effect of the fishing method upon the habitat that it affects

1.00 The fishing method causes great damage to physical and biogenic habitats (e.g., cyanide; blasting; bottom trawling; dredging).

A variety of fishing gears are used to target Dover Sole. For example, in the Bay of Biscay, the French fixed-net fishery lands around 60% of Dover Sole (ICES 2007a) and in the North Sea around 90% of Dover Sole are landed by twin beam trawlers in the mixed fishery (plaice, Dover Sole and other flatfish) (ICES 2011). In addition, gillnets are used in inshore waters to target Dover Sole, primarily during the spawning season (ICES 2011). In the Sussex Inshore Fisheries and Conservation Authority district, it is common for fisherman to target Dover Sole during their spawning migration with fixed nets (IFCA 2011). This fishing method is also common during the summer because it allows fishermen to avoid large amounts of bycatch (IFCA 2011).
In the North Sea, beam trawlers are primarily used to capture Dover Sole (ICES 2010i). In the eastern channel, Dover Sole are primarily caught by beam trawls and in a mixed fishery that uses otter trawls (ICES 2010e). Inshore fishermen also target Dover Sole on the English and French coasts using trawls and fixed nets during some parts of the year (ICES 2010e). In Skagerrak, Kattegat and the Belts, Dover Sole are taken in the trawl fishery and by a gillnet fishery in Skagerrak during the summer (ICES 2010h).

In the Celtic Sea, beam trawlers are primarily used to target Dover Sole (ICES 2010c) and in the western channel of the Celtic Sea, beam and otter trawls as well as gillnets are used to catch Dover Sole (ICES 2010f). In the Irish sea, beam trawlers are primarily used to catch Dover Sole (ICES 2010g).

Dover Sole are also caught by trammel nets, gillnets and trawls in inshore waters between Beachy Head and Dungeness (Hough et al. 2009). Bottom gillnets typically have a medium impact on bottom habitat (Morgan and Chuenpagdee 2003).

In Portuguese waters, Dover Sole are caught using gillnets, bottom trawls and trammel nets, but are mainly caught by trammel nets (Batista et al. 2009; Teixeira and Cabral 2010).

Beam trawling is known to have a significant impact on bottom habitats (ICES 2010f) and decreases in biodiversity after trawling have been shown in offshore areas of the North Sea (ICES 2010i)). For example, decreases of 56% and 21% of bottom biomass and production respectively, were seen in fished compared to non fished areas in the North Sea (Hiddink et al. 2006; Hinz et al. 2008). Changes in the species composition have also been seen as a result of bottom trawling (Kaiser et al. 2001). However, in Hastings, the primary gears used to catch Dover Sole are trawl nets and these nets are used on soft ground and the impact with the bottom is light with little bycatch of bottom animals (Hough et al. 2009). The fishery begins in February/March and goes through the middle of June and then starts up in July and runs through November (Nichols et al. 2007). Trammel nets are also used to a lesser degree in Hastings (Nichols et al. 2007) and these nets have a light leadline at the bottom that also causes little damage to the bottom habitat (MSC 2005). We have awarded a low score because bottom trawling is a common method to catch Dover Sole.

![Image of a rating scale with scores]

2.00 The fishing method does moderate damage to physical and biogenic habitats (e.g., bottom gillnets; traps and pots; bottom longlines).

3.00 The fishing method does little damage to physical or biogenic habitats (e.g., hand picking; hand raking; hook and line; pelagic long lines; mid-water trawl or gillnet; purse seines).
**Points of Adjustment (multiple selections allowed)**

-0.25 Habitat for this species is so compromised from non-fishery impacts that the ability of the habitat to support this species is substantially reduced (e.g., dams; pollution; coastal development).

-0.25 Critical habitat areas (e.g., spawning areas) for this species are not protected by management using time/area closures, marine reserves, etc.

-0.25 No efforts are being made to minimize damage from existing gear types OR new or modified gear is increasing habitat damage (e.g., fitting trawls with roller rigs or rockhopping gear; more robust gear for deep-sea fisheries).

-0.25 If gear impacts are substantial, resilience of affected habitats is very slow (e.g., deep water corals; rocky bottoms).

**+0.25 Habitat for this species remains robust and viable and is capable of supporting this species.**

Sandy and muddy substrates are common habitats for Dover Sole (Miller and Loates 1997). Adults are commonly found in water up to 40 m depth during the summer and they migrate out to deeper, warmer water during the fall and winter (Riley 1974).

The central English waters are important for young Dover Sole after they hatch (Koubbi et al. 2006). High larval abundances have been found near the French and Belgium coasts along the sandy areas of the coastal habitat (Koubbi et al. 2006) and the optimum habitat in this area is near Pays de Caux and in the North Sea (Belgium and French coasts), which are located near known spawning areas (Koubbi et al. 2006). In the Tagus estuary (Portugal), which is also used as a nursery, high abundances of Dover Sole have been reported in deep, warm, low-salinity waters that have sediment made up primarily of fine sand and with a high number of amphipods present (Cabral and Costa 1998). In this area, abundances of Dover Sole peak in June and July, while during October to April, abundances are low (Cabral and Costa 1998). In addition, in the Douro estuary (Portugal), high juvenile Dover Sole abundances were found in the middle of the estuary in areas with low water depth and high amounts of crustaceans and worms present (Vinagre et al. 2005).

There does appear to be differences in the spatial distribution of age-groups between regions. For example, in the north-east Irish Sea, juveniles are found almost exclusively in shallow (<20 m) waters and adults are found in shallow as well as deeper waters (Symonds and Rogers 1995). However, in the Bristol Channel, juveniles are found in both shallow and deeper water and adults were more abundant in water deeper than 40 m compared to adults in the Irish Sea (Symonds and Rogers 1995).

There is no indication that this habitat cannot sustain Dover Sole populations, so we have awarded points.
Critical habitat areas (e.g., spawning areas) for this species are protected by management using time/area closures, marine reserves, etc.

There are some inshore closed areas, mainly aimed at protecting salmon, that may afford Dover Sole protection as well (Hough et al. 2009). However, this represents only a small portion of Dover Sole’s range and protection is only secondary to salmon, so we have not awarded points.

Gear innovations are being implemented over a majority of the fishing area to minimize damage from gear types OR no innovations necessary because gear effects are minimal.

If gear impacts are substantial, resilience of affected habitats is fast (e.g., mud or sandy bottoms) OR gear effects are minimal.

In most fishing regions (e.g. Hastings, UK), bottom trawling is done on mud and sandy bottoms (MSC 2011) which are relatively resilient to damage.

1.50 Points for Habitat Quality and Fishing Gear Impacts

MANAGEMENT

Core Points (only one selection allowed)

Select the option that most accurately describes the current management of the fisheries of this species.

1.00 Regulations are ineffective (e.g., illegal fishing or overfishing is occurring) OR the fishery is unregulated (i.e., no control rules are in effect).

2.00 Management measures are in place over a major portion over the species' range but implementation has not met conservation goals OR management measures are in place but have not been in place long enough to determine if they are likely to achieve conservation and sustainability goals.

The European Community (EC) Fisheries Council sets the total allowable catch for the Dover Sole fishery and this is divided among member states (UK (19%), France (54%) and Belgium (27%)) (Hough et al. 2009). Member States Fisheries Departments then divide the quota between their fleets (Hough et al. 2009). Landings are reported to the European Commission and the fishery is closed once the aggregate Total Allowable Catch (TAC) is close to being reached (Hough et al. 2009). The Center for Environment, Fisheries and Aquaculture Science is in charge of research and monitoring of fish for the
UK (Hough et al. 2009). The Fisheries Directorate of the Department for Environment, Food and Rural Affairs (DEFRA) manages sea fisheries in England and the Marine and Fisheries Agency works under DEFRA and is responsible for enforcement of the Common Fisheries Policy (Hough et al. 2009). There is a minimum size limit for Dover Sole and a days-at-sea regulation (Hough et al. 2009). There are also additional regulations within 6 nm of the UK, including gear restrictions, vessel length restrictions and a trawl exclusion from May 1st through October 30th within ¼ nm of the coast (Hough et al. 2009). We have awarded a middle score because despite management measures in place over the majority of Dover Sole’s range, some populations are still below target levels.

3.00 Substantial management measures are in place over a large portion of the species range and have demonstrated success in achieving conservation and sustainability goals.

**Points of Adjustment (multiple selections allowed)**

-0.25 There is inadequate scientific monitoring of stock status, catch or fishing effort.

-0.25 Management does not explicitly address fishery effects on habitat, food webs, and ecosystems.

-0.25 This species is overfished and no recovery plan or an ineffective recovery plan is in place.

-0.25 Management has failed to reduce excess capacity in this fishery or implements subsidies that result in excess capacity in this fishery.

+0.25 There is adequate scientific monitoring, analysis and interpretation of stock status, catch and fishing effort.

The International Council for the Exploration of the Sea (ICES) assesses the status of Dover Sole on a rolling basis (assessments are updated yearly). Both fishery independent and dependent information is available along with data on the age structure and weight of Dover Sole landed in the various fisheries (Hough et al. 2009). However, the ICES indicates a need for fisheries independent data from Biscay Bay and the western Iberian Seas region to improve the assessment process for Dover Sole in this area (ICES 2010d). In addition, there have been issues with misreporting by the beam trawl fleet as well as under-reporting by small vessels (Hough et al. 2009).

Landings are carefully monitored and recorded (Hough et al. 2009). For example, in 2007 99% of Dover Sole “official” landings were covered by port sampling programs (Hough et al. 2009) but in the Bay of Biscay, landings of Dover Sole frequently exceed the TAC, especially from 2002-2006 (ICES 2007a). We have not added points because there are some issues with accurate monitoring of some populations.
Management explicitly and effectively addresses fishery effects on habitat, food webs, and ecosystems.

Fishing practices are monitored by the Sussex Sea Fisheries Committee and management measures can be put into place to mitigate unacceptable fishing methods (MSC 2011). In addition, information on the trophic position, and the status and relationships within the food web is available (MSC 2011).

This species is overfished and there is a recovery plan (including benchmarks, timetables and methods to evaluate success) in place that is showing signs of success OR recovery plan is not needed.

Management has taken action to control excess capacity or reduce subsidies that result in excess capacity OR no measures are necessary because fishery is not overcapitalized.

2.25 Points for Management

BYCATCH

Core Points (only one selection allowed)

Select the option that most accurately describes the current level of bycatch and the consequences that result from fishing this species. The term, "bycatch" used in this document excludes incidental catch of a species for which an adequate management framework exists. The terms, "endangered, threatened, or protected," used in this document refer to species status that is determined by national legislation such as the U.S. Endangered Species Act, the U.S. Marine Mammal Protection Act (or another nation's equivalent), the IUCN Red List, or a credible scientific body such as the American Fisheries Society.

1.00 Bycatch in this fishery is high (>100% of targeted landings), OR regularly includes a "threatened, endangered or protected species."

2.00 Bycatch in this fishery is moderate (10-99% of targeted landings) AND does not regularly include "threatened, endangered or protected species" OR level of bycatch is unknown.

Bycatch is low in some fisheries (Hough et al. 2009) but high in others (Enever et al. 2007; ICES 2010g). In the UK, common bycatch species in the bottom trawl fishery include dab, gurnards, flounders, cod and starfish (Hough et al. 2009). Allis shad, which is protected from intentionally being killed, are also reported as bycatch, although the amount of bycatch is unknown and Twaite are also protected in some areas and can be
caught as bycatch in this fishery (Hough et al. 2009). In the UK (Hastings) Dover Sole trammel net fishery the main bycatch species are mackerels, rays, plaice, whiting, cod, turbot, bass, and dogfish (Nichols et al. 2007). Interactions with marine mammals in the Hastings Dover Sole fisheries are reported to be small (Nichols et al. 2007; Hough et al. 2009). For example, Swarbrick et al. (1994) reported one interaction with a harbor porpoise. The Hastings trammel net fishery has had limited interactions with sea birds (Nichols et al. 2007). The Celtic Sea Dover Sole fishery catches plaice, cod, rays, brill, turbot and anglerfish as bycatch (ICES 2010c) and the western channel of the Celtic Sea Dover Sole fisheries have substantial catches of plaice, anglerfish, lemon sole and cuttlefish (ICES 2010F). The Bay of Biscay fixed net fishery has a low amount of bycatch (ICES 2010d). Because bycatch levels varies from low to high depending on fishing region, a middle score was selected.

3.00 Bycatch in this fishery is low (<10% of targeted landings) and does not regularly include "threatened, endangered or protected species."

Points of Adjustment (multiple selections allowed)

-0.25 Bycatch in this fishery is a contributing factor to the decline of "threatened, endangered, or protected species" and no effective measures are being taken to reduce it.

-0.25 Bycatch of targeted or non-targeted species (e.g., undersize individuals) in this fishery is high and no measures are being taken to reduce it.

-0.25 Bycatch of this species (e.g., undersize individuals) in other fisheries is high OR bycatch of this species in other fisheries inhibits its recovery, and no measures are being taken to reduce it.

Dover Sole are caught as bycatch in the Nephrops trawl fishery in the North Sea’s Skagerrak, Kattegat and Belts fishery (ICES 2010h) and as bycatch in the English Channel French offshore trawl fishery that targets roundfish (Hough et al. 2009). In the Portuguese artisanal trammel net fishery, around 1.1% of Dover Sole captured are discarded (Batista et al. 2009).

In addition to being caught as bycatch in other fisheries, Dover Sole are also discarded in targeted fisheries. For example, the discard rate of Dover Sole is around 5% in the Dover Sole Hastings trawl fishery (ICES 2007) and in the Hastings Dover Sole trammel fishery, the mesh size is larger than typical nets and therefore catches fewer juveniles (MSC 2005). Since we do not know the actual level of bycatch in other fisheries we have not subtracted any points.

-0.25 The continued removal of the bycatch species contributes to its decline.
Measures taken over a major portion of the species range have been shown to reduce bycatch of "threatened, endangered, or protected species" or bycatch rates are no longer deemed to affect the abundance of the "protected" bycatch species OR no measures needed because fishery is highly selective (e.g., harpoon; spear).

Interactions with marine mammals in UK (Hastings) Dover Sole fisheries are reported to be small (Hough et al. 2009; Nichols et al. 2007). For example, Swarbrick et al. reported one interaction with a harbor porpoise. The Hastings trammel net fishery has had limited interactions with sea birds (Nichols et al. 2007). Allis shad, which is protected from intentionally being killed are reported as bycatch in the Hastings Dover Sole fishery, although the amount of bycatch is unknown (Hough et al. 2009). Twaiite are also protected in some areas and can be caught as bycatch in this fishery (Hough et al. 2009). Overall, bycatch of threatened or endangered species appears to be low/very low, so points are added.

There is bycatch of targeted (e.g., undersize individuals) or non-targeted species in this fishery and measures (e.g., gear modifications) have been implemented that have been shown to reduce bycatch over a large portion of the species range OR no measures are needed because fishery is highly selective (e.g., harpoon; spear).

Common bycatch species associated with the Hastings bottom trawl fishery include starfish, dab, gurnards, flounders and cod (Hough et al. 2009). Discard rates can be high (Enever et al. 2007). For example out of 186 million fish caught every year in one area, 117 million were discarded and 90% of these discards were from trawl vessels (Enever et al. 2007). However, the Hastings trawl fishery has a very low discard rate (Hough et al. 2009). In the Hastings Dover sole fishery, Allis shad, which is protected from intentionally being killed, are reported as bycatch, although the amount of bycatch is unknown (Hough et al. 2009). Twaiite are also protected in some areas and can be caught as bycatch (Hough et al. 2009). In the Hastings Dover Sole trammel net fishery, cod discarding, mainly during September to December, have increased in recent years due to changes in the allowable cod quota (Hough et al. 2009b). The main bycatch species in this fishery are mackerel and ray species, along with plaice, whiting, cod, turbot, bass, and dogfish to a lesser degree (Nichols et al. 2007). In addition, spider crabs are commonly discarded.

The Celtic Sea Dover Sole fishery catches plaice, cod, rays, brill, turbot and anglerfish (ICES 2010c). The western channel of the Celtic Sea Dover Sole fisheries have substantial catches of plaice, anglerfish, lemon sole and cuttlefish (ICES 2010f). The Celtic Sea beam trawl fishery discards a large number of other commercial and non-commercial species (ICES 2010c).

In the North Sea Dover Sole gillnet fishery, a large number of small plaice are discarded (ICES 2010e), while the Bay of Biscay fixed net fishery has a low amount of bycatch (ICES 2010d). In addition, the discard rates of other species in the Irish Sea trawl fisheries can be very high (ICES 2010g). In the Portuguese artisanal trammel net fishery
chub mackerel, shining gurnard and dragonet fishes are commonly discarded (Batista et al. 2009). In addition to these species, some species currently under recovery plans were also caught by this fishery (Batista et al. 2009). Because bycatch levels vary between fishing regions, no points are added.

+0.25 Bycatch of this species in other fisheries is low OR bycatch of this species in other fisheries inhibits its recovery, but effective measures are being taken to reduce it over a large portion of the range.

+0.25 The continued removal of the bycatch species in the targeted fishery has had or will likely have little or no impact on populations of the bycatch species OR there are no significant bycatch concerns because the fishery is highly selective (e.g., harpoon; spear).

2.25 Points for Bycatch

REFERENCES


Witthames, P.R., Greer Walker, M., Dinis, M.T. and Whiting, C.L. 1995. The geographical variation in the potential annual fecundity of Dover sole *Solea solea* (L.) from European shelf waters during 1991.