Turbot

(*Scophthalmus maximus*)

Summary

Size (total length)	Female 67 cm Male 45 cm (Hammen et al., 2013)
Lifespan	35 years (Hammen et al., 2013)
Size of maturity (L_{50}) (North Sea pop.)	Female 34 cm Male 18 cm (Hammen et al., 2013)
Fecundity	>3.5 million (Jones, 1974)
Reproductive frequency	Annual
Capture methods	Bycatch in trawl/nets/hook&line
Minimum Landing Size	30 cm total length
Fishing Season	Year round


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Description

Turbot (*Scophthalmus maximus*) is widely distributed from Norway to the Mediterranean and the Black Sea (Nielsen, 1986). It occurs at a low abundance throughout its range and inhabits sandy, rocky or muddy seabeds to depths of 100 m, although it is more frequently found in shallower parts of the continental shelf (Nielsen, 1986; Hammen et al., 2013). Turbot is ecologically similar to brill (*Scophthalmus rhombus*) and consumes a similar diet. Between the length range of 20-50 cm turbot prey upon sandgoby, dragonets, small cod and sandeels. Individuals greater than 50 cm mainly predate whiting and cod (Wetsteijn, 1981).

Reproductive Life history

Turbot spawn in coastal waters from April to August with a spawning duration of 8 weeks for males and females (Hammen et al., 2013; Jones, 1974). Peak densities of turbot eggs in the water column have been recorded in the eastern North Sea in May and June (van der Land, 1991). Turbot is a highly fecund species with an estimated mean fecundity of 3,658,740 (Jones, 1974). Fecundity increases with size therefore, large females are reproductively highly valuable (Jones, 1974).

The pelagic larvae remain in the surface layer where they are transported by wind-driven currents to the surf zone of sandy beach nursery areas (van der Land, 1991). As larvae, turbot is around 2-3 mm long and remains in the pelagic phase for a relatively long period. Estimates vary between 45 and 72 days (Al-maghazacgu and Gibson, 1984). Following this period larvae undertake metamorphosis to transform

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into benthic juveniles. All flatfish larvae resemble typical fish larvae with eyes on both sides of the body before metamorphosis. However, during metamorphosis the right eye of the turbot migrates to the left side of the head and the entire skull shifts in the process to create an asymmetrical appearance. The body increases in depth and the upper side develops pigmentation to help achieve camouflage whilst the underside remains white (Power et al., 2008). The flat body and location of both eyes on the top of the head make flatfish highly adapted for living on the sea bed.

Juvenile turbot settle in the surf zone from July onwards. They remain in waters less than 1 m deep for the first few months of their life before moving to slightly deeper waters of less than 10 m deep (Hammen et al., 2013). Individuals between 10-25cm in length mainly occur in waters down to 30 m whilst the largest individuals of more than 25 cm in length may range to depths of 100 m (Hammen et al., 2013). Although the distribution of brill and turbot overlap, the range of the turbot tends to extend to slightly deeper depths (Hammen et al., 2013).

Turbot is sexually dimorphic with the female growing to a greater size than the male. In the North Sea females are found to reach ~67 cm in length whilst males reach 45cm (Hammen et al., 2013). Total length ranges across the species range with a maximum length of 74 cm recorded in the Black Sea (combined sexes) (Eryilmaz and Dalyan, 2015) and 74 cm and 54 cm for females and males respectively in the Bay of Biscay (Deniel, 1990 cited in Hammen et al., 2013). Market sampling of 10,000 turbot caught in the North Sea found the oldest individuals to be 35 years old for both males and females (Hammen et al., 2013).

Size of maturity (SOM)

Size of maturity (SOM) is often used to help establish an appropriate Minimum Conservation Reference Size (MCRS) to ensure individuals can reproduce at least once before capture. For finfish, SOM is commonly accepted as the total length (L) at which 50% of a population are mature and is referred to as the L_{50}. Maturity in finfish is determined by the classification of gonad development based on macroscopic (external appearance of the gonad) or microscopic (histology) methods. Histological techniques (analysis of microscopic morphological features) provide the most accurate results but it is a time consuming and expensive process. Maturity classification based on the external appearance of the gonad is quick, simple and cheap however, it is not as accurate as histology and results may be subjective (Brown-Peterson et al., 2011).

There are very few studies that have analysed the SOM for turbot in British waters (table 1). Hammen et al, (2013) sampled 10,000 turbot caught in the North Sea and found males mature at a significantly smaller size than females at 18 cm and 34 cm, respectively. A previous study of females in the North Sea between 1967 and 1970 found SOM to be 46 cm (Jones, 1974). This indicates the SOM of females has declined over time in the North Sea, as is the case with other flatfish species such as plaice (van Keeken et al., 2004). Age at 50% maturity has also declined over time as females used to mature at 4.5 years in the North Sea in 1967 (Jones, 1974). Sampling between

2004-2005 found females matured at 2 years (Hammen et al., 2013). Males mature at an earlier age than females at around 1 year.

Outside British waters male turbot in the south-western Black Sea have been found to mature at a larger size than females at 25 cm and 20 cm respectively (table 1). However, in the South-eastern Black Sea females mature at a larger size and SOM for both sexes is larger than the North Sea turbot population at 39 cm (female) and 35 cm (male) (Zengin and Düzgüneş, 2003 cited in Eryilmaz and Daylan, 2015 – not cited in table 1 as paper could not be accessed).

Table 1. Size at maturity estimates (L_{50}) for turbot (*Scophthalmus maximus*) in studies undertaken in the North Sea and Black Sea. Male and female total length given in cm and rounded. Please refer to the Appendix for more information.

Location	Male	Female	Reference
North Sea, Netherlands	18	34	Hammen et al., 2013
North Sea, UK	-	46	Jones, 1974
South-western Black Sea, Turkey	25	20	Eryilmaz and Daylan, 2015

The minimum size for turbot in the Southern IFCA district is 30 cm. Based on the limited literature available female turbot mature at a greater size (34 cm) than the current minimum size. However, the majority of males would have an opportunity to reproduce at least once before potential removal from the fishery.

Southern IFCA Fishery

Fishing activity

Turbot is a highly prized commercial fish due to the high market price it commands as a result of its limited supply. In 2019, 400 tonnes of turbot worth £4.6 million was landed into England by UK vessels (MMO, 2019). The highest catch rates occur offshore but adults do migrate to shallower water in the spring and summer to spawn (Hammen et al., 2013). Turbot can be caught in low quantities all year round within the District but its sparse distribution means it is not part of a targeted fishery, instead it is a highly valued bycatch species (Haynes et al., 2014). Turbot is taken as bycatch in demersal fisheries that target other flatfish species such as plaice and sole. In the Southern IFCA district turbot is mainly caught in gill nets, entangling nets, otter trawls and by hook and line.

Recreational

Turbot is as equally prized by recreational anglers as it is commercial fishers and the south coast of England is one of the best locations to target the species. Shore angling mainly takes place in the spring and early summer when the turbot can be found in shallower water, however they can be caught throughout most of the year. A number

of charter boats in the District offer turbot and brill trips from March to October. They are commonly targeted over sand banks with the Shambles Bank off Portland Bill being recognised as one of the best locations in the country. Flatfish are the fifth most valuable species for charter boats in the South Inshore marine planning area (Devon and Severn, Southern and Sussex IFCA districts) (MMO,2020).

Landings & Value of Fishery

Over the period 2005 - 2019 total landings of turbot into ports within the Southern IFCA district ranged from 3 to 7 tonnes per year, with the lowest landings in 2007 and the highest peaks in 2012 and 2017 (fig 1*). Landings within the last four years have remained above 5 tonnes per year, prior to 2016 landings fluctuated considerably. In 2019 nearly 6 tonnes of turbot was landed in the District at an estimated value of £63,500. Price per tonne reached its highest peak in 2019 at ~ £10,800 increasing from ~ £9,060 per tonne in 2016.

*these figures represent vessels that land into ports in the Southern IFCA district, some of which would have fished outside the district and be >12 metres in length.

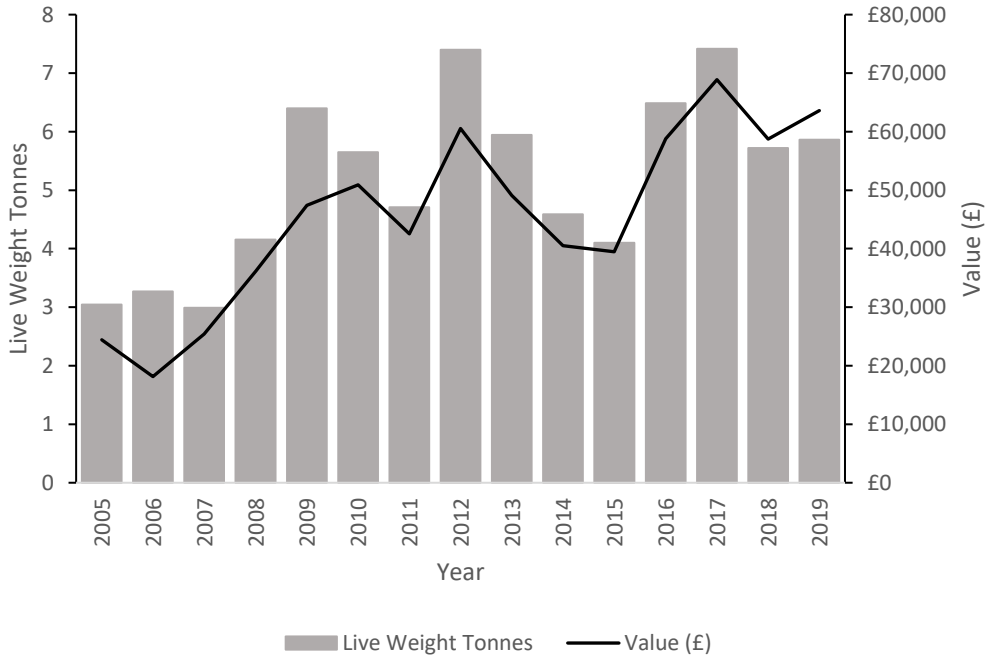

Figure 1. Landings of turbot (*Scophthalmus maximus)* in the Southern IFCA district from 2005 to 2019. Data sourced from the Marine Management Organisation (MMO)

ICES do not provide advice on turbot landings within Divisions VIIe and VIId and there are no assessments of stock status for this area. However, for turbot caught in the North Sea ICES advises that catches should be no more than 3948 tonnes in 2021 (ICES, 2020). The most recent stock assessments in the North Sea suggest the stock is in a healthy state as biomass is above the MSY $B_{trigger}$ (Maximum Sustainable Yield) (ICES, 2020).

Associated management

Turbot caught within the Southern IFCA district is primarily managed by a minimum landing size of 30 cm (total length) under the Minimum Fish Sizes byelaw. There is no minimum length restriction imposed for turbot by the European Commission however a minimum size of 30 cm is enforced by two additional IFCAs in England and the Government of Jersey (table 2).

There are no Total Allowable Catch (TAC) measures in place for turbot in the English Channel. In the North Sea turbot is managed under a combined TAC with brill.

Table 2. Minimum Conservation Reference Sizes (MCRS) for turbot (*Scophthalmus maximus*) enforced by Inshore Fisheries and Conservation Authorities (IFCA) in England and authorities in other regions. All measurements in cm for total length (L).

IFCA	**Minimum Landing Size (MLS)**
Northumberland	-
North Eastern	-
Eastern	-
Kent & Essex	-
Sussex	-
Southern	30
Devon & Severn	-
Cornwall	30
Isles of Scilly	0
North Western	30*
Other	
EU	-
States of Jersey Government	30

*Only applies within a certain area of the district

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Appendix

Table A. Size at maturity estimates (L_{50}) for turbot (*Scophthalmus maximus*) from the published literature. Measurements given in cm for total length (L_{50}). (* All mature individuals).

Study location	Total No. surveyed	No. of individuals (n)		Length Data		Size at Maturity Data											Reference
				Size range		Total No. of individuals	No. of individuals (n)		Size of smallest mature individual		Size at 50% maturity (L_{50})		Age at 50% maturity (years)		Size range of mature individuals		
		M	F	M	F		M	F	M	F	M	F	M	F	M	F	
North Sea, Netherlands	10,000	-	-	-	-	3,943	1291	2652	-	-	17.9	34.2	1.1	2.2	-	-	Hammen et al., 2013
North Sea, UK	-	-	-	-	-	-	-	-	-	-	-	46	-	4.5	-	-	Jones, 1974
South-western Black Sea, Turkey	264	-	-	14-70		166*	32*	134*	-	-	24.6	20.3	2	2	-	-	Eryilmaz and Daylan, 2015