Marine Management Organisation

Small-eyed ray in the English Channel: Synthesis of available data (MMO1297)

Technical Report

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MMO1297: Small-eyed ray in the English Channel: Synthesis of available data, November 2022

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When referencing this publication, please cite as:
MMO (2022). Small-eyed ray in the English Channel: Synthesis of available data. A report produced for the Marine Management Organisation, MMO Project No: 1297, November 2022, 61pp

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1. Introduction

1.1 Small-eyed ray

Small-eyed ray *Raja microocellata* (Family Rajidae; FAO code RJE) is a medium-bodied skate that attains a maximum total length of about 91 cm (Ryland and Ajayi, 1984). It is distributed in the coastal waters of the North-eastern Atlantic (FAO Area 27) from northern Morocco to the British Isles, and favours sandy habitats (Kaiser *et a*l., 2004; Ellis *et al*., 2015). Small-eyed ray has a patchy distribution and may be locally abundant in some areas, such as in parts of the Bristol Channel (Ellis, 2000; Ellis *et al*., 2005), the Cove of Bertheaume in Brittany (Rousset, 1990) and parts of the western English Channel, including along the south coast of England (Simpson *et al.*, 2020) and Channel Islands (Ellis *et al.*, 2011).

The biology of the small-eyed ray is little known, with life-history parameters and data provided by Ryland and Ajayi (1984), McCully *et al.* (2012) and Hume (2019). Small-eyed ray predates on small crustaceans when young, with larger individuals also predating on fish (Ajayi, 1982; Rousset, 1987).

Tagging studies (Ellis *et al.*, 2011; Bird *et al*., 2020; Simpson, 2020, 2021; Ribeiro Santos *et al.*, 2021) indicate that the species does not make longer-distance movements, and suggests that stocks may be quite localised, although this perception is based on limited tagging data.

1.2 International Council for the Exploration of the Sea (ICES) assessments and advice

ICES assess and provide advice for two stocks of small-eyed ray, one in the Bristol Channel and northern Celtic Sea (Divisions 7.f–g) and another in the English Channel (Divisions 7.d–e), and the former stock may also extend into the southernmost parts of the Irish Sea (Division 7.a). Small-eyed ray also occurs in parts of the Biscay-Iberian ecoregion (ICES Divisions 8.a–c and 9.a), although there are neither assessments of, nor advice for, small-eyed ray stocks in these areas.

The stock in the Bristol Channel and northern Celtic Sea (ICES stock code: rje.27.7fg) is assessed using data from the UK beam trawl survey of that area and is currently a Category 3 assessment (survey-based assessments or exploratory assessments indicate trends, ICES, 2020a). There is currently no stock-size indicator for the English Channel stock (ICES stock code: rje.27.7de), which is subject to a Category 5 assessment (assessments based only on landings or a short series of catches) and based on landings data only (ICES, 2020b).

1.3 Management applicable

European Union (EU) fishery regulations required landings of small-eyed ray from the western Channel to be reported to species-level from 2009 (relating to the Total Allowable Catch (TAC) management unit for SRX/67AKXD), with this requirement for species-level reporting in the eastern Channel (for the TAC management unit SRX/7D) only required since 2013. Nevertheless, many nations improved national reporting of species-specific landings data for all skate and ray species from 2008 onwards.

In 2016, small-eyed ray was listed as a species that was not to be retained in various areas managed under the system of skate and ray TACs (EC, 2016a), namely the North Sea (SRX/2AC4-C), eastern English Channel (SRX/7D) and wider Celtic Seas (SRX/67AKXD). Such a non-retention policy was not introduced for the TAC management area in the Bay of Biscay and Iberian waters (SRX/89-C).

The evidential basis for introducing the non-retention policy is unclear, with the then previous ICES advice for the English Channel stock of small-eyed ray being for a precautionary 20% reduction in catches (ICES, 2014).

A subsequent in-year amendment in March 2016 (EU, 2016b) allowed for small-eyed ray to be landed from Divisions 7.f–g (with a stock-specific TAC established within the framework of the SRX/67AKXD TAC), and the non-retention policy in the eastern Channel (SRX/7D) was also removed during this in-year revision. However, the non-retention policy in the western Channel (Division 7.e) was maintained.

Consequently, management regulations that would affect the ability to land small-eyed ray should be considered when interpreting commercial data for this stock:

- western Channel (Division 7.e): Retention allowed from 2008–2015; no retention allowed from 2016–2021.
- eastern Channel (Division 7.d): Retention allowed from 2008–2021 (except for the initial part of 2016).

1.4 Present study

The basis for the non-retention policy for small-eyed ray in the western Channel has been questioned by the local fishing industry, with the issue raised at meetings of the south-western Regional Fisheries Group (RFG). Consequently, an improved knowledge of this stock is required in order to determine whether there is sufficient evidence to reinstate fishing opportunities for the species in the western Channel part of the stock range, and also to determine how relevant data to provide a stock-size indicator for future assessments could be collected.

The overall objectives of the project were to:

(1) Collate available data on small-eyed ray (*Raja microocellata*; RJE) in the English Channel, in relation to their spatial distribution and proportional importance within the skate assemblage (Rajidae),

(2) Develop a potential work plan for future monitoring of small-eyed ray in the western Channel.

2. Commercial landings data

2.1 Introduction

This section of the report considers reported landings data, including data for UK-vessels (Section 2.2) and international landings data, based on ICES estimated landings (Section 2.3). Data for the former are available at a finer-scale spatial and temporal resolution, allowing for more detailed analyses of spatial and seasonal factors.

2.2 Reported UK landings (2008–2021)

2.2.1 Data sources

Landings and effort data were derived from the official national fisheries statistics, as recorded under the EU Control Regulation No. 1224/2009. This information was obtained from official logbooks, for vessels of 10 metres and over (≥10 m), and/or sales slips for vessels under 10 metres (<10 m).

Landings data for all skate and ray species (Divisions 7.d–e only), including small-eyed ray (RJE), were retrieved from the IFish database (the MMO fisheries database) on the 1st February 2022 for the years 2008–2021[1].

Corresponding information on year, month (and quarter), spatial coverage (ICES rectangle) and gear were extracted. Data relating to gear codes were aggregated into broader fleet definitions for subsequent analyses: demersal otter trawl, beam trawl, set net, demersal seines, midwater trawl, purse seines, dredges, hooks and lines, pots and traps, and miscellaneous gears.

2.2.2 Reported annual landings

English vessels accounted for 95% of the reported UK landings of small-eyed ray from the English Channel (Divisions 7.d–e). Between 2009 and 2015, the vast majority (92%) of reported small-eyed ray landings were from the western Channel (Division 7.e; Table 1 and Table 2). In 2016, with the start of the non-retention policy, the reported UK landings of the stock almost halved and, since then, most of the UK landings have been reported from the eastern Channel (Division 7.d; Figure 1).

The increase in reported landings from the eastern Channel following the introduction of the non-retention policy in the western Channel is also noteworthy. This could relate to a number of factors, such as improved species-specific reporting, a potential increase in population size, and possibly a degree of area misreporting, given that the adjacent rectangles 30E7 (Division 7.e) and 30E8 (Division 7.d) are important fishing grounds for small-eyed ray.

The spatial distribution of the reported UK landings (Figure 2) shows that most of the landings were from those ICES Rectangles close to shore, in particular in Lyme Bay (Division 7.e) and near the Isle of Wight and off Brighton (Division 7.d).

[1] Landings data for 2021 should be considered provisional.

The average[2] annual value of reported small-eyed ray landings from the eastern Channel (Division 7.d) was £3,800 per annum (pa) (range = £2,260–4,500) from 2010–2015, and £14,500 pa (range = £11,700–17,300) from 2016–2021 (Table 1). Corresponding data for the western Channel (Division 7.e) indicated that the average value of the reported landings of small-eyed ray decreased from £53,600 pa (range = £44,300–70,100) from 2008–2015 to £9,400 pa (range = £5,400–15,200) from 2016–2021 (Table 1).

2.2.3 Reported landings by gear

The main gears landing small-eyed ray in the English Channel were demersal otter trawls, set nets (gillnets, tangle nets and trammel nets), beam trawls, and hooks and lines (Table 3 and Figure 3).

In Division 7.e, most reported UK landings of small-eyed ray (2008–2015) were taken by demersal otter trawl (average annual landings 143 t; 55% of the Division 7.e landings between 2008 and 2015) and set nets (average annual landings 93 t; 35% of the Division 7.e landings between 2008 and 2015). Since the non-retention policy was introduced in 2016, reported landings[3] of both demersal otter trawl and set nets have decreased, but these gears still account for the majority of small-eyed ray reported from Division 7.e (48% and 33% of the total landings between 2016–2021, respectively). However, considerably smaller quantities are reported, average annual landings being 3.3 t from demersal trawl and 2.3 t from set nets.

The non-retention policy of small-eyed ray does not apply in Division 7.d, and there has been an increase in the reported landings from 2016 onwards (Table 3). Most of the reported UK landings from the eastern Channel were from set net fisheries, and averaged 2 tonnes per year between 2008-2015, and 7 tonnes per year between 2016–2021.

2.2.4 Reported landings by season

Small-eyed ray were landed throughout the year in both periods examined (Figure 4). However, in the years 2008–2015 (retention allowed), reported UK landings from the western Channel (Division 7.e) were higher in quarter 2 (Q2) and Q3. On the other hand, most of the UK landings from the eastern Channel (Division 7.d) were reported in Q4.

2.2.5 Spatial variation in species composition of skates and rays

Based on the official UK landings data for skates and rays that had been reported to species-level, small-eyed ray accounted for 3% of the total species-level skate and ray landings between 2008 and 2021, across Divisions 7.d–e.

However, between the two periods there was a shift in the relative importance of small-eyed ray landings in relation to the total species-specific skate and ray landings (Figure 5).

Small-eyed ray accounted for an average of 0.9% (0.63–1.3%) of identified skates and rays landed from the western Channel (Division 7.e) after the no-retention regulation, but was 5% (3.5–7.1%) in those years prior to the retention ban.

[2] The average values given in this report refer to the mean, unless otherwise specified.
[3] Some landings of small-eyed ray have been made under dispensation as part of regional fishery projects.

In the eastern Channel (Division 7.d), small-eyed ray accounted for 5% of the skate and ray landings in 2016–2021, though was only 1.5% during the earlier period (2008–2015).

2.2.6 Reported UK landings by port

This section details the main ports where small-eyed ray caught in the English Channel were landed. Whilst most ports detailed below are on the English Channel coast, some vessels operating out of other ports may sometimes fish in the English Channel and land into their home port. As such, some of these data refer to some ports (e.g., Padstow and Bideford) outside the English Channel.

Between 2008 and 2015, the majority of the reported UK landings of small-eyed ray from the English Channel were from Division 7.e, with most landings reported from vessels landing into Brixham, Lyme Regis, Plymouth, West Bay and Weymouth (Table 2). Bideford was the port with the highest proportion of small-eyed ray being landed (24% in relation to the total species-level skate and ray landings). During this period, most of the small-eyed ray from Division 7.d were landed in Christchurch, with average annual landings of 490 kg. From 2016, there was a shift in the reported landings from Division 7.e to Division 7.d.

Landings from Division 7.e decreased markedly and most of the small-eyed ray landings were in Newlyn and Plymouth. The proportion of small-eyed ray in relation to the total landings of skates and rays was considerable smaller (0.2–2.0%) than previous years. Other ports, such as Poole and Padstow, had high proportions of small-eyed ray in the landings, 36% and 10%, respectively, although landing quantities were relatively low.

An increase in small-eyed ray landings in Division 7.d was observed, both in quantity (Table 3) and relative importance in relation to other skates and rays (Table 2). Most of the small-eyed ray landings were reported from Shoreham, Brighton, Lymington and Portsmouth. In these ports, small-eyed ray contributed to 7–26% of the total skate and ray landings (Table 2).

2.3 ICES estimated landings

Given that there are often coding errors and misidentifications in relation to reported skate and ray landings (ICES, 2016), the ICES Working Group on Elasmobranch Fishes (WGEF) review and, where deemed appropriate, reallocate landings for the various assessed species. These ICES estimated landings data are used in the formulation of ICES advice.

Working Group estimates of skate and ray landings data for the eastern Channel (Table 4) and western Channel (Table 5) indicate that annual landings (2011–2020) of small-eyed ray have been in the region of 12–36 tonnes per year from Division 7.d and 14–58 tonnes per year from Division 7.e.

Based on the landings data reported to species-level, small-eyed ray has generally accounted for about 1.5% (1.0–2.2%) of the skate landings in Division 7.d (Table 6), but was 2.9–3.8% in Division 7.e (Table 7) in those years prior to the retention ban (2011–2015, Figure 6).

Overall, the estimated landings of the stock were broadly stable over the years 2010–2015, at approximately 66.2 tonnes per year (Figure 7) before declining to 40.5 tonnes per year following the non-retention policy in Division 7.e.

Table 1. Reported UK landings and value (£) of small-eyed ray from the English Channel (ICES Divisions 7.d–e) from 2010–2021. Data source: IFish [date of retrieval 1st February 2022].

Period	Year	UK landings (tonnes)		Value (£)	
		Div. 7.d	Div. 7.e	Div. 7.d	Div. 7.e
2010–2015	2010	2.2	37.1	4,148	70,149
	2011	2.3	25.2	4,115	51,188
	2012	2.3	30.7	3,747	57,082
	2013	3.1	29.1	4,420	47,016
	2014	3.3	32.6	4,541	44,337
	2015	1.7	36.8	2,267	51,575
2016–2021	2016	10.2	8.7	13,958	12,762
	2017	8.6	6.0	11,774	8,611
	2018	8.2	3.8	11,774	5,442
	2019	12.2	6.8	14,777	8,896
	2020	18.9	5.2	17,322	5,720
	2021	16.2	11.3	17,188	15,221

Table 2. Main UK ports that accounted for 90% of the reported UK landings (tonnes) of the English Channel stock of small-eyed ray (rje.27.7de) and the corresponding percentage of the total species-specific skate and ray landings by Division and time period (2008–2015 and 2016–2021). Whilst most ports border the English Channel, vessels from ports outside the English Channel (denoted *) may fish in, and report landings from, the English Channel. Data source: IFish [date of retrieval 1st February 2022].

ICES Division	Port	2008–2015			2016–2021		
		RJE average annual landings	SKA average annual landings	Percentage of RJE landings (%)	RJE average annual landings	SKA average annual landings	Percentage of RJE landings (%)
7.d	Christchurch	0.5	1.8	21.8	0.4	2.9	11.8
	Poole	0.4	11.2	3.2	0.7	7.8	7.7
	Portsmouth	0.3	12.7	2.5	1.1	15.0	6.6
	Lymington	0.3	2.5	9.7	1.2	6.0	16.5
	Shoreham	0.2	30.7	0.6	5.5	49.1	10.1
	Eastbourne	0.2	12.2	1.3	0.3	22.0	1.5
	Cowes	0.1	2.1	6.2	0.2	1.7	12.9
	Brixham	0.1	5.6	2.1	0.3	13.5	1.9
	Isle of Wight	0.1	2.2	3.9	0.1	0.6	8.0
	Brighton	0.0	1.5	0.0	1.5	4.3	25.6
	Newhaven	0.0	14.8	0.3	0.6	27.5	2.0
7.e	Brixham	6.0	129.2	4.4	1.0	271.5	0.3
	Lyme Regis	4.1	31.6	11.6	0.1	52.3	0.2
	Plymouth	2.2	42.0	5.0	1.0	49.8	2.0
	West Bay	1.9	11.1	14.6	0.3	19.8	1.3
	Weymouth	1.6	29.6	5.1	0.1	34.4	0.4
	Newlyn	1.4	84.3	1.7	2.2	124.7	1.8
	Dartmouth	1.1	11.5	8.7	0.0	3.6	0.3
	Granville	1.0	41.0	2.5	0.0	27.2	0.0
	Exmouth	1.0	13.6	6.8	0.1	11.5	0.9
	*Bideford	0.9	2.8	24.0	0.1	1.4	6.8
	Salcombe	0.7	23.6	2.8	0.2	19.7	0.8
	Looe	0.6	6.8	8.1	0.3	10.6	2.3
	Mevagissey	0.6	5.4	9.6	0.3	9.9	2.6
	Beer	0.6	4.0	12.2	0.4	4.7	8.5
	Portland	0.4	2.0	15.9	0.0	0.2	0.0
	*Padstow	0.2	1.5	9.9	0.4	3.4	10.4
	Poole	0.0	0.7	2.9	0.1	0.2	36.4

Table 3. Annual reported UK landings of small-eyed ray (2008–2021, tonnes) from the English Channel by ICES Division and gear. * Data for 2021 should be considered provisional. Data source: IFish [date of retrieval 1st February 2022].

Division	Gear	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021*
7.d	Beam trawl	0.68	0.97	0.19	0.32	0.38	0.41	0.72		5.08	2.47	1.44	0.73	3.52	3.32
	Demersal otter trawl	0.11	0.45	0.30	0.41	0.14	0.31	1.04	0.22	1.32	0.85	1.71	2.63	5.39	5.17
	Set nets		1.33	1.45	1.48	1.75	2.29	1.49	1.55	3.79	5.06	4.84	8.50	9.82	7.65
	Hooks and lines		0.07	0.21	0.10	0.03	0.03	0.02	0.01	0.06	0.18	0.07	0.00	0.07	0.02
	Dredges			0.00	0.00	0.01					0.01		0.28	0.00	0.01
	Midwater trawl					0.00									
	Pots and traps		0.02	0.09	0.04	0.03	0.04	0.04		0.01	0.05	0.17	0.04	0.07	0.01
	Total 7.d	**0.79**	**2.84**	**2.25**	**2.34**	**2.34**	**3.08**	**3.33**	**1.77**	**10.26**	**8.63**	**8.23**	**12.19**	**18.87**	**16.18**
7.e	Beam trawl	0.60	2.37	2.57	1.72	1.83	2.48	2.08	3.09	1.90	1.74	0.97	0.61	0.44	0.77
	Demersal otter trawl	1.61	9.48	22.04	13.34	14.50	15.90	15.41	22.28	4.31	1.98	1.50	1.97	2.90	7.43
	Set nets	0.98	2.48	11.92	9.62	13.88	9.98	14.62	10.75	2.26	2.22	0.91	3.91	1.76	2.87
	Hooks and lines		0.02	0.10	0.02	0.05	0.16	0.00	0.02	0.05	0.02	0.36	0.11		0.20
	Dredges		0.22	0.34	0.38	0.23	0.27	0.08	0.03	0.04	0.03	0.03	0.15		0.01
	Midwater trawl			0.01			0.07	0.11	0.01		0.01				
	Pots and traps		0.01	0.13	0.13	0.18	0.21	0.26	0.59	0.12	0.01	0.04	0.04		0.06
	Purse seine													0.10	
	Miscellaneous		0.00					0.01	0.06		0.00				0.00
	Total 7.e	**3.20**	**14.59**	**37.12**	**25.20**	**30.68**	**29.06**	**32.58**	**36.83**	**8.67**	**6.01**	**3.81**	**6.78**	**5.20**	**11.35**

Table 4. ICES estimates of skate and ray landings (tonnes) in the eastern Channel (Division 7.d). Species-specific reporting was only required from 2009 and data for 2009–2010 are not shown, as a larger proportion of overall skate and ray landings were reported in generic landing categories.

Year	Common skate complex	Sandy ray	Shagreen ray	Cuckoo ray	Blonde ray	Thornback ray	Small-eyed ray	Spotted ray	Undulate ray	White skate	Skates and rays (unspecified)	Total
2011		0.00		37.10	90.39	657.87	19.36	37.70	12.82	18.02	389.28	**1 262.53**
2012		1.30		40.71	84.25	934.63	12.97	32.66	3.99	9.46	251.40	**1 371.39**
2013		0.04		13.99	92.74	1 132.37	13.42	33.25	0.85	12.00	107.51	**1 406.17**
2014		0.13		3.58	90.42	1 186.04	15.58	35.18	2.02	6.81	35.09	**1 374.84**
2015				2.28	87.05	987.64	12.08	19.14	4.50	3.24	18.33	**1 134.27**
2016				3.37	84.84	1 114.85	20.97	23.23	14.04	2.02	24.79	**1 288.10**
2017	0.19		0.00	3.00	116.22	1 081.69	21.15	44.36	21.74	2.18	22.65	**1 313.19**
2018			0.10	2.97	139.88	1 439.15	22.97	30.68	19.84	4.71	20.01	**1 680.31**
2019				0.60	153.75	1 511.86	34.84	47.50	58.05		11.46	**1 818.06**
2020	0.01		0.00	0.68	174.25	1 537.62	36.46	47.54	54.93		11.71	**1 863.19**

Table 5. ICES estimates of skate and ray landings (tonnes) in the western Channel (Division 7.e). Species-specific reporting was only required from 2009 and data for 2009–2010 are not shown, as a larger proportion of overall skate and ray landings were reported in generic landing categories.

Year	Common skate complex	Shagreen ray	Cuckoo ray	Blonde ray	Thornback ray	Small-eyed ray	Spotted ray	Undulate ray	White skate	Skates and rays (unspecified)	Total
2011	0.97	5.39	367.86	413.71	216.49	40.55	362.28	7.28	6.19	86.42	**1 507.15**
2012	0.56	4.50	279.49	349.13	242.06	48.58	347.37	2.31	1.96	49.78	**1 325.72**
2013	0.56	3.55	264.87	419.48	338.96	50.74	400.29	1.84	2.58	36.90	**1 519.76**
2014	0.07	4.22	356.18	578.54	378.89	50.34	308.11	8.07	3.46	36.07	**1 723.96**
2015	0.11	4.85	264.27	708.24	394.77	58.20	308.99	49.83	0.49	7.78	**1 797.51**
2016	0.23	5.88	285.64	586.65	423.03	14.21	389.16	70.10	0.90	5.05	**1 780.85**
2017	0.05	3.78	285.88	504.06	371.89	14.51	762.30	117.00	0.27	1.53	**2 061.27**
2018	0.14	3.84	280.88	735.13	437.87	15.11	439.95	126.01	1.11	6.56	**2 046.59**
2019	0.24	3.61	323.24	896.32	490.09	17.50	478.23	186.21		11.93	**2 407.38**
2020	0.11	3.64	296.24	1,013.55	463.97	16.45	337.08	170.30	0.04	17.12	**2 318.50**

Table 6. Species-composition of commercially-landed skates and rays in the eastern Channel (Division 7.d) as derived from ICES estimated landings (excluding skates and rays not allocated to species).

Year	Common skate complex	Sandy ray	Shagreen ray	Cuckoo ray	Blonde ray	Thornback ray	Small-eyed ray	Spotted ray	Undulate ray	White skate
2011	0.00%	0.00%	0.00%	4.25%	10.35%	75.34%	2.22%	4.32%	1.47%	2.06%
2012	0.00%	0.12%	0.00%	3.63%	7.52%	83.45%	1.16%	2.92%	0.36%	0.85%
2013	0.00%	0.00%	0.00%	1.08%	7.14%	87.20%	1.03%	2.56%	0.07%	0.92%
2014	0.00%	0.01%	0.00%	0.27%	6.75%	88.53%	1.16%	2.63%	0.15%	0.51%
2015	0.00%	0.00%	0.00%	0.20%	7.80%	88.50%	1.08%	1.72%	0.40%	0.29%
2016	0.00%	0.00%	0.00%	0.27%	6.72%	88.25%	1.66%	1.84%	1.11%	0.16%
2017	0.01%	0.00%	0.00%	0.23%	9.01%	83.82%	1.64%	3.44%	1.68%	0.17%
2018	0.00%	0.00%	0.01%	0.18%	8.43%	86.68%	1.38%	1.85%	1.19%	0.28%
2019	0.00%	0.00%	0.00%	0.03%	8.51%	83.68%	1.93%	2.63%	3.21%	0.00%
2020	0.00%	0.00%	0.00%	0.04%	9.41%	83.05%	1.97%	2.57%	2.97%	0.00%
Average	0.00%	0.01%	0.00%	1.02%	8.16%	84.85%	1.52%	2.65%	1.26%	0.52%
Standard Deviation	0.00%	0.04%	0.00%	1.58%	1.20%	4.02%	0.42%	0.79%	1.11%	0.63%
Minimum	0.00%	0.00%	0.00%	0.03%	6.72%	75.34%	1.03%	1.72%	0.07%	0.00%
Maximum	0.01%	0.12%	0.01%	4.25%	10.35%	88.53%	2.22%	4.32%	3.21%	2.06%

Table 7. Species-composition of commercially-landed skates and rays in the western Channel (Division 7.e) as derived from ICES estimated landings (excluding skates and rays not allocated to species).

Year	Common skate complex	Shagreen ray	Cuckoo ray	Blonde ray	Thornback ray	Small-eyed ray	Spotted ray	Undulate ray	White skate
2011	0.07%	0.38%	25.89%	29.12%	15.24%	2.85%	25.50%	0.51%	0.44%
2012	0.04%	0.35%	21.90%	27.36%	18.97%	3.81%	27.22%	0.18%	0.15%
2013	0.04%	0.24%	17.86%	28.29%	22.86%	3.42%	26.99%	0.12%	0.17%
2014	0.00%	0.25%	21.10%	34.28%	22.45%	2.98%	18.25%	0.48%	0.21%
2015	0.01%	0.27%	14.77%	39.57%	22.06%	3.25%	17.26%	2.78%	0.03%
2016	0.01%	0.33%	16.09%	33.04%	23.82%	0.80%	21.91%	3.95%	0.05%
2017	0.00%	0.18%	13.88%	24.47%	18.06%	0.70%	37.01%	5.68%	0.01%
2018	0.01%	0.19%	13.77%	36.04%	21.46%	0.74%	21.57%	6.18%	0.05%
2019	0.01%	0.15%	13.49%	37.42%	20.46%	0.73%	19.96%	7.77%	0.00%
2020	0.00%	0.16%	12.87%	44.04%	20.16%	0.71%	14.65%	7.40%	0.00%
Average	0.02%	0.25%	17.16%	33.36%	20.55%	2.00%	23.03%	3.51%	0.11%
Standard Deviation	0.02%	0.08%	4.42%	6.11%	2.58%	1.35%	6.45%	3.10%	0.14%
Minimum	0.00%	0.15%	12.87%	24.47%	15.24%	0.70%	14.65%	0.12%	0.00%
Maximum	0.07%	0.38%	25.89%	44.04%	23.82%	3.81%	37.01%	7.77%	0.44%

Figure 1. Reported annual UK landings (tonnes, 2008–2021) of small-eyed ray from the western Channel (Division 7.e) and eastern Channel (Division 7.d). The vertical dashed line indicates 2016, when the non-retention policy for Division 7.e was introduced. Data source: IFish.

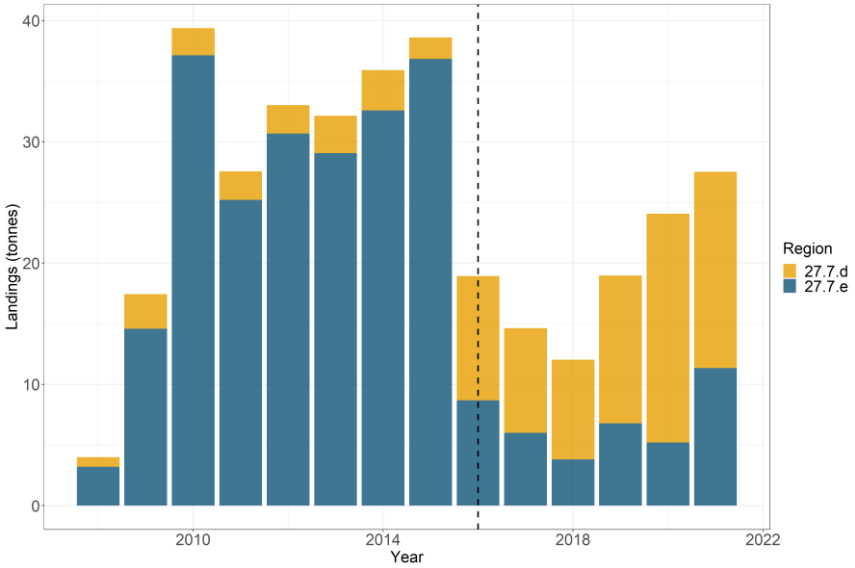


Figure 2. The spatial distribution of reported annual UK landings (tonnes, 2008–2021) of small-eyed ray from the English Channel (Divisions 7.d and 7.e). Data aggregated across all gear categories. Data source: IFish.

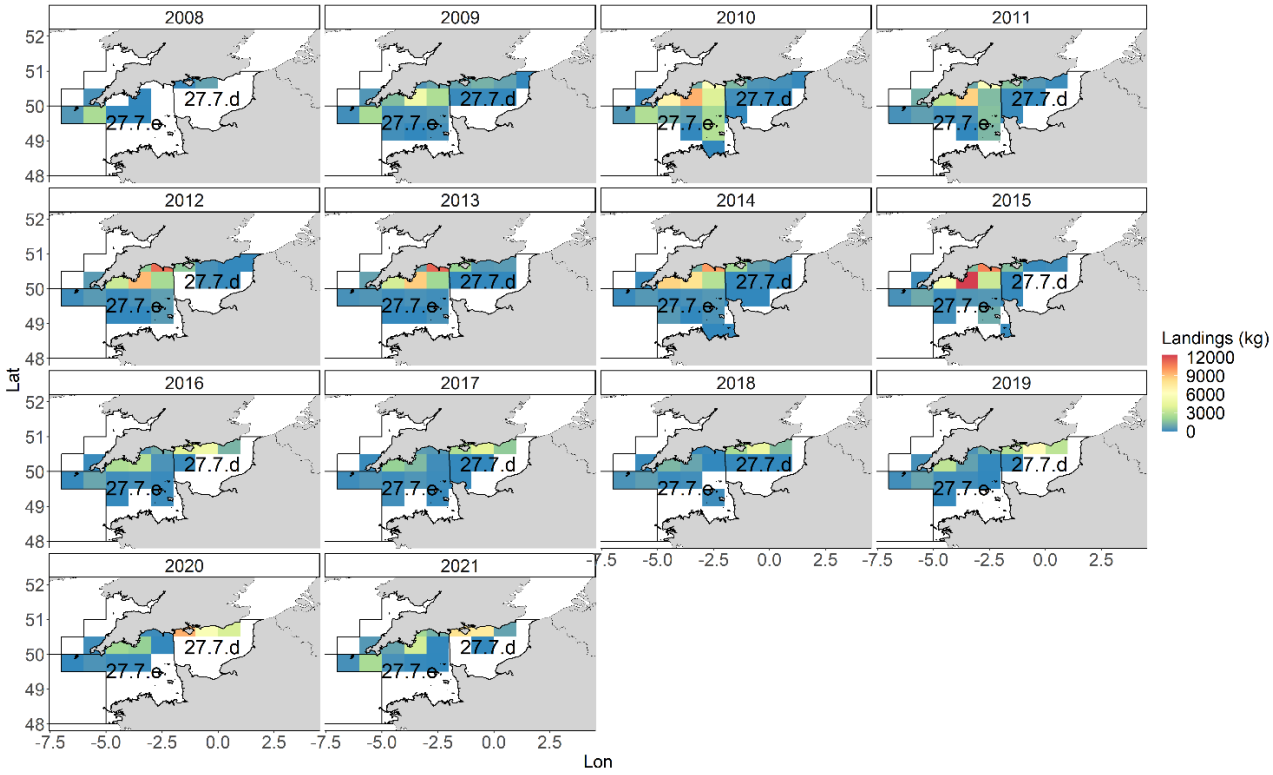


Figure 3. Spatial distribution of average annual UK landings of small-eyed ray from the English Channel (Divisions 7.d–e) by gear type (top to bottom: beam trawl, demersal otter trawl, hooks and lines, and set nets) and regulatory period (left: 2008–2015, retention permitted; right: 2016–2021, no retention in Division 7.e). Data source: IFish.

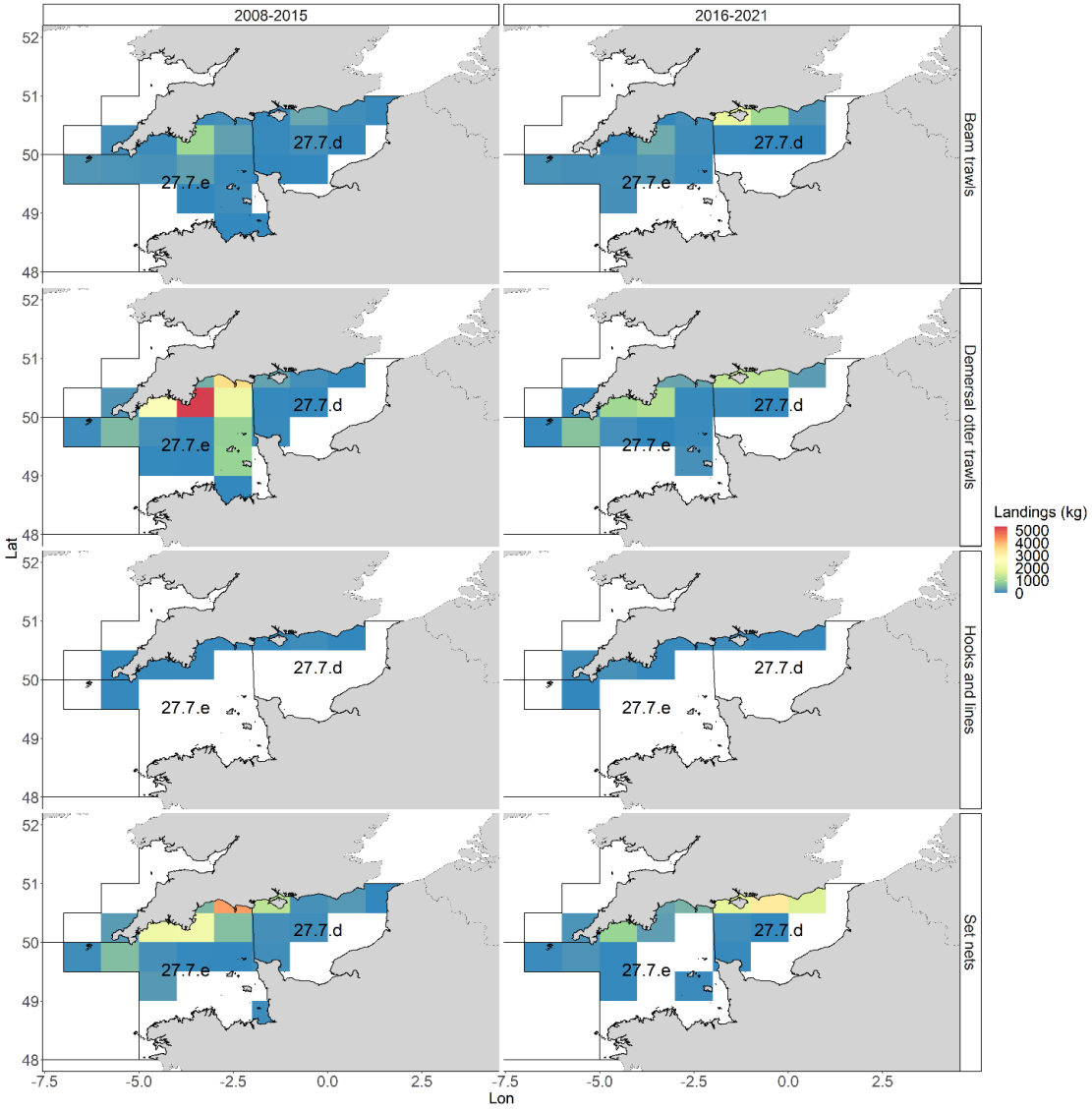


Figure 4. Spatial distribution of averaged annual UK landings of small-eyed ray from the English Channel (Divisions 7.d–e) by quarter (top: Q1; bottom: Q4) and regulatory period (left: 2008–2015, retention permitted; right: 2016–2021, no retention in Division 7.e). Data source: IFish.

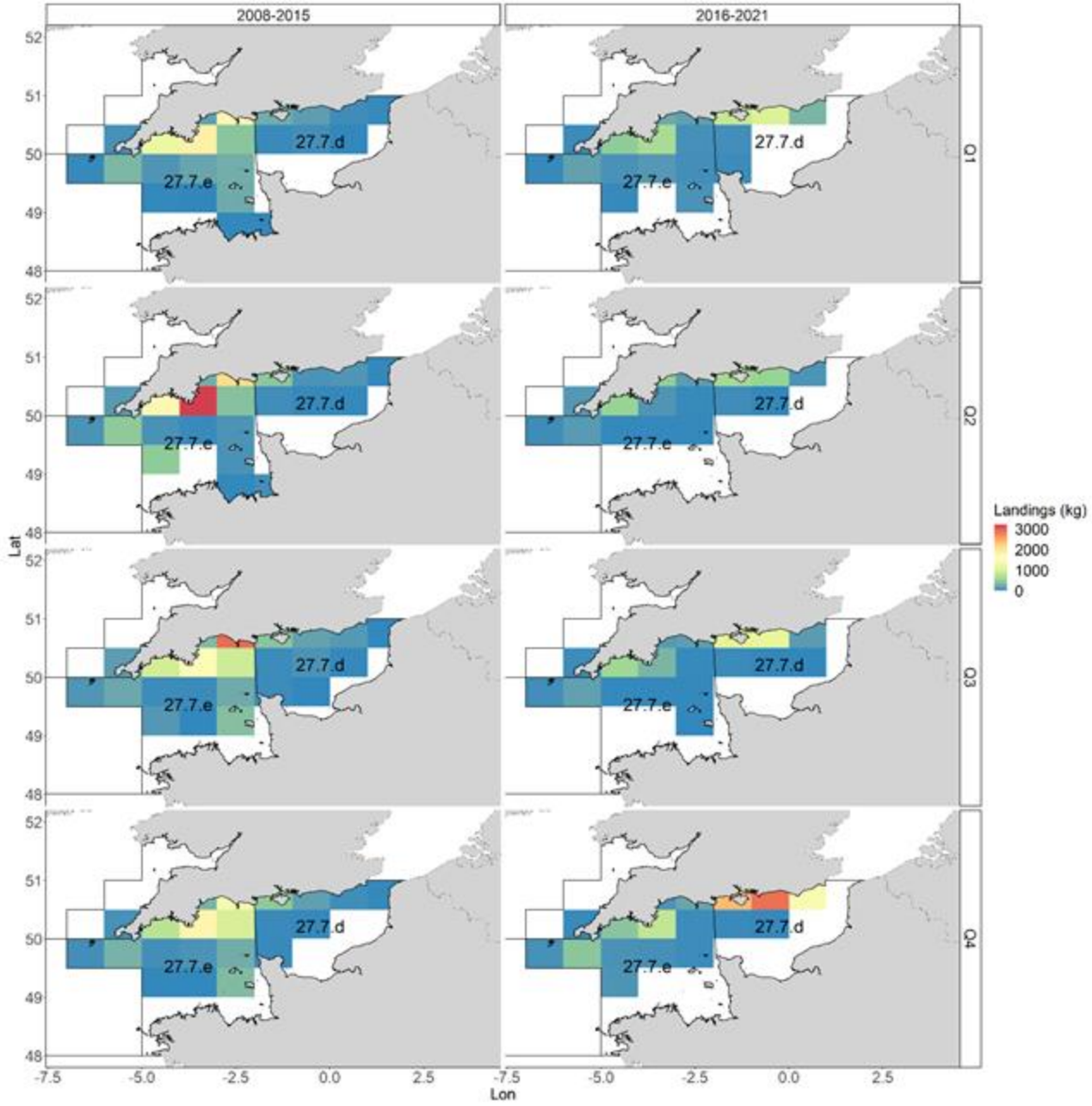


Figure 5. Proportion of small-eyed ray landings in relation to the total UK species-specific skate and ray landings, by ICES rectangle, for each regulatory period (top: 2008–2015, retention permitted; bottom: 2016–2021, no retention in Division 7.e). Data source: IFish.

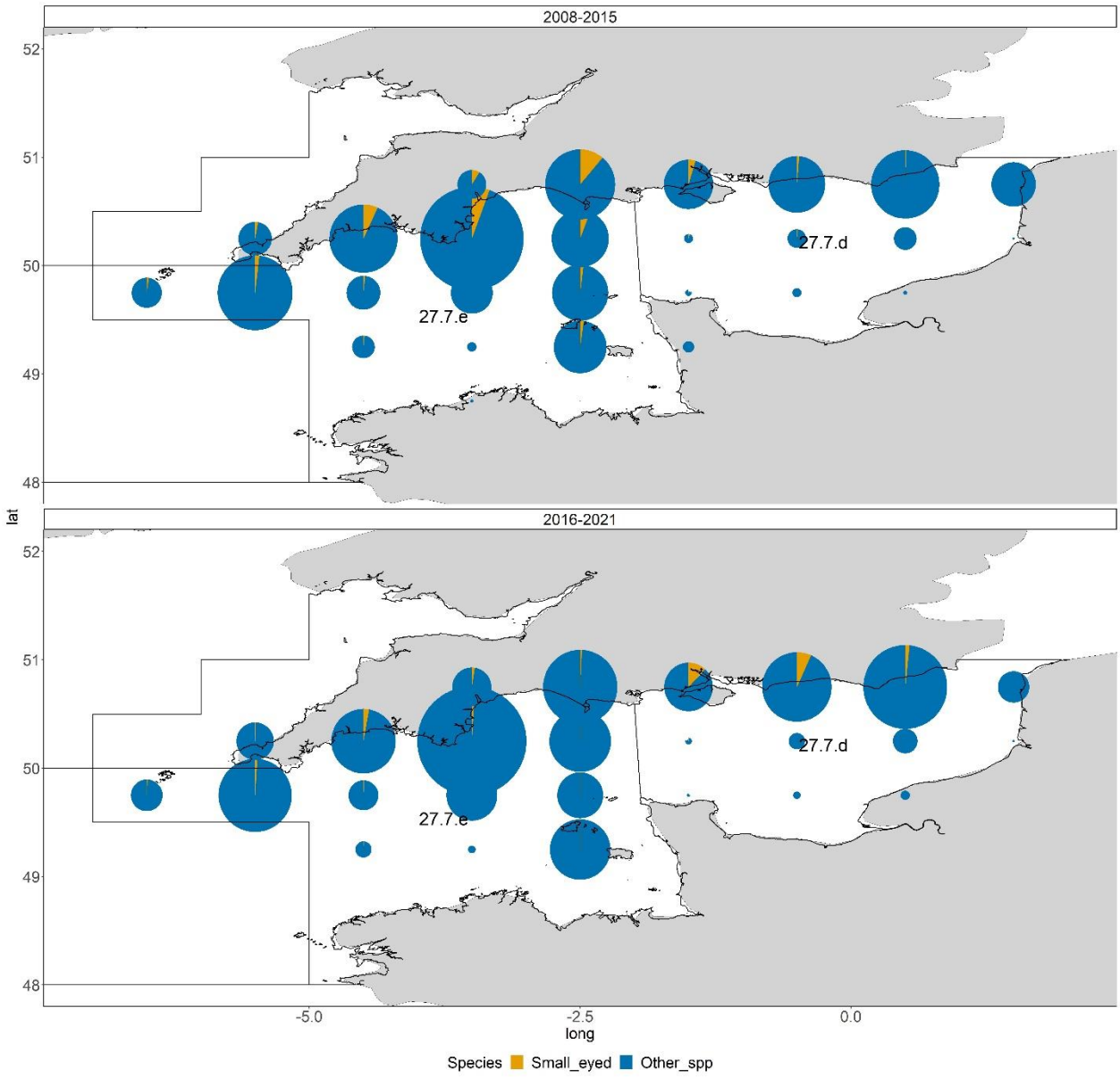


Figure 6. Species composition of skate and ray landings in the eastern Channel (Division 7.d) and western Channel (Division 7.e), as derived from ICES estimated species-specific landings data.

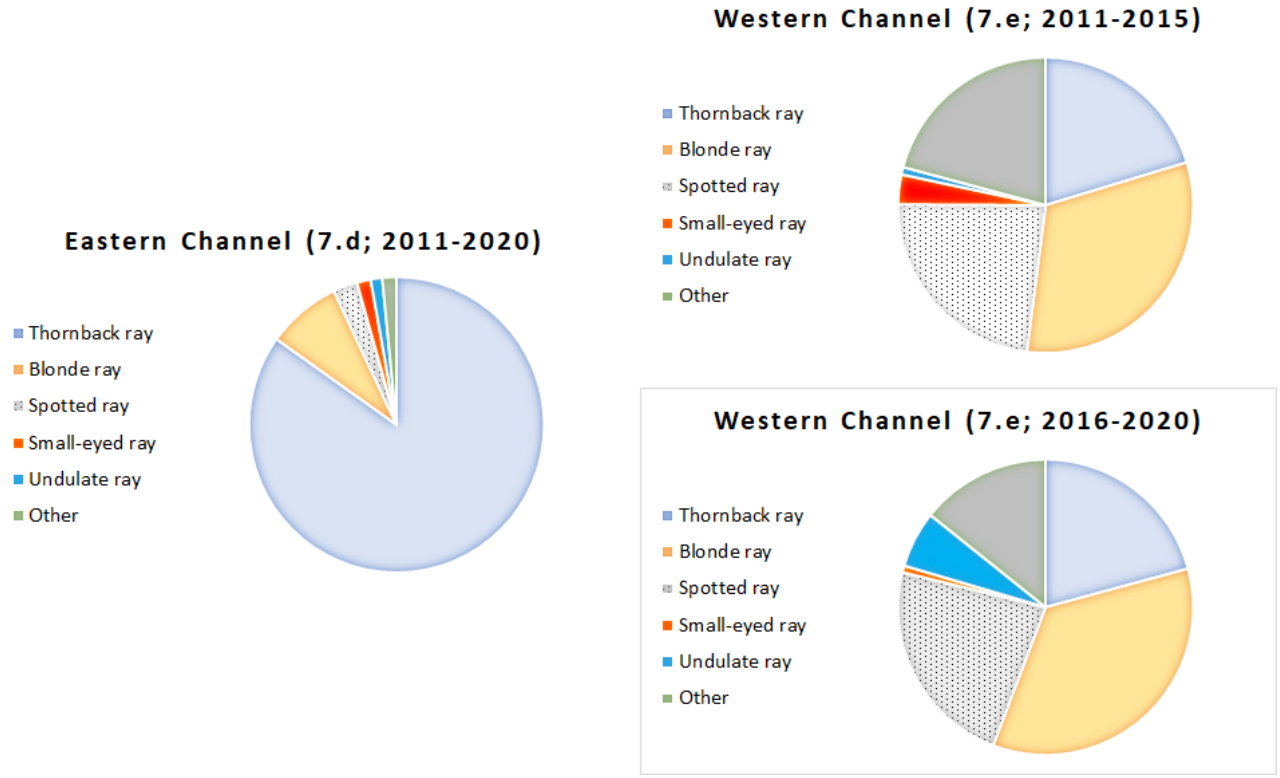
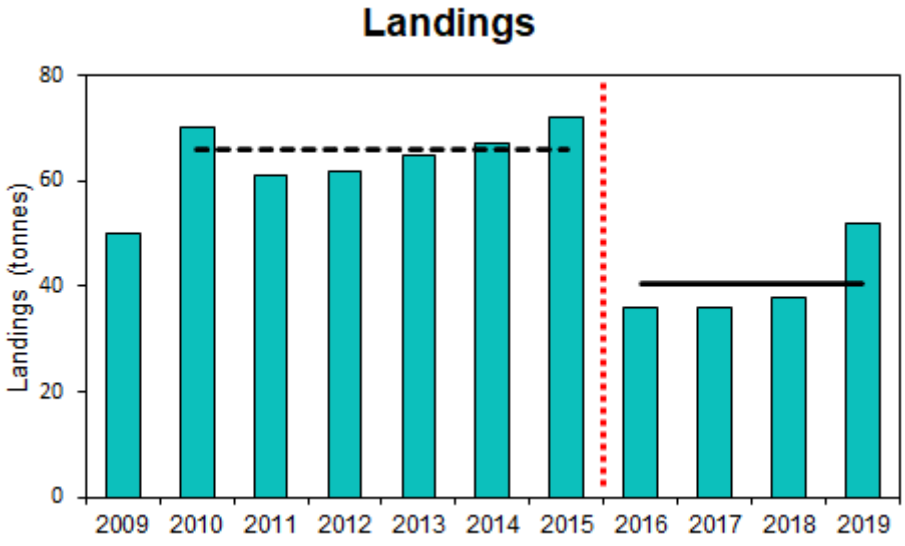


Figure 7. ICES estimated landings of small-eyed ray in the English Channel (rje.27.7de) for the period 2009–2019. The non-retention regulation was introduced at the start of 2016 (vertical dotted line). The average annual landings for 2010–2015 (dashed horizontal line; 66.2 t) and 2016–2019 (solid horizontal line; 40.5 t) are also indicated. Adapted from ICES (2020b).



3. At-sea observer data

3.1 Introduction

The current English at-sea observer programme (Cefas' Observer Programme) was implemented in 2002 to collect information on the quantities, length distributions and, where relevant, associated biological data, for the discarded and retained portions of commercial catches. It is currently the only source of data which allows full estimates of total removals by the English and Welsh commercial fishing for assessed stocks and non-quota species.

The programme is designed to sample fishing vessels, using a random stratified selection[4] of fishing trips from vessels that are statistically representative of the English and Welsh fishing fleets. Vessels are selected for sampling using a randomly ordered list which is generated each quarter. The allocation of sampling effort to fleets is based relative to the proportion of fishing effort, estimated discards and number of vessels operating during the same quarter of the previous year.

The offshore observer programme complements the onshore fishery dependent sampling in that it provides more comprehensive spatial information due to the observer collecting finer resolution effort data in relation to the catches sampled (e.g., including the recording of the commercial species that are landed and the unmarketable catch components[5] that are discarded). Due to the high costs associated with this method of sampling, less than 0.5 % of the English fishery effort is sampled under the current offshore observer programme (Lambert *et al*., 2019). These figures exclude vessels under 7 m, dredgers (other than scallop), potters and pelagic vessels.

3.2 Data preparation and analysis

The data used for this analysis were collected in the ongoing Cefas observer (off-shore) programme between 2008 and 2021.

The off-shore programme is randomly stratified according to region (landing port location i.e., northeast, east, northwest, south), predominant fishing gear (nets, lines, scallop dredges, beam trawls, otter trawls) and vessel length (7–10 m, over 10m). Within each stratum vessels were selected randomly using a vessel draw list.

For each stratum, a target number of trips is defined quarterly. The sampling effort allocation to each stratum is based on a number of information sources from the previous year (e.g. quarterly landings data from preceding year). Information on catch (landings and discards) and effort (number and length of fishing trips and number of vessels) are used as equal weights to split the number of sampling days between strata. The current stratification of the observer programme includes several fleets and fisheries within a stratum that are highly variable in terms of gear, mesh size, trip duration, and catch composition.

[4] This process involves randomly selecting fishing vessels according to gear type, vessel size class, geographical area and quarter.
[5] Discarded fish may include non-commercial species, those species designated as not to be landed, individuals that are below the minimum conservation reference size, and individuals outside the catch limits available to the vessel (e.g. in relation to quota).

The catch sampling scheme on each trip is a multi-stage process in which discards are recorded for the haul or estimated from a fraction of a haul, and typically >60% of the hauls are sampled during a trip. In each sampled haul, all the species are sampled; length measurements are recorded for all fish, commercial crustaceans and cephalopod species. When it is not possible to sample the whole haul catch, the observer estimates the volume measured relative to the total catch to generate a raising factor that is used to estimate the total catch of the haul. For each sampled haul, the following information is collected: gear type and mesh size, tow duration, shot and haul position, species catch composition and the different catch components, namely (i) landings, for the fraction that is landed, (ii) discards, for the fraction that is returned back to sea, (iii) landings that are below minimum size (BMS), the fraction below minimum conservation size and (iv) landings that are used to supply bait (e.g., for pot fisheries).

For each observer-sampled trip, numbers-at-length of fish landed and discarded were raised to the haul, based on an estimated proportion of the total catch volume sampled, then to the trip, based on the proportion of sampled hauls and fished hauls. The length data were converted to biomass, using length-weight relationships (Silva *et al*., 2013). Trips were aggregated by fleet (using the same definition used for the landings data), ICES rectangle and quarter.

The average total weight (kg) and number of fish per trip were calculated for small-eyed ray by ICES rectangle and fleet segment. To calculate the average weight and number per haul for each area and fleet segment, zero catches were included in the calculation. Average discard rates by species-gear combination are presented for year, where data are available. This indicates whether the proportion of the catch discarded changed over the period. Finally, the length frequency distributions, indicating the size of fish that were landed and discarded for each fleet segment, are presented.

3.3 Change in discard patterns

The average discard rates per trip for small-eyed ray were calculated for individuals less than 50 cm total length[6] (<50 cm) and for individuals of 50 cm or more (≥50 cm). This split was based on the length at which skates and rays are thought to be of more marketable size (Silva *et al.*, 2012) and the lengths split of ≥50 cm also equates with the 'exploitable biomass' used by ICES. It should also be noted that there are no national or international Minimum Conservation Reference Sizes (MCRS) for skates and rays which would affect the retention patterns, although the Southern Inshore Fisheries Conservation Authority (IFCA) has a minimum landing size for skates and rays in their district. Data were analysed for the western and eastern Channel separately.

The discard rates for small-eyed ray <50 cm were generally 100% in the eastern Channel (i.e. small-eyed ray less than 50 cm in length were nearly always discarded in Division 7.d), whilst the discard rates in the western Channel (Division 7.e) ranged from 50–100%. The discard rates for small-eyed ray ≥50 cm showed different profiles in each Division. In the eastern Channel (Division 7.d), the discard rate varied between 0% in 2008 and 63% in 2016, without any consistent pattern. However, in the western Channel (Division 7.e), the discard rates for small-eyed ray increased from 2016, reaching a discard rate of 83–91%. Between 2008–2015, prior to the non-retention regulation, the discard rate of larger small-eyed ray in the western Channel was low but variable, ranging from 0% in 2012 to 62% in 2014 (Figure 8).

[6] All fish lengths referred to in the present report refer to total length *the distance from the tip of the snout to the end of the tail).

3.4 Spatial distribution of small-eyed ray catches

In this section the spatial distribution of both observer coverage and the catches of small-eyed ray in Divisions 7.d–e are presented in relation to the following main gear categories: nets, demersal otter trawls and beam trawls.

3.4.1 Nets (gillnets, tangle nets and trammel nets)

Most of the net trips sampled by the observer programme are from inshore trips, in particular Division 7.d. In Division 7.e more trips were sampled offshore in Lyme Bay and southwest England, but most of the small-eyed ray catches were confined to the inshore ICES rectangles, in particular those off Start Bay (Division 7.e), around the Isle of Wight and off Brighton (Division 7.d) (Figure 9).

3.4.2 Otter trawl

Most of the demersal otter trawl trips sampled were off southwest England, in particular off Plymouth, Lizard Point, Start point and Mount's Bay (Figure 10). In Division 7.d, most demersal otter trawl trips were sampled off Eastbourne. In the period between 2008 and 2015, higher catches of small-eyed ray were observed around the Isle of Wight (average 4 fish caught per trip) and off Weymouth (average 7 fish caught per trip).

Between 2016–2021, there was an observed increase in the average number of fish caught per trip in Division 7.e, with highest catches off Mount's Bay (average 10 fish caught per trip) and south Plymouth (average 5 fish caught per trip). The grounds around the Isle of Wight continued to be where most small-eyed ray were caught in Division 7.d.

3.4.3 Beam trawl

Catches of small-eyed ray from beam trawls were highly variable between trips, which is likely due to the sampling coverage for this fleet. Beam trawls trips were more commonly sampled offshore, with fewer trips fishing inshore[7], where this species is more abundant. Between 2008–2015, small-eyed ray catch rates in Division 7.e were very low, varying between zero and two fish caught per trip, on average. However, between 2016 and 2021 higher catches were observed in both Divisions, especially off Weymouth (average 73 fish caught per trip) and around the Isle of Wight (average 40 fish caught per trip) (Figure 11).

3.4.4 Other gears

Other fishing gears, such as dredges, hooks and lines, midwater trawl, purse seines and pots and traps are also sampled during the at-sea observer programme. From these, only the dredges and hook and lines are consistently sampled by the observer programmes, while the others are not included in the target population to be sampled and are, therefore, sampled infrequently. Apart from dredges, none of the other gears caught small-eyed ray during the time-series analysed (2008–2021; Figure 12).

[7] Local bylaws in some areas can limit beam trawl activity in coastal waters.

3.5 Length distribution of discarded and landed small-eyed ray

This section shows the length distributions of small-eyed ray that were landed or discarded for each gear. These can indicate any changes in selectivity, any avoidance measures undertaken by fishers or changes to sorting patterns of the catch during the time-series (Silva *et al.*, 2012). Length distributions plots were produced only where ≥20 fish were measured per year, area and gear type.

3.5.1 Nets (gillnets, tangle nets and trammel nets)

Small-eyed ray length distributions for nets were available between 2015 and 2019. During this period in Division 7.d there were no notable differences in the selectivity and sorting patterns, with most individuals <50 cm being discarded (Figure 13). An exception was observed in 2016, where more larger fish were discarded, probably due to the non-retention policy in place in Division 7.d in the first part of that year. In Division 7.e, length distribution data were only available for 2016 and 2019, when the non-retention policy was in place, and all fish were discarded. Between 2016 and 2019, more small (< 50 cm) individuals were caught in Division 7.d. The median (midpoint) length caught by nets varied from 65 cm (Division 7.d; 2015) to 77 cm (Division 7.e; 2016), although no significant differences in the median length were found between Divisions, using a statistical t-test (*p>0.05*[8]).

3.5.2 Otter trawl

Length distribution data for otter trawls were available for Division 7.e over much of the 2008–2021 time-series, but for Division 7.d, data were available only for 2017. In Division 7.e, between 2008 and 2015, there were no notable differences in the selectivity and sorting patterns, with most small-eyed ray <50 cm being discarded and the individuals ≥50 cm fish being retained. From 2016, discarding approached 100% across the whole length distribution, but in 2021, it was observed that more individuals ≥50 cm were being retained[9]. The average length for otter trawls ranged from 56 cm in 2010 and 79 cm in 2020. No significant differences in the average length were found between Divisions (t-test, p>0.05[8]) (Figure 14).

3.5.3 Beam trawl

Length distribution data for beam trawls were available for Division 7.d, between 2012 and 2016, but data for Division 7.e were available only for 2017 and 2019. Due to the lack of consistent length data during the time-series, there were no notable differences in the selectivity and sorting patterns. As in the other gears, 100% of the catches were discarded in Division 7.e. In Division 7.d, and a higher proportion of smaller fish were caught (median length = 58 cm) (Figure 15).

[8] less than 5% chance the that the hypothesis is true
[9] This may include landings made under dispensation during various projects.

Comparison of mean length between the gears, showed that nets caught larger fish (average length = 66 cm), followed by the otter trawls (average length = 64 cm) and beam trawls (average length = 58 cm).

3.6 Spatial variation in length composition

In this section we investigated if there were spatial differences in the length composition of small-eyed ray. This was undertaken by analysing the length distributions in each ICES rectangle, by sex for each gear, for nets and towed gears (beam trawls and demersal otter trawls). Exploratory analyses of the data showed there were no significant differences in the length distributions between beam trawls and demersal otter trawls (probability less than 5% using the Kolmogorov-Smirnov test – a hypothesis test procedure for determining if two samples of data are from the same distribution), therefore the data from these gears were combined. Length distribution plots were produced where more than 20 fish were measured per ICES rectangle and gear type.

Length distribution for the towed gears showed that larger fish (including large females) were caught in ICES rectangles 29E6 (Start Point, median length = 74 cm), 30E7 (South Plymouth, median length = 72 cm) and 30F0 (off Eastbourne, median length = 73 cm) (Figure 16).

Length distributions from nets were only possible to plot for three ICES rectangles (Figure 17). Similar to the observations for towed gears, larger fish were found in ICES rectangle 29E6 (Start Point, median length = 75 cm). However, in contrast to towed gears, proportionally more smaller fish were caught by netters off Eastbourne (30F0, median length = 42 cm).

Figure 8. Change in the overall average discard rate of small-eyed ray over the time-series, (2008–2021) for individuals less than 50 cm total length (left) and those ≥50 cm total length (right).

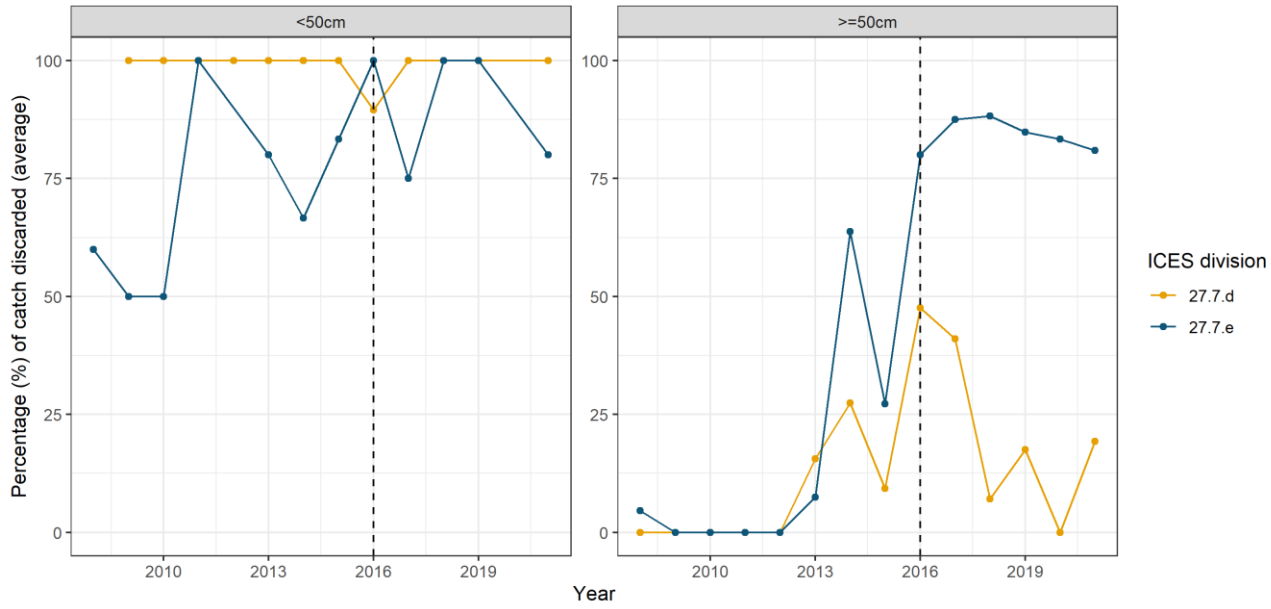


Figure 9. Number of sampled trips (on netters; coloured rectangles) and average number of small-eyed ray caught per trip (black circles) by ICES rectangle for the periods 2008–2015 (left, retention permitted) and 2016–2021 (right, no retention in Division 7.e).

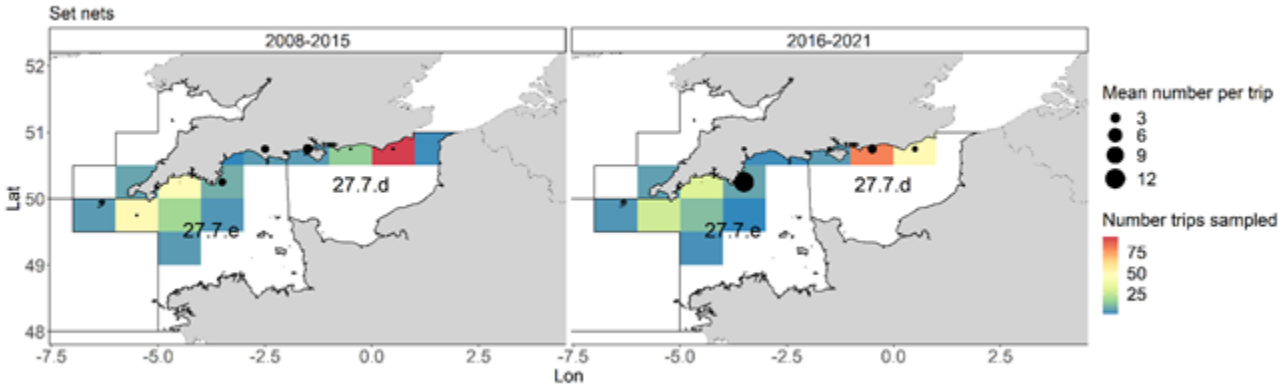


Figure 10. Number of sampled trips (on demersal otter trawlers; coloured rectangles) and average number of small-eyed ray caught per trip (black circles) by ICES rectangle for the periods 2008–2015 (left, retention permitted) and 2016–2021 (right, no retention in Division 7.e).

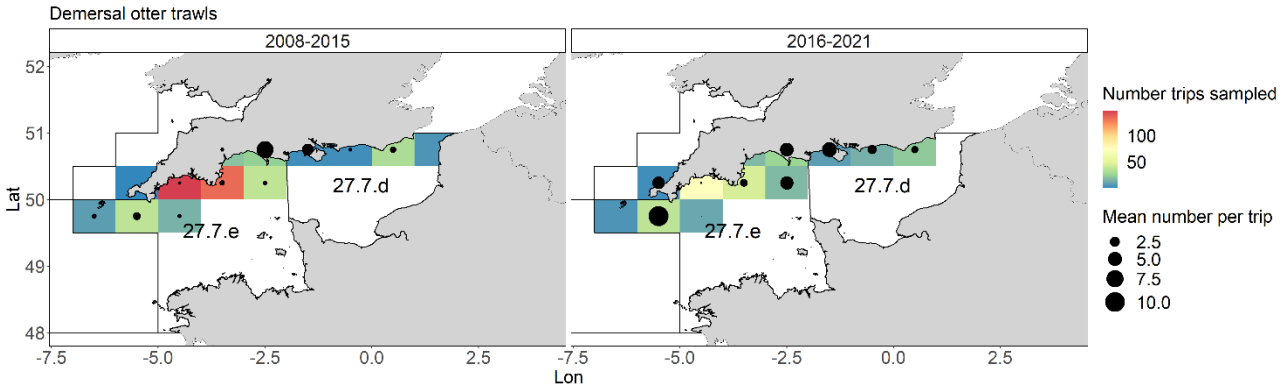


Figure 11. Number of trips sampled (on beam trawlers; coloured rectangles) and average number of small-eyed ray caught per trip (black circles) by ICES rectangle for the periods 2008–2015 (left, retention permitted) and 2016–2021 (right, no retention in Division 7.e).

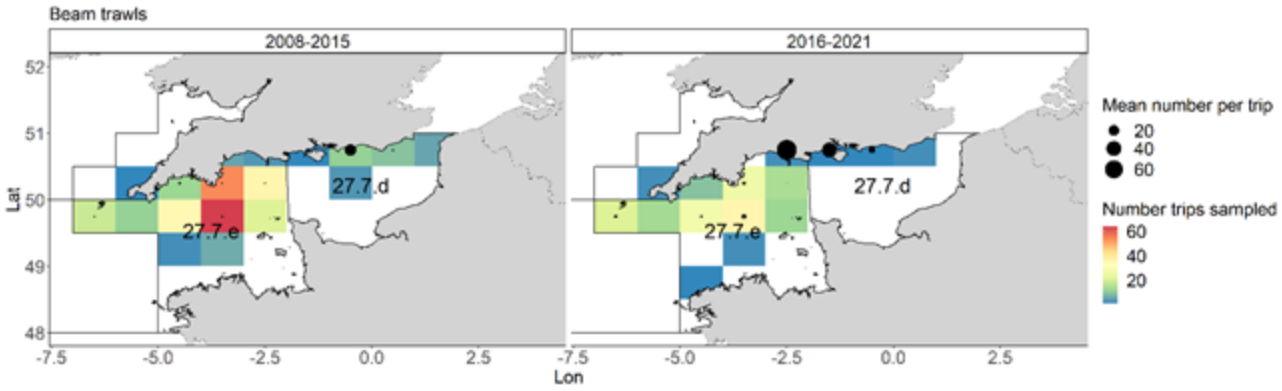


Figure 12. Number of sampled trips (coloured rectangles) and average number of small-eyed ray caught per trip (black circles) for other gears (all years combined).

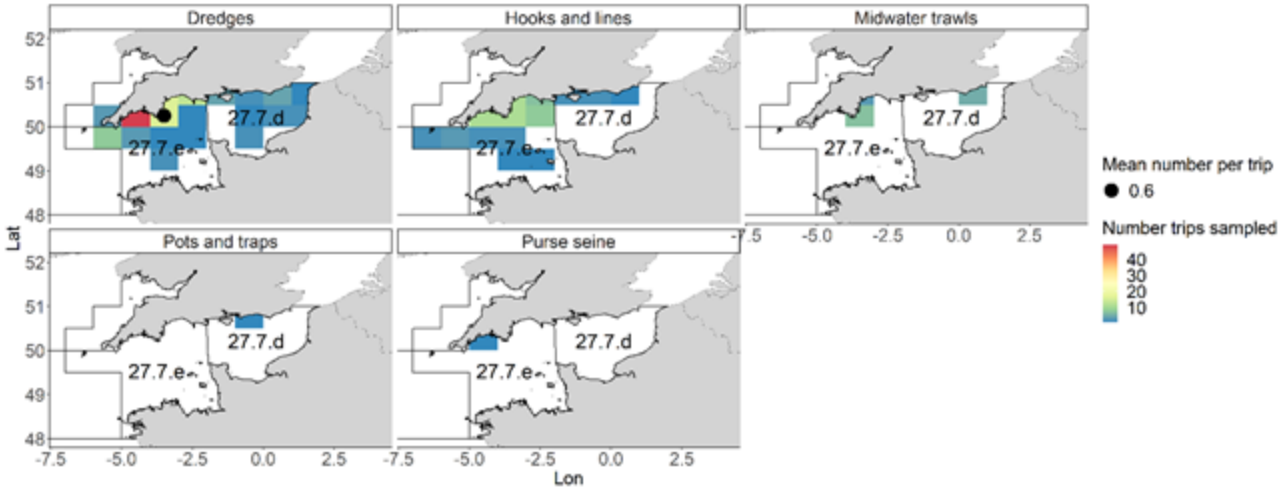


Figure 13. Length distributions of discarded (D) and retained (R) small-eyed ray caught by nets in Division 7.d (left) and Division 7.e (right), between 2015 and 2019.

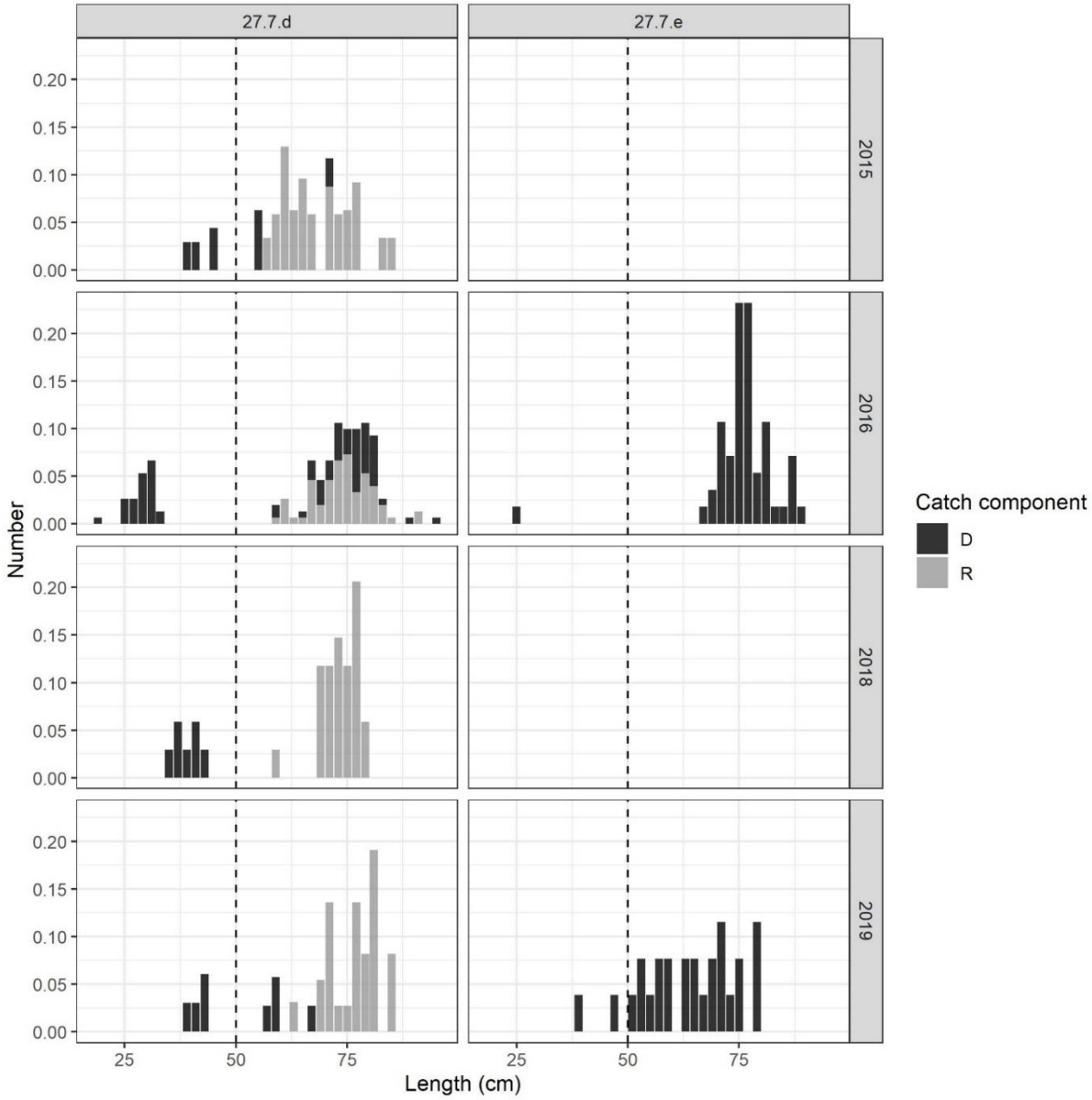


Figure 14. Length distributions of discarded (D) and retained (R) small-eyed ray caught by otter trawl in Division 7.d (left) and Division 7.e (right), between 2008 and 2021.

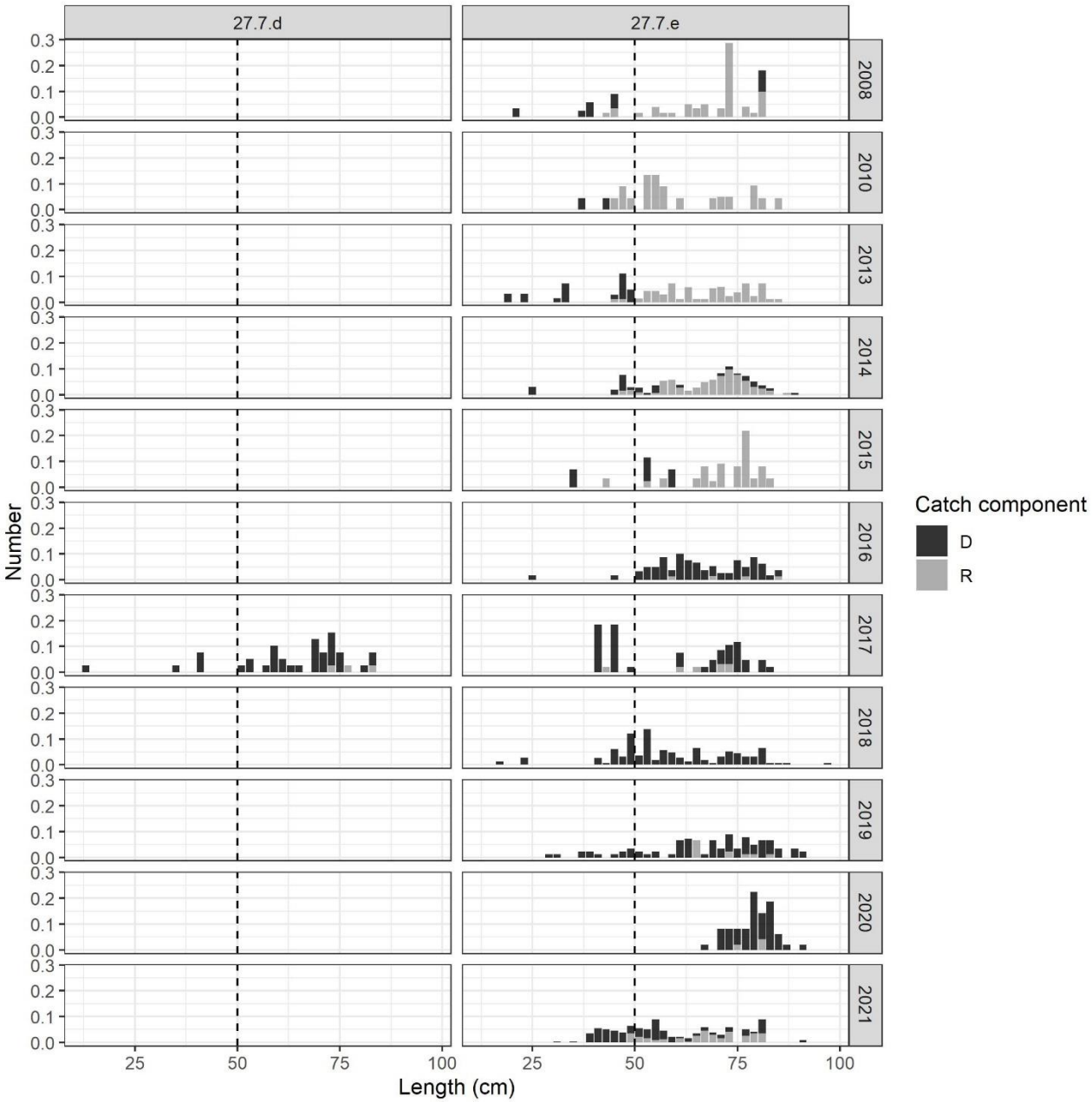


Figure 15. Length distributions of discarded (D) and retained (R) small-eyed ray caught by beam trawl in Division 7.d (left) and Division 7.e (right), between 2012 and 2019.

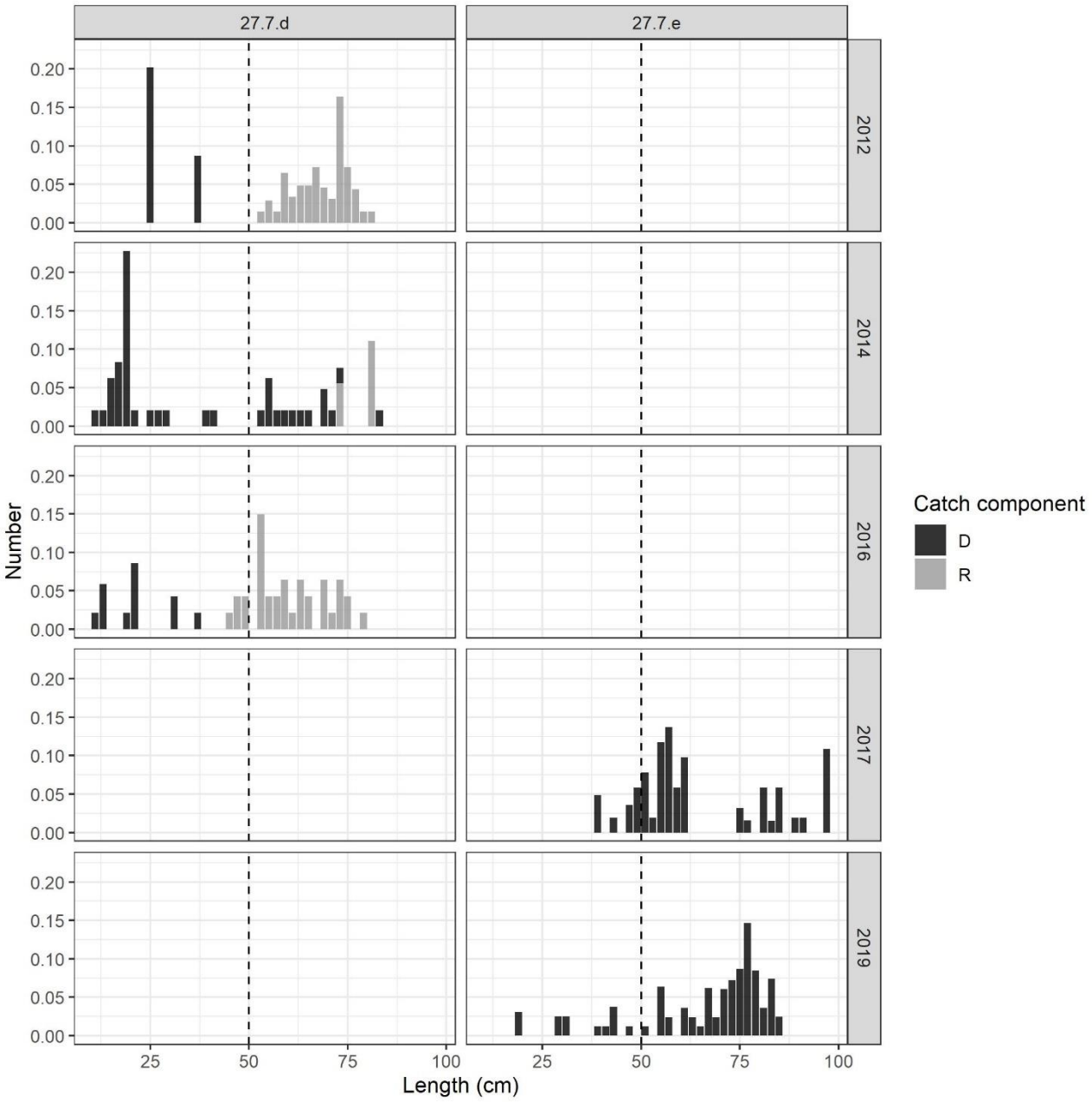


Figure 16. Length distribution of small-eyed ray by rectangle and sex (F = female; M = male) sampled from towed gear catches (otter trawl and beam trawl) between 2008 and 2019 (top; vertical lines indicate the median lengths), and the number of individuals sampled per ICES rectangle (bottom).

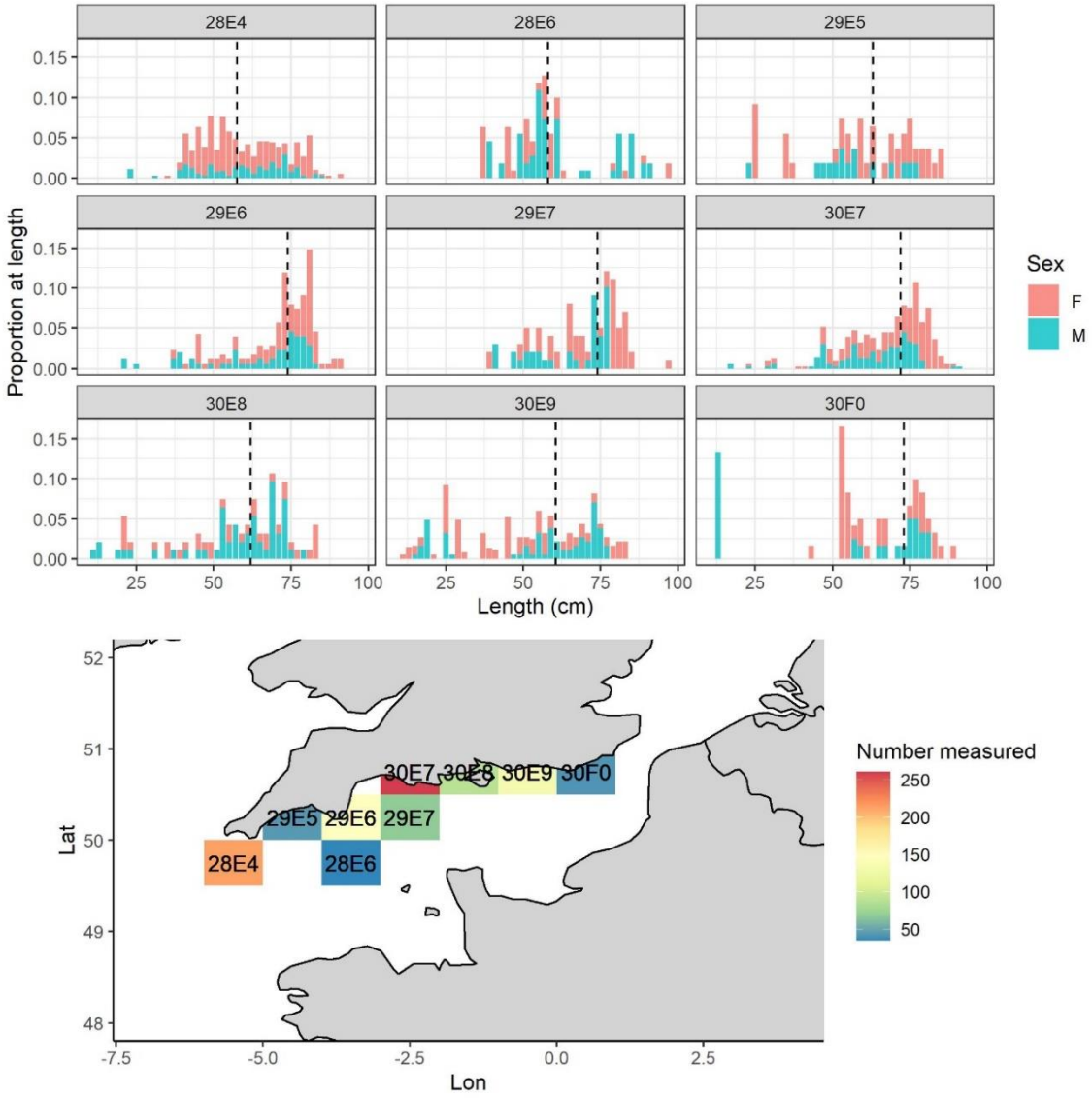
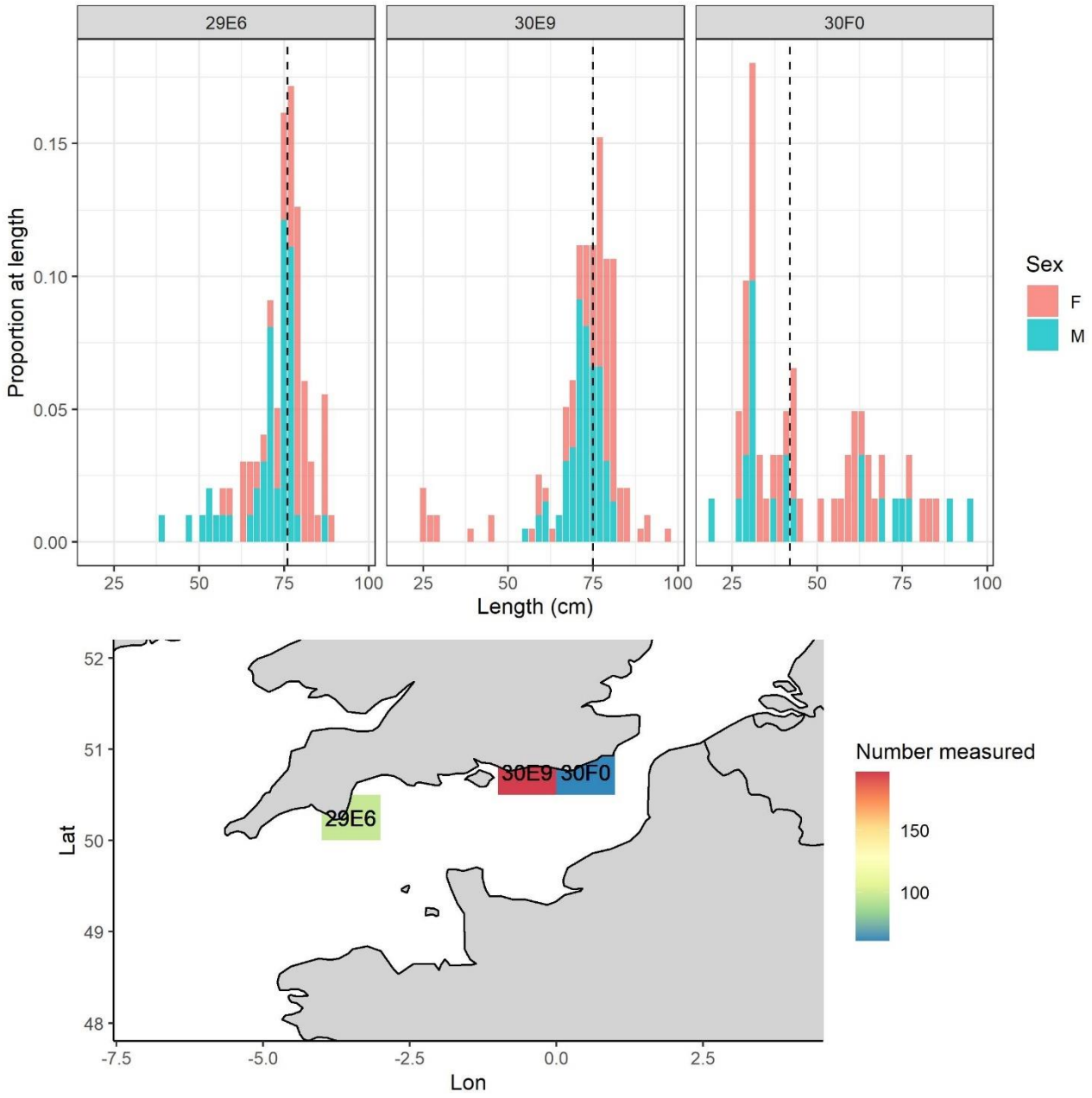


Figure 17. Length distribution of small-eyed ray by rectangle and sex (F = female; M = male) sampled from nets between 2008 and 2019 (top; vertical lines indicate the median lengths), and the number of individuals sampled per ICES rectangle (bottom).



4. Onshore (market) sampling data

4.1 Introduction

Commercial catches are either sampled onshore at landing or selling sites, or offshore onboard fishing vessels (see Section 3). In combination, they aim to cover the different catch components, different parts of the species populations and provide complementary data.

The overall objective of the onshore catch sampling programme is to collect biological data for landings of all finfish and shellfish species landed into England for the provision of landings at age or length required for stock assessments. Biological data, collected as part of the market sampling programme, provides valuable information on the species and size ranges that are commercially landed. The onshore programme is an effective and efficient way of collecting biological data from the retained component of the catch, from multiple trips at relatively low cost. These data may be the only reference to the population structure removed by commercial fishing. However, the onshore programme is limited to some extent in that it does not capture all catch components (i.e., fish that are discarded at sea) and may also lack certain catch details, such as spatial and effort information, particularly from smaller vessels (under 10 m overall length).

The data used for this analysis were collected in the ongoing Cefas market (onshore) sampling programme between 2012 and 2021. Due to the low numbers of small-eyed ray sampled in the onshore programme, only the numbers measured by port and the overall observed length distribution are shown.

4.2 Sampling summary

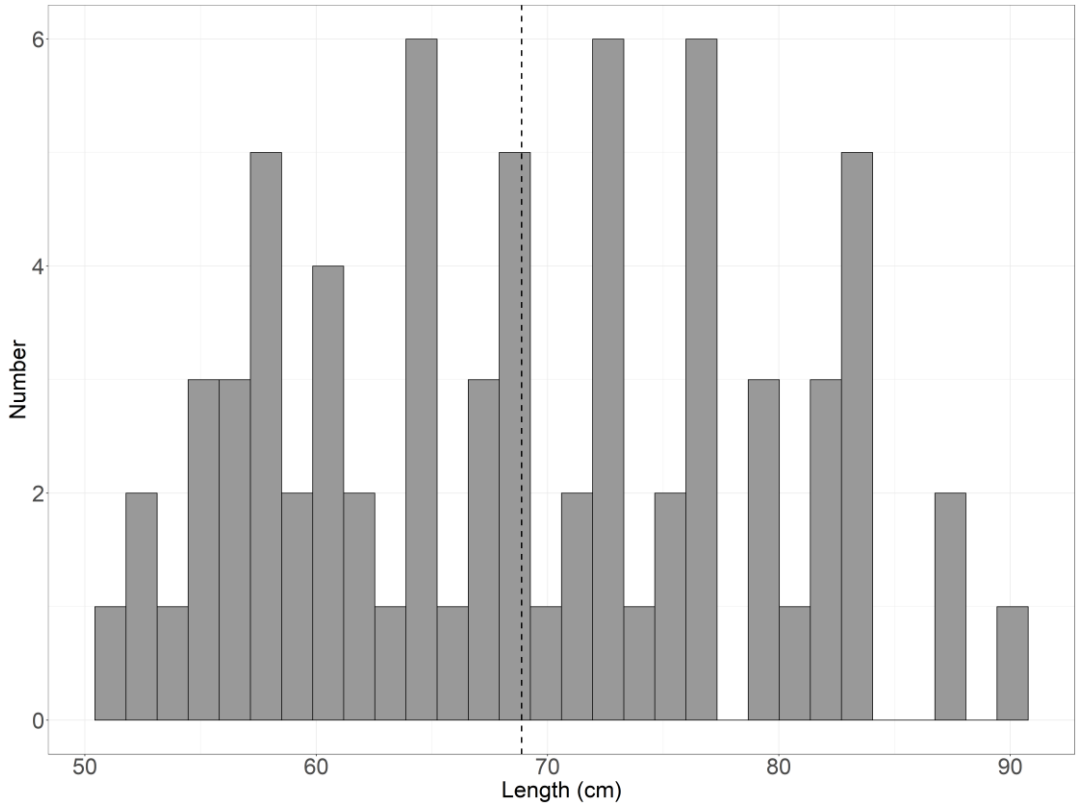
Between 2012 and 2021, small-eyed ray was sampled occasionally in the market sampling programme, with 229 fish measured over the time-series. The main ports (markets) where they were sampled were Newlyn and Brixham, from Division 7.e. Very low numbers were observed during port sampling from Division 7.d (Table 8).

Due to the low numbers sampled in the onshore programme, length distributions were plotted across all years and gears (Figure 18). The observed length range was 50–90 cm with an average length of 69 cm (standard deviation +/– 10 cm).

Table 8. Total number of small-eyed ray measured in each port and Division (2012–2021) during the onshore programme.

Division	Port name	Number measured
7.d	Hastings	7
	Lymington	2
	Shoreham	1
	Christchurch	1
7.e	Newlyn	123
	Brixham	40
	Plymouth	15
	Cadgwith	13
	Brixham	12
	Coverack	5
	Salcombe	5
	Mevagissey	1
	Weymouth	1
	West Bay	1
	Lyme Regis	2

Figure 18. Length distributions of commercially landed small-eyed ray from Division 7.e, sampled as part of the onshore sampling programme (2012–2021), all gears combined.



5. Fishery-independent trawl survey data

5.1 Introduction

This section of the report relates to 'fishery-independent data, which are collected separately from commercial fisheries (fishery-dependent data). These are primarily based on scientific trawl surveys, which provide information on the distribution and relative abundance of fish.

5.2 Eastern Channel beam trawl survey

The eastern Channel beam trawl survey[10] has operated since 1988, but with a more standardised survey grid since 1993 (Parker-Humphreys, 2005). This annual survey is conducted in July (but may extend into June or August in some years) and samples over a fixed station grid. Most stations are along the English and French coastlines (Figure 19), although most stations are deeper than 20 m (observed depth).

Small-eyed ray were observed across a 23–81 cm length range, but the low numbers caught (n = 61 between 1993–2021) resulted in this being a relatively small component of the surveyed skate assemblage (Table 9 and Table 10). Over the years 1993–2021, small-eyed ray was observed in 79.4% of the years, although this increased slightly over the 29-year time-series from 70% in the first decades, and 100% in the more recent 9-year block. Small-eyed ray was generally only found at a small number of stations, averaging ca. 2% of survey stations, but this had increased slightly in the last two years (Table 10).

Whilst there were scattered records of small-eyed ray from along much of the English coast, the locations with most sightings were Poole Bay (west of the Isle of Wight) and Pevensey Bay (off Eastbourne) on the English coast, and the Baie de Veys (the western part of the Baie de Seine, along the east coast of the Cherbourg (or Cotentin) Peninsula) (Figure 20).

The length-frequency data (Figure 21) were too limited to be informative. The minimum length observed was 23 cm, and the absence of smaller fish is likely to relate to the very shallow distribution of the smallest length classes (0-groups[11]).

5.3 South-west beam trawl survey

The South-west beam trawl survey[12] is a Q1 survey that has operated since 2006 in the western Channel, and extended to sample the Celtic Sea and Bristol Channel from 2014. This survey has a random stratified design, in which an ordered list of randomly pre-selected sites are sampled in each stratum of the survey area (Figure 22).

There were only a limited number of records of small-eyed ray in the South-west beam trawl survey (2006–2019), with 82 individuals (13–83 cm total length) observed over the survey series (Table 11). Of these, 26 individuals (31.7%) were from Division 7.e (

[10] The eastern Channel beam trawl survey is referred to as BTS7D on Cefas' Fishing Survey System (FSS) and often referred to as BTS-Eng-Q3 by ICES.
[11] Fish in their first year of life are often termed 0-groups.Small-eyed ray hatch at a length of 10 cm, and these smaller individuals are known to reside in very shallow water.
[12] The south-west beam trawl survey (Q1SWBEAM) is sometimes referred to as the South-west Ecosystem survey (Q1SWECOS)

Table 12) and the remaining 56 individuals (68.3%) from the Bristol Channel (Division 7.f).

Across Division 7.e, small-eyed ray accounted for a small proportion of the skates encountered (1.2%), but was proportionally more important in some strata (e.g. strata 2–4 and 7 in Figure 22, where it comprised 2.7–7.9% of the skates observed (Table 12).

The sites where small-eyed ray was present included Mounts Bay, St Austell Bay and the Great West Bay (from Start Point to Portland) along the south coast of England, as well as the Channel Islands and western Cherbourg Peninsula (Figure 23). Once again, the length-frequency data (Figure 24) were too limited to be informative.

This survey is unlikely to provide an informative survey index, as the random selection of trawl stations can mean that any species with a restricted and patchy distribution, such as small-eyed ray, may not be sampled effectively each year.

5.4 Other Cefas surveys

Cefas also undertook a survey on board the Fishing Vessel *Carhelmar*, with the original survey grid sampling the Great West Bay (Lyme Bay). The fixed stations covered a range of depths and distances from shore (Figure 25), with the data from this survey series (1989–2011) analysed previously by Burt *et al.* (2013).

Similar to the observations from the South-west beam trawl survey, small-eyed ray was found to occur in a band ranging from south of Start Point and across the bay towards Bridport (Figure 26). Once again, catch rates were low, with individuals only reported in 15 of the 23 years analysed, and generally occurring at <5% of trawl stations in any single year (Figure 27). Small-eyed ray was observed over a length range of 27–88 cm (Figure 28; n = 46).

5.5 French Channel Groundfish Survey

The French Channel Groundfish Survey (CGFS) has operated since 1988, with scientists from IFREMER sampling much of Division 7.d[13]using a GOV trawl[14]. It should be noted that the survey vessel and the size of trawl changed from 2015 onwards, and so the data summarised below (downloaded from ICES DATRAS on 02/03/2022) should be interpreted with caution and are shown for illustrative purposes.

Data for small-eyed ray were limited, and whilst it was observed in 20 years (62.5%) of the 32-year survey period, it only occurred in 35 individual survey hauls (out of a total of 2,766 hauls conducted from 1988 to 2019; 1.3% of all hauls). However, there was the general indication of it being encountered more frequently in recent years, with it being found in 20% of survey years in the initial decade (1988–1997), 70% of survey years in the subsequent decade (1998–2007), and in 91.7% of survey years over the period 2009–2019. Similarly, there was an increase in the frequency of occurrence (Figure 29). However, given subtle changes in survey (distribution of survey stations, vessel and trawl), more detailed analyses of these data would be required.

[13] This survey has also been extended to sample parts of Division 7.e in recent years.
[14] The GOV trawl (Grande Ouverture Verticale) is a bottom trawl used in various scientific trawl surveys.

Small-eyed ray were caught over an overall length range of 26–89 cm (Figure 30) and the majority of records were from shallow waters. Indeed, 23 (65.7%) of the 35 positive hauls were made in waters less than 20 m deep.

5.6 Historic surveys

Garstang (1903) provided data on the fish caught by trawl in the years 1901–1902 in three Devon bays, namely Start Bay, Torbay and Teignmouth Bay (Table 13). Small-eyed ray was encountered most frequently in Start Bay, being observed at 20.9% of trawl stations and comprising 4.3% of all the skates caught in that area. Small-eyed ray was also present in Teignmouth Bay, occurring at 18.8% of trawl stations and comprising 2.7% of the skates caught. However, no small-eyed ray were observed in Torbay, despite the close proximity to both Start Bay (to the south) and Teignmouth Bay (to the north).

In a subsequent study of the skates and rays of Devon and Cornwall, Steven (1932) noted "*The periodic appearance of* R. undulata *and* R. microocellata *on the fish market … does not appear to be due to any periodicity in the movements of occurrence of the fish themselves. These two species are very restricted in their distribution,* R. undulata *being confined to a trawling grounds 18–20 miles outside the Eddystone and* R. microocellata *to a few sandy bays and estuaries. It is because of their very restricted distribution that these two species do not appear regularly in the landings. When the grounds on which they do occur are visited they seldom fail to appear in the catches*".

The findings of Garstang (1903) and Steven (1932), both from the early 20th century, would suggest that small-eyed ray has always had a patchy distribution in the western Channel and, whilst it can be locally abundant, it is also a small proportion of the skate assemblage when examined over the wider region. Neither study would indicate that small-eyed ray was perceived as being more abundant than it is at the current time.

Table 9. Total numbers observed (unraised) of skates (Rajidae) during the eastern Channel beam trawl survey (1993–2020), with associated length range (cm) and depth range. Source: ICES (2021).

Common name	Scientific name	Code	Length range (cm)	Depth range (m)	Total number	%
Thornback ray	*Raja clavata*	RJC	10–94	8.5–59	7985	90.3%
Spotted ray	*Raja montagui*	RJM	14–70	8.5–59	424	4.8%
Blonde ray	*Raja brachyura*	RJH	17–95	13–57	187	2.1%
Undulate ray	*Raja undulata*	RJU	17–97	8.8–57	182	2.1%
Small-eyed ray	***Raja microocellata***	**RJE**	**23–81**	**11–58**	**57**	**0.6%**
[1] Cuckoo ray	*Leucoraja naevus*	RJN	19–22	14.4–45.7	3	0.0%
[2] Shagreen ray	*Leucoraja fullonica*	RJF	75	29.7	1	0.0%

Notes: [1] Earlier records of cuckoo ray could potentially be misidentified specimens of spotted ray that had single false eye-spots on the pectoral fins; [2] The nominal record of shagreen ray likely to be a misidentified small-eyed ray.

Table 10. Total numbers (unraised) of small-eyed ray caught during the eastern Channel beam trawl survey (1993–2020) and frequency of occurrence in the survey. Adapted from ICES (2021).

Year	Total number caught	Number ≥50 cm total length	Frequency of occurrence (%)
1993	1	1	1.6
1994	1	–	1.5
1995	2	1	2.6
1996	–	–	0.0
1997	3	2	2.6
1998	2	2	1.3
1999	5	4	3.9
2000	3	2	2.6
2001	–	–	0.0
2002	–	–	0.0
2003	–	–	0.0
2004	2	1	2.7
2005	–	–	0.0
2006	2	1	2.8
2007	3	1	4.1
2008	3	1	3.9
2009	1	1	1.3
2010	3	2	2.6
2011	3	3	2.7
2012	–	–	0.0
2013	1	1	1.3
2014	3	2	3.9
2015	1	–	1.3
2016	5	4	3.8
2017	4	3	2.6
2018	2	1	2.6
2019	1	1	1.3
2020	6	1	5.3
2021	4	2	5.3
Total	61	35	Average = 2.0%
% Occurrence	79.3%	72.4%	Range = 0.0–5.3%

Table 11. Total numbers (unraised) of skates (Rajidae) observed during the south-west beam trawl survey (2006–2019), with associated length range (total length, cm) and depth range. Data include the western Channel, Bristol Channel and Celtic Sea. Adapted from Silva *et al.* (2020).

Common name	Scientific name	Code	Length range (cm)	Depth range (m)	Total number	%
Cuckoo ray	*Leucoraja naevus*	RJN	12 – 72	23 – 184	1064	35.0%
Spotted ray	*Raja montagui*	RJM	11 – 70	19 – 120	712	23.4%
Thornback ray	*Raja clavata*	RJC	10 – 93	15 – 120	483	15.9%
Blonde ray	*Raja brachyura*	RJH	13 – 103	23 – 120	266	8.7%
Undulate ray	*Raja undulata*	RJU	13 – 100	15 – 150	216	7.1%
Common skate	*Dipturus* spp.	RJB	18 – 114	58 – 150	188	6.2%
Small-eyed ray	***Raja microocellata***	**RJE**	**13 – 83**	**30 – 93**	**82**	**2.7%**
Shagreen ray	*Leucoraja fullonica*	RJF	18 – 105	90 – 170	31	1.0%
Skate (indet.)	Rajidae	SKA	31	53	1	<0.1%

Table 12. Total numbers (and percentage) of skates (Rajidae) measured (unraised) during the south-west beam trawl survey (2006–2019) by stratum and area for the western Channel (Division 7.e). Areas include inshore waters along the English coast, mid-Channel and inshore waters along the French coast and around the Channel Islands (CI). See

Table 11 for species codes and associated common and scientific names. Strata areas shown in Figure 22. Adapted from Silva *et al*. (2020).

Area	Stratum	RJN	RJM	RJC	RJH	RJU	RJB	RJE	RJF	SKA	Total
Inshore (England)	1	226	118	1	9	–	16	**–**	2	–	372
		60.8%	31.7%	0.3%	2.4%	0.0%	4.3%	**0.0%**	0.5%	0.0%	
	2	291	53	2	8	1	2	**10**	–	1	368
		79.1%	14.4%	0.5%	2.2%	0.3%	0.5%	**2.7%**	0.0%	0.3%	
	3	12	12	6	–	–	–	**1**	–	–	31
		38.7%	38.7%	19.4%	0.0%	0.0%	0.0%	**3.2%**	0.0%	0.0%	
	4	3	22	16	10	7	–	**5**	–	–	63
		4.8%	34.9%	25.4%	15.9%	11.1%	0.0%	**7.9%**	0.0%	0.0%	
	5	–	90	288	12	8	–	**4**	–	–	402
		0.0%	22.4%	71.6%	3.0%	2.0%	0.0%	**1.0%**	0.0%	0.0%	
Mid-Channel	8	186	15	–	–	–	54	**–**	9	–	264
		70.5%	5.7%	0.0%	0.0%	0.0%	20.5%	**0.0%**	3.4%	0.0%	
	13	65	5	–	2	2	–	**–**	–	–	74
		87.8%	6.8%	0.0%	2.7%	2.7%	0.0%	**0.0%**	0.0%	0.0%	
	7	2	6	2	3	8	–	**1**	–	–	22
		9.1%	27.3%	9.1%	13.6%	36.4%	0.0%	**4.5%**	0.0%	0.0%	
	9	7	2	3	8	19	–	**–**	–	–	39
		17.9%	5.1%	7.7%	20.5%	48.7%	0.0%	**0.0%**	0.0%	0.0%	
	6	–	51	75	6	32	–	**3**	–	–	167
		0.0%	30.5%	44.9%	3.6%	19.2%	0.0%	**1.8%**	0.0%	0.0%	
Inshore (France/CI)	12	5	2	1	9	3	–	**–**	–	–	20
		25.0%	10.0%	5.0%	45.0%	15.0%	0.0%	**0.0%**	0.0%	0.0%	
	10	–	4	4	18	31	–	**–**	–	–	57
		0.0%	7.0%	7.0%	31.6%	54.4%	0.0%	**0.0%**	0.0%	0.0%	
	11	–	8	18	87	105	–	**2**	–	–	220
		0.0%	3.6%	8.2%	39.5%	47.7%	0.0%	**0.9%**	0.0%	0.0%	
Total		797	388	416	172	216	72	**26**	11	1	2099
		38.0%	18.5%	19.8%	8.2%	10.3%	3.4%	**1.2%**	0.5%	0.0%	

Table 13. Catches and species composition of skates observed during early trawl experiments in Start Bay, Torbay and Teignmouth Bay. Adapted from Garstang (1903).

Bay	Details	Skate species				
		Blonde ray	Thornback ray	Small-eyed ray	Spotted ray	White skate
Start Bay	Stations fished	67	67	67	67	67
	Positive stations	33	22	14	30	7
	% Occurrence	49.3%	32.8%	20.9%	44.8%	10.4%
	Total number	578	124	36	88	7
	% Skates caught	69.4%	14.9%	4.3%	10.6%	0.8%
Teignmouth Bay	Stations fished	32	32	32	32	32
	Positive stations	9	30	6	8	5
	% Occurrence	28.1%	93.8%	18.8%	25.0%	15.6%
	Total number	57	834	26	29	5
	% Skates caught	6.0%	87.7%	2.7%	3.0%	0.5%
Torbay	Stations fished	36	36	36	36	36
	Positive stations	1	27	0	1	1
	% Occurrence	2.8%	75.0%	0.0%	2.8%	2.8%
	Total number	3	364	0	1	1
	% Skates caught	0.8%	98.6%	0.0%	0.3%	0.3%

Figure 19. Fixed survey stations sampled during the eastern Channel beam trawl survey. For purpose of illustration, the locations shown are based on the 2019 shot positions. Source: ICES (2021).

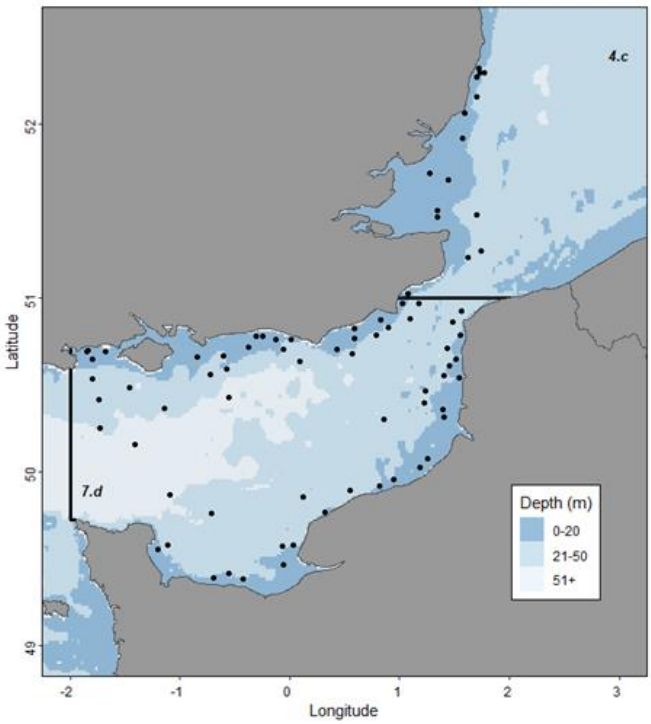


Figure 20. Spatial distribution of small-eyed ray as observed in the eastern Channel beam trawl survey (all specimens, aggregated over 4-yr time periods for the years 1993–2020). Note: zero catches shown as black crosses and the stock unit extends into Division 7.e. Source: ICES (2021).

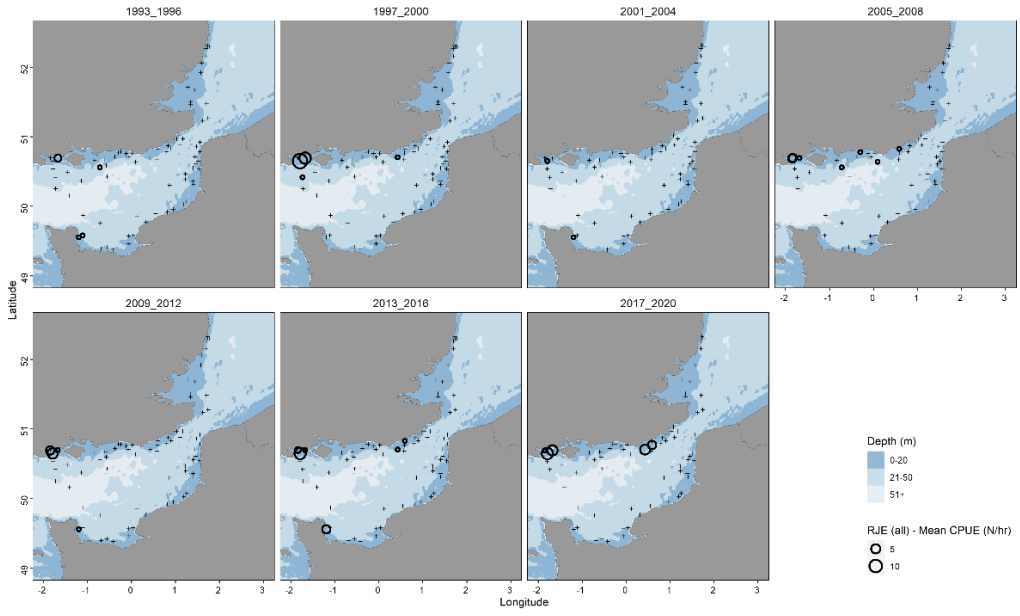


Figure 21. Length-frequency distribution of small-eyed ray as observed in the eastern Channel beam trawl survey over the period 1993–2020. The dashed vertical line at 50 cm total length represents the length assumed for 'exploitable biomass'. Source: ICES (2021).

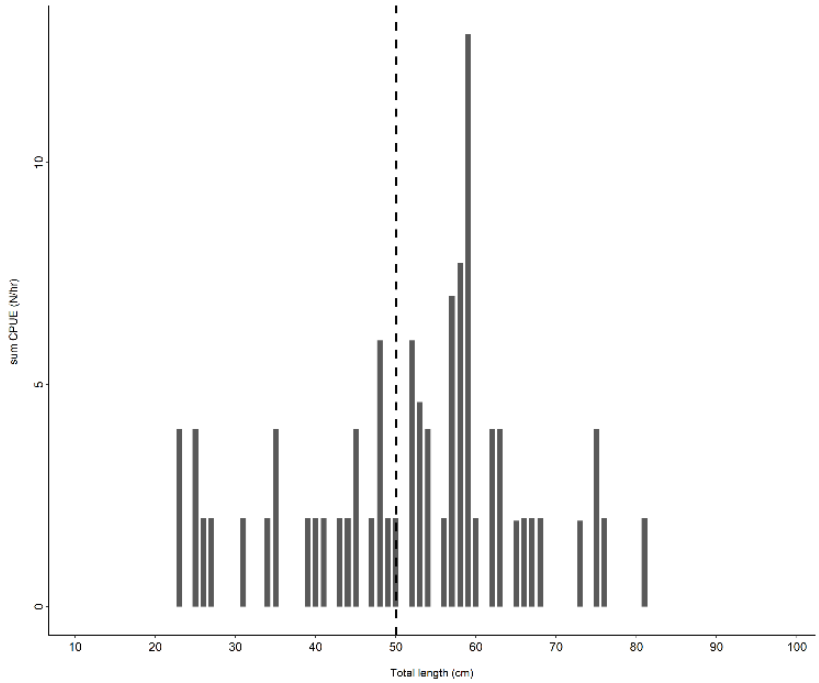


Figure 22. Survey area from the south-west beam trawl survey showing the strata in the western Channel (Division 7.e; strata 1–13), and the strata in the Bristol Channel and Celtic Sea (Divisions 7.f–j; A–P). Note: The strata shown here show the survey design since 2016. Source: Silva *et al.* (2020).

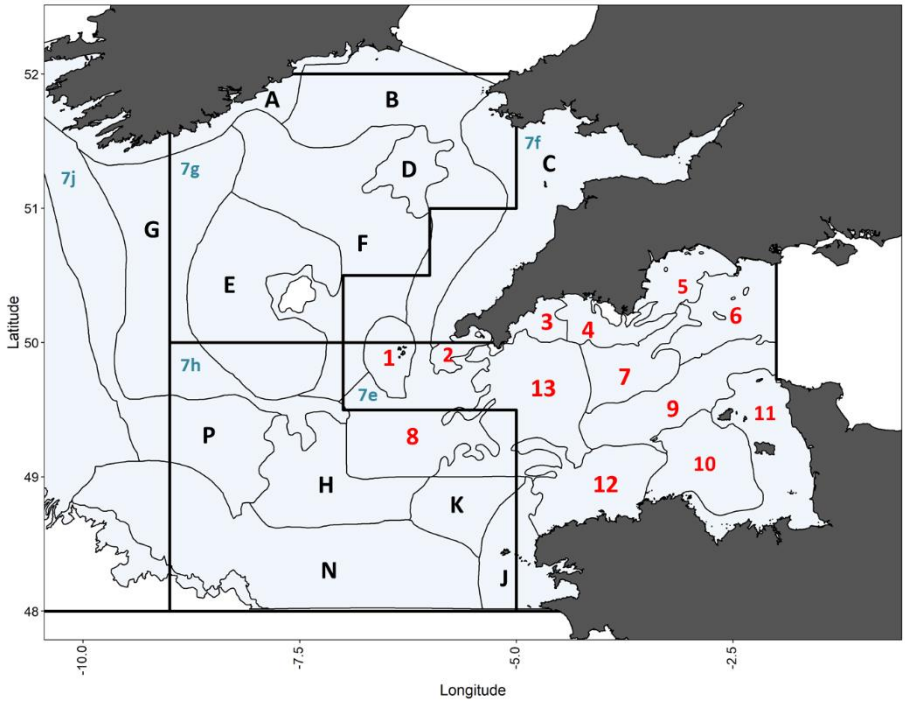


Figure 23. Distribution and relative abundance of small-eyed ray (blue circles) and shagreen ray *Leucoraja fullonica* (red circles[15]) as observed in the south-west beam trawl survey (2006–2019). Source: Silva *et al.* (2020).

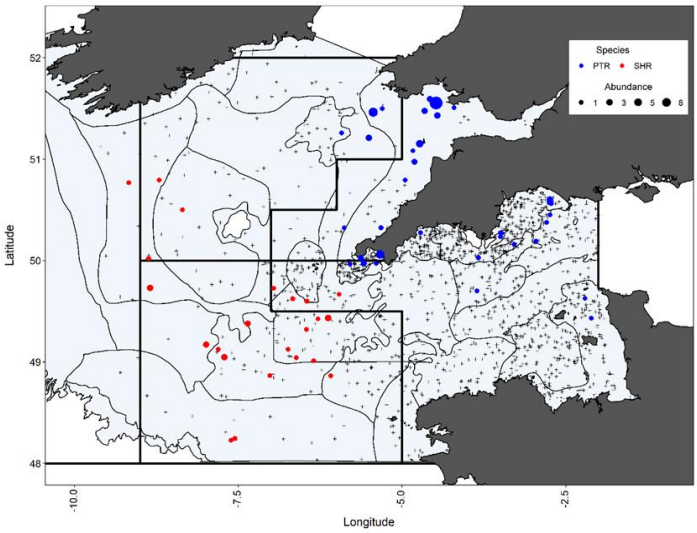
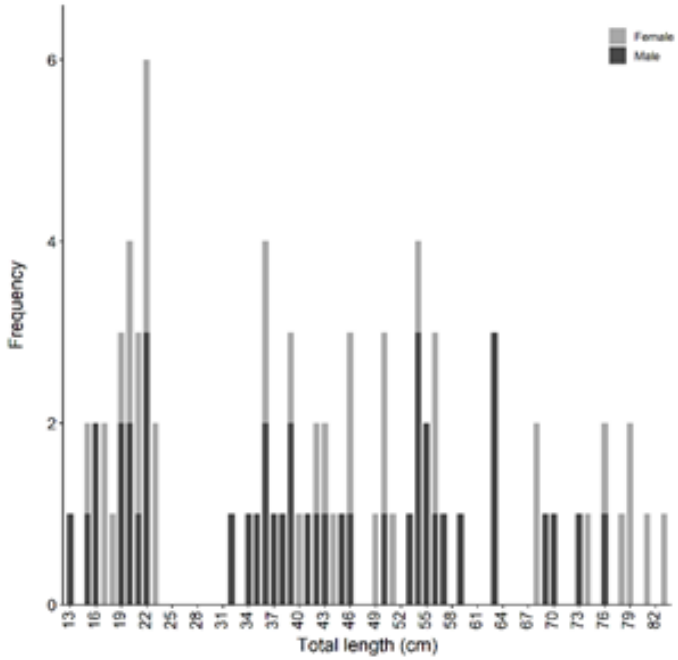


Figure 24. Length-frequency distribution of small-eyed ray by sex as observed in the south-west beam trawl survey (2006–2019. Source: Silva *et al.* (2020).



[15] There have been instances in other data sets where data for small-eyed ray and shagreen ray are thought to have been confounded due to misidentifications, and so data for both species are shown here.

Figure 25. Survey stations sampled during the *Carhelmar* survey. Fixed stations include those are 0–3 nm from shore (red), 2–6 nm from shore (green), 6–12 nm from shore (purple) and >12 nm from shore in both inshore (orange) and offshore (blue) zones. Source: Burt *et al.* (2013).

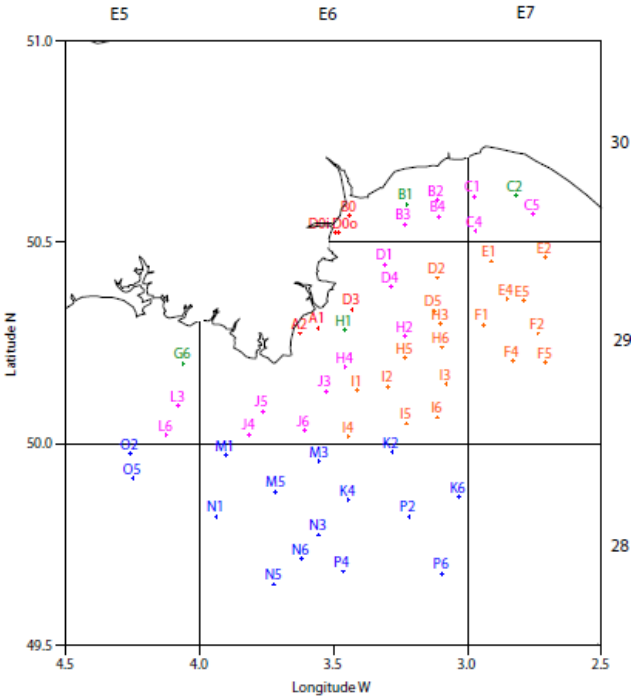


Figure 26. Distribution and relative abundance (average number caught per 30 min. tow) at fixed stations sampled during the *Carhelmar* survey (1989–2011). Source: Burt *et al.* (2013).

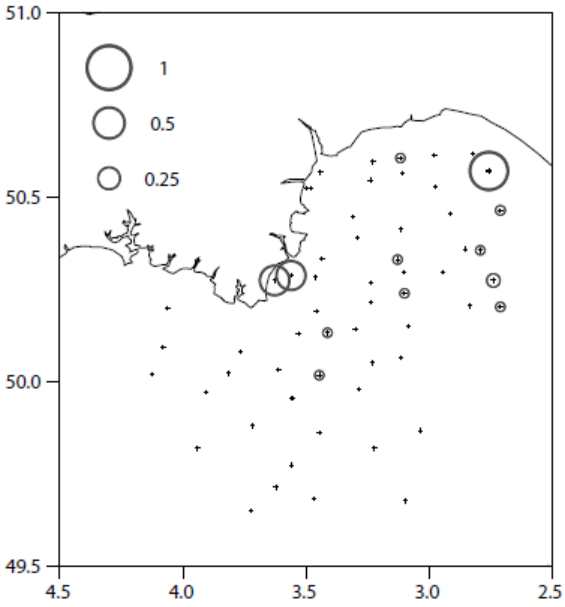


Figure 27. Nominal catch rate and frequency of occurrence of small-eyed ray in the *Carhelmar* survey (1989–2011). Source: Burt *et al.* (2013).

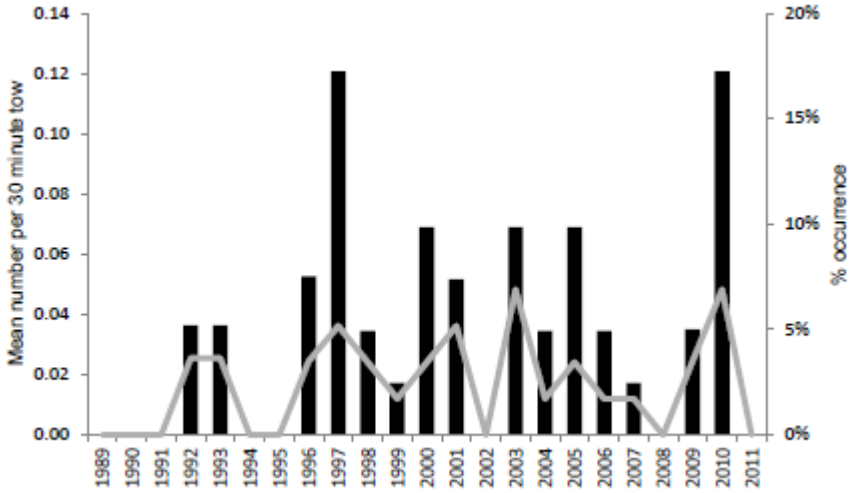


Figure 28. Length-frequency distribution of small-eyed ray as observed in the *Carhelmar* survey (1989–2011). Source: Burt *et al.* (2013).

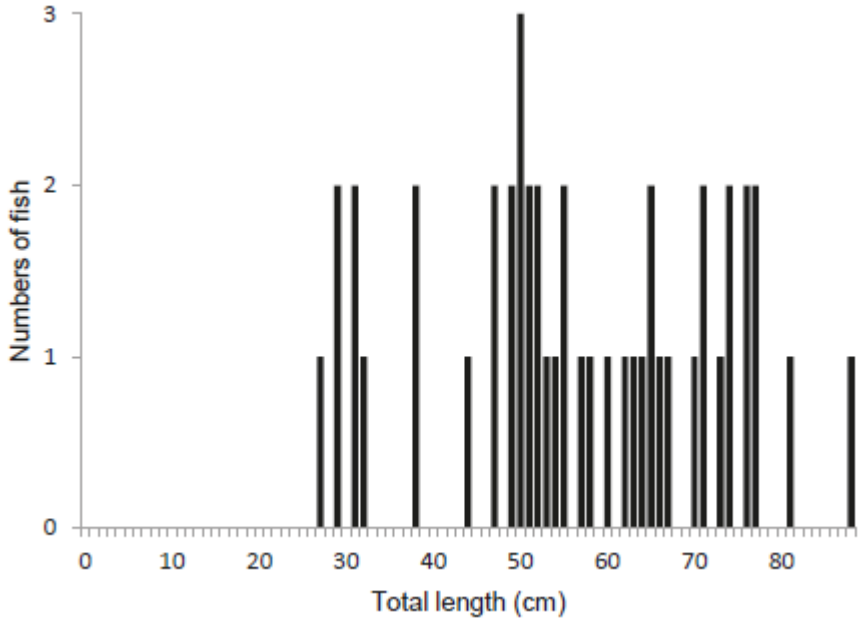


Figure 29. Nominal catch rate (numbers per hour) and frequency of occurrence of small-eyed ray in the Channel groundfish survey (1988–2019). Note: The size of vessel and trawl increased from 2015 onwards. Data source: DATRAS (Data retrieved 3 March 2022).

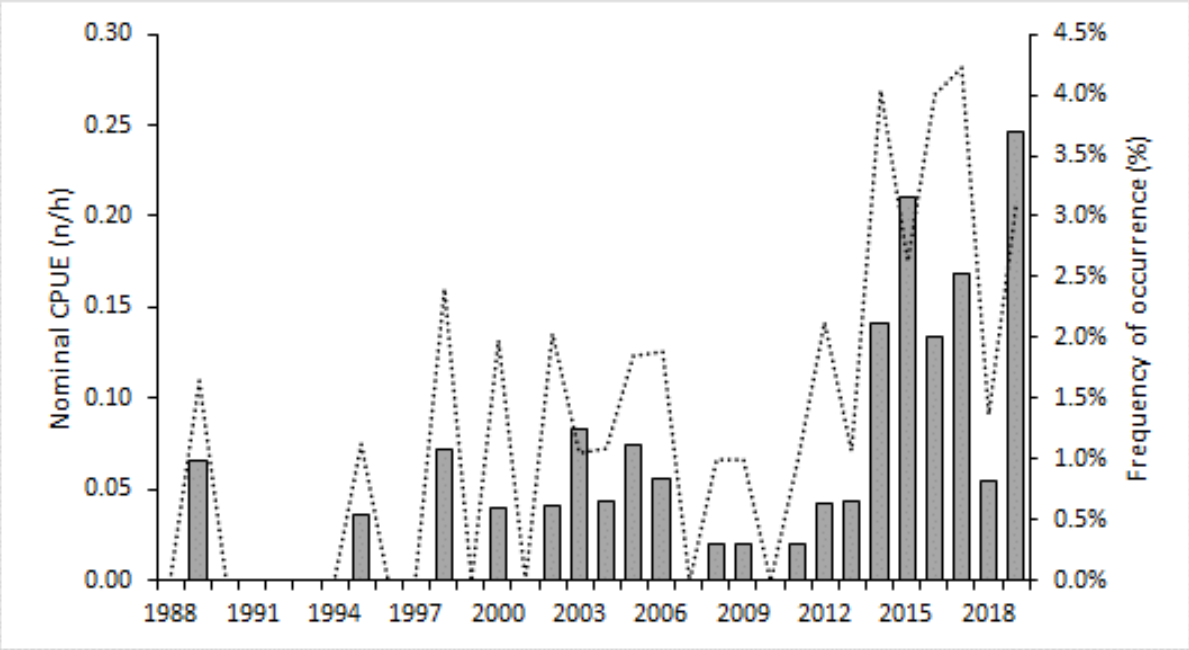
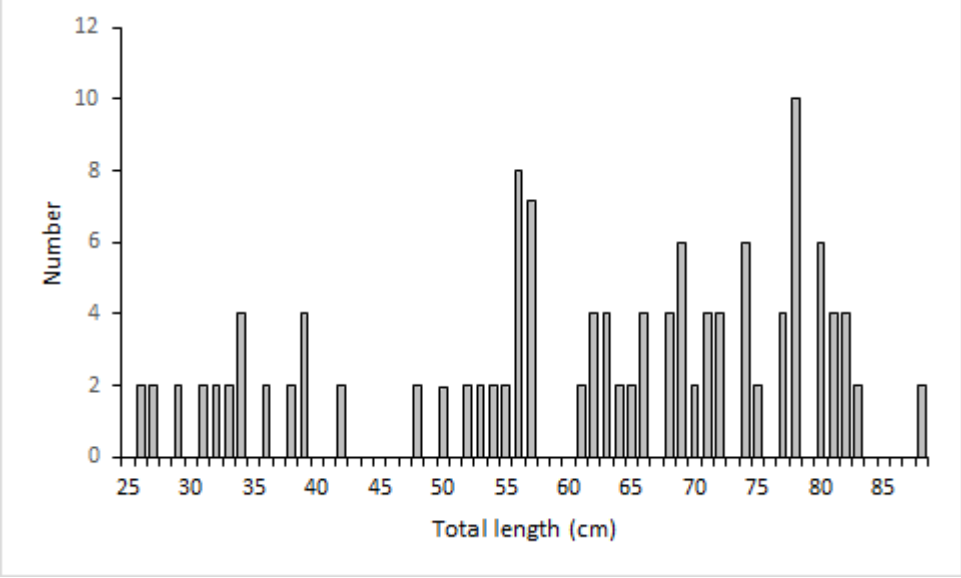


Figure 30. Length-frequency distribution of small-eyed ray as observed in the Channel groundfish survey (1988–2019). Data source: DATRAS (Data retrieved 3 March 2022).



6. Summary and future work

Small-eyed ray has a patchy and localised distribution in the English Channel. This restricted distribution was also evident from early 20th Century studies of skates in the western Channel (Garstang, 1903; Steven, 1932).

The at-sea observer programme and survey data highlight the patchy distribution of the species over the broader English Channel area, with small-eyed ray tending to occur in a range of sandy bays. Current fishery-independent trawl surveys have limited sampling effort in many of these inshore areas. Consequently, data from these surveys (see Section 5) have not been used by ICES to derive a stock-size indicator, as the catch rates are low and variable.

It is acknowledged that due to the random design of the at-sea observer sampling procedure and low coverage of the programme, rarer species and/or species with a patchy distribution, may not be sampled effectively, due to the random vessel selection and subsequent variation in sampled fishing grounds. For these species, catch estimates from the observer programme are considered to be less reliable and more uncertain, and would arguably benefit from either higher levels of sampling, or additional species-specific sampling (e.g., from a reference fleet that is a subset of the wider fleet).

Whilst catch rates from both the at-sea observer programme and trawl surveys are low and variable, simpler metrics such as frequency of occurrence suggest that small-eyed ray is observed more frequently, and none of the available information available indicates that the species has declined in spatial extent in this area.

The main UK Channel ports where small-eyed ray have been landed (see Table 2) were generally in close proximity to the sites where small-eyed ray were observed in trawl surveys (see Section 5). Indeed, most landings were from ports near to Mount's Bay (Newlyn), in the vicinity of St Austell Bay and the stretch of coastline near Plymouth (Mevagissey, Looe and Plymouth), Great West Bay (Salcombe, Dartmouth, Brixham, Exmouth, Beer, Lyme Regis, West Bay, Portland and Weymouth), Poole Bay to the Isle of Wight (Poole, Christchurch, Lymington, Portsmouth, Cowes and Isle of Wight), the stretch of coastline including Shoreham, Brighton and Newhaven, and near Pevensey Bay (Eastbourne). Certain sites along the coasts of France and the Channel Islands may also be important, including the Baie de Veys (Beillois *et al.*, 1979; Section 5).

The reasons for the original no-retention regulation in 2016 EU fishing opportunities (EU, 2016) are unclear, and there was no indication in the preceding ICES advice that catches of this species, or any constituent stocks, should be reduced to zero. The relevant ICES advice for the English Channel stock of small-eyed ray was for a precautionary 20% reduction in catches (ICES, 2014).

It is also uncertain why other areas within the distribution range of small-eyed ray, such as Subareas 8 and 9, were not included in the no-retention regulation.
Given the localised distribution of small-eyed ray in the English Channel, dedicated field studies would be required to provide a more robust indicator of stock size. However, the degree of sampling required to provide a robust stock-size indicator is

uncertain. Options for further work to improve our understanding of the state of the stock could include:

(a) Fishery-independent survey(s) on Research Vessel: Adding extra days on existing fishery-independent trawl surveys to provide more robust sampling of representative sites (e.g. Pevensey Bay, Poole Bay, Lyme Bay, St Austell Bay and Mount's Bay). Such additional sampling could be incorporated as 'additional stations' within the current survey design.

(b) Scientific survey(s) on chartered fishing vessels: Chartering inshore commercial vessels to undertake scientific surveys of representative sites would allow the main areas of small-eyed ray to be surveyed by local fishing vessels. For example, this could be conducted by undertaking surveys (each of 2–3 days duration) in 5–7 sites that are considered to be representative of small-eyed ray habitats.

(c) Reference fleet: Establishing a 'reference fleet', whereby additional at-sea observer coverage is undertaken on participating vessels to ensure appropriate coverage of those fisheries operating in the main areas that are considered to be representative of small-eyed ray habitats. Such additional observer coverage, using agreed vessels, gears and sites, could be incorporated as 'additional trips' within the current (random) design. Whilst the non-random nature of such trips means the data would not be used in routine estimates of discards for various fish species (as the current data are used), it would provide relevant information on the catch rates of small-eyed ray (and any related species of interest).

(d) Fishery-dependent data: Using relevant data collection methods (e.g., log-book scheme; Remote Electronic Monitoring (REM); fisher self-sampling) to gather fishery-dependent data on catch rates and catch composition of small-eyed ray.

(e) Mixed approach: Given the patchy distribution of small-eyed ray in the English Channel, there would also be options of using a combination of the above approaches. For example, an extra day during the eastern Channel beam trawl survey would allow more sampling stations in that part of the stock in Division 7.d, whilst scientific surveys using commercial fishing vessels and/or use of reference fleet could provide data for that part of the stock in Division 7.e. Whilst a mixed approach may not result in a single standardised series of catch-per-unit effort (CPUE), such data could be normalised and then combined.

The advantages and disadvantages of these approaches are summarised in Table 14 (noting that the mixed approach is not highlighted separately). No one preferred option is identified here, as the amount of potential resource for any future work is unclear.

Table 14. Advantages and disadvantages of the various options for better monitoring the stock of small-eyed ray in the English Channel.

Option	Advantages	Disadvantages
Fishery-independent survey(s) on Research Vessel (i.e., additional days on existing Research Vessel surveys)	✓ Could better develop a longer time-series using standardised sampling. ✓ Staffing would allow additional biological information on small-eyed ray to be collected, as well as full processing of all catches. ✓ Data collected at sea and stored as part of wider survey, therefore no additional costs relating to data entry ✓ Allows for relevant biological data collection, including mark-recapture tagging	× High fieldwork costs × Sampling limited in relation to water depth (though sampling could be undertaken at high water) × Sampling may be impacted by static gear or local bylaws from spatial management × Survey may not be optimal for catching skates and rays × Sampling limited to certain times of the year
Scientific survey(s) on chartered fishing vessels	✓ Involves collaboration with parts of the fishing industry ✓ Local knowledge of fishing grounds (including locations of static gear) ✓ Commercial gears may allow better sampling of skates and rays ✓ Allows for relevant biological data collection, including mark-recapture tagging ✓ Improved sampling of shallower parts of the distribution ✓ Cheaper (cf. Research Vessel)	× The use of different vessels in different areas would result in different gears × Vessel or gear configuration may change over time, thus hampering collection of time-series data × Vessel size and staffing may limit wider data collection

Table 14 (continued). Advantages and disadvantages of the various options for better monitoring the stock of small-eyed ray in the English Channel.

Option	Advantages	Disadvantages
Reference fleet (e.g., dedicated sampling of selected parts of the commercial fleet)	✓ Cheaper (fieldwork costs) ✓ Involves collaboration with parts of the fishing industry ✓ Local knowledge of fishing grounds (including locations of static gear) ✓ Ability to sample in shallower waters Commercial gears may allow better sampling of skates and rays	× Changes in fleet behaviour and participation may impact on time-series data × May be difficult to standardise sampling (e.g., gear used, sampling stations), especially if other factors influence fishing patterns
Fishery-dependent data (e.g., REM technology, self-sampling, etc.)	✓ Cheaper (fieldwork costs) ✓ Could involve wider parts of the fishing industry ✓ Data collection could involve more vessels, trips and hauls ✓ May allow seasonality to be examined	× The no-retention policy for small-eyed ray might result in vessels avoiding areas where small-eyed ray are predominant, which may impact on the quality and representativeness of the data × Increased processing time for fishery-dependent data (including quality assurance) × Some data may be of variable quality × REM footage may not be appropriate for all vessel layouts × Limits collection of biological data

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