

# Thornback ray

## *(Raja clavata)*

### Summary

<b>Size (total length)</b>	105 cm male 130 cm female Most specimens <105 cm (Ebert and Stehmann, 2013)
<b>Lifespan</b>	15 years (Kadri et al., 2014)
<b>Size of maturity (DW<sub>50</sub>) (English Channel &amp; North Sea populations)</b>	44 cm male 47-49 cm female
<b>Fecundity</b>	62-150 egg capsules
<b>Reproductive frequency</b>	Annual
<b>IUCN Status</b>	Near Threatened (Ellis, 2016)
<b>Minimum Landing Size</b>	40 cm (disc width) 20 cm (detached wing)
<b>Capture methods</b>	Primarily nets but also trawl and rod & line
<b>Fishing Season</b>	All year (peak spring-autumn)



### Description

The thornback ray (*Raja clavata*) is a widely distributed skate in the eastern Atlantic, ranging from Norway to as far south as South Africa, including the Mediterranean and Black Seas (Ebert and Stehmann, 2013). Thornbacks are widespread in coastal waters and bays around the British Isles with a greater abundance concentrated in the eastern English Channel and southern North Sea (Ellis et al., 2008a; Elliott et al., 2020).

As a demersal species thornback ray inhabit a variety of sediments including mud, gravel, sand and shingle from shallow inshore waters to depths of 300 m (Ebert and Stehmann, 2013). They remain hidden in the day and become active at night when juveniles feed on small crustaceans such as shrimps and small crabs while adults prey upon larger crustaceans and fish (Ebert and Stehmann, 2013).

### Reproductive Life history

The thornback ray, like all skates, is characterised by slow growth rate, late maturity and low fecundity. Adults migrate to shallow waters (<10 m) in the spring to form mating aggregations in the same breeding grounds each year (Walker et al., 1997; Hunter et al., 2005). Mating begins in February and it is thought females mate with multiple males. Chevolut et al, (2007) analysed egg clutches from four females and found all clutches were sired by a minimum of 4-6 fathers. Thornback rays are oviparous and enclose their internally fertilised eggs in a tough case which they deposit on the seabed throughout the spawning season between February and September (Holden, 1975). The number of egg capsules laid is estimated to range

from 62 up to 150 with an egg-laying rate of one capsule per day (Ryland and Ajayi, 1984; Holden, 1975; Ebert and Stehmann, 2013). Development takes around five months after which the young hatch resembling miniature thornback rays at 10 to 13 cm in length (Ebert and Stehmann, 2013). Male and female thornback rays grow at similar rates between the ages of 1-4 years but growth rate appears to reduce in males after 4 years of age (Whittamore and McCarthy, 2005). It is thought female skates attain a larger size before reaching sexual maturity to provide more space within the body cavity to hold their egg cases (Walmsley-Hart et al., 1999 Cited in Saglam and Ak, 2012).

Juvenile thornbacks remain in shallow water for the first years of development before migrating to deeper waters (Hunter et al., 2006). Thornback rays undertake seasonal movements residing in deeper waters between 10-30 m in autumn and winter and shallow waters in spring/summer for breeding purposes (Hunter et al., 2005). During the winter months thornbacks from different populations are thought to mix at foraging grounds offshore whereas spring/summer populations are more isolated as individuals return to their breeding grounds (Chevolot et al., 2006).

### 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. SOM for skates and rays is commonly accepted as the total length (L) at which 50% of a population are mature and is referred to as the  $L_{50}$ . Some studies may also measure SOM based on the total disc width (DW) of a specimen. Table 1 includes total length-disc width conversions based on conversion factors in McCully et al, (2012).

Maturity in skates and rays is determined using criteria to define maturity stages either externally or internally. External observations are based upon analysing the length of claspers in males and the cloaca in females in relation to total body length. Internal examination includes macroscopic inspection of reproductive organs e.g. coiling of the vas deferens and development of the testes in males; development of the ovaries, ova and nidamental glands in females (Saglam and Ak, 2012).

A review of the literature reveals female thornback rays mature between 70-78 cm ( $L_{50}$ ) and males between 59-68 cm ( $L_{50}$ ) around the British Isles (table 1). Size at 50% maturity does appear to vary slightly depending on geographical location with females in the Celtic Sea reaching maturity at a larger size of 78 cm in comparison to females in the North Sea and English Channel at 70-74 cm. McCully et al., (2012) calculated SOM based on combined ecoregions in the UK to be 67 cm and 77 cm for males and females respectively.

The size of the smallest mature female was found to be 47 cm in the Celtic Sea whereas in the North Sea the smallest mature female was substantially larger at 57 cm (McCully et al., 2012). The smallest mature male was sampled in the North Sea at 47 cm (McCully et al., 2012). All studies confirmed females matured at a larger size than males with a difference of 12 cm in populations assessed in Wales and 5 cm for males and females sampled in the North Sea and English Channel (table 1). Of the

studies that assessed age at maturity in table 1 males were found to reach maturity between 4-6 years of age and females between 5 and 7 years of age (Gallagher et al., 2005; Whittamore and McCarthy, 2005; Kadri et al., 2014).

Outside of the British Isles in the Black Sea, Adriatic Sea and Mediterranean Sea SOM ranged between 61-81 cm for female thornback rays and 59-72 cm for males (table 1).

Table 1. Size at maturity estimates ( $L_{50}/DW_{50}$ ) for thornback ray *Raja clavata* in studies undertaken around and outside the British Isles. Male and female total length ( $L_{50}$ ) has been converted to disc width ( $DW_{50}$ ) using conversion factors ( $DW=0.6572L_{50} + 0.9095$ ) presented in McCully et al., 2012. Measurements given in cm and figures rounded. Refer to the Appendix for more information.

Location	$L_{50}$		$DW_{50}$		Reference
	Male	Female	Male	Female	
North Sea & English Channel	65	70	44	47	Walker et al., 1997
North Sea	-	74	-	49	McCully et al., 2012
North Sea - Greater Thames Estuary	67-68	-	45-46	-	Ellis et al., 2008b
Wales – Caernarfon Bay	59	71	40	47	Whittamore and McCarthy, 2005
Celtic Sea	-	78	-	52	McCully et al., 2012
Irish Sea	66	72	44	48	Gallagher et al., 2005
UK*	67	77	45	51	McCully et al., 2012
<b>Outside British Isles</b>					
Turkey – Black Sea	64	67	43	45	Demirhan et al., 2005
Turkey – Black Sea	72	75	48	50	Saglam and Ak, 2012
Italy – Adriatic Sea	59	61	40	41	Krstulović Šifner et al., 2009
Gulf of Gabes – Mediterranean Sea	67	81	45	54	Kadri et al., 2014

\*ecoregions of Celtic Sea and North Sea combined

The minimum size for thornback rays in the Southern IFCA district is 40 cm and refers to disc width (wing tip to wing tip) rather than total length. Using the CEFAS conversion presented in McCully et al. (2012) the current minimum size for total length is 59 cm. The literature review infers the SOM of thornback rays around the British Isles is above the current minimum size for all but one study in Wales where males were found to mature at 40 cm DW/ 59 cm L. However, females sampled from the same population were found to mature at a much larger size of 47 cm DW/ 71 cm L (table 1).

Immature individuals could be removed from the fishery before having an opportunity to reproduce at least once under the current minimum size observed within the Southern IFCA district.

## Southern IFCA Fishery

### Fishing activity

Thornback ray is locally abundant in areas of the eastern and western English Channel (Ellis et al., 2008a; Elliott et al., 2020) and is the dominant skate species caught in the east of the Southern IFCA district. Thornbacks can be caught throughout the year but are particularly abundant inshore from spring to autumn. They are targeted as part of skate and ray fisheries using nets including gill, entangling and trammels but are also an important component of mixed demersal trawl fisheries and are taken as bycatch in a number of different target fisheries such as sole and plaice. The wings of skates and rays are usually removed at sea rather than landed whole (excluding undulate rays which must be landed whole) because it is not always practical to retain the whole fish due to their size and market prices are based upon wing weight. The remaining parts of the tail and central body cavity aren't wasted as they can be used as bait for crab pots.

### Recreational

Thornback rays are a popular target species for recreational rod and line fisheries both from the shore and at sea. They can be caught all year round but are mainly targeted during the summer months if angling from shore. The two largest charter boat ports in the UK reside within the Southern IFCA district at Weymouth and Poole (Williams and Davies, 2018). Many of these boats provide specialised trips to target skates and rays, including thornback rays. A recent review undertaken by the MMO to map recreational sea angling activity in England found skates and rays to be the most valued species for charter boats operating in the South Inshore marine planning area (Devon and Severn, Southern and Sussex IFCA districts) and amongst the top three most valued species across England (MMO, 2020a). The vast majority of skates and rays caught recreationally are released.

### Landings & Value of Fishery

Thornback rays are one of the most commercially valuable skates but their economic value is small in comparison to other demersal species such as sole (Chevolot et al., 2006). Southern IFCA do not hold effort or catch data for the thornback ray fishery but landings data from the MMO can help indicate the scale of the commercial thornback fishery within the Southern IFCA district over time. Figure 1. shows landings and value of thornback ray within the district since 2009. Before this point thornback ray landings were recorded under a general category of skates and rays.

In 2019 approximately 107 tonnes of thornback ray worth £129,360 was landed into ports across the district (fig 1\*). Since 2011 landings have generally increased each year after dipping slightly in 2010 - 2011 to 46 tonnes from 55 tonnes in 2009. Between 2013 and 2017 (excluding 2016) landings remained between 76-86 tonnes per year increasing by over 30 tonnes in 2018 to 109 tonnes and remaining around this level in 2019. In 2016 landings almost doubled from 86 tonnes in 2015 to 162 tonnes, before falling to 76 tonnes in 2017. The value of thornbacks has declined slightly over recent

years from approximately £1,359 per tonne in 2017 to £1,208 per tonne in 2019. Peak value occurred in 2011 at around £1,866 per tonne.

\*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.

ICES advice states the stock and exploitation status of thornback rays relative to maximum sustainable yield cannot be assessed due to a lack of data, therefore a precautionary approach is applied for advised landings (ICES, 2019a;2019b;2020). The stock structure of thornback ray in the western English Channel (Division 7.e) is unclear and it is not known whether the stock is associated with neighbouring stocks in the eastern English Channel (Division 7.d). Separate advice is therefore provided for the western English Channel (ICES,2019a). In 2021 and 2022 ICES advises landings should be no more than 170 tonnes in each year for thornback rays caught within the western English Channel (ICES, 2020). Advice for stock located in the eastern English Channel is combined with the North Sea, Skagerrak and Kattegat (Subarea 4 and Divisions 3.a and 7.d) and states landings should be no more than 2237 tonnes in each of the years 2020 and 2021 (ICES, 2019b).

The value of the recreational thornback ray fishery or the quantity of retained catches in the district is not known.

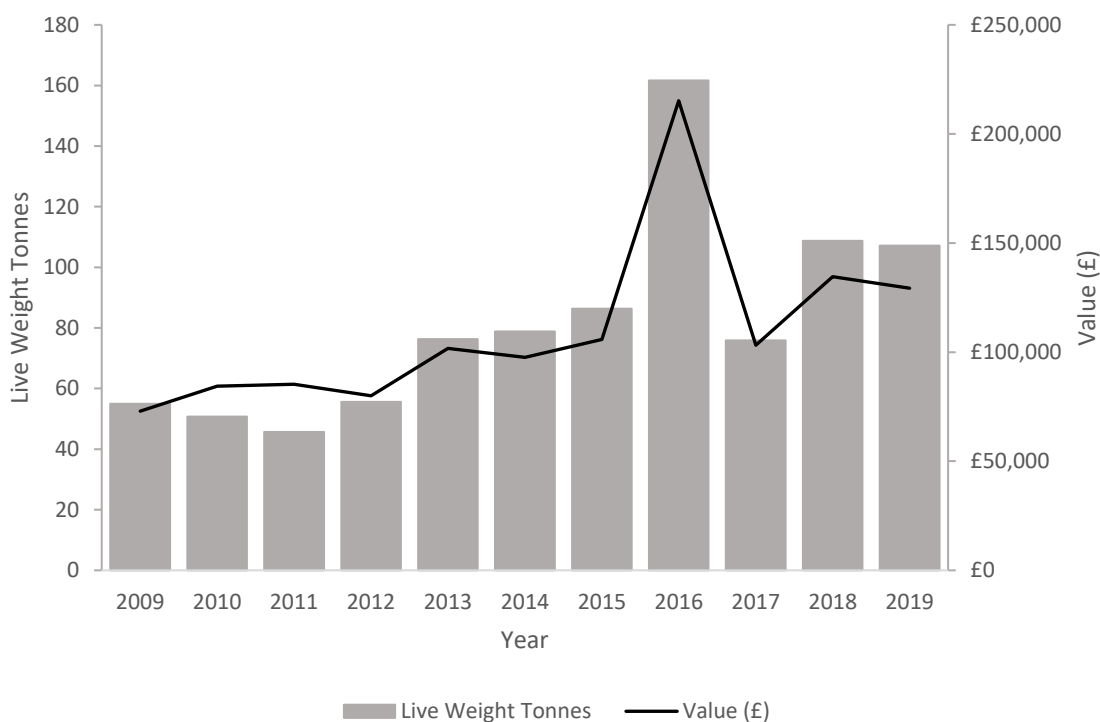


Figure 1. Landings of Thornback ray (*Raja clavata*) into the Southern IFCA district from 2009 to 2019. Data sourced from the Marine Management Organisation (MMO).

## Associated management

Thornback ray caught within the Southern IFCA district is subject to a minimum size byelaw 'Skates and Rays – Minimum Size'. The byelaw prohibits the retainment of any species of skate or ray that measures less than 40 cm between the extreme tips of the wings or any detached wing that measures less than 20cm in its maximum dimension. There are no minimum landing sizes for skates and rays on a national/EU level but some IFCAs have introduced minimum size byelaws within their districts (table 2). Kent and Essex IFCA's minimum size for skates and rays is 40 cm measured from the extreme tips of the wings and 19 cm for a detached wing measured in a straight line from the tip of the wing to the centre of the cut edge. North Western IFCA apply a minimum size within a certain area of their district, as introduced under the former Cumbria Sea Fisheries Committee District. Any skate or ray caught from Haverigg Point in Cumbria to the Scottish border in the Solway Firth must not measure less than 45 cm between the extreme tips of the wings and 22 cm based on maximum dimensions for detached wings.

Thornback rays are part of a mixed Total Allowable Catch (TAC) under the European Union's Common Fisheries Policy (CFP). Within recent years the CFP has introduced bycatch restrictions to reduce discarding. All quota species are subject to Landing Obligations meaning all catch must be landed and counted against quota regardless of size unless exemptions apply. Skates and rays (excl. undulate rays) caught in the English Channel are currently exempt of the Landings Obligation based on their survival rates (MMO, 2020b). Discard survival has been estimated to be 96% for thornback rays caught in trammel nets (Catchpole et al., 2017 Cited in ICES, 2019b) but survival rates for bycatch from other fishing methods is unknown. However, Cefas have assessed the health condition of 17,259 individual skates and rays caught as bycatch from various projects and found 100%, 98% and 95% survived fishing capture in longline, otter trawl and net fisheries, respectively (Cefas, 2018).

Table 2. Minimum Landing Size (MLS) for *Raja clavata* in Inshore Fisheries and Conservation Authority (IFCA) Districts in England. All measurements in cm measured wing tip to wing tip.

IFCA	Minimum Landing Size (MLS) (cm)
Northumberland	-
North Eastern	-
Eastern	-
Kent & Essex	40 Detached wing: 19*
Sussex	-
Southern	40 Detached wing: 20*
Devon & Severn	-
Cornwall	-
Isles of Scilly	-
North Western	45 Detached wing: 22 * **

\*Please note detached wings are measured differently depending on the byelaw

\*\*North Western IFCA MLS only applies to a certain are of the district (from Haverigg Point in Cumbria to the Scottish border in the Solway Firth)

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## Appendix

Table A. Size at maturity estimates ( $L_{50}/DW_{50}$ ) for thornback ray (*Raja clavata*) in studies undertaken around and outside the British Isles. Male and female total length ( $L_{50}$ ) has been converted to disc width ( $DW_{50}$ ) using conversion factors ( $DW=0.6572L_{50} + 0.9095$ ) presented in McCully et al., 2012. Measurements given in cm and figures rounded.

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 ( $L_{50}$ )		Size at 50% maturity ( $DW_{50}$ )		Size range of mature individuals		
		M	F	M	F		M	F	M	F	M	F	M	F	M		F
North Sea and English Channel	5714	-	-	-	-	-	-	-	-	-	65	70	44	47	-	-	Walker et al., 1997
North Sea	1410	696	705	13-94	13-92	942	843*	99*	47	57	-	73.7	-	49	-	-	McCully et al., 2012
North Sea - Greater Thames Estuary	6050	-	-	14-91	11-99	-	-	-	54	-	67-68	-	45-46	-	-	-	Ellis et al., 2008
North Sea	47	20	27	-	-	-	-	-	-	-	-	77-82	-	52-55	-	-	Steenberg, 1994
Wales – Caernarfon Bay	189	54	135	-	-	-	-	-	-	-	58.8	70.5	40	47	-	-	Whittamore and McCarthy, 2005
Celtic Sea	4795	2427	2368	10-89	10-98	383	276*	107*	56	47	-	78.2	-	52	-	-	McCully et al., 2012
Irish Sea	258	165	93	-	-	-	-	-	-	-	65.7	71.8	44	48	-	-	Gallagher et al., 2005
UK	6196	3123	3073	10-94	10-98	1325	1119	206	47	47	66.6	76.6	45	51	-	-	McCully et al., 2012
<b>Outside British Isles</b>																	
Turkey – Black Sea	52	-	-	48-95	34-88	-	-	-	57	-	64	66.7	43	45	-	-	Demirhan et al., 2005
Turkey – Black Sea	230	99	131	14-92	16-93	230	99	131	68	72	71.8	74.6	48	50	-	-	Saglam and Ak, 2011
Italy – Adriatic Sea	364	183	181	12-95		-	-	-	47	47.5	59.3	61.2	40	41	-	-	Krstulovic et al., 2009
Gulf of Gabes	1280	530	750	15-89	14-110	-	-	-	55	72.4	67.4	81.4	45	54	-	-	Kadri et al., 2014

\*number mature