15 Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel

15.1 Ecoregion and stock boundaries

In the North Sea, about ten skate and ray species occur, as well as about ten demersal shark species (Daan *et al.*, 2005). Thornback ray *Raja clavata* is the most important skate for the commercial fisheries. Preliminary assessments on this species were presented in ICES (2005, 2007), based on research survey data. WGEF is still concerned about the possibility of misidentification of skates in some recent IBTS surveys, especially differentiation between *R. clavata* and starry ray *Amblyraja radiata*.

R. clavata in the Greater Thames Estuary (southern part of Division 4.c) is known to move into the eastern English Channel (Walker *et al.*, 1997; Ellis *et al.*, 2008b). For most other demersal species in the North Sea ecoregions, stock boundaries are not well known. Stocks of cuckoo ray *Leucoraja naevus*, spotted ray *R. montagui* and *R. clavata* (northern North Sea) probably continue into the waters west of Scotland and, in the case of *R. montagui,* also into the eastern English Channel. Blonde ray *Raja brachyura* has a patchy distribution, occurring in the southern North Sea (presumably extending to the eastern English Channel) and north-western North Sea (and this stock may extend to north-west Scotland) (Ellis *et al*., 2015).

Dipturus batis, frequently referred to as common skate, has recently been confirmed to comprise of two species being erroneously synonymised in the 1920s (Iglésias *et al*., 2010; Griffiths *et al*., 2010). The smaller species (previously described as *Dipturus flossada* by Iglésias *et al*., 2010) is the common blue skate (*Dipturus batis* (FAO code RJB)) and the larger species may refer to the flapper skate (*Dipturus intermedius* (FAO code DRJ)). The member of the common skate complex present in the northern North Sea is *Dipturus intermedius*, which is generally considered the more vulnerable to fishing pressure. Both species were accepted by Last *et al*. (2016) and are now also accepted in the Catalog of Fishes (Fricke *et al*., 2021) and WoRMS. The distribution and stock boundaries of the two species are uncertain. The larger-bodied flapper skate *Dipturus intermedius* occurs in the north-western North Sea, and this stock is likely the same as occurs of North-west Scotland. The presence and geographical extent of blue skate *Dipturus batis* in this region is uncertain, but this species may have occurred in the southern North Sea historically. Additional work was developed in 2021 in response to WGEF *ToR l*, with further information on *Dipturus* species presented in Section 26.

This section focuses primarily on skates (Rajidae). For the main demersal sharks in this ecoregion, the reader is referred to the relevant chapters for spurdog (Section 2), tope (Section 10), smooth-hounds (Section 21) and lesser-spotted dogfish and other catsharks (Section 25).

15.2 The fishery

15.2.1 History of the fishery

Demersal elasmobranchs are caught as a bycatch in the mixed demersal fisheries for roundfish and flatfish. A few inshore vessels target skates and rays with tangle nets and longlines. For a description of the demersal fisheries see the Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (ICES, 2009a) and the report of the DELASS project (Heessen, 2003).

In 2007, the EC brought in a 25% bycatch ratio (see also Section 15.2.4, footnote 1) for vessels over 15 m. This has restrained some fisheries and may have resulted in misreporting, both of area and species composition.

15.2.2 The fishery in 2021

The landings peaked in the middle of the 1980s and declined steadily thereafter in the North Sea (Figure 15.3.1). Since 2008, the TAC appears to have been restrictive for the fisheries in the North Sea (Subarea 4), with landings ranging between approximately 1300–1600 t since 2010. A similar trend is observed for Division 7.d although since 2015, landings have increased by >50% to ~1700 t.

The impact of the COVID-19 pandemic on fishing activity, though so far unquantified, may be assumed depending on national or local restrictions, to have reduced fishing effort in place for at least part of 2020.

15.2.3 ICES Advice applicable

Stock-specific advice for several species/stocks in this region was provided in 2021, see table below (and Section 15.9). Note that for most of stocks ICES provides biennial advice, however, for common skate complex and starry ray quadrennial advice is provided.

ICES stock code	Stock description	ICES Data Category	Advice basis	Previous ICES advice
rjb.27.3a4	Common skate *Dipturus batis-complex* Subarea 4 and Division 3.a	6.3.0	Precautionary approach	ICES has not been requested to provide advice on fishing opportunities in 2021. Last catch advice provided of zero was valid for 2016 to 2019.
rjc.27.3a47d	Thornback ray *Raja clavata* Subarea 4 and divisions 3.a and 7.d	3.2	Precautionary approach	2446 t
rjh.27.4a6	Blonde ray *Raja brachyura* Subarea 6 and divisions 4.a	5.2	Precautionary approach	7 t
rjh.27.4c7d	Blonde ray *Raja brachyura* Divisions 4.c and 7.d	3.2	Precautionary approach	191 t
rjm.27.3a47d	Spotted ray *Raja montagui* Subarea 4 and divisions 3.a and 7.d	3.2	Precautionary approach	232 t
rjn.27.3a4	Cuckoo ray *Leucoraja naevus* Subarea 4 and Division 3.a	3.2	Precautionary approach	89 t
rjr.27.23a4	Starry ray *Amblyraja radiata* Subareas 2, 4 and Division 3.a	3.1.5	Precautionary approach	Zero Valid for 2020 to 2023
raj.27.3a47d	Other skates and rays Subarea 4 and divisions 3.a and 7.d	6.2.0	Insufficient data to provide advice	NA

15.2.3.1 State of the stocks

Since 2012, WGEF provides a qualitative summary of the general status of the major species based on surveys and landings. See sections 15.9 and 15.10 for further details on the assessment methodology of these species.

Common skate complex: Depleted. It was formerly widely distributed over much of the North Sea but is now found only rarely, and only in the northern North Sea. The distribution extends into the west of Scotland and the Norwegian Sea [Note: This perception was based on comparisons of historical and contemporary trawl survey data]. In the last 10 years, catch rates have increased in the IBTS surveys.

R. clavata: Stable/increasing. The distribution area and abundance have decreased over the past century, with the stock concentrated in the south-western North Sea where it is the main commercial skate species. Its distribution extends into the eastern Channel. Survey catch trends in divisions 4.c and 7.d have been increasing since 2009, but have been stable in recent years. The status of *R. clavata* in divisions 4.a-b is uncertain.

R. montagui: Stable The area occupied has fluctuated without trend. Abundance in the North Sea is increasing since 2000. In the eastern Channel a slight increase can be observed during recent years. The stock size indicator has increased during the last decade, and whilst showing a slight decrease in 2020, it has been above the long-term average since 2011.

***A. radiata*:** Decreasing. Survey catch rates increased from the early 1970s to the early 1990s and have decreased since then.

L. naevus: Decreasing. Since 1990 the area occupied has fluctuated without trend. Abundance has decreased since the early 1990s. Catch rates in the IBTS increased during 2004–2012, followed by a marked inter-annual variability between 2013–2016 and a consistent decreasing trend since 2017. Meanwhile abundance has been stable in the BTS Tridens survey.

R. brachyura: Uncertain. This species has a patchy occurrence in the North Sea. It is at the edge of its distributional range in this area. However, several surveys have shown increased catch rates in the last 15 years.

15.2.4 Management applicable

In 1999, the EC first introduced a common TAC for "skates and rays". From 2008 onwards, the EC has obliged Member States to provide species-specific landings data for the major North Sea species: *R. clavata*, *R. montagui*, *R. brachyura*, *L. naevus*, *A. radiata* and the 'common skate complex'. WGEF is of the opinion that this measure is ultimately expected to improve our understanding of the skate fisheries in the area.

The TACs (Council Regulation (EU) 2020/123); for skates and rays for the different parts of the area in 2021 are: 1764 t for EU waters of Division 2.a and Subarea 4; 1497 t for Division 7.d; and 48 t for Division 3.a. Some transfer (5%) between the Division 7.d TAC area and the Celtic Seas ecoregion is allowed, which may account for some quota overshoot of the TAC in 7.d.

In 2015 a separate species-specific precautionary TAC for undulate ray (*Raja undulata*) was set within the overall skate TAC for Division 7.d. A special condition applied that up to 5% may be fished in Union waters of 7.e and reported under the following code: (RJU/*67AKD). However, in 2018 France requested ICES to update the advice for undulate ray in divisions 7.d–e and 8.a–b (ICES, 2018). The outcomes of the report contributed to a separate TAC for undulate ray in divisions 7.d and 7.e from 2019 onwards.

The list of prohibited species on EU fisheries regulations (Council Regulation (EU) 2016/72) included the following species within the North Seas ecoregion: white skate *Rostroraja alba* (Union waters of ICES subareas 6–10), thornback ray *Raja clavata* (Union waters of Division 3.a), starry ray *Amblyraja radiata* (Union waters of Divisions 2.a, 3.a and 7.d and Subarea 4) and common skate complex in Union waters of Division 2.a and ICES subareas 3, 4, 6–10.

Year	TAC*	TAC for 2.a and 4	TAC for 7.d	TAC for RJU 7.d-e	TAC for 3.a	Landings**
1999	6060	6060				3997
2000	6060	6060				3992
2001	4848	4848				4011
2002	4848	4848				3904
2003	4121	4121				3797
2004	3503	3503				3237
2005	3220	3220				3238 (3030)
2006	2737	2737				2928 (2845)
2007	2190	2190 (1)				3145 (3141)
2008	1643	1643 (2)				3183 (3025)
2009	2755	1643 (3,4,5)	1044 (i, ii)		68 (a, b)	3069 (3192)
2010	2342	1397 (3,4,5)	887 (i, ii, iii)		58 (a, b)	2883 (2951)
2011	2342	1397 (3,4,5)	887 (i, ii, iii)		58 (a, b)	2682 (2672)
2012	2340	1395 (3,4,5)	887 (i, ii, iii)		58 (a, b)	2800 (2738)
2013	2106	1256 (3,4,5)	798 (ii, iii, iv)		52 (c,d)	2977 (3000)
2014	2101	1256 (4,6,7)	798 (iii,v,vi)		47 (e,f)	2839 (2603)
2015	2307	1382 (4,6,7)	878 (iii, vii, viii)		47 (e)	2522
2016	2326	1313 (6,8,9)	966 (iii, vii, ix)		47 (e)	2697
2017	2488	1378 (6,8,9)	1063 (iii, vii, ix)		47 (e)	2792
2018	2977	1654 (6,8,9,10)	1276 (v,x,xi,xii)		47 (e)	3469
2019	3105	1654(6,8,9,10)	1404(v,x,xi,xiii)	234(1a)	47 (e)	3493
2020	3258	1737(6,8,9,10)	1474(v,x,xi,xiii)	234(1a)	47(e)	3204
2021	3095	1650(6,8,9,10)	1400(v,x,xi,xiii)	234(1a)	45(e)	3324
2022	3309	1764(6,8,9,10)	1497(v,x,xi,xiii)	234(1a)	48(e)	

***TAC does not include TAC for rju.27.7de for 2019 and 2020.**

****Data from 2005 onwards revised following 2016–2021 Data Call, with previous estimates in brackets. Data contain those species part of the TAC (raj.27.3a47d, rjc.27.3a47d, rjm.27.3a47d, rjh.27.4a6, rjh.27.4c7d and rjn.27.3a4) and include landings for *Raja undulata* and *Raja microocellata* declared by Member States in 7.d.**

1) By-catch quota. These species shall not comprise more than 25% by live weight of the catch retained on board.

2) Catches of cuckoo ray *Leucoraja naevus*, thornback ray *Raja clavata*, blonde ray *Raja brachyura*, spotted ray *Raja montagui*, starry ray *Amblyraja radiata* and common skate *Dipturus batis* to be reported separately.

3) Catches of cuckoo ray *Leucoraja naevus*, thornback ray *Raja clavata*, blonde ray *Raja brachyura*, spotted ray *Raja montagui* and starry ray *Amblyraja radiata* to be reported separately.

4) By-catch quota. These species shall not comprise more than 25% by live weight of the catch retained on board. This condition applies only to vessels over 15 m length overall.

5) Does not apply to common skate *Dipturus batis*. Catches of this species may not be retained on board and shall be promptly released unharmed to the extent practicable. Fishers shall be encouraged to develop and use techniques and equipment to facilitate the rapid and safe release of the species.

6) Catches of cuckoo ray *Leucoraja naevus*, thornback ray *Raja clavata*, blonde ray *Raja brachyura* and spotted ray *Raja montagui* to be reported separately.

7) Shall not apply to common skate *Dipturus batis* complex and starry ray *Amblyraja radiata* . When accidentally caught, these species shall not be harmed. Specimens shall be promptly released. Fishermen shall be encouraged to develop and use techniques and equipment to facilitate the rapid and safe release of the species.

8) By-catch quota. These species shall not comprise more than 25% by live weight of the catch retained on board per fishing trip. This condition applies only to vessels over 15 metres' length overall. This condition applies only to vessels over 15 m LOA. This provision shall not apply for catches subject to the landing obligation as set out in Article 15(1) of Regulation (EU) No 1380/2013.

9) Shall not apply to blonde ray *Raja brachyura* in Union waters of 2.a and small-eyed ray *Raja microocellata* in Union waters of 2.a and 4. When accidentally caught, these species shall not be harmed. Specimens shall be promptly released. Fishermen shall be encouraged to develop and use techniques and equipment to facilitate the rapid and safe release of the species

10) Special condition: of which up to 10 % may be fished in Union waters of 7.d (SRX/*07D2.), without prejudice to the prohibitions set out in Articles 13 and 45 of this Regulation for the areas specified therein. Catches of blonde ray (*Raja brachyura*) (RJH/*07D2.), cuckoo ray (*Leucoraja naevus*) (RJN/*07D2.), thornback ray (*Raja clavata*) (RJC/*07D2.) and spotted ray (*Raja montagui*) (RJM/*07D2.) shall be reported separately. This special condition shall not apply to small-eyed ray (*Raja microocellata*) and undulate ray (*Raja undulata*).

(i) Catches of cuckoo ray *Leucoraja naevus*, thornback ray *Raja clavata*, blonde ray *Raja brachyura*, spotted ray *Raja montagui* and starry ray *Amblyraja radiata* to be reported separately.

(ii) Does not apply to common skate *Dipturus batis* and undulate ray *Raja undulata*. Catches of these species may not be retained on board and shall be promptly released unharmed to the extent practicable. Fishers shall be encouraged to develop and use techniques and equipment to facilitate the rapid and safe release of the species.

(iii) Of which up to 5% may be fished in EU waters of 6.a-b, 7.a-c and 7.e-k

(iv) Catches of cuckoo ray *Leucoraja naevus*, thornback ray *Raja clavata*, blonde ray *Raja brachyura*, spotted ray *Raja montagui*, small-eyed ray *Raja microocellata* and starry ray *Amblyraja radiata* to be reported separately.

(v) Catches of cuckoo ray *Leucoraja naevus*, thornback ray *Raja clavata*, blonde ray *Raja brachyura*, spotted ray *Raja montagui* and small-eyed ray *Raja microocellata* to be reported separately.

(vi) Does not apply to common skate complex *Dipturus batis*, undulate ray *Raja undulata* and starry ray *Amblyraja radiata*. Catches of these species may not be retained on board and shall be promptly released unharmed to the extent practicable. Fishers shall be encouraged to develop and use techniques and equipment to facilitate the rapid and safe release of the species.

(vii) Catches of cuckoo ray *Leucoraja naevus*, thornback ray *Raja clavata*, blonde ray *Raja brachyura*, spotted ray *Raja montagui*, small-eyed ray *Raja microocellata* and undulate ray *Raja undulata* to be reported separately.

(viii) Undulate ray not to be targeted, with a trip limit of 20 kg live weight per trip, and catches to remain under an overall quota of 11 t

(ix) Undulate ray not to be targeted, with a trip limit of 40 kg live weight per trip, and to remain under an overall quota of 12 t

(x) of which up to 5 % may be fished in Union waters of 6.a, 6.b, 7.a-c and 7.e-k. This special condition shall not apply to small-eyed ray *Raja microocellata* and to undulate ray *Raja undulata*.

(xi) of which up to 10 % may be fished in Union waters of 2a and 4. This special condition shall not apply to small-eyed ray *Raja microocellata*.

(xii) Undulate ray not to be targeted. The catches shall remain under an overall quota of 19 t.

(xiii) Not applicable to undulate ray *Raja undulata*

1a) This species shall not be targeted in the areas covered by this TAC. This species may only be landed whole or gutted. The former provisions are without prejudice to the prohibitions set out in Articles 14 (16 in 2020 regulations) and 50 (52 in 2020 regulations) of this Regulation for the areas specified therein.

a) Catches of cuckoo ray *Leucoraja naevus*, thornback ray *Raja clavata*, blonde ray *Raja brachyura*, spotted ray *Raja montagui* and starry ray *Amblyraja radiata* to be reported separately.

b) Does not apply to common skate *Dipturus batis*. Catches of this species may not be retained on board and shall be promptly released unharmed to the extent practicable. Fishers shall be encouraged to develop and use techniques and equipment to facilitate the rapid and safe release of the species.

c) Catches of cuckoo ray *Leucoraja naevus*, blonde ray *Raja brachyura*, spotted ray *Raja montagui* and starry ray *Amblyraja radiata* to be reported separately.

d) Does not apply to common skate *Dipturus batis* and thornback ray *Raja clavata*. Catches of this species may not be retained on board and shall be promptly released unharmed to the extent practicable. Fishers shall be encouraged to develop and use techniques and equipment to facilitate the rapid and safe release of the species.

e) Catches of cuckoo ray *Leucoraja naevus*, blonde ray *Raja brachyura* and spotted ray *Raja montagui* to be reported separately.

f) Does not apply to common skate complex *Dipturus batis*, thornback ray *Raja clavata* and starry ray *Amblyraja radiata*. Catches of this species may not be retained on board and shall be promptly released unharmed to the extent practicable. Fishers shall be encouraged to develop and use techniques and equipment to facilitate the rapid and safe release of the species.

Within the North Sea ecoregion, some of the UK's Inshore Fisheries and Conservation Authorities (IFCAs), formerly Sea Fisheries Committees, have a minimum landing size of 40 cm disc width for skates and rays.

In 2013, Dutch Producer Organisations introduced a minimum landings size of 55 cm (total length) for skates and rays. In addition, to keep landings within the national quota, the POs have implemented landing restrictions which may varying throughout the year to control the quota uptake. Restriction can vary between 40 and 250 kg dead weight. Since 2019, the weekly landings were capped to 160 kg rays per trip. Similarly, Belgium implements a minimum landing size of 50 cm (total length) for skates and rays.

Since 2009, Norway has had a discard ban that applies to skates and sharks, as well as other fish, in the Norwegian Economic Zone. Whilst some discarding of skates is likely to have continued, the precise quantity is unknown.

15.3 Catch data

15.3.1 Landings

The landings tables for all rays and skates combined (tables 15.3.1–15.3.3) were updated. Since 2008, EC member states are required to provide species-specific landings data for the main species of rays and skates and these are collated by stock (Table 15.3.4). These data were all based on data submitted in the 2021 Data Call, with appropriate corrections made, following the recommendations of WKSHARK2 (ICES, 2016), with further updates conducted in 2021.

Figure 15.3.1 shows the total international landings of rays and skates from Division 3.a, Subarea 4, and Division 7.d since 1973. The figure also includes the combined landings from Division 3.a and Subarea 4 plus the TAC for recent years. Data from 1973 onwards are WGEF estimates.

Up to the early 1990s landings of skates in Division 7.d have been relatively stable around 1500 t, thereafter decreasing with lowest levels reported in the early 2000s (<1000 t). During 2007–2017 landings fluctuated around 1300 t. In 2020, landings were over 50% larger compared to 2015 (ca. 1808 t). Contrary to the TAC in the North Sea, in the eastern English Channel the TAC appears less restrictive with estimated landings exceeding it (see also Section 15.2.4). In addition, whereas historically estimated landings in Division 7.d have been much lower than landings Subarea 4, landings in Division 7.d are now above the landings estimated for the North Sea.

Landings of skates in Division 3.a (Skagerrak and Kattegat) are low compared to both other areas. Before the early 2000s landings have been relatively stable around 150 t. Since 2005 landings largely decreased (<50 t) with recent years showing similar levels to earlier years. The TAC appears to have been restrictive in early years though since 2016 estimated landings have been considerably higher than the overall TAC for Division 3.a.

15.3.2 Discard data

Information on discards in the different demersal fisheries is being collected by several Member States, and was submitted to the Expert Group. In 2020, all discard data available in the WGEF accessions folders were collated into a single Microsoft Excel® spreadsheet, with the 2020 data added in 2021. Whilst discard data are shown per stock from 2009 to 2021 (Table 15.3.5), these should be viewed with caution as further work is required in terms of QA/QC procedures prior to use in the assessments (see Section 1.14).

The estimation of elasmobranch total discards has raised concerns as raising to national catch levels is uncertain, with raising procedures not standardized among member states. Therefore, discard data were deemed unreliable and were not included in the 2021 advice of the skates within the North Sea ecoregion. The main issues concerning discards data are summarized in Section 1.14 of this report.

In addition, discards data collection is likely to have been affected by COVID-19 national restrictions in place during 2020 (e.g. social distancing) hence, a decrease in the number of samples comparatively to previous years may be assumed, though the impact is yet to be quantified.

Length–frequency distributions of discarded and retained elasmobranchs (for the period 1998–2006) were provided by UK-England (ICES, 2006), with updated information in Ellis *et al*. (2010). Silva *et al*. (2012) investigated the UK skate catches, including those from the North Sea, and using observer data, discussed discarding patterns. In general, 50% retention occurred at 49–51 cm total length (L_T) for the main commercial skate species, and nearly all skates larger than 60 cm L_T were retained. *A. radiata* was generally discarded across the entire length range (12–69 cm L_T).

A Dutch (industry) study funded by the European Maritime and Fisheries Fund (2016–2018) was set up to get a more detailed view on the catch composition. Vessels register and retain discards of quota regulated species by haul on board. In the auction, the discards are sorted by species, measured and weighed (Dutch industry report). The sorting process includes skates and rays and results show that, for the Dutch pulse fishery, 80–90% of the rays are discarded, with L_T ranging from 20 to >80 cm for the main commercial species (i.e. *Raja clavata*, *Raja montagui* and *Raja brachyura*). This high discard rate is mainly due to restrictive Dutch quotas for skates and rays.

15.3.3 Quality of the catch data

In 2008, the EC asked Member States to start reporting their landings of skates and rays by (major) species. Compliance with this varies from 0–100% by region and Member State (see Section 15.4.1), with a greatly increased proportion of skates now reported at species-level. The quality of the species-specific data is discussed in Section 15.4.2.

Several nations have market sampling and discard observer programmes that can also provide information on the species composition, although comparable information is lacking for earlier periods. Updated analyses of these data are required.

The ongoing French project "RAIMEST", conducted by French fisheries regional committees, aims to improve existing knowledge on skate stocks in Division 7.d based on fisher knowledge. This work aims to improve knowledge on functional fishery areas and on the spatial characteristics of skate catches (presence of areas, species distribution, seasonality, individual size, etc). Another goal is to define a correction coefficient to apply to declarative data (logbook) in this area.

15.3.4 Discard survival

Skates and rays were due to come under the European landing obligation (LO) from 1 January 2019 onwards, and given the disparity in quota and actual landings, they were expected to become "choke" species in certain fisheries. As stated in STECF 2014 "Article 15 paragraph 2(b)", exemptions from the LO are possible for species for which "scientific evidence demonstrates high survival rates". There have since been exemptions made for skates and rays in the North Sea whereby, they can be discarded until the end of 2023 while additional data and information are collected on survivability.

Ellis *et al.* (2017) provided a review of discard survival studies. Skates taken in coastal fisheries using trawls, longlines, gillnets and tangle nets generally show low at-vessel mortality (Ellis *et al*., 2008a, 2018), though it should be noted that the inshore fleet generally have limited soak times and haul durations. Studies for beam trawlers indicate that just over 70% of skates may survive (Depestele *et al*., 2014).

The SUMARiS project funded by the INTERREG 2 Seas Programme (2014–2020) provided further information on the vitality, reflex impairment, injury and survival probability of skates discarded in the English Channel and North Sea after being captured onboard commercial fishing vessels using active (beam trawl, otter trawl) or passive (gillnets, trammel nets) fishing gears. A total of 31 trips were organized on-board of French, English and Belgian commercial vessels. The discard survival probability (using immediate and delayed survival estimates (monitored in captivity for 21 days)) for thornback ray and blonde ray discarded by beam trawlers were 54% and 67% respectively. Meanwhile otter trawlers showed overall survival estimates for thornback and blonde ray of 72% and 86%, respectively. For spotted ray and undulate ray by beam trawlers, the overall discard survival estimates was accounted for 27% and 58%, respectively (Van Bogaert *et al.*, 2020).

A Dutch study quantitatively estimated the longer-term discard survival probability of thornback ray. Discard survival was assessed during nine trips with commercial pulse-trawlers, monitoring survival in captivity for 15–18 days (Schram and Molenaar, 2018). The discard survival probability estimates varied among sea trips, resulting in a survival probability estimate of 53% (95% CI 40–65%). Also, during two trips, discard survival probabilities were estimated for spotted ray, resulting in survival probabilities of 21% and 67%. Given the limited numbers of observations per species, estimates should be considered and treated as a first indication of the actual discard survival probability for these species in the 80 mm pulse-trawl fisheries. Further quantitative estimates of longer-term survival are required for a variety of elasmobranchs captured in various European fisheries (Ellis *et al.*, 2018).

15.4 Commercial landings composition

15.4.1 Species and size composition

From 2008 onwards, all EU countries are obliged to register species-specific landings for the main skate species. In the past, only France and Sweden provided landings data by species based on information from logbooks and auctions. However, the accuracy of some of these data was doubtful. The landings for each country have been analysed to determine the percentage of landings that have been reported to species-specific level. It can be seen that this percentage varies between regions and countries. Belgium, France, the Netherlands, UK-England and UK-Scotland demonstrate consistently high levels of species-specific declaration for Subarea 4 and Division 7.d; in 2014 they all declared >75% of their landings in Subarea 4 and Division 7.d to species level. Sweden mainly landed rays and skates from Division 3.a, and 100% of landings were declared at species level. Even though EU nations should declare species-specific landings data for the main species, Denmark, Germany and Norway (Division 3.a and Subarea 4) had lower percentages of landings recorded to species levels, or did not declare any landings to species level. Whilst the Norwegian Reference Fleet provides some information on species composition, this cannot be regarded as representative of the whole Norwegian fishery.

Figure 15.3.2 shows the length–frequency of sampled Dutch skate and ray landings in 2016–2020.

15.4.2 Quality of data

The WG is of the opinion that analyses of data from market sampling and observer programmes can provide reliable data on the recent species composition of landings and discards, and such data should be used to validate and/or complement reported species-specific landings data.

From 2008 onwards, improved species-specific landings are available. Such data can be compared with market sampling and observer programmes to determine whether species identification has occurred correctly. The market sampling programme of the Dutch beam trawl fishery from 2000–2008 demonstrated that *R. montagui* and *R. clavata* are the most common species landed, followed by *R. brachyura* (Table 15.3.5 in ICES, 2020). Since the species-specific landings data were available (from 2008 onwards), it appears that the percentage of *R. montagui* has decreased in the Dutch landings (ICES, 2009b, 2010, 2011a, 2012, 2014) compared with 2000–2007.

It is likely that before 2008, misidentification has occurred (especially between *R. montagui* and *R. brachyura*). Misidentification probably affects most nations reporting these two species.

Data quality issues were addressed in more detail at WKSHARK2 (ICES, 2016), and some of the national data, submitted during the 2016 Data Call, were amended accordingly.

Landings of white skate *Rostroraja alba* and *R. microocellata* as reported by France in Subarea 4, Arctic skate *Amblyraja hyperborea* as reported by France in Subarea 4 and Division 7.d, and *D. oxyrinchus* as reported by the UK (England) in Division 7.d are likely the result of misidentifications or coding errors. Furthermore, landings of *L. circularis* reported by Belgium in Division 7.d are unlikely and are suspected to refer to *R. microocellata*, as both species are sometimes known locally as 'sandy ray'. Very low landings (39 kg) of *R. alba* were reported by UK (England) in Subarea 4 and Division 7.d, but the accuracy of this species identification remains unclear.

These examples demonstrate that more robust protocols for ensuring correct identification, both at sea and in the market, and quality assurance of landings data are still needed. The species-specific landings data indicate that some nations still report a considerable proportion of unidentified ray and skate landings or do not report species-specific landing data at all.

In 1981 France reported exceptionally high landings for Subarea 4 and Division 7.d. This is likely to be caused by misreporting. Misreporting may also have taken place in 2007 as a consequence of limited quota and the 25% bycatch limitation.

15.5 Commercial catch-effort data

There are no effort data specifically for North Sea skates and rays.

15.6 Fishery-independent surveys

Time-series of abundance and biomass indices for the most relevant species are available, based on North Sea IBTS, BTS, and CGFS-Q4 surveys. Data were extracted from the DATRAS database or supplied by national laboratories. A description of the surveys is given below. Additional information on all these surveys was collated during WKSKATE (ICES, 2021).

15.6.1 International Bottom Trawl Survey North Sea Q1 (IBTS-Q1) and Q3 (IBTS-Q3)

Fishery-independent data are available from the International Bottom Trawl Survey (IBTS), in winter (Q1) and summer (Q3). An overview of North Sea elasmobranchs based on survey data was presented in Daan *et al.* (2005), with further information collated during WKSKATE on all skates and rays encountered during these surveys (ICES, 2021).

Daan *et al.* (2005) also analysed the time-series of abundance for the major species caught for the period 1977–2004 (see Figure 12.3 of ICES, 2006). *A. radiata* appears to have increased from the late 1970s to the early 1980s, followed by a decline. The reasons for this decline are unknown, but could include changing environmental conditions, multi-species interactions (including with other skates), fishing impacts, or even improved species identification. The same patterns seem to apply to *L. naevus* and *R. montagui*, these species increase in the most recent ten years in the Q1 and Q3 surveys. The 'common skate complex' showed an overall decline, supporting the findings of ICES (2006). Since 2009 an increase of the 'common skate complex' has been observed (Figure 15.6.5). *R. clavata* has been stable, with one outlier in 1991 owing to a single exceptionally large catch (confirmed record), but shows an increasing trend in most recent years (Figure 15.6.3).

15.6.2 Channel groundfish survey

Martin *et al.* (2005) analysed data from the Channel Groundfish Survey (CGFS-Q4) and the Eastern Channel Beam Trawl Survey (UK (BTS-Q3)) for the years 1989–2004. Migratory patterns related to spawning and nursery areas were postulated, with the coast of southeast England an important habitat for *R. clavata*. Updated analyses for this survey were recently published by Martin *et al*. (2010, 2012). CGFS-Q4 continued in 2013, where high indices were noted for *R. clavata* and *R. undulata*. While most species fluctuate without clear trend, *R. clavata* has increased in the last ten years. Information on *R. undulata* is presented in Section 18, as the main part of the stock is considered to occur in Division 7.e. For further information see also WKSKATE report (ICES, 2021).

15.6.3 Beam trawl surveys

The UK beam trawl survey in quarter 3 (BTS-Eng-Q3) started in the late 1980s, although the survey grid was not standardized until 1993 (see Ellis *et al*., 2005a, b and Parker-Humphreys, 2005 for a description of the survey, ICES, 2021). The primary target species for the survey are commercial flatfish (plaice *Pleuronectes platessa* and sole *Solea solea*) and so most sampling effort occurs in relatively shallow water. *Raja brachyura*, *R. clavata*, *R. montagui* and *R. undulata* are all sampled during this survey.

The Dutch beam trawl survey in quarter 3 consists of two parts: the BTS-ISIS-Q3 started in the late 1980s, and the NL BTS Tridens or BTS-TRI-Q3 started in the 1990s. The primary target species for the survey are commercial flatfish (plaice and sole) the BTS ISIS fishes in the Southern North Sea, and the BTS Tridens fishes in the Southern and central North Sea. For more detailed information see also WKSKATE report (ICES, 2021).

The German beam trawl survey in quarter 3 (BTS-GFR-Q3) data are available since the late 2000s (ICES, 2021). Catch rates are generally lower than for the other BTS surveys, with the exception of *A. radiata*.

The Belgian beam trawl survey in quarter 3 (BTS-BEL-Q3) survey data have been uploaded to DATRAS for the following years 2010–2021. Historical data (prior to 2010) are being prepared for uploading to DATRAS. This North Sea survey is organized yearly at the end of August and beginning of September since 1985 on-board of the *RV* Belgica and covers an important area in the south-western part of the North Sea (i.e. Greater Thames estuary and the Wash). The most abundant skate species observed in the survey are thornback ray *Raja clavata* and spotted ray *Raja montagui*. Figure 15.6.8 shows the distribution plots for these species from all BTS surveys in the central-southern North Sea and shows that the highest concentrations (numbers per km^2) are covered by the Belgian BTS. Other elasmobranchs such as lesser-spotted dogfish (*Scyliorhinus canicula*) are caught in large numbers, while smooth-hounds *Mustelus sp.* and blonde ray *Raja brachyura* are also caught, though in smaller numbers. For more detailed information see also WKSKATE report (ICES, 2021).

15.6.4 Index calculations

All survey indices were updated in 2021 following methodologies described in WKSKATE (ICES, 2021), so values may differ from previous advice.

Survey data for the IBTS Q1 and Q3, as well as BTS-ISI-Q3, BTS-TRI-Q3 and BTS-GFR-Q3 were downloaded from DATRAS on 8 June 2021 as CPUE per length per haul. For the CGFS-Q4 and BTS-Eng-Q3, exchange data were downloaded from DATRAS, while the BTS-BEL-Q3 survey data refer to data held within the national database.

For IBTS and BTS, starting from the CPUE (in numbers per hour) per length per haul, indices were calculated for n. hr^{-1}, biomass hr^{-1}, and exploitable biomass h^{-1}. Data for exploitable biomass relate to individuals ≥50 cm total length. This was done by first combining observations for *Dipturus batis* (including for the junior synonym *Dipturus flossada*) and *Dipturus intermedius* as "common skate complex", and to split the observations for *Raja brachyura* for areas 4.a and 4.c. Only IBTS roundfish areas 1–7 were used when calculating indices for the IBTS-Q1 and IBTS-Q3. Data included in the calculations relate to successfully fished (valid) hauls.

Zero observations were added for all length-haul combinations. he average CPUE per length per ICES statistical was then calculated from the CPUE per length per haul. The CPUE per length per ICES statistical rectangle data was combined with the life history information to obtain CPUE per length per ICES statistical rectangle in numbers per hour and in weight per hour. These were summed across lengths to obtain the overall CPUE per ICES statistical rectangle (numbers and biomass).

For each survey, the annual index value was calculated for the mean catch rate by abundance (mean $n.h^{-1}$), total biomass (mean $kg.h^{-1}$) and exploitable biomass ($kg.h^{-1}$) with associated confidence intervals (95% CI). These values were obtained through the method of bootstrapping (1000 replicates) using 'boot' R package (Davison and Hinkley, 1997; Canty and Ripley, 2021). Input data were the total number (abundance), total biomass and exploitable biomass per statistical rectangle and year (including zero catches) thus, obtaining an annual mean value with a lower and upper confidence limit.

For the BTS-Eng-Q3, survey indices for the whole time series were updated following recommendations from WKSKATE (ICES, 2021). Additionally, calculations are now based on DATRAS exchange data as per ICES (2021) contrary to indices used in the 2019 assessments, with the latter previously described in Silva and Ellis (2019).

The CGFS-Q4indices were calculated using a swept area approach (km^{-2}) for the total abundance, total and exploitable biomass, following the methodology developed during WKSKATE (ICES, 2021). Catches in weight per haul were calculated using a length-weight relationship from McCully *et al.* (2012).

The abundance indices in n. h^{-1} for the different species are presented in tables 15.6.1–15.6.7. The biomass indices in $kg.h^{-1}$ are presented in tables 15.6.8–15.6.14. The exploitable biomass indices in $kg.h^{-1}$ are presented in tables 15.6.15–15.6.21. CGFS-Q4 results are per km^2 instead of per hour in all the tables. Important to note that while CGFS-Q4 2020 data are shown in this report, these should be viewed with caution as survey spatial coverage was reduced due to the lack of dispensation to fish in ICES rectangles 29F1 and 30E9.All indices including the 95% CIs are also given in figures 15.6.1–15.6.7.

In addition to estimating the indices, the annual mean length and range of the individuals caught in the surveys was calculated for the IBTS and BTS surveys (Figure 15.6.9). These can be used to detect possible species misidentifications.

Spatial distribution of the species in the North Sea was estimated by plotting the CPUE information for the IBTS and the BTS surveys in maps (Figure 15.6.10). CGFS-Q4 data were not included in the analysis. These maps were made for 6-year periods, so that changes in spatial distribution can be detected.

15.6.5 Other surveys

French surveys of coastal areas that aim to sample scallops and coastal fish nurseries and communities have bycatch of skates. These surveys include Comor (dedicated to monitoring scallop abundance in 7.d) NourSom (fish nurseries in the Baie de Somme) and NourSeine (fish nurseries in Baie de Seine).

As a part of the biological surveillance of the Penly nuclear power plant, IFREMER surveys the coastal area from Dieppe to the Baie de Somme. Since 1979, the sampling methodology has been standardized, using a stratified sampling scheme relying upon small meshed beam trawls. The surveys are conducted yearly in autumn and juvenile *Raja clavata* are commonly caught (mean length = 28.2 cm L_T; range = 15–45 cm L_T). Catches are mostly in the coastal area between Ault and Cayeux, which may be considered as a nursery ground for the species. Because this survey consists of a long time-series, it would be interesting to describe the evolution of their catches over the last 30 years (Tetard *et al.*, 2015). For more details, see Deschamps *et al.* (1981) and Schlaich *et al.* (2014).

15.7 Life-history information

Elasmobranchs are not routinely aged, although techniques for ageing are available (e.g. Walker, 1999; Serra-Pereira *et al*., 2005). Limited numbers of species have been aged in dedicated studies.

Updated length–weight conversion factors and lengths-at-maturity are available for nine skate species (McCully *et al*., 2012; Silva *et al.*, 2013). The length-weight conversions used for the calculations of the fisheries independent biomass indices are given in Table 15.7.1. Three species had conversion factors specific to the North Sea ecoregion, with the lengths at maturity for both sexes of *L. naevus*, and female *R. clavata*, being significantly smaller in the North Sea than the Celtic Seas ecoregion.

Demographic modelling requires more accurate life-history parameters, in terms of age or length and fecundity. For example, recent studies of the numbers of egg-cases laid by captive female *R. clavata* were 38–66 eggs over the course of the egg-laying season (Ellis, unpublished), whereas other studies using oocyte counts and the proportion of females carrying eggs have suggested that the fecundity may be >100.

15.7.1 Ecologically important habitats

Ecologically important habitats for the skates include (a) oviposition (egg-laying) sites (b) nursery grounds; (c) habitats of the rare species, as well as other sites where there can be large aggregations (e.g. for mating or feeding).

Little is known about the presence of egg-laying grounds, although parts of the southern North Sea (e.g. the Thames area) are known to have large numbers of juvenile *R. clavata* (Ellis *et al.*, 2005a) and egg-laying is thought to occur in both the inshore grounds of the Outer Thames estuary and the Wash.

Trawl surveys could provide useful information on catches of (viable) skate egg-cases. This recommendation has therefore been put into the offshore and inshore manuals of the trawl surveys (ICES, 2011b). The Netherlands already collects data on viable elasmobranch egg-cases.

Surveys may be able to provide information on the locations of nursery grounds and other juvenile habitats, and these should be further investigated to identify sites where there are large numbers of 0-groups and where these life-history stages are found on a regular basis.

Little is known about the habitats of the rare elasmobranch species, and further investigations on these are required (e.g. Martin *et al*., 2010; 2012; Ellis *et al*., 2012).

15.8 Exploratory assessment models

Given the lack of longer term species-specific data from commercial fleets and limited biological information, the status of North Sea skates and rays have been evaluated based on survey data, including historical information. Different methods have been explored to assess the stock status of several skate species. Early assessments methods as conducted under the DELASS project (Heessen, 2003) and the SPANdex approach were used to examine changes in abundance and distribution of the four main skate species in the North Sea (*A. radiata*, *L. naveus*, *R. clavata* and *R. montagui*). These have been extensively discussed in previous ICES reports (ICES, 2002 and 2007). Only more recent stock assessment developments are hereby presented. GAM analyses of survey trends

In 2016, a GAM analysis focused on *A. radiata* in the IBTS-Q1, IBTS-Q3 and BTS surveys (and also *Scyliorhinus canicula*; see Section 25). The length-based CPUE per haul for the period 1977–2016 were used as input data. These variables were used to predict CPUE in a GAM analysis (Wood, 2006). To estimate the total individuals per length class for the North Sea the predicted spatial distribution of mean CPUE (GAM-outcome) was combined with the swept areas for the NL BTS survey (with the highest catchability estimate in the analysis). The numbers per length were then converted to weights using data from McCully *et al.* (2012). Future work on these analyses could include converting the CPUE indices to numbers per unit area (density estimates) for all surveys (including IBTS), but it should be noted that different ground gears and sweep lengths can be used in some surveys, which may influence catchability.

15.8.1 Population model of starry ray in the North Sea

A minimum population size estimate of starry ray was calculated as part of a request of the Dutch MSC certified trawl fisheries targeting plaice and sole to analyse the impact of these fisheries on the starry ray population (van Overzee *et al.*, 2019).

Data from the IBTS and BTS surveys were downloaded from DATRAS exchange data. Information per haul on numbers caught by length (cm) and tow duration enabled to obtain the total numbers recorded in each haul.

The total number per haul were modelled as a function of year, surface area, survey, and depth, with a spatial or spatio-temporal correlation structure using the statistical package Intergrated Nested Laplace Approximation (INLA) (Rue *et al.*, 2009). This package has the advantage that it can combine, amongst others, spatial and temporal models into one. Detailed information on the model can be found in van Overzee *et al.*, 2019.

The population model shows an increase in the estimated total stock weight in the eighties and early nineties with an estimated stock biomass at 128 667 t. Halfway the nineties and onwards the stock severely declines and stock biomass was estimated to be below 30 000 t since 2010 (Figure 15.8.1). This trend corresponds with ICES assessments conducted by WGEF. It must be noted that the results of this study concern a minimum estimate of the starry population size as the model assumes a catchability of 1, i.e. we assume all fish encountered by the fishing gear are caught.

15.8.2 Exploratory assessment of thornback ray in the eastern English Channel

An exploratory assessment of *R. clavata* in the eastern Channel (Division 7.d) was made using a Bayesian production model, fitted to total catch and survey biomass indices (Marandel *et al.*, 2016). The modelling is applied here to the eastern Channel only, and therefore not to the stock unit considered for advice. This modelling approach suggests that the biomass has been increasing since the 1990s (ICES, 2017). However, the results are conditioned by strong assumptions, in particular the assumed constant intrinsic population growth rate, which may not be true as seen for spurdog *Squalus acanthias* where a clear density dependence in stock fecundity has been observed.

15.8.3 Data limited stock assessment methods applied to North Sea and English Channel

In 2020, two different production models were explored for *Raja clavata*, *Raja montagui* and *Raja brachyura* (Amelot *et al.*, 2021). First, a Surplus Production Model in Continuous Time (SPiCT, Pedersen and Berg, 2017) and a second, a State Space Bayesian Model (SSBM, Marandel *et al.*, 2019). Landings data before 2009 were based on FAO data, no discards data were available for this period. Landings and discards data from 2009–2018 were extracted from WGEF landing and discard tables. Multiple regression was applied to discard data to obtain an effort (time spent at sea) elevation by fleet and species. Abundance indices have been revised, to obtain for all species biomass indices based on CGFS-Q4, BTS and IBTS data. The mean biomass per swept area, species, year survey and statistical rectangle were calculated. Details on the model settings are described in Amelot *et al.* (2021).

For the SSBM, four scenarios were run:

1. A full discard scenario making the hypothesis that discard did correspond to the same ratio of landing before 2009 than after.
2. A 50% discard scenario, making the hypothesis that before 2009 the amount of discard was reduce by half because the TAC was less restrictive compared to recent years.
3. A short time series scenario using only species-specific data from 2009 to 2018
4. A non-depleted hypothesis scenario with an initial biomass (relative to B_{MSY}) up to 0.5 in 1990 instead of 0.3.

Model outputs from SSBM and SPiCT tends to follow the same biomass trajectories. However, SPiCT produces a broader standard error than the SSBM 95% posterior distribution. Initial biomass in 1990 has been estimated to be under 0.5 of the biomass at MSY for all species. The biomass is increasing for all species, even if these stocks' rebuilding dynamics are not going at the same speed. *Raja clavata* present the fastest increase with a final biomass in 2018 of 0.68 B_{MSY} (SPiCT) and 1.02 B_{MSY} (SSBM). The relative biomass for both *Raja brachyura* and *Raja montagui* is larger in the SPiCT analysis compared to the biomass obtained from the SSBM. This could be caused by an underestimation of the carrying capacity by SPiCT compared to the SSBM.

Overall, in both models none of the species are currently exploited above the estimated MSY, when considering landings or the total estimated catches. It should be noted, though, that these models are exploratory models and include assumptions and data which need further exploration and evaluation. In particular, discard data which represent up to half of the total catch for some of the species. Discard values should be improved and standardised for future stock assessments and potential benchmark concerning these stocks.

15.9 Stock assessment

Assessment of the North Sea skate and ray species follow the ICES procedure for data-limited stocks (see Section 15.2.3). The assessments were updated in 2021 for four category 3 stocks based on survey trends (rjc.27.3a47d, rjh.27.4c7d, rjm.27.3a47d, rjn.27.3a4), one category 5 based on landings (rjh.27.4a6), and one category 6 (raj.27.3a47d).

The remaining stocks within this ecoregion are due in 2023, with these being rjr.27.23a4 (category 3) and rjb.27.3a4 (category 6). During the ICES Workshop on the use of surveys for stock assessment and Reference Points for Rays and Skates (WKSKATE; ICES, 2021) the basis of advice from data available to methodology were examined in order to standardize the assessment and the stock size indicators estimation. During this workshop, the group examined stock assessments using different surveys, and different methods for combining surveys. Extensive discussions were undertaken on swept area indices and the raising methodology to either geographical area covered by an individual survey, to the stock unit, to ICES Division. Methods for deciding how and whether surveys should be used were agreed during the meeting (ICES, 2021).

The following outcomes of WKSKATE have been applied to the North Sea stock assessments in 2021:

- The IBTS-Q1 and IBTS-Q3 are to be aggregated by averaging the indices in a given year, prior to normalizing the indices over their long-term mean.
- *Leucoraja naevus* in 3.a and 4. It was considered that the IBTS-Q1 and IBTS-Q3 surveys should be used as the basis for the Category 3 assessment.
- *Raja clavata* in 3.a, 4 and 7.d. The surveys with a good spatial coverage of the stock unit are the four surveys used in the 2019 assessment (IBTS-Q1, IBTS-Q3, BTS-Eng-Q3 and CGFS-Q4). The BTS-Bel-Q3 was added as a fifth survey given it also covers parts of the stock unit in both 4.c and 7.d. The stock size indicator is therefore based on five surveys and based on exploitable biomass.
- *Raja montagui* in 3.a, 4 and 7.d. It was considered that the IBTS-Q1 and IBTS-Q3 surveys should be the only surveys used in the 2021 assessment. Whilst BTS-Eng-Q3 would cover part of the stock unit in 7.d and was used in the 2019 assessment, given that the stock size indicator is based on exploitable biomass (individuals ≥50 cm total length), data for this survey were deemed too limited to be used in the assessment. Thus, stock size indicator in the 2021 assessment refer only to surveys covering Subarea 4.
- *Raja brachyura* in 6 and 4.a. This species is not sampled effectively in many trawl surveys. Whilst the current surveys are unlikely to provide stock-size indicators that would be sufficiently robust to support Category 3 assessments and ICES advice on fishing opportunities, further work should be undertaken. Available trawl survey data should be examined with a view to providing alternative metrics that may help inform a more qualitative perception of stock status.
- *Raja brachyura* in 4.c and 7.d. The CGFS-Q4 is currently used in the assessment and, whilst there is a clear sign of improving status in recent years, catch rates are variable. Catch rates of *R. brachyura* in IBTS-Q1 and IBTS-Q3 show a similar recent increase, but the underlying data are highly variable, with a large number of zero hauls recorded. Further studies to develop more robust indices for this stock are required.

15.10 Quality of assessments

Analyses of survey data for *R. clavata* undertaken by ICES (2002; 2005) may have been compromised by misidentifications in submitted IBTS data, and so the extent of the decline in distribution reported in these reports may be exaggerated. The distribution of *R. clavata* in the southern North Sea has certainly contracted to the south-western North Sea, and they are now rare in the south-eastern North Sea, where they previously occurred (as indicated by historical surveys). The perceived decline in catches in the north-eastern North Sea may have been based, at least in part, on catches of *A. radiata*. Excluding questionable records from analyses still indicates that the area occupied by *R. clavata* has declined, with the stock concentrated in the south-western North Sea, with catch trends in Division 4.c more stable/increasing in recent times (ICES, 2017).

Previous issues encountered during the 2019 WG for BTS-Eng-Q3 and CGFS-Q4 have since been resolved (ICES, 2019), with new indices produced for both surveys following methodology developed during WKSKATE (ICES, 2021). Whilst the results may differ from previous assessment in 2019 these do not change the perception of stock status.

While the use of a swept area approach for *R. clavata* was agreed at WKSKATE (ICES, 2021), the group decided further development of swept area indices is required. During the meeting a subgroup convened to discuss data quality issues relating to swept area (i.e. width of the gear and distance travelled) as well as most appropriate approaches to raising swept area estimates. The group decided more work is needed and is to be coordinated intersessionally before WGEF is to apply the swept area approach. Nevertheless, future assessments of *R. clavata* or other stocks (e.g. spotted ray (*R. montagui*) in Subarea 4 and in Divisions 3.a and 7.d) for which this approach may be relevant should consider the use of swept-area indices.

Note that for the CGFS-Q4 survey, the 2020 sampling was restricted to French waters, with the ICES rectangles 29F1 and 30E9 not sampled thus, the values derived for 2020 were deemed not representative and were not considered in the assessment. Therefore, the missing data approach for category 3 and 4 stocks was applied, where only data up to 2019 are included in the combined stock size indicator. A 2 over 5 ratio was still applied. For the skate stocks, where the CGFS-Q4 was the only available survey (e.g. rjh.27.4c7d), the ratio was calculated considering 2020 was missing. This meant that the last 2-year average would be based on the one available estimate for 2019.

15.11 Reference points

No reference points have been proposed for *R. clavata* or other skate stocks in this ecoregion.

15.12 Conservation considerations

Both members of the 'common skate complex' are considered 'Critically Endangered by the IUCN, and '*D. batis*', *R. montagui*, and *R. clavata* are all on the OSPAR list of Threatened and Declining species. However, WKSTATUS considered that both *R. montagui* and *R. clavata* do not continue to justify inclusion in the OSPAR list (ICES, 2020).

Various elasmobranchs are contained in the Swedish Red List (Gärdenfors, 2010), with *R. lintea* considered Near Threatened, *R. clavata* and rabbit fish *Chimaera monstrosa* considered Endangered, and '*D. batis*' considered Regionally Extirpated.

The Norwegian Red List (Gjøsæter *et al*., 2010) includes various skates. '*D. batis*' (complex) is considered Critically Endangered, and *B. spinicauda*, *D. nidarosiensis* and *L. fullonica* are all considered Near Threatened.

15.13 Management considerations

Skates are usually caught in mixed fisheries for demersal teleosts, although some inshore longline and gillnet fisheries target *R. clavata* in seasonal fisheries in the south-western North Sea. *Raja brachyura* may be locally and seasonally important for some inshore fisheries.

Up to 2008, skates were traditionally landed and reported in mixed categories such as "skates and rays". For assessment purposes, species-specific landings data are essential. Species-specific reporting for the main skate species has been required since 2008. An increasing proportion of skate landings are now reported to species and, whilst there are some inconsistencies, the overall proportions broadly correspond with what would be expected, given survey information.

Nevertheless, some doubt exists as to the quality of some of the data provided, particularly the distinction between *R. montagui* and *R. brachyura.* Continued species-specific reporting is required, and further scientific sampling of commercial catches (to validate species-specific landings) and training are required.

A TAC for skates was first established for Union waters of Division 2.a and Subarea 4 (combined) in 2009. Since 2009, there have been three separate TAC areas in this ecoregion: Union waters of Division 2.a and Subarea 4 (combined); Division 3.a; and Division 7.d.

Landings have been at or above the TAC since 2006 (but slightly above in Division 7.d, possibly due to transfer between 7.d and 7.e) (Figure 15.3.1) and may now be restrictive for some fisheries. Since its introduction, the TAC has gradually been reduced, which may have induced regulatory discarding. In recent years (2016–2020), the TAC has increased slightly.

At-vessel mortality is low for inshore trawlers in the south-western North Sea, as tow duration tends to be relatively short and longline fisheries also have low at-vessel mortality (Ellis *et al.*, 2008a, b, 2018). At-vessel mortality in gillnets may also be low, depending on soak-time. A study on survival from beam trawlers indicated survival of >70% for skates (Depestele *et al.*, 2014). Discard survival probability varies significantly according to species and gear combination and ranged between 27%86%. Fish condition, individual length and sorting time strongly affected both short and medium-term survival (Van Bogaert *et al.*, 2020). In pulse-trawlers the long-term discard survival probability for thornback ray was estimated to be 53% (Schram and Molenaar, 2018).

Effort restrictions and high fuel prices have resulted in reduced effort, but can also result in using different gears with different catchabilities for skates. Also, some fisheries may redirect effort to fishing grounds closer to port, which may affect more coastal species, such as *R. clavata* in the Thames estuary and in the Wash in the south-western North Sea.

Current TAC regulations have a condition so that "*up to 5%* [of the TAC for Union waters of 6.a-b, 7.a–c and 7.e–k] *may be fished in Union waters of 7.d*". Whilst it is pragmatic allowing vessels in the English Channel (7.d–e) to transfer quota between these divisions, further studies to examine the implications of this needs to be evaluated. For example, 5% of the overall 2014 quota for 6.a-b, 7.a–c and 7.e–k (8032 t) is 401.6 t, which is more than half of the 2014 TAC for 7.d (798 t). Whilst this is a theoretical maximum and unlikely to be realised, further studies of this issue are required.

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Table 15.3.1. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Total landings of skates (Rajidae) in ICES Division 3.a (in tonnes). Note blank = no data reported; that "0" indicates landings <0.5. Data from 2005 onwards from the 2016–2022 Data Call.

Year	DK	DE	NL	NOR	SE	Total
1999	11			208	2	221
2000	41			123	2	166
2001	56			154	12	222
2002	22			159	13	194
2003	36			163	9	208
2004	129			85	20	234
2005	65	0		94	10	170
2006	25	0.5	0	51	18	95
2007	8	0	0	13	11	33
2008	4	0		23	6	33
2009	12			33	2	47
2010	12			24	10	45
2011	43	0		25	3	71
2012	16	0		28	3	47^
2013	18	0		50	6	74^
2014	14	0		39	3	56
2015	27	0	0	32		60
2016	40		0	50	0	90
2017	72	0		55	0	128
2018	157	0	0	52	0	209
2019	122		0	34	2	159
2020	108		2	31	0	141
2021	122		0.8	41	0	164

^ Data revised in 2021.

Table 15.3.2. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Total landings of skates (Rajidae) in ICES Subarea 4 (in tonnes). Note: blank = no data reported; "0" indicates landings <0.5. Data from 2005 onwards from the 2016–2021 Data Call. Data include accepted lower quantities of landings for *Raja microocellata* and *Raja undulata* declared by Member States in 4.c.

Year	BEL	DK	FRA	DE	NLD	NOR	SE	GBR	Total
1999	336	45	41	16	515	152		1583	2688
2000	332	93	31	23	693	161		1376	2709
2001	370	65	61	11	834	173		1298	2812
2002	436	34	62	22	805	83		1353	2794
2003	323	33	36	21	686	113		1278	2490
2004	276	25	37	17	561	77		1062	2055
2005	350	25	60	28	493	87	0	833	1876
2006	346	28	77	16	530	98	0	732	1826
2007	261	29	66	17	659	71	0	704	1807
2008	387	24	72	29	506	97	0	762	1878
2009	303	30	80^	22	379	121	0	666^	1601^
2010	310	30	100^	32	390	105	0	662	1631^
2011	237^	38	60^	19	212	56	0.5	788	1410^
2012	188^	21	48	17	431	69	0	662	1436^
2013	214^	45	53	25	312	74	0	804	1526^
2014	199^	44	52	32	225	88	0	778	1419^
2015	246^	40	22	25	274	62		666	1335^
2016	184^	41^	39	50	281	69	0	664^	1328^
2017	176	40^	38	42	287	91	0	700	1373^
2018	178	56^	38	55	363	118	0	809	1617
2019	148	70^	47	53	320	128	0	768	1535
2020	95	34	57	52	372	106	0	496	1211^
2021	114	72	30	12	321	72		674	1296

^ Data revised in 2021.

Table 15.3.3. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Total landings of skates (Rajidae) in ICES Division 7.d (in tonnes). Note: blank = no data reported; "0" indicates landings <0.5. Data from 2005 onwards from the 2016–2021 Data Call. Data include landings of *Raja microocellata* and *Raja undulata* declared by Member States in 7.d.

Year	BEL	FRA	IRL	NLD	UK	Total
1999	93	558			437	1088
2000	69	693			355	1117
2001	79	729			169	977
2002	113	725			140	978
2003	153	796			186	1135
2004	96	695			157	948
2005	100	940	0	9	144	1193
2006	113	738		12	144	1007
2007	158	926		18	204	1305
2008	171	880		12	209	1272
2009	119	1185		10	164	1478
2010	107	960		10^	139	1216
2011	106	956		12	151	1225
2012	105	1040		14	172	1331
2013	131	1065		4	193	1392
2014	112	1060		6	193	1371
2015	115	868		3	146	1132
2016	136	941		8	200	1285
2017	141	924		9	236	1310
2018	166	1186^		25	301	1677
2019	183	1295		31	308	1817
2020	207	1302		43	311	1863
2021	220	1304	2	33	313	1871

^ Data revised in 2021.

Table 15.3.4. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Landings per stock and country in the North Seas ecoregion (Subarea 4 and divisions 3.a and 7.d) (in tonnes). Note: blank = no data reported; "0" indicates landings <0.5; ^ data revised in 2021

Raj.27.3a47d										
Year	BEL	DE	DK	FRA	GBR	IRL	NLD	NOR	SE	Total
2005	450.1	28.3	90.0	754.9	977.2	0.1	501.5	180.2	10.4	2992.7
2006	458.4	16.6	53.0	675.1	876.2		541.8	149.2	17.7	2788.0
2007	417.2	17.6	37.0	735.4	907.8		677.1	84.3	11.2	2887.5
2008	186.5	29.3	28.0	806.7	720.9		66.4	119.6	6.4	1963.9
2009	128.0	22.1	40.0	578.1	412.9		4.5	153.6	2.0	1341.2
2010	137.3	32.4	39.0	444.7	210.1		5.2	123.0	9.5	1001.2
2011	93.5	19.0	77.0	378.7	144.3		5.8	80.0	2.8	801.1
2012	50.9	16.8	37.0	248.9	107.5		25.3	95.2	1.6	583.0
2013	15.9	25.1	60.0	107.1	99.0		12.1	120.4	4.2	443.8
2014	25.1	32.2	49.0	40.5	81.5		9.5	126	3.2	366.9
2015	31.3	25.1	62.6	17.5	33.2		5.8	94.7		270.4
2016	39.6	11.7	74.8	19.9	27.6		2.4	119.1	0	295.1
2017	35.9	8.4	88.2	25.6	32.2		1.8	146.0	^	338.2^
2018	4.3	9.8^	169.8	21.0^	31.2			169.4		405.5^
2019	0.7	2.6	117.3	9.7	46.1			162.3	2.6	341.4
2020	1.1	0.2	76.1	10.0	19.1			137.1	0.4	244.0
2021	5.8	0	148.1	13.9	30.5			112.3	0	310.7

rjb.27.3a4								
Year	BEL	DE	DK	FRA	GBR	NLD	SE	Total
2005				0.7				0.7
2006				0.1			0.4	0.5
2007				0.1			0	0.1
2008	0			0.2	0.5	0		0.8
2009			2.0	0.2	7.0			9.2
2010	0		2.0	0.5	0.7		0.5	3.7
2011			1.0	0.1	4.2	0	0.7	6.0
2012					1.8	0.5	1.4	3.7
2013				0.0	1.0		1.9	2.9
2014				0.0	0.3			0.3
2015			0.7		0.3			1.0
2016			2.0		0.3	0	0	2.4
2017			15.7	0.1	0.7	0	0	16.5
2018	0		25.3		0.4^	0.5		26.0
2019			14.8		0	0.2	0	15.1
2020		0	7.3		0.7	0.5	0	8.6
2021			5.1		0	0.1		5.2

rjc.27.3a47d										
Year	**BEL**	**DE**	**DK**	**FRA**	**GBR**	**IRL**	**NLD**	**NOR**	**SE**	**Total**
2005				196.4	0			0.8		197.2
2006				107.8					0	107.9
2007	0.6			155.3	0				0	155.9
2008	214.2			90.1	208.9		196.6	0.0		709.7
2009	153.9			461.9	334.9		178.1			1128.8
2010	175.6		1.0	541.1	409.1		203.2	5.9		1335.8
2011	163.9		1.0	533.8	485.2		97.0	0.5	0	1281.6
2012	154.3			769.0	477.5		186.4	2.0	0	1589.2
2013	200.7		2.0	940.5	572.7		149.0	3.3		1868.3
2014	205.9		8.0	988.6	570.8		130.8	1.2		1905.3
2015	219.1		3.7	814.2	447.3		160.6			1644.8
2016	195.8	33.8	2.7	890.5	518.0		185.2		0	1825.9^
2017	173.5	27.3	1.1	829.3	595.9		162.7		0^	1790^
2018	193.3	33.0	1.7	1117.1	663.8		211.3^		0	2220.4^
2019	192.2	36.9	0.1	1190.8	589.4		194.1		0	2203.5
2020	169.1	41.5	3.7	1237.1	488.4		282.7			2222.6
2021	168.4	10.4	18.7	1239.4	561.7	1.7	230.9			2231.2

rjm.27.3a47d							
Year	**BEL**	**DE**	**DK**	**FRA**	**GBR**	**NLD**	**Total**
2005				41.9	0.0		41.9
2006				25.9			25.9
2007	0.1			93.4	0.0		93.5
2008	38.7			46.2	9.4	240.4	334.7
2009	34.6			127.8	28.3	199.7	390.3
2010	35.1			32.2	56.2	182.3	305.8
2011	31.2			30.8	93.2	108.0	263.2
2012	10.0			25.5	82.2	180.0	297.7
2013	11.6			28.2	127.1	119.4	286.2
2014	4.3		1.0	35.7	106.7	66.4	214
2015	9.4		0.1	15.2	123.6	76.9	225.3
2016	9.9	4.1		15.7	117.2	76.3	223.2
2017	15.4	5.9		36.8	113.7	87.4	259.2
2018	27.1	10.8		16.0	188.6	112.5	356^
2019	40.9	12.5	0.1	22.5	174.3	92.6	342.8
2020	17.0	9.7	0.6	25.2	35.6	86.8	174.9
2021	39.8	1.8	7.7	14.7	137.2	71.6	272.8

rjh.27.4c7d							
Year	BEL	DE	DK	FRA	GBR	IRL	NLD	Total
2005								
2006								
2007	0.2							0.2
2008	115.8				22.4		14.6	152.8
2009	104.3			12.9	35.1		5.9	158.2
2010	63.1			20.9	38.9		9.9	132.8
2011	45.5			26.9	58.5		12.8	143.6
2012	72.4			22.7	45.3		53.1	193.6
2013	109.1			23.9	70.6		35.7	239.4
2014	69.3			30.4	57.4		24.3	181.4
2015	90.2			30.9	36.1		33.8	191.1
2016	65.2	0		35.6	21.6		24.8	147.3
2017	75.1	0		50.2	29.4		43.9	198.6
2018	107.8	0		46.3	32.3		64.6	251.2
2019	83.4	1		75	27.6		64.8	251.8
2020	101.1	0		59.5	33.3		46.4	240.8
2021	119.3	0		45.7	56.2	0	52.4	274.0

rjh.27.4a6						
Year	BEL	DK	ES	FRA	GBR	IRL*	Total
2005							
2006							
2007							
2008					6.8		6.8
2009	0		0	0.9	5.2	0	6.4
2010	0				6.7	3.7	10.4
2011					16.6	0.9	17.5
2012					4.0	1.4	5.4
2013					0.5	23.6	24.1
2014				0.6	0.7	8.6	10.0
2015		0		0.8	3.4	9.3	13.6
2016				0.6	2.3	10.9	13.8
2017				0	1.1	5.4	6.8
2018				1.2	2.8	23.0	27.0
2019				0.8^	1.5^	33.2	35.4^
2020	0			0.6	0	20.4	21.5
2021		0		0	0.7	13.6	14.7

***Landings of Ireland are declared coming out of Subarea 6.**

rjn.27.3a4							
Year	BEL	DE	DK	FRA	GBR	NLD	Total
2005							
2006							
2007							
2008	2.5			0	0	0	3.3
2009	1.0			1.1	4.6	0	7.1
2010	3.7			1.0	81.2	0	86.3
2011	5.0		2.0	1.0	143.1		151.1
2012	1.1			0.5	115.5		117.1
2013	0.6		1.0	0	122.6	0	124.4
2014	0.5			0	151.7	0	152.5
2015	3.1		0	0	169.0		172.5
2016	0		1.4	0	167.6	0	169.7
2017	0		7.4	0	154.3		162.4
2018	0		14.6	0	179.6		194.5
2019	0		56.8	1.1	201.6		259.7
2020	0		53.8	0	176.1		230.5
2021			14.7	0	167.6		182.4

rjr.27.23a4								
Year	BEL	DE	DK	FRA	GBR	NLD	SE	Total
2005								
2006								
2007								
2008	0							0.1
2009					0			0.1
2010					0			0
2011				1.2			0	1.3
2012					0	0		0.3
2013				0	0			0
2014	0			0	0			0
2015				0				0
2016				0				0
2017			0	0				0.1
2018		0	1.1	0.9	0			2.4
2019			2.6	0.6	0			3.2
2020				1.2	0	0.1		1.3
2021		0		1.5			0	1.6

Table 15.3.5 Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Discards per stock and country in the North Seas ecoregion (Subarea 4 and divisions 3.a and 7.d) (in tonnes). "0" indicates discards <0.5. Values to be viewed with caution as further QA/QC procedures still required prior to use in assessment (see Section 15.3.2).

raj.27.3a47d										
Year	**BEL**	**DE**	**DK**	**FRA**	**GBR**	**IRL**	**NLD**	**NOR**	**SE**	**Total**
2009										
2010										
2011										
2012										
2013										
2014			0							0
2015										
2016				778						778
2017				827						827
2018			8.0						4.5	12.6
2019			10.9						1.7	12.5
2020			2.4							2.4^
2021			3.5						14.8	18.2

^Data revised in 2022

rjb.27.3a4								
Year	**BEL**	**DE**	**DK**	**FRA**	**GBR**	**NLD**	**SE**	**Total**
2009			18.3					18.3
2010			13.3					13.3
2011			28.9					28.9
2012			100.7					100.7
2013			34.8					34.8
2014			1.6					1.6
2015			4.4					4.4
2016			8.2					8.2
2017			2.3					2.3
2018			15.3				0.6	15.9
2019			2.7				1.9	4.6
2020			5.2					5.2
2021			2.1					2.1

rjc.27.3a47d									
Year	**BEL**	**DE**	**DK**	**FRA**	**GBR**	**NLD**	**NOR**	**SE**	**Total**
2009					89.9				89.9
2010					446.4				446.4
2011			1.4	78.2	423.8	249.6			753.0
2012			1.6	128.3	199.1	187.2			516.2
2013	139.5		2.1	265.6	175.5	110.2			692.8
2014	238.7		1.6	62.9	153.5	289.6			746.2
2015	185.4		22.1	313.0	227.1	214.1			961.8
2016	143.2	5.3	21.0	402.3	156.5	165.0			893.3
2017	243.4		6.4	429.2	291.4	526.9			1497.2
2018	119.6	35.9	9.9	282.7	60.5	329.3		15.0	852.8
2019	228.9	32.7	8.3	391.4	440.2	578.6		12.9	1692.9
2020	191.5	9.9	38.2	507.9	85.7	417.6			1250.8
2021	318.8	8.8	17.0	265.5	115.4	730.3			1455.8

rjm.27.3a47d							
Year	**BEL**	**DE**	**DK**	**FRA**	**GBR**	**NLD**	**Total**
2009					10.9		10.9
2010					283.4		283.4
2011				17.6	7.0	364.2	388.9
2012				0	3.5	274.1	277.9
2013	7.6			2.4	17.6	290.2	317.9
2014	2.3			16.2	12.1	386.5	417.1
2015	4.7			10.1	42.5	282.9	340.2
2016	10.9			4.2	181.5	422.5	619.1
2017	14.0	0		33.2		935.1	982.3
2018	45.7	59.3	1.0	302.4	15.3	780.1	1203.8
2019	20.9	90.1	0.9	22.4	6.0	415.8	556.1
2020	43.0	32.4	0.6	12.7	8.7	457.8	555.1
2021	59.6	47.4	0.5	0	11.8	826.3	945.7

rjh.27.4c7d							
Year	BEL	DE	DK	FRA	GBR	NLD	Total
2009					5.6		5.6
2010					35.3		35.3
2011				5.4	0.5	252.7	258.7
2012			0	7.9	64.6	22.3	94.7
2013	16.9			3.8	5.4	18.7	44.9
2014	22.2			14.8	33.9	36.6	107.6
2015	43.7			9.5	3.2	91.8	148.2
2016	44.9		0	8.0	11.6	31.5	96.1
2017	25.1			20.0		191.5	236.6
2018	28.5			18.4		168.1	215.0
2019	28.0			12.3		207.6	247.9
2020	36.6				0	46.5	83.1
2021	24.6			2.5	0.9	75.0	103.1

rjh.27.4a6							
Year	BEL	DK	ES	FRA	GBR	IRL	Total
2009						4.2	4.2
2010						2.2	2.2
2011						2.4	2.4
2012						0	0
2013						5.7	5.7
2014						0.6	0.6
2015						0.9	0.9
2016							
2017						0	0
2018		0				3.6	3.8
2019						0.5	0.5
2020						0.6	0.6
2021						0.6	0.6

rjn.27.3a4								
Year	**BEL**	**DE**	**DK**	**FRA**	**GBR**	**NLD**	**SE**	**Total**
2009			0		11.1			11.6
2010					1.3			1.3
2011			0		5.6			5.8
2012					11.1	36.3		47.3
2013	0				5.3			5.6
2014	0		0.9		25.7	4.3		31.0
2015			1.2		22.7			23.9
2016	0		3.6		1.9	1.2		7.0
2017	1.0		0.8	7.2				8.9
2018			12.6	15.7	1.5	7.1	0	37.2
2019	0		7.2	269.6	1.9			278.9
2020			0	12.0	218.1			230.1
2021			6.5		159.8			166.3

rjr.27.23a4								
Year	**BEL**	**DE**	**DK**	**FRA**	**GBR**	**NLD**	**SE**	**Total**
2009			3245.4					3245.4
2010			2453.7					2453.7
2011			3612.0					3612.0
2012			3548.8					3548.8
2013			1083.3					1083.3
2014			1767.3					1767.3
2015			2979.6					2979.6
2016			1317.3					1317.3
2017			1017.1	1.3		139.0		1157.4
2018			488.8	4.7		92.7	95.8	682.0
2019			622.6			66.6	122.6	811.7
2020			420.3		609	85.5		1114.9
2021			363.8			29.6^	34.0	427.4

^ Discard data available for beam trawls only due to sampling coverage, while previous years for NLD have been available for both beam trawls and other bottom trawls.

Table 15.6.1. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Time-series of abundance estimates (n.h^{-1}) for *Amblyraja radiata* (all individuals). Information obtained from IBTS-Q1, IBTS-Q3 (roundfish areas 1–7) and several BTS surveys in the period 1987–2020. Data extracted from DATRAS. Time-series updated in 2021.

Year	IBTS-Q1	IBTS-Q3	BTS-ISI-Q3	BTS-TRI-Q3	BTS-GFR-Q3
1987	7.095	NA	NA	NA	NA
1988	2.670	NA	0.621	NA	NA
1989	6.612	NA	0.382	NA	NA
1990	4.891	NA	1.472	NA	NA
1991	4.171	9.449	0.447	NA	NA
1992	7.528	2.463	0.184	NA	NA
1993	12.232	1.773	0.053	NA	1.322
1994	3.913	1.994	0.045	NA	7.743
1995	8.526	1.930	0.188	NA	1.325
1996	7.111	2.227	0.118	20.452	NA
1997	5.518	1.822	0.000	16.279	11.542
1998	5.692	2.180	0.000	23.308	0.898
1999	6.473	3.134	0.143	34.191	15.780
2000	7.914	3.215	0.000	34.000	NA
2001	11.358	6.520	0.037	21.217	17.531
2002	4.353	3.307	0.031	25.459	0.865
2003	4.543	3.722	0.067	18.972	0.517
2004	3.795	2.143	0.071	20.762	0.375
2005	4.022	2.270	0.303	19.343	0.098
2006	1.992	2.499	0.179	13.729	NA
2007	3.180	3.794	0.000	14.557	17.412
2008	2.521	2.646	NA	15.174	15.396
2009	0.982	2.967	0.897	14.759	10.693
2010	0.945	1.939	0.000	15.479	9.950
2011	1.012	2.435	0.000	13.842	8.783
2012	1.502	2.014	0.091	13.239	18.278
2013	0.684	1.367	0.069	13.379	13.372
2014	1.088	1.630	0.817	12.298	1.462
2015	1.605	2.223	0.172	10.101	9.518
2016	1.137	2.059	0.469	8.315	11.737
2017	1.255	1.453	NA	4.059	8.463
2018	0.326	1.528	NA	4.293	6.158
2019	0.564	1.238	NA	6.184	5.250
2020	0.272	1.119	NA	5.531	6.240
2021	0.352	0.306	NA	12.218	16.168

Table 15.6.2. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Time-series of abundance estimates (n.h^{-1}) for *Leucoraja naevus* (all individuals). Information obtained from IBTS-Q1, IBTS-Q3 (roundfish areas 1–7) and several BTS surveys in the period 1987–2020. Data extracted from DATRAS. Time-series updated in 2021.

Year	IBTS-Q1	IBTS-Q3	BTS-ISI-Q3	BTS-TRI2-Q3
1987	0.131	NA	NA	NA
1988	0.526	NA	0.035	NA
1989	0.550	NA	0.000	NA
1990	0.575	NA	0.000	NA
1991	0.549	0.316	0.000	NA
1992	0.764	0.439	0.000	NA
1993	0.903	0.144	0.000	NA
1994	0.586	0.186	0.000	NA
1995	0.611	0.138	0.000	NA
1996	0.499	0.157	0.000	0.905
1997	0.262	0.235	0.000	1.302
1998	0.478	0.113	0.000	3.115
1999	0.398	0.436	0.000	3.841
2000	0.556	0.371	0.000	2.169
2001	0.332	0.589	0.000	1.478
2002	0.449	0.428	0.000	2.840
2003	0.278	0.373	0.000	3.015
2004	0.306	0.362	0.000	0.972
2005	0.308	0.433	0.000	1.659
2006	0.397	0.535	0.000	1.420
2007	0.487	0.367	0.000	2.507
2008	0.420	0.795	NA	4.400
2009	0.401	0.700	0.000	2.013
2010	0.459	0.855	0.000	0.576
2011	0.489	0.798	0.000	0.958
2012	0.464	0.920	0.000	1.013
2013	0.804	0.623	0.000	1.220
2014	0.525	0.486	0.000	1.465
2015	0.911	0.543	0.000	0.702
2016	0.545	0.541	0.000	1.333
2017	0.891	0.770	NA	1.772
2018	0.393	0.744	NA	1.827
2019	0.508	0.578	NA	1.606
2020	0.364	0.461	NA	1.615
2021	0.527	0.309	NA	1.541

Table 15.6.3. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Time-series of abundance estimates (n.h^{-1}) for 'common skate complex' (all individuals). Information obtained from IBTS-Q1, IBTS-Q3 (roundfish areas 1–7) and BTS-TRI-Q3 in the period 1987–2020. Data extracted from DATRAS. Time-series updated in 2021.

Year	IBTS-Q1	IBTS-Q3	BTS-TRI-Q3
1987	0.000	NA	NA
1988	0.013	NA	NA
1989	0.000	NA	NA
1990	0.000	NA	NA
1991	0.026	0.007	NA
1992	0.000	0.000	NA
1993	0.019	0.000	NA
1994	0.000	0.000	NA
1995	0.000	0.000	NA
1996	0.020	0.000	0.000
1997	0.000	0.000	0.000
1998	0.006	0.014	0.000
1999	0.013	0.033	0.000
2000	0.000	0.000	0.000
2001	0.000	0.000	0.000
2002	0.007	0.021	0.000
2003	0.000	0.000	0.000
2004	0.000	0.000	0.000
2005	0.006	0.013	0.105
2006	0.000	0.005	0.000
2007	0.051	0.000	0.000
2008	0.006	0.026	0.000
2009	0.013	0.013	0.000
2010	0.044	0.000	0.000
2011	0.056	0.033	0.000
2012	0.000	0.133	0.160
2013	0.093	0.062	0.000
2014	0.039	0.067	0.086
2015	0.063	0.013	0.080
2016	0.080	0.064	0.000
2017	0.055	0.100	0.076
2018	0.157	0.030	0.000
2019	0.135	0.108	0.000
2020	0.220	0.055	0.020
2021	0.136	0.000	0.033

Table 15.6.4. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Time-series of abundance estimates for *Raja clavata* (all individuals). Information obtained from IBTS-Q1, IBTS-Q3 (roundfish areas 1–7), several BTS surveys and eastern Channel CGFS-Q4 in the period 1987–2020. Data extracted from DATRAS, except for BTS-BEL-Q3 (extracted from the National database). Estimates are in n.h^{-1} for all surveys except CGFS-Q4 where n.km^{-2} are used. Time-series updated in 2021.

Year	IBTS-Q1	IBTS-Q3	BTS-ISI-Q3	BTS-ENG-Q3	BTS-TRI-Q3	BTS-GFR-Q3	BTS-BEL-Q3	CGFS-Q4
1987	0.926	NA	NA	NA	NA	NA	NA	NA
1988	0.219	NA	0.023	NA	NA	NA	NA	NA
1989	0.931	NA	0.741	NA	NA	NA	NA	NA
1990	0.631	NA	0.982	NA	NA	NA	NA	NA
1991	19.181	0.457	0.000	NA	NA	NA	NA	NA
1992	1.237	0.646	0.579	NA	NA	NA	NA	NA
1993	0.355	0.571	0.000	3.060	NA	0.000	NA	15.906
1994	0.379	0.065	0.030	2.759	NA	0.000	NA	18.878
1995	0.083	0.015	0.083	1.632	NA	0.000	NA	14.909
1996	0.362	0.372	0.162	3.221	0.048	NA	NA	11.035
1997	0.593	0.140	0.825	2.553	0.000	0.000	NA	35.887
1998	0.669	0.028	0.023	2.823	0.269	0.000	NA	22.977
1999	0.211	0.052	2.057	3.895	0.000	0.000	NA	25.515
2000	0.460	0.020	0.357	3.897	0.197	NA	NA	25.818
2001	0.440	0.059	0.000	4.766	0.087	0.000	NA	27.423
2002	0.593	0.276	0.078	2.780	0.972	0.000	NA	38.587
2003	0.551	0.020	0.100	3.846	0.558	0.000	NA	36.264
2004	0.263	0.065	0.000	4.100	0.085	0.000	1.170*	36.659
2005	0.513	0.020	0.182	4.115	0.091	0.000	2.097	55.343
2006	0.610	0.277	0.000	5.444	0.181	NA	3.062*	41.059
2007	0.283	0.060	0.024	4.678	0.647	0.000	2.303	49.569
2008	1.014	0.288	NA	5.360	0.030	0.000	3.618	64.346
2009	1.164	0.283	0.000	4.573	0.091	0.000	2.767	51.369
2010	0.178	0.393	0.063	8.241	0.214	0.000	1.682*	44.525
2011	0.110	0.138	0.040	9.702	0.085	0.000	2.138*	49.518
2012	1.411	0.290	0.030	6.214	1.713	0.000	2.964*	88.805
2013	0.545	0.841	0.035	8.834	0.557	0.000	4.165*	134.990
2014	0.681	0.811	0.320	14.455	0.257	0.000	6.375	156.574
2015	0.976	1.863	0.368	12.401	0.481	0.066	4.774	123.857
2016	0.706	2.103	0.261	11.592	1.306	0.000	5.662	143.286
2017	1.369	0.351	NA	15.528	0.287	0.000	8.246	89.121
2018	0.617	1.425	NA	23.898	2.798	0.033	8.485	142.200
2019	1.265	0.748	NA	25.270	0.330	0.000	8.831	353.680
2020	1.082	0.523	NA	18.368	0.577	0.200	9.323	371.786
2021	0.825	0.388	NA	17.365	1.588	0.000	5.634	

^CGFS-Q4 data for 2020 here shown but not used for assessment purposes due to reduced survey area.

***Data revised in 2022**

Table 15.6.5. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Time-series of abundance estimates for *Raja montagui* (all individuals). Information obtained from IBTS-Q1, IBTS-Q3 (roundfish areas 1–7), several BTS surveys and eastern Channel CGFS-Q4 in the period 1987–2020. Data extracted from DATRAS, except for BTS-BEL-Q3 (extracted from the National database). Estimates are in n.h^{-1} for all surveys except CGFS-Q4 where n.km^{-2} are used. Time-series updated in 2021 except for CGFS-Q4 (last update for this species provided in 2019 WGEF).

Year	IBTS-Q1	IBTS-Q3	BTS-ISI-Q3	BTS-ENG-Q3	BTS-TRI-Q3	BTS-BEL-Q3	CGFS-Q4
1987	0.053	NA	NA	NA	NA	NA	NA
1988	0.065	NA	0.000	NA	NA	NA	15.349
1989	0.180	NA	0.592	NA	NA	NA	6.469
1990	0.117	NA	0.278	NA	NA	NA	10.278
1991	1.210	0.172	0.579	NA	NA	NA	2.725
1992	0.188	0.200	0.184	NA	NA	NA	0.451
1993	0.223	0.221	0.637	0.349	NA	NA	3.594
1994	0.151	0.346	0.000	0.606	NA	NA	5.921
1995	0.387	0.082	0.000	0.526	NA	NA	3.099
1996	0.138	0.150	0.824	0.390	0.667	NA	3.343
1997	0.543	0.007	0.226	0.585	0.000	NA	4.29
1998	0.165	0.102	0.000	0.538	1.123	NA	3.019
1999	0.146	0.377	0.000	0.684	1.079	NA	0.567
2000	0.159	0.027	0.029	0.359	0.648	NA	1.274
2001	0.127	0.054	0.000	0.338	1.015	NA	1.285
2002	0.355	0.074	0.000	0.605	0.361	NA	0.637
2003	0.395	0.061	0.033	0.105	0.247	NA	2.596
2004	0.276	0.094	0.000	0.288	0.359	0.620*	0.261
2005	0.539	0.376	0.000	0.066	0.136	1.394	3.425
2006	0.122	0.361	0.000	0.253	0.536	1.292*	1.385
2007	0.694	0.859	0.000	0.123	0.239	1.022	1.441
2008	1.125	0.394	NA	0.333	0.167	0.522	0.229
2009	1.151	1.100	0.000	0.195	0.242	1.633*	0
2010	0.895	1.184	0.000	0.425	0.273	1.102*	0.29
2011	0.759	1.401	0.000	0.312	0.928	1.033*	4.398
2012	0.678	1.419	0.000	0.188	1.305	1.139*	2.169
2013	1.322	0.828	0.046	0.263	0.841	0.986*	2.047
2014	0.979	1.254	0.160	0.212	0.543	1.923	4.248
2015	1.242	0.521	0.058	0.313	0.550	2.580	2.514
2016	1.060	0.915	0.135	1.026	2.445	2.609	0.671
2017	0.905	0.615	NA	0.390	0.911	4.132	1.28
2018	1.052	1.026	NA	0.395	1.366	5.320	0.729
2019	1.246	1.477	NA	0.885	0.871	3.281	NA
2020	1.028	0.352	NA	0.733	1.191	2.807	NA
2021	0.846	0.223	NA	0.613	1.095	1.186	

***Data revised in 2022**

Table 15.6.6. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Time-series of abundance estimates (n.h^{-1}) for *Raja brachyura* in 4.a (all individuals). Information obtained from IBTS-Q1, IBTS-Q3 (roundfish areas 1–7) in the period 1987–2020. Data extracted from DATRAS. Time-series updated in 2021.

Year	IBTS-Q1	IBTS-Q3
1987	0.000	NA
1988	0.000	NA
1989	0.047	NA
1990	0.000	NA
1991	0.000	0.000
1992	0.119	0.000
1993	0.035	0.000
1994	0.000	0.000
1995	0.000	0.000
1996	0.022	0.000
1997	0.000	0.000
1998	0.007	0.000
1999	0.021	0.000
2000	0.000	0.000
2001	0.000	0.000
2002	0.000	0.000
2003	0.064	0.000
2004	0.000	0.000
2005	0.000	0.000
2006	0.064	0.000
2007	0.429	0.077
2008	0.292	0.039
2009	0.286	0.200
2010	0.471	0.000
2011	0.137	0.340
2012	0.000	0.000
2013	0.654	0.000
2014	0.490	0.000
2015	0.039	0.000
2016	0.019	0.071
2017	0.000	0.036
2018	0.000	0.000
2019	0.061	0.000
2020	0.727	0.036
2021	0.000	0.000

Table 15.6.7. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Time-series of abundance estimates for *Raja brachyura* in 4.c and 7.d (all individuals). Information obtained from IBTS-Q1, IBTS-Q3 (roundfish areas 1–7) and several BTS surveys and eastern Channel CGFS-Q4 in the period 1987–2020. Data extracted from DATRAS, except for BTS-BEL-Q3 (extracted from the National database). Estimates are in n.h^{-1} for all surveys except CGFS-Q4 where n.km^{-2} are used. Time-series updated in 2021.

Year	IBTS-Q1	IBTS-Q3	BTS-ISI-Q3	BTS-ENG-Q3	BTS-TRI-Q3	BTS-BEL-Q3	CGFS-Q4
1987	0.000	NA	NA	NA	NA	NA	NA
1988	0.000	NA	0.000	NA	NA	NA	0.000
1989	0.000	NA	0.000	NA	NA	NA	4.229
1990	0.000	NA	0.000	NA	NA	NA	0.458
1991	0.000	0.000	0.000	NA	NA	NA	0.000
1992	0.308	0.000	0.000	NA	NA	NA	0.000
1993	0.160	0.000	0.000	0.159	NA	NA	0.000
1994	0.000	0.000	0.000	0.121	NA	NA	1.351
1995	0.000	0.000	0.000	0.053	NA	NA	2.103
1996	0.000	0.000	0.000	0.052	0.000	NA	0.000
1997	0.000	0.000	0.000	0.027	0.000	NA	1.132
1998	0.000	0.000	0.000	0.077	0.000	NA	2.455
1999	0.039	0.000	0.000	0.158	0.000	NA	1.586
2000	0.000	0.000	0.056	0.103	0.000	NA	1.567
2001	0.000	0.000	0.000	0.154	0.000	NA	1.741
2002	0.000	0.000	0.000	0.105	0.000	NA	4.454
2003	0.019	0.000	0.000	0.132	0.000	NA	4.111
2004	0.000	0.000	0.000	0.137	0.242	0.113*	4.139
2005	0.039	0.000	0.071	0.262	0.000	0.238	0.000
2006	0.115	0.000	0.000	0.054	0.323	0.260	2.191
2007	0.154	0.000	0.000	0.164	0.600	0.088	3.346
2008	0.423	0.000	NA	0.083	0.000	0.329	0.255
2009	0.051	0.000	0.000	0.153	0.000	0.589	3.579
2010	0.000	0.000	0.000	0.027	0.000	0.402*	1.415
2011	0.037	0.000	0.000	0.140	0.000	0.117	4.877
2012	0.154	0.095	0.071	0.082	0.000	0.377*	5.932
2013	0.111	0.000	0.000	0.187	0.000	0.588*	3.432
2014	0.995	0.000	0.000	0.291	0.000	0.417	12.208
2015	0.346	0.000	0.000	0.132	1.239	0.762	4.441
2016	0.205	0.429	0.000	0.269	0.000	0.987	6.165
2017	0.481	0.333	NA	0.524	0.000	0.579	9.015
2018	0.747	0.571	NA	0.526	0.091	0.785	5.554
2019	0.852	0.238	NA	0.423	1.000	0.862	6.851
2020	0.160	0.500	NA	0.427	1.500	0.541	2.235
2021	0.692	1.506	NA	0.987	1.636	0.793	

***Data revised in 2022**

Table 15.6.8. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Time-series of biomass estimates (kg.h^{-1}) for *Amblyraja radiata* (all individuals). Information obtained from IBTS-Q1, IBTS-Q3 (roundfish areas 1–7) and several BTS surveys in the period 1987–2020. Data extracted from DATRAS.

Year	IBTS-Q1	IBTS-Q3	BTS-ISI-Q3	BTS-TRI-Q3	BTS-GFR-Q3
1987	3.746	NA	NA	NA	NA
1988	1.451	NA	0.178	NA	NA
1989	3.325	NA	0.075	NA	NA
1990	2.423	NA	0.387	NA	NA
1991	2.040	4.158	0.124	NA	NA
1992	3.485	1.340	0.038	NA	NA
1993	6.208	0.880	0.014	NA	0.391
1994	1.898	0.940	0.023	NA	3.200
1995	4.206	0.832	0.102	NA	0.295
1996	3.493	0.980	0.237	4.493	NA
1997	2.684	0.857	0.000	4.383	4.021
1998	2.861	1.207	0.000	6.313	0.154
1999	2.352	1.312	0.059	8.558	6.100
2000	3.282	1.386	0.000	8.015	NA
2001	1.236	2.124	0.016	4.733	4.890
2002	1.573	1.123	0.035	5.947	0.179
2003	1.469	1.270	0.034	4.551	0.164
2004	1.283	0.675	0.015	5.140	0.111
2005	1.158	0.772	0.171	5.407	0.036
2006	0.741	0.899	0.112	4.089	NA
2007	1.404	1.605	0.000	5.191	6.359
2008	1.192	1.232	NA	6.182	5.996
2009	0.533	1.542	0.494	6.321	4.587
2010	0.484	1.029	0.000	6.176	3.765
2011	0.501	1.239	0.000	4.709	2.789
2012	0.641	0.848	0.051	3.467	5.721
2013	0.265	0.561	0.047	3.253	2.753
2014	0.586	0.728	0.318	3.475	0.535
2015	0.716	1.148	0.074	4.071	3.039
2016	0.527	0.941	0.165	2.700	3.112
2017	0.597	0.606	NA	1.558	2.829
2018	0.167	0.614	NA	1.236	1.956
2019	0.238	0.463	NA	1.379	1.633
2020	0.120	0.441	NA	1.317	1.407
2021	0.131	0.135	NA	3.193	2.075

Table 15.6.9. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Time-series of biomass estimates (kg.h^{-1}) for *Leucoraja naevus* (all individuals). Information obtained from IBTS-Q1, IBTS-Q3 (roundfish areas 1–7) and several BTS surveys in the period 1987–2020. Data extracted from DATRAS. Time-series updated in 2021.

Year	IBTS-Q1	IBTS-Q3	BTS-ISI-Q3	BTS-TRI2-Q3
1987	0.109	NA	NA	NA
1988	0.518	NA	0.021	NA
1989	0.476	NA	0.000	NA
1990	0.558	NA	0.000	NA
1991	0.444	0.167	0.000	NA
1992	0.739	0.407	0.000	NA
1993	0.828	0.110	0.000	NA
1994	0.390	0.166	0.000	NA
1995	0.520	0.184	0.000	NA
1996	0.450	0.095	0.000	0.503
1997	0.198	0.308	0.000	0.726
1998	0.387	0.121	0.000	1.382
1999	0.342	0.322	0.000	0.944
2000	0.406	0.259	0.000	0.928
2001	0.215	0.282	0.000	0.379
2002	0.240	0.250	0.000	0.573
2003	0.170	0.214	0.000	1.080
2004	0.145	0.196	0.000	0.453
2005	0.181	0.296	0.000	0.544
2006	0.250	0.330	0.000	0.460
2007	0.286	0.225	0.000	0.854
2008	0.246	0.512	NA	1.473
2009	0.192	0.475	0.000	0.795
2010	0.296	0.630	0.000	0.258
2011	0.343	0.606	0.000	0.489
2012	0.375	0.705	0.000	0.514
2013	0.558	0.459	0.000	0.449
2014	0.376	0.315	0.000	0.564
2015	0.836	0.470	0.000	0.279
2016	0.430	0.432	0.000	0.577
2017	0.702	0.562	NA	0.798
2018	0.327	0.495	NA	0.689
2019	0.376	0.348	NA	0.424
2020	0.288	0.250	NA	0.467
2021	0.331	0.229	NA	0.481

Table 15.6.10. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Time-series of biomass estimates (kg.h^{-1}) for 'common skate complex' (all individuals). Information obtained from IBTS-Q1, IBTS-Q3 (roundfish areas 1–7) and BTS-TRI-Q3 in the period 1987–2020. Data extracted from DATRAS. Time-series updated in 2021.

Year	IBTS-Q1	IBTS-Q3	BTS-TRI-Q3
1987	0.000	NA	NA
1988	0.029	NA	NA
1989	0.000	NA	NA
1990	0.000	NA	NA
1991	0.113	0.010	NA
1992	0.000	0.000	NA
1993	0.042	0.000	NA
1994	0.000	0.000	NA
1995	0.000	0.000	NA
1996	0.030	0.000	0.000
1997	0.000	0.000	0.000
1998	0.015	0.028	0.000
1999	0.021	0.010	0.000
2000	0.000	0.000	0.000
2001	0.000	0.000	0.000
2002	0.015	0.025	0.000
2003	0.000	0.000	0.000
2004	0.000	0.000	0.000
2005	0.014	0.041	0.046
2006	0.000	0.009	0.000
2007	0.061	0.000	0.000
2008	0.004	0.059	0.000
2009	0.003	0.002	0.000
2010	0.026	0.000	0.000
2011	0.224	0.020	0.000
2012	0.000	0.249	0.130
2013	0.259	0.061	0.000
2014	0.175	0.119	0.025
2015	0.111	0.011	0.215
2016	0.254	0.157	0.000
2017	0.415	0.278	3.140
2018	0.643	0.048	0.000
2019	0.678	0.202^	0.000
2020	1.118	0.670	0.038
2021	0.341	0.000	0.007

^Data revised in 2022

Table 15.6.11. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Time-series of biomass estimates for *Raja clavata* (all individuals). Information obtained from IBTS-Q1, IBTS-Q3 (roundfish areas 1–7), several BTS surveys, and eastern Channel CGFS-Q4 in the period 1987–2020. Data extracted from DATRAS, except for BTS-BEL-Q3 (extracted from the National database). Estimates are in kg.h^{-1} for all surveys except CGFS-Q4 where kg.km^{-2} are used. Time-series updated in 2021.

Year	IBTS-Q1	IBTS-Q3	BTS-ISI-Q3	BTS-ENG-Q3	BTS-TRI-Q3	BTS-GFR-Q3	BTS-BEL-Q3	CGFS-Q4
1987	1.569	NA	NA	NA	NA	NA	NA	NA
1988	0.223	NA	0.004	NA	NA	NA	NA	NA
1989	0.916	NA	0.418	NA	NA	NA	NA	NA
1990	0.698	NA	0.806	NA	NA	NA	NA	NA
1991	8.856	0.534	0.000	NA	NA	NA	NA	NA
1992	0.959	0.408	0.698	NA	NA	NA	NA	NA
1993	0.310	0.366	0.000	1.088	NA	0.000	NA	19.857
1994	0.218	0.036	0.008	0.974	NA	0.000	NA	45.129
1995	0.081	0.052	0.011	0.782	NA	0.000	NA	32.690
1996	0.243	0.703	0.233	1.326	0.111	NA	NA	7.437
1997	0.512	0.212	0.588	1.162	0.000	0.000	NA	50.848
1998	0.154	0.009	0.004	1.162	0.130	0.000	NA	45.941
1999	0.121	0.131	1.130	1.773	0.000	0.000	NA	36.231
2000	0.261	0.038	0.298	1.577	0.074	NA	NA	47.508
2001	0.279	0.062	0.000	1.540	0.053	0.000	NA	38.327
2002	0.356	0.260	0.088	1.061	0.831	0.000	NA	56.775
2003	0.360	0.034	0.055	1.779	0.408	0.000	NA	41.689
2004	0.177	0.044	0.000	2.475	0.058	0.000	0.652*	38.572
2005	0.393	0.027	0.471	1.557	0.094	0.000	0.395	87.306
2006	0.809	0.274	0.000	1.684	0.150	NA	0.759*	70.294
2007	0.192	0.019	0.022	2.173	0.541	0.000	0.350	92.942
2008	1.594	0.340	NA	2.924	0.014	0.000	1.951	94.537
2009	1.034	0.243	0.000	2.172	0.142	0.000	1.910*	89.228
2010	0.193	0.210	0.004	3.388	0.196	0.000	1.418*	90.478
2011	0.049	0.204	0.096	2.475	0.056	0.000	1.345*	66.975
2012	1.654	0.168	0.084	3.199	0.741	0.000	1.960*	113.665
2013	0.529	1.048	0.012	2.360	0.305	0.000	2.289*	223.638
2014	0.795	1.132	0.263	4.865	0.296	0.000	4.959	265.211
2015	1.031	1.561	0.490	4.670	0.651	0.141	2.766	211.768
2016	0.707	1.644	0.499	4.011	0.525	0.000	3.846	291.861
2017	1.637	0.629	NA	4.398	0.758	0.000	4.649	174.664
2018	0.656	1.621	NA	5.120	1.251	0.027	4.766	302.729
2019	1.415	0.631	NA	6.352	0.202	0.000	4.627	376.898
2020	1.318	0.601	NA	5.546	0.413	0.251	5.162	659.203^
2021	1.023	0.623	NA	4.248	1.193	0.000	2.756	

^CGFS-Q4 data for 2020 here shown but not used for assessment purposes due to reduced survey area.

***Data revised in 2022**

Table 15.6.12. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Time-series of biomass estimates for *Raja montagui* (all individuals). Information from IBTS-Q1, IBTS-Q3 (roundfish areas 1–7), several BTS surveys and eastern Channel CGFS-Q4 in the period 1987–2020. Data extracted from DATRAS, except for BTS-BEL-Q3 (extracted from the National database). Estimates are in $kg.h^{-1}$ for all surveys except CGFS-Q4 where $kg.km^{-2}$ are used. Time-series updated in 2021 except for CGFS-Q4 (last update for this species provided in 2019 WGEF).

Year	IBTS-Q1	IBTS-Q3	BTS-ISI-Q3	BTS-ENG-Q3	BTS-TRI-Q3	BTS-BEL-Q3	CGFS-Q4
1987	0.066	NA	NA	NA	NA	NA	NA
1988	0.068	NA	0.000	NA	NA	NA	22.215
1989	0.136	NA	0.163	NA	NA	NA	6.007
1990	0.116	NA	0.055	NA	NA	NA	9.587
1991	0.448	0.130	1.125	NA	NA	NA	3.364
1992	0.211	0.183	0.153	NA	NA	NA	0.721
1993	0.215	0.240	0.422	0.065	NA	NA	4.426
1994	0.179	0.439	0.000	0.212	NA	NA	9.903
1995	0.567	0.091	0.000	0.197	NA	NA	3.027
1996	0.154	0.110	0.584	0.166	0.409	NA	0.653
1997	0.252	0.005	0.262	0.296	0.000	NA	4.61
1998	0.218	0.069	0.000	0.148	0.504	NA	2.767
1999	0.183	0.444	0.000	0.143	0.638	NA	0.266
2000	0.135	0.024	0.013	0.128	0.063	NA	1.586
2001	0.130	0.029	0.000	0.082	0.091	NA	1.376
2002	0.237	0.056	0.000	0.282	0.198	NA	0.447
2003	0.299	0.040	0.058	0.032	0.072	NA	1.863
2004	0.204	0.110	0.000	0.067	0.215	0.212*	0.047
2005	0.378	0.384	0.000	0.079	0.108	0.060*	2.535
2006	0.066	0.263	0.000	0.109	0.482	0.074*	2.999
2007	0.666	0.828	0.000	0.008	0.216	0.084*	1.27
2008	1.020	0.387	NA	0.121	0.118	0.165*	0.055
2009	0.677	0.903	0.000	0.088	0.103	0.514*	0
2010	0.803	1.009	0.000	0.056	0.154	0.302*	0.058
2011	0.633	1.229	0.000	0.144	0.434	0.710*	3.359
2012	0.552	1.451	0.000	0.135	0.873	0.357*	1.621
2013	0.994	0.731	0.043	0.182	0.644	0.356*	2.363
2014	1.017	1.402	0.128	0.091	0.542	0.552*	1.74
2015	1.367	0.588	0.057	0.138	0.566	0.551*	1.63
2016	1.002	1.004	0.097	0.197	0.798	0.819*	0.329
2017	0.855	0.666	NA	0.136	0.501	0.838*	5.443
2018	1.179	1.098	NA	0.208	0.391	1.131*	0.877
2019	1.091	1.584	NA	0.204	0.555	0.809*	NA
2020	1.120	0.343	NA	0.260	0.458	0.378*	NA
2021	0.731	0.123	NA	0.233	0.512	0.228	

***Data revised in 2022**

Table 15.6.13. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Time-series of biomass estimates (kg.h^{-1}) for *Raja brachyura* 4.a (all individuals). Information obtained from the IBTS-Q1 and IBTS-Q3 (roundfish areas 1–7) surveys in the period 1987–2020. Data extracted from DATRAS. Time-series updated in 2021.

Year	IBTS-Q1	IBTS-Q3
1987	0.000	NA
1988	0.000	NA
1989	0.072	NA
1990	0.000	NA
1991	0.000	0.000
1992	0.062	0.000
1993	0.073	0.000
1994	0.000	0.000
1995	0.000	0.000
1996	0.005	0.000
1997	0.000	0.000
1998	0.016	0.000
1999	0.017	0.000
2000	0.000	0.000
2001	0.000	0.000
2002	0.000	0.000
2003	0.088	0.000
2004	0.000	0.000
2005	0.000	0.000
2006	0.057	0.000
2007	0.895	0.267
2008	1.076	0.142
2009	0.604	0.904
2010	1.849	0.000
2011	0.669	1.515
2012	0.000	0.000
2013	2.724	0.000
2014	1.913	0.000
2015	0.221	0.000
2016	0.092	0.410
2017	0.000	0.116
2018	0.000	0.000
2019	0.237	0.000
2020	3.200	0.054
2021	0.000	0.000

Table 15.6.14. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Time-series of biomass estimates for *Raja brachyura* in 4.c and 7.d (all individuals). Information obtained from IBTS-Q1, IBTS-Q3 (roundfish areas 1–7), several BTS surveys and eastern Channel CGFS-Q4, in the period 1987–2020. Data extracted from DATRAS, except for BTS-BEL-Q3 (extracted from the National database). Estimates are in $kg.h^{-1}$ for all surveys except CGFS-Q4 where $kg.km^{-2}$ are used.

Year	IBTS-Q1	IBTS-Q3	BTS-ISI-Q3	BTS-ENG-Q3	BTS-TRI-Q3	BTS-BEL-Q3	CGFS-Q4
1987	0.000	NA	NA	NA	NA	NA	NA
1988	0.000	NA	0.000	NA	NA	NA	0.000
1989	0.000	NA	0.000	NA	NA	NA	1.488
1990	0.000	NA	0.000	NA	NA	NA	0.000
1991	0.000	0.000	0.000	NA	NA	NA	0.000
1992	0.179	0.000	0.000	NA	NA	NA	0.000
1993	0.456	0.000	0.000	0.182	NA	NA	0.000
1994	0.000	0.000	0.000	0.013	NA	NA	0.342
1995	0.000	0.000	0.000	0.008	NA	NA	3.251
1996	0.000	0.000	0.000	0.006	0.000	NA	0.000
1997	0.000	0.000	0.000	0.003	0.000	NA	1.806
1998	0.000	0.000	0.000	0.008	0.000	NA	3.881
1999	0.084	0.000	0.000	0.049	0.000	NA	2.159
2000	0.000	0.000	0.025	0.012	0.000	NA	0.336
2001	0.000	0.000	0.000	0.069	0.000	NA	2.638
2002	0.000	0.000	0.000	0.076	0.000	NA	2.530
2003	0.034	0.000	0.000	0.066	0.000	NA	6.136
2004	0.000	0.000	0.000	0.045	1.316	0.108*	0.680
2005	0.102	0.000	0.062	0.118	0.000	0.104	0.000
2006	0.024	0.000	0.000	0.026	0.224	0.103*	2.322
2007	0.356	0.000	0.000	0.288	1.868	0.027	7.783
2008	0.766	0.000	NA	0.009	0.000	0.166	0.237
2009	0.071	0.000	0.000	0.068	0.000	0.147	5.765
2010	0.000	0.000	0.000	0.020	0.000	0.122*	3.251
2011	0.009	0.000	0.000	0.097	0.000	0.150	6.315
2012	0.739	0.245	0.062	0.021	0.000	0.095	19.327
2013	0.414	0.000	0.000	0.068	0.000	0.098*	4.609
2014	1.368	0.000	0.000	0.103	0.000	0.108	20.937
2015	0.587	0.000	0.000	0.046	0.129	0.169	17.310
2016	0.316	0.294	0.000	0.124	0.000	0.159	20.450
2017	1.086	0.662	NA	0.166	0.000	0.113	21.502
2018	1.835	0.442	NA	0.305	0.439	0.303	14.664
2019	2.264	0.352	NA	0.216	0.817	0.232	20.477
2020	0.492	0.638	NA	0.088	1.246	0.467	2.355^
2021	0.548	2.299	NA	0.586	3.241	0.724	

^CGFS-Q4 data for 2020 here shown but not used for assessment purposes due to reduced survey area.

***Data revised in 2022**

Table 15.6.15. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Time-series of exploitable biomass index (kg.h^{-1} for individuals ≥50 cm L_T) for *Amblyraja radiata*. Information obtained from IBTS-Q1, IBTS-Q3 (roundfish areas 1–7) and several BTS surveys in the period 1987–2020. Data extracted from DATRAS. Time-series updated in 2021.

Year	IBTS-Q1	IBTS-Q3	BTS-ISI-Q3	BTS-TRI-Q3	BTS-GFR-Q3
1987	0.496	NA	NA	NA	NA
1988	0.333	NA	0.000	NA	NA
1989	0.377	NA	0.000	NA	NA
1990	0.370	NA	0.000	NA	NA
1991	0.288	0.361	0.000	NA	NA
1992	0.335	0.128	0.000	NA	NA
1993	0.431	0.112	0.000	NA	0.053
1994	0.231	0.162	0.000	NA	0.679
1995	0.578	0.058	0.000	NA	0.106
1996	0.228	0.096	0.205	0.318	NA
1997	0.293	0.049	0.000	0.313	0.657
1998	0.322	0.175	0.000	0.776	0.000
1999	0.253	0.115	0.000	0.682	1.180
2000	0.363	0.108	0.000	0.419	NA
2001	0.089	0.145	0.000	0.295	0.454
2002	0.141	0.038	0.035	0.213	0.037
2003	0.152	0.067	0.000	0.194	0.000
2004	0.081	0.018	0.000	0.276	0.000
2005	0.053	0.000	0.000	0.066	0.000
2006	0.025	0.011	0.045	0.000	NA
2007	0.069	0.052	0.000	0.000	0.000
2008	0.037	0.000	NA	0.032	0.113
2009	0.012	0.014	0.000	0.038	0.215
2010	0.021	0.096	0.000	0.166	0.256
2011	0.037	0.020	0.000	0.222	0.224
2012	0.052	0.008	0.000	0.170	0.109
2013	0.014	0.014	0.000	0.000	0.000
2014	0.086	0.039	0.000	0.070	0.081
2015	0.008	0.043	0.000	0.028	0.000
2016	0.042	0.000	0.000	0.029	0.053
2017	0.030	0.007	NA	0.057	0.053
2018	0.031	0.000	NA	0.000	0.063
2019	0.000	0.007	NA	0.000	0.056
2020	0.000	0.014	NA	0.000	0.000
2021	0.000	0.000	NA	0.112	0.000

Table 15.6.16. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Time-series of exploitable biomass index (kg.h^{-1} for individuals ≥50 cm L_T) for *Leucoraja naevus*. Information obtained from IBTS-Q1, IBTS-Q3 (roundfish areas 1–7) and several BTS surveys in the period 1987–2020. Data extracted from DATRAS. Time-series updated in 2021.

Year	IBTS-Q1	IBTS-Q3	BTS-ISI-Q3	BTS-TRI2-Q3
1987	0.094	NA	NA	NA
1988	0.458	NA	0.000	NA
1989	0.352	NA	0.000	NA
1990	0.485	NA	0.000	NA
1991	0.329	0.097	0.000	NA
1992	0.639	0.326	0.000	NA
1993	0.670	0.098	0.000	NA
1994	0.245	0.154	0.000	NA
1995	0.396	0.174	0.000	NA
1996	0.362	0.068	0.000	0.392
1997	0.145	0.293	0.000	0.417
1998	0.294	0.106	0.000	0.782
1999	0.269	0.245	0.000	0.400
2000	0.328	0.174	0.000	0.380
2001	0.137	0.118	0.000	0.048
2002	0.130	0.131	0.000	0.209
2003	0.102	0.115	0.000	0.234
2004	0.055	0.070	0.000	0.180
2005	0.091	0.156	0.000	0.185
2006	0.119	0.191	0.000	0.136
2007	0.160	0.122	0.000	0.434
2008	0.130	0.305	NA	0.112
2009	0.084	0.330	0.000	0.188
2010	0.182	0.435	0.000	0.050
2011	0.209	0.437	0.000	0.190
2012	0.276	0.520	0.000	0.255
2013	0.349	0.354	0.000	0.147
2014	0.218	0.167	0.000	0.218
2015	0.691	0.391	0.000	0.097
2016	0.328	0.328	0.000	0.186
2017	0.530	0.418	NA	0.191
2018	0.252	0.360	NA	0.232
2019	0.275	0.231	NA	0.084
2020	0.205	0.159	NA	0.059
2021	0.186	0.143	NA	0.071

Table 15.6.17. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Time-series of exploitable biomass index (kg.h^{-1} for individuals ≥50 cm L_T) for 'common skate complex'. Information obtained from IBTS-Q1, IBTS-Q3 (roundfish areas 1–7) and BTS survey in the period 1987–2020. Data extracted from DATRAS. Time-series updated in 2021.

Year	IBTS-Q1	IBTS-Q3	BTS-TRI-Q3
1987	0.000	NA	NA
1988	0.029	NA	NA
1989	0.000	NA	NA
1990	0.000	NA	NA
1991	0.113	0.010	NA
1992	0.000	0.000	NA
1993	0.042	0.000	NA
1994	0.000	0.000	NA
1995	0.000	0.000	NA
1996	0.025	0.000	0.000
1997	0.000	0.000	0.000
1998	0.016	0.028	0.000
1999	0.021	0.000	0.000
2000	0.000	0.000	0.000
2001	0.000	0.000	0.000
2002	0.015	0.025	0.000
2003	0.000	0.000	0.000
2004	0.000	0.000	0.000
2005	0.014	0.041	0.000
2006	0.000	0.009	0.000
2007	0.055	0.000	0.000
2008	0.000	0.059	0.000
2009	0.000	0.000	0.000
2010	0.011	0.000	0.000
2011	0.215	0.010	0.000
2012	0.000	0.229	0.130
2013	0.237	0.041	0.000
2014	0.170	0.109	0.000
2015	0.101	0.011	0.215
2016	0.249	0.151	0.000
2017	0.412	0.271	3.140
2018	0.636	0.040	0.000
2019	0.675	0.195^	0.000
2020	1.098	0.665	0.038
2021	0.331	0.000	0.000

^Data revised in 2022

Table 15.6.18. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Time-series of exploitable biomass index (individuals ≥50 cm L_T) for *Raja clavata*. Information obtained from IBTS-Q1, IBTS-Q3 (roundfish areas 1–7), several BTS surveys, and eastern Channel CGFS Q4 in the period 1987–2020. Data extracted from DATRAS, except for BTS-BEL-Q3 (extracted from National database). Estimates are in $kg.h^{-1}$ for all surveys except CGFS-Q4 where $kg.km^{-2}$ are used. Time-series updated in 2021.

Year	IBTS-Q1	IBTS-Q3	BTS-ISI-Q3	BTS-ENG-Q3	BTS-TRI-Q3	BTS-GFR-Q3	BTS-BEL-Q3	CGFS-Q4
1987	1.458	NA	NA	NA	NA	NA	NA	NA
1988	0.183	NA	0.000	NA	NA	NA	NA	NA
1989	0.734	NA	0.277	NA	NA	NA	NA	NA
1990	0.525	NA	0.601	NA	NA	NA	NA	NA
1991	3.043	0.394	0.000	NA	NA	NA	NA	NA
1992	0.634	0.202	0.610	NA	NA	NA	NA	NA
1993	0.240	0.221	0.000	0.589	NA	0.000	NA	17.828
1994	0.098	0.031	0.000	0.563	NA	0.000	NA	44.307
1995	0.069	0.053	0.000	0.562	NA	0.000	NA	31.055
1996	0.145	0.654	0.207	0.804	0.111	NA	NA	4.084
1997	0.368	0.209	0.439	0.702	0.000	0.000	NA	43.043
1998	0.018	0.000	0.000	0.565	0.045	0.000	NA	43.728
1999	0.050	0.130	0.657	1.117	0.000	0.000	NA	33.081
2000	0.131	0.033	0.186	0.908	0.031	NA	NA	43.997
2001	0.131	0.055	0.000	0.874	0.040	0.000	NA	35.328
2002	0.158	0.200	0.086	0.502	0.675	0.000	NA	50.563
2003	0.227	0.031	0.000	1.066	0.256	0.000	NA	32.726
2004	0.097	0.041	0.000	1.508	0.031	0.000	0.459*	31.837
2005	0.272	0.026	0.471	0.601	0.072	0.000	0.125	79.625
2006	0.709	0.202	0.000	0.996	0.130	NA	0.032	63.887
2007	0.129	0.013	0.022	1.357	0.374	0.000	0.000	88.975
2008	1.480	0.279	NA	1.937	0.000	0.000	1.458	86.437
2009	0.779	0.173	0.000	1.409	0.138	0.000	1.348	83.955
2010	0.171	0.104	0.000	2.170	0.146	0.000	1.156*	87.252
2011	0.034	0.176	0.096	1.267	0.028	0.000	0.976	60.191
2012	1.418	0.103	0.084	1.892	0.245	0.000	1.203*	98.224
2013	0.436	0.906	0.000	1.023	0.213	0.000	1.406*	208.965
2014	0.682	1.026	0.129	2.810	0.253	0.000	3.831	245.041
2015	0.853	1.009	0.454	2.719	0.627	0.141	1.663	198.867
2016	0.584	1.075	0.482	1.963	0.188	0.000	2.813	281.260
2017	1.410	0.608	NA	2.284	0.749	0.000	3.432	165.981
2018	0.565	1.402	NA	2.628	0.533	0.027	3.603	290.030
2019	1.168	0.467	NA	3.537	0.147	0.000	2.927	326.159
2020	1.142	0.490	NA	2.630	0.306	0.251	3.659	611.607^
2021	0.914	0.554	NA	2.328	0.828	0.000	1.554	

^CGFS-Q4 data for 2020 here shown but not used for assessment purposes due to reduced survey area.

***Data revised in 2022.**

Table 15.6.19. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Time-series of exploitable biomass index (individuals ≥50 cm L_T) for *Raja montagui*. Information obtained from IBTS-Q1, IBTS-Q3 (roundfish areas 1–7), several BTS surveys, and eastern Channel CGFS Q4, in the period 1987–2020. Data extracted from DATRAS, except for BTS-BEL-Q3 (extracted from National database). Estimates are in kg.h^{-1} for all surveys except CGFS-Q4 where kg.km^{-2} are used. Time-series updated in 2021 except for CGFS-Q4 (last update for this species provided in 2019 WGEF).

Year	IBTS-Q1	IBTS-Q3	BTS-ISI-Q3	BTS-ENG-Q3	BTS-TRI-Q3	BTS-BEL-Q3	CGFS-Q4
1987	0.063	NA	NA	NA	NA	NA	NA
1988	0.060	NA	0.000	NA	NA	NA	0.514
1989	0.099	NA	0.049	NA	NA	NA	1.347
1990	0.102	NA	0.000	NA	NA	NA	2.123
1991	0.299	0.090	1.048	NA	NA	NA	0.84
1992	0.185	0.144	0.079	NA	NA	NA	0.205
1993	0.166	0.214	0.261	0.000	NA	NA	1.257
1994	0.163	0.405	0.000	0.106	NA	NA	2.438
1995	0.508	0.090	0.000	0.118	NA	NA	0.748
1996	0.141	0.090	0.284	0.095	0.243	NA	0
1997	0.168	0.000	0.218	0.205	0.000	NA	0.686
1998	0.206	0.014	0.000	0.035	0.383	NA	0.651
1999	0.169	0.406	0.000	0.000	0.548	NA	0
2000	0.100	0.010	0.000	0.065	0.000	NA	0.333
2001	0.110	0.007	0.000	0.044	0.000	NA	0.276
2002	0.152	0.029	0.000	0.187	0.103	NA	0.103
2003	0.221	0.026	0.058	0.000	0.000	NA	0.201
2004	0.168	0.101	0.000	0.028	0.094	0.196*	0
2005	0.209	0.324	0.000	0.079	0.060	0.000	0.669
2006	0.038	0.193	0.000	0.097	0.379	0.000	0.699
2007	0.537	0.624	0.000	0.000	0.183	0.000	0.327
2008	0.808	0.320	NA	0.087	0.058	0.133	0
2009	0.334	0.623	0.000	0.000	0.041	0.257	0
2010	0.624	0.783	0.000	0.027	0.107	0.152*	0
2011	0.457	0.889	0.000	0.110	0.196	0.523	0.796
2012	0.426	1.209	0.000	0.082	0.535	0.236*	0.08
2013	0.782	0.528	0.031	0.168	0.427	0.196*	0.716
2014	0.931	1.280	0.051	0.049	0.447	0.473	0.158
2015	1.260	0.571	0.040	0.104	0.526	0.217	0.279
2016	0.819	0.890	0.049	0.103	0.264	0.372	0
2017	0.760	0.578	NA	0.094	0.310	0.453	1.708
2018	1.056	0.982	NA	0.152	0.172	0.587	0.228
2019	0.871	1.369	NA	0.142	0.386	0.697	NA
2020	1.005	0.274	NA	0.176	0.168	0.097	NA
2021	0.555	0.063	NA	0.141	0.209	0.102	

***Data revised in 2022**

Table 15.6.20. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Time-series of exploitable biomass index (kg.h^{-1} for individuals ≥50 cm L_T) for *Raja brachyura* 4.a. Information obtained from IBTS-Q1, IBTS-Q3 (roundfish areas 1–7) surveys in the period 1987–2020. Data extracted from DATRAS. Time-series updated in 2021.

Year	IBTS-Q1	IBTS-Q3
1987	0.000	NA
1988	0.000	NA
1989	0.072	NA
1990	0.000	NA
1991	0.000	0.000
1992	0.000	0.000
1993	0.073	0.000
1994	0.000	0.000
1995	0.000	0.000
1996	0.000	0.000
1997	0.000	0.000
1998	0.016	0.000
1999	0.000	0.000
2000	0.000	0.000
2001	0.000	0.000
2002	0.000	0.000
2003	0.088	0.000
2004	0.000	0.000
2005	0.000	0.000
2006	0.020	0.000
2007	0.887	0.267
2008	1.076	0.142
2009	0.604	0.904
2010	1.849	0.000
2011	0.669	1.515
2012	0.000	0.000
2013	2.697	0.000
2014	1.913	0.000
2015	0.221	0.000
2016	0.092	0.410
2017	0.000	0.116
2018	0.000	0.000
2019	0.207	0.000
2020	3.184	0.054
2021	0.000	0.000

Table 15.6.21. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Time-series of exploitable biomass index (individuals ≥50 cm L_T) for *Raja brachyura* 4.c and 7.d. Information obtained from IBTS-Q1, IBTS-Q3 (roundfish areas 1–7), several BTS surveys, and eastern Channel CGFS-Q4 in the period 1989–2020. Data extracted from DATRAS, except for BTS-BEL-Q3 (extracted from National database). Estimates are in $kg.h^{-1}$ for all surveys except CGFS-Q4 where $kg.km^{-2}$ are used. Time-series updated in 2021.

Year	IBTS-Q1	IBTS-Q3	BTS-ISI-Q3	BTS-ENG-Q3	BTS-TRI-Q3	BTS-BEL-Q3	CGFS-Q4
1987	0.000	NA	NA	NA	NA	NA	NA
1988	0.000	NA	0.000	NA	NA	NA	0.000
1989	0.000	NA	0.000	NA	NA	NA	0.001
1990	0.000	NA	0.000	NA	NA	NA	0.000
1991	0.000	0.000	0.000	NA	NA	NA	0.000
1992	0.055	0.000	0.000	NA	NA	NA	0.000
1993	0.449	0.000	0.000	0.161	NA	NA	0.000
1994	0.000	0.000	0.000	0.000	NA	NA	0.000
1995	0.000	0.000	0.000	0.000	NA	NA	0.003
1996	0.000	0.000	0.000	0.000	0.000	NA	0.000
1997	0.000	0.000	0.000	0.000	0.000	NA	0.002
1998	0.000	0.000	0.000	0.000	0.000	NA	0.004
1999	0.084	0.000	0.000	0.000	0.000	NA	0.002
2000	0.000	0.000	0.000	0.000	0.000	NA	0.000
2001	0.000	0.000	0.000	0.032	0.000	NA	0.003
2002	0.000	0.000	0.000	0.028	0.000	NA	0.003
2003	0.034	0.000	0.000	0.044	0.000	NA	0.006
2004	0.000	0.000	0.000	0.000	1.316	0.089*	0.001
2005	0.102	0.000	0.000	0.072	0.000	0.047	0.000
2006	0.000	0.000	0.000	0.025	0.198	0.000	0.002
2007	0.352	0.000	0.000	0.259	1.868	0.000	0.008
2008	0.739	0.000	NA	0.000	0.000	0.062	0.000
2009	0.062	0.000	0.000	0.029	0.000	0.080	0.006
2010	0.000	0.000	0.000	0.000	0.000	0.029*	0.003
2011	0.000	0.000	0.000	0.087	0.000	0.147	0.006
2012	0.740	0.245	0.000	0.000	0.000	0.040	0.019
2013	0.413	0.000	0.000	0.026	0.000	0.022*	0.005
2014	1.162	0.000	0.000	0.037	0.000	0.080	0.021
2015	0.563	0.000	0.000	0.000	0.000	0.059	0.017
2016	0.299	0.139	0.000	0.071	0.000	0.000	0.020
2017	0.963	0.590	NA	0.044	0.000	0.027*	0.022
2018	1.709	0.385	NA	0.220	0.439	0.063	0.015
2019	2.150	0.343	NA	0.178	0.677	0.070	0.020
2020	0.471	0.482	NA	0.000	0.808	0.281	0.002^
2021	0.431	2.045	NA	0.493	3.199	0.517	

^CGFS-Q4 data for 2020 here shown but not used for assessment purposes due to reduced survey area.

***Data revised in 2022**

Table 15.7.1: Length-weight parameters (a and b) used to convert length to weight (values taken from Silva *et al.*, 2013).

Species	a	b
Leucoraja. Naevus	0.0036	3.1399
Raja brachyura	0.0027	3.2580
Raja clavata	0.0045	3.0961
Raja microocellata	0.0030	3.2250
Raja montagui	0.0041	3.1152
Raja undulata	0.0040	3.1346
Amblyraja radiata	0.0107	2.940
‘common skate complex’	0.0038	3.1201
Scyliorhinus canicula	0.0022	3.1194
Mustelus spp	0.003	3.0349

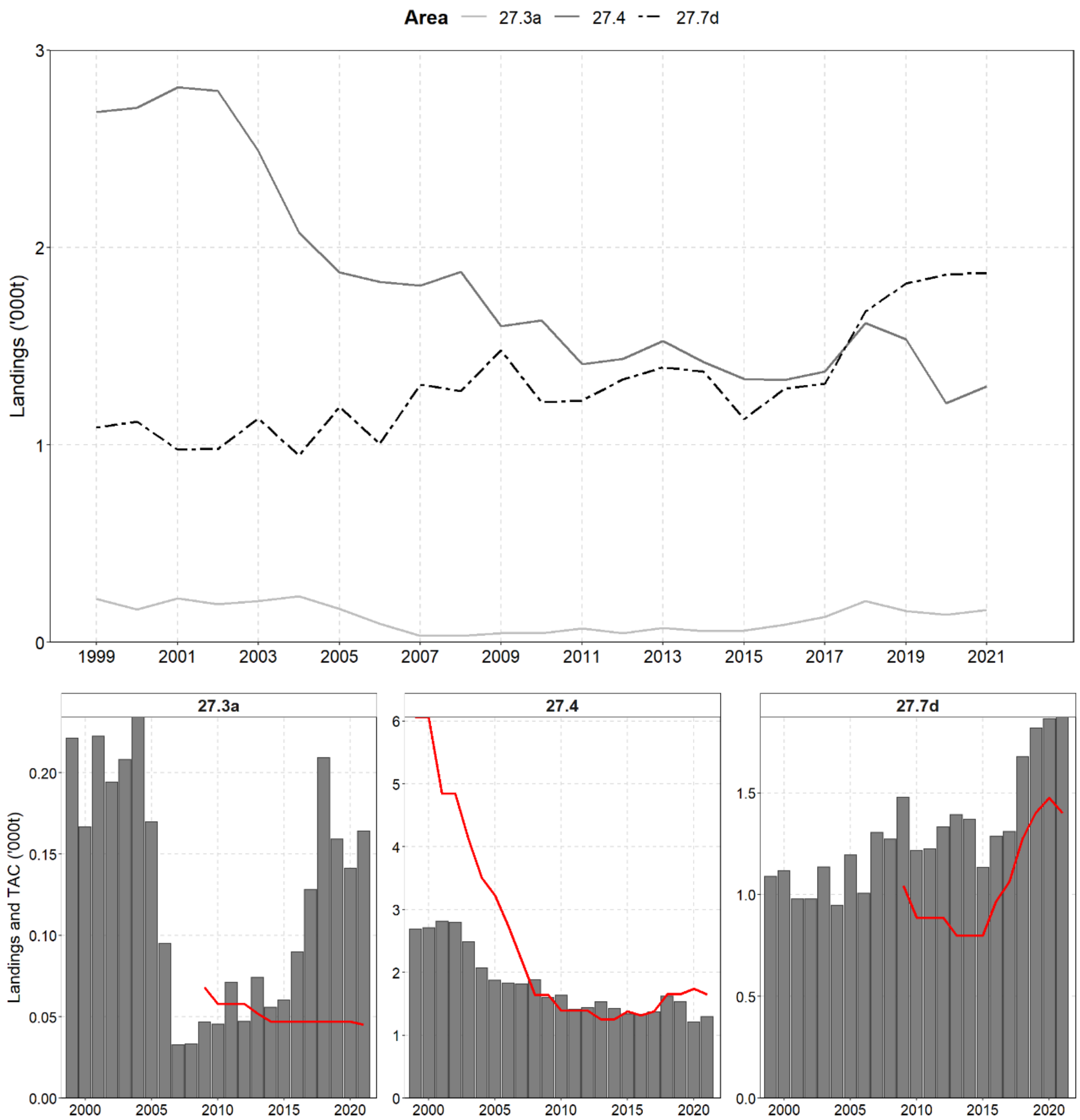

Figure 15.3.1. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. (top) total international landings of rays and skates in Division 3.a and Subarea 4 and Division 7.d since 1973, based on WG estimates. (bottom) Landings in Division 3.a, Subarea 4 and Division 7.d, including the TACs for the three areas (black lines) since 1999. Note: Different y-axis (bottom panel).

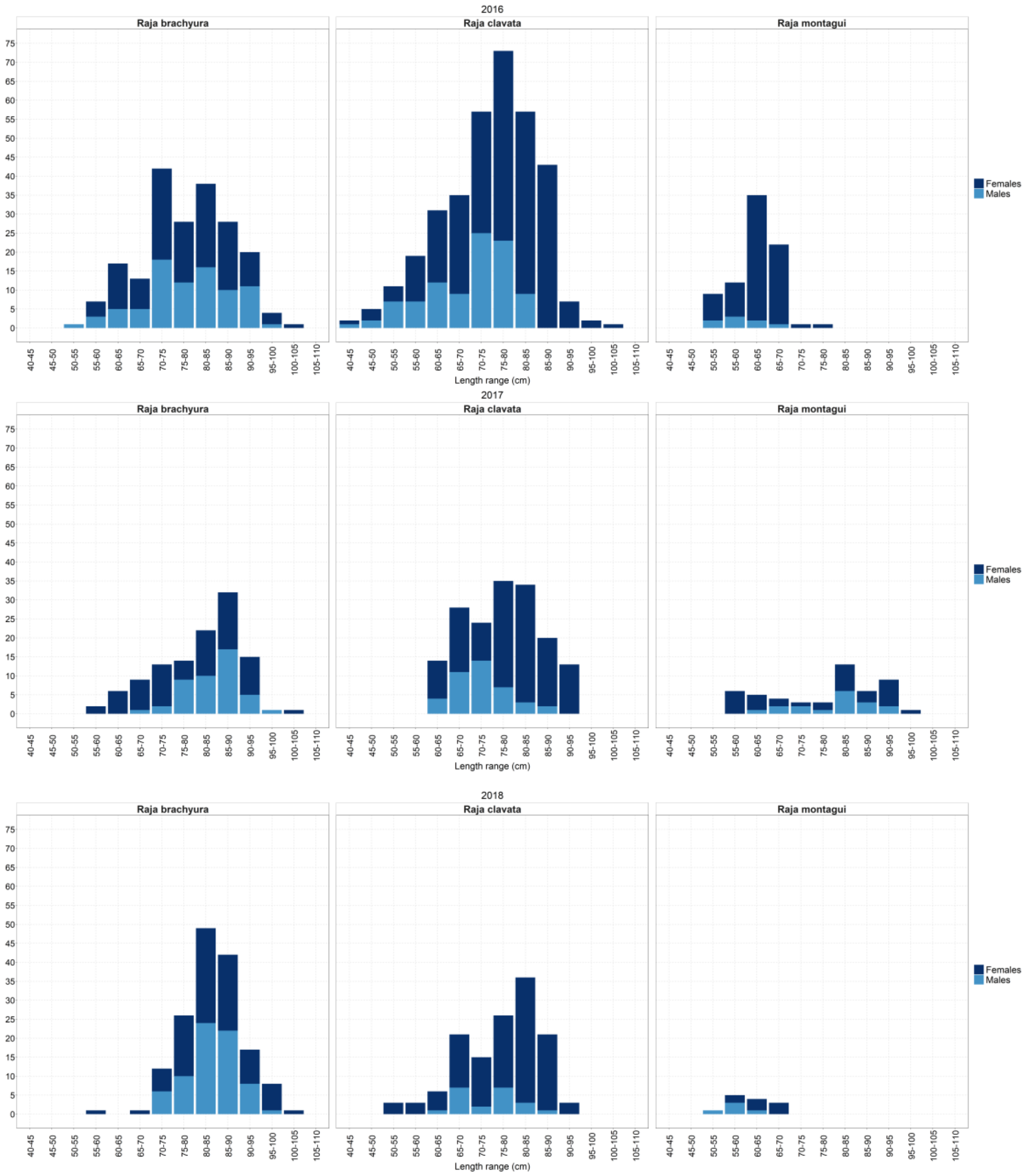

Figure 15.3.2. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Length–frequency distribution of *R. brachyura*, *R. clavata* and *R. montagui* measured during the market sampling programme of the Dutch beam trawl fleet in 2016–2020.

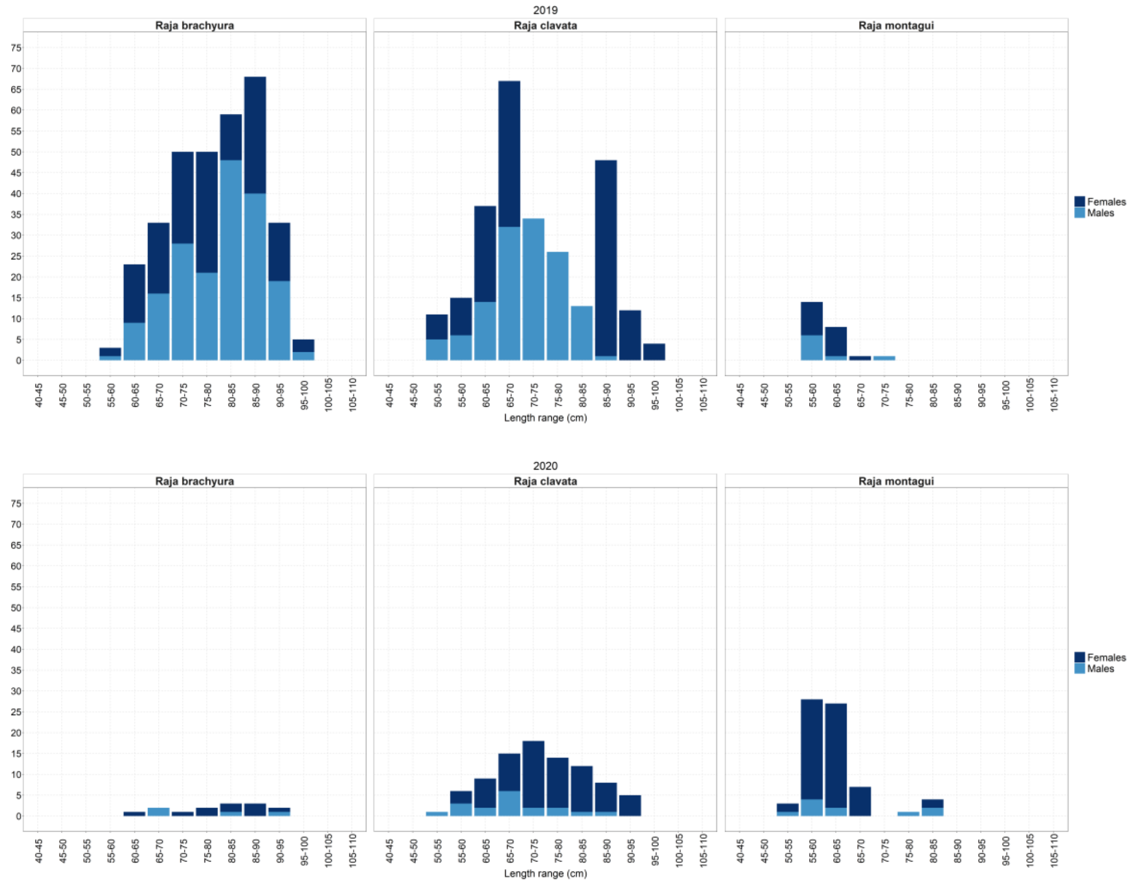

Figure 15.3.2 (continued). Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Length–frequency distribution of *R. brachyura*, *R. clavata* and *R. montagui* measured during the market sampling programme of the Dutch beam trawl fleet in 2016–2020.

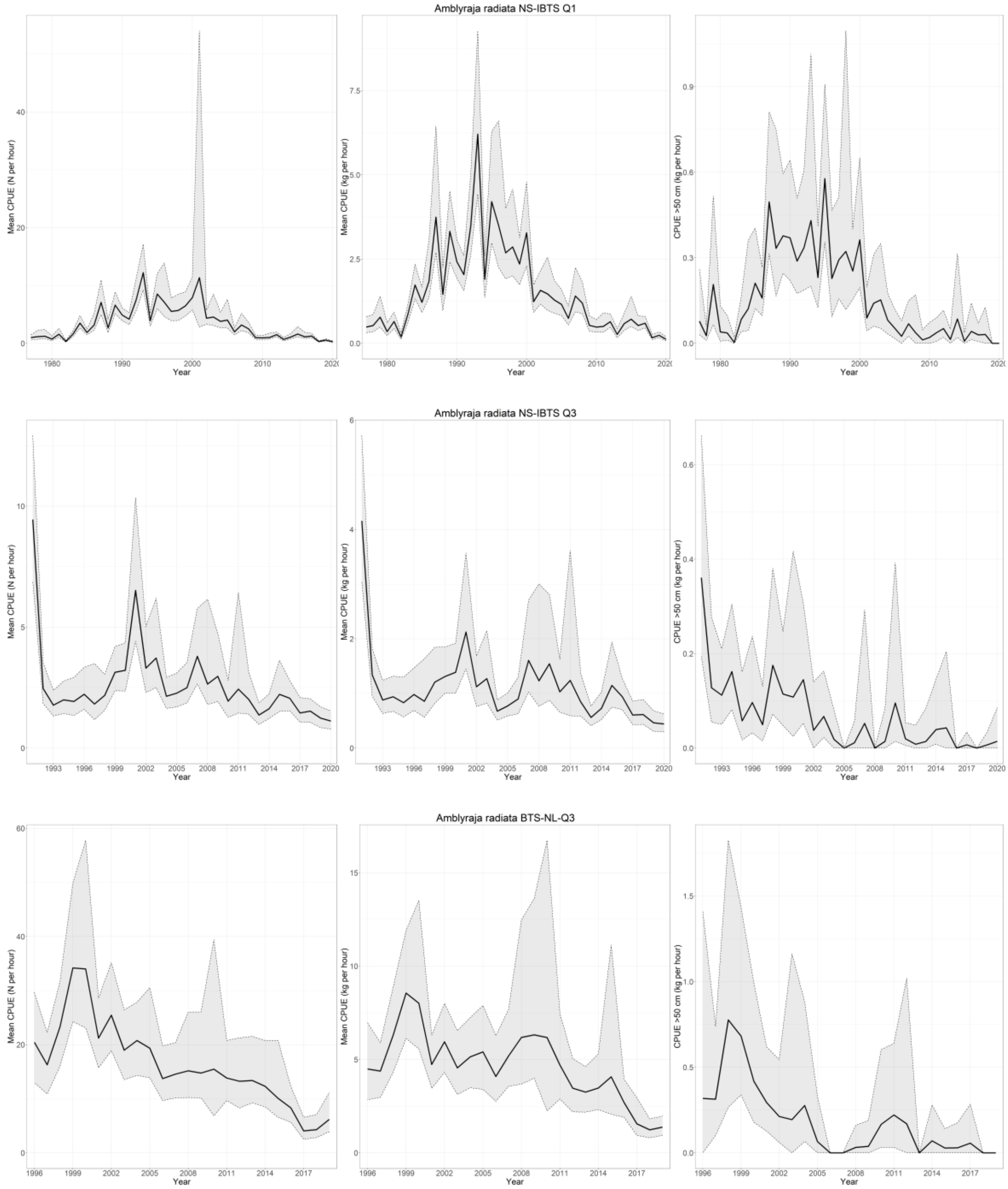

Figure 15.6.1. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. *Amblyraja radiata*. Abundance index (n. h^{-1}), biomass index ($kg.h^{-1}$) and exploitable biomass ($kg.h^{-1}$), with 95% confidence intervals, during the North Sea IBTS (in roundfish areas 1–7) and BTS in the years 1977–2020. Data extracted from the DATRAS database (selected for CPUE per length per haul) on 8 June 2021.

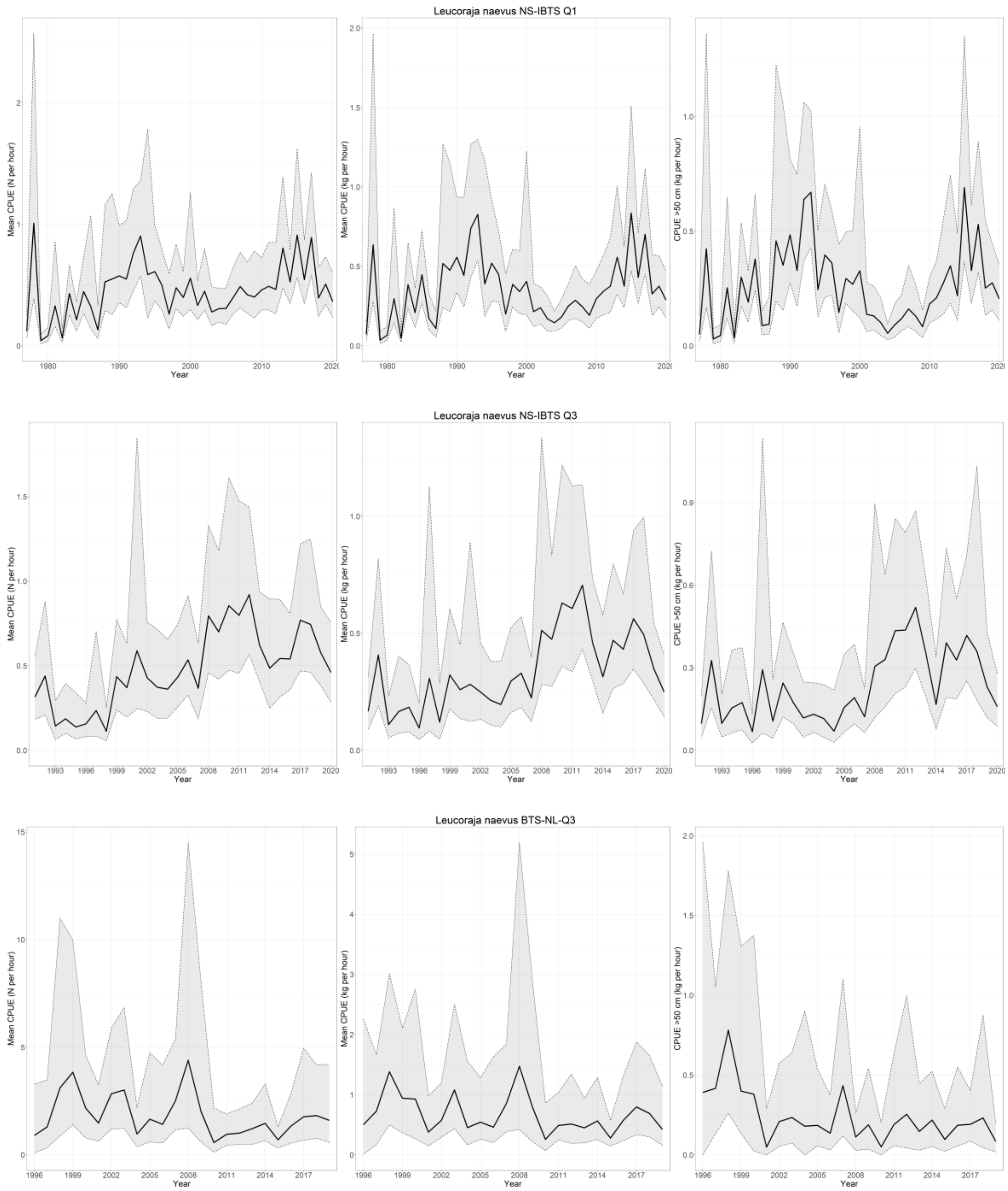

Figure 15.6.2. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. *Leucoraja naevus*. Abundance index ($n.h^{-1}$), biomass index ($kg.h^{-1}$) and exploitable biomass ($kg.h^{-1}$), with 95% confidence intervals, during the North Sea IBTS (in roundfish areas 1–7) and BTS surveys in the years 1977–2020. Data extracted from the DATRAS database (selected for CPUE per length per haul) on 8 June 2021.

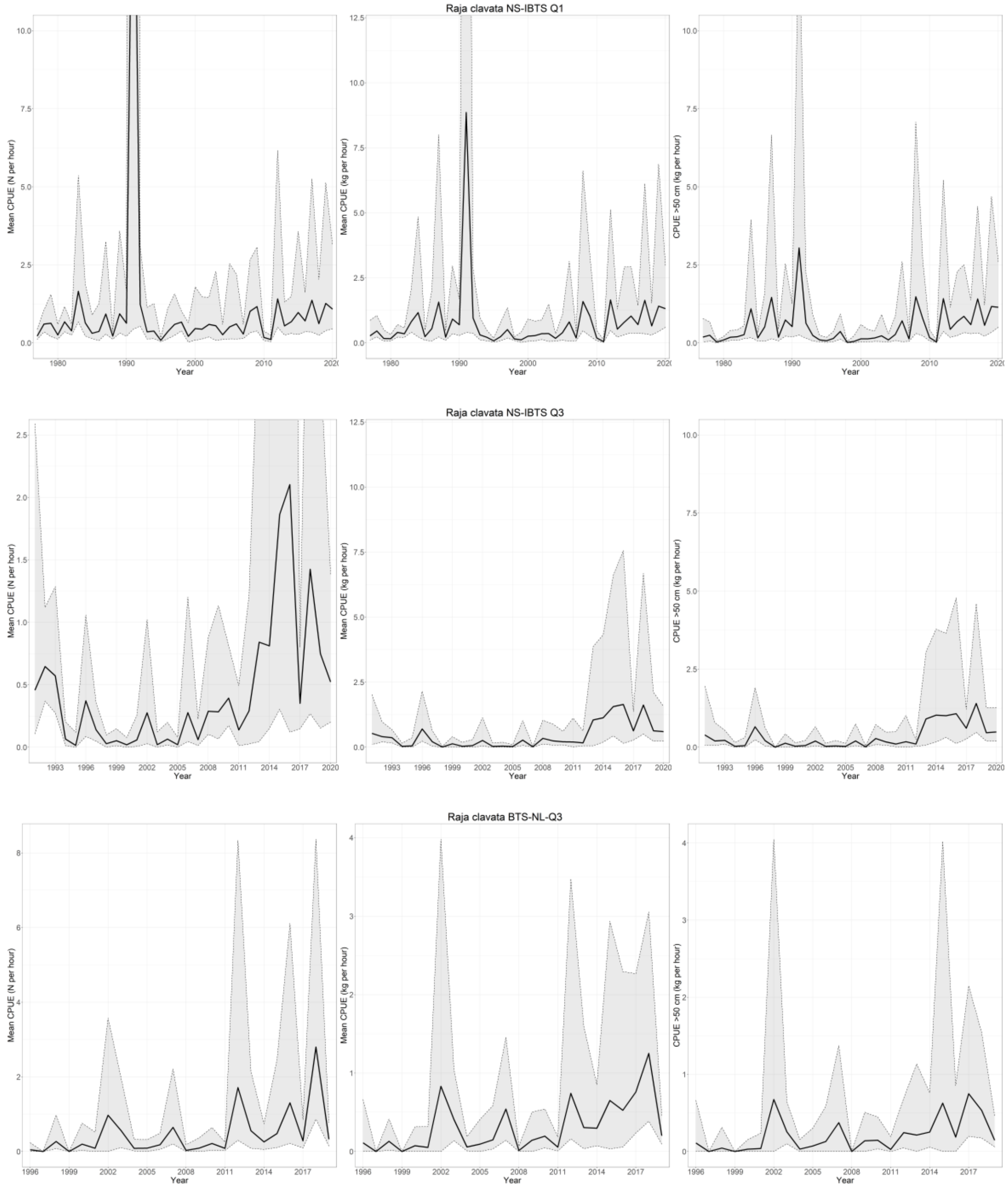

Figure 15.6.3. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. *Raja clavata*. Abundance index (n.h^{-1}), biomass index (kg.h^{-1}) and exploitable biomass (kg.h^{-1}), with 95% confidence intervals, during the North Sea IBTS (in roundfish areas 1–7), BTS, and CGFS-Q4 surveys in the years 1977–2020. Data for BTS-BEL-Q3 extracted from national database. Other data extracted from the DATRAS database, see Section 15.6.4 for details on data source.

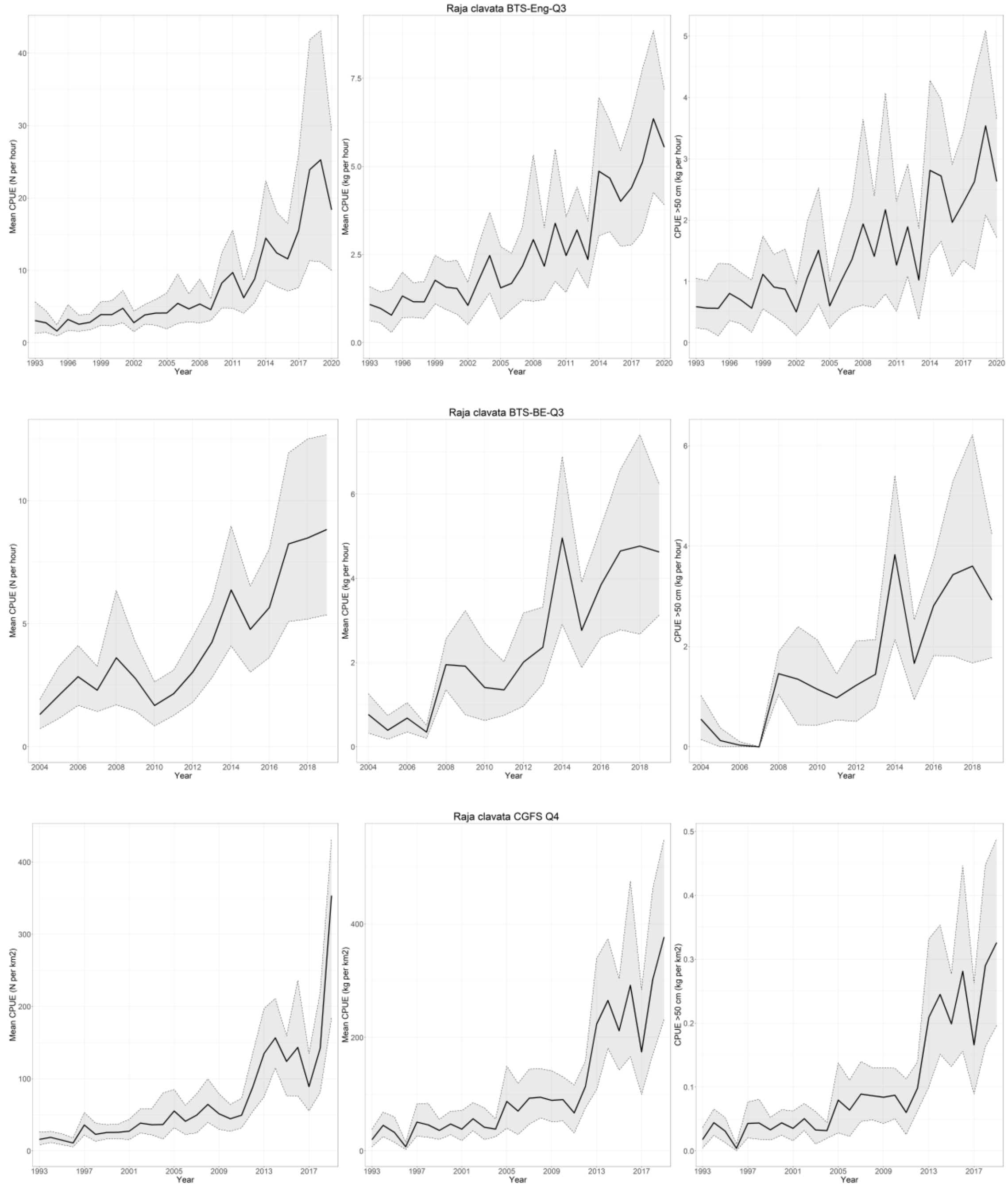

Figure 15.6.3 (continued). Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. *Raja clavata*. Abundance index (n.h^{-1}), biomass index (kg.h^{-1}) and exploitable biomass (kg.h^{-1}), with 95% confidence intervals, during the North Sea IBTS (in roundfish areas 1–7), BTS, and CGFS-Q4 surveys in the years 1977–2020. Data for BTS-BEL-Q3 extracted from national database. Other data extracted from the DATRAS database, see Section 15.6.4 for details on data source.

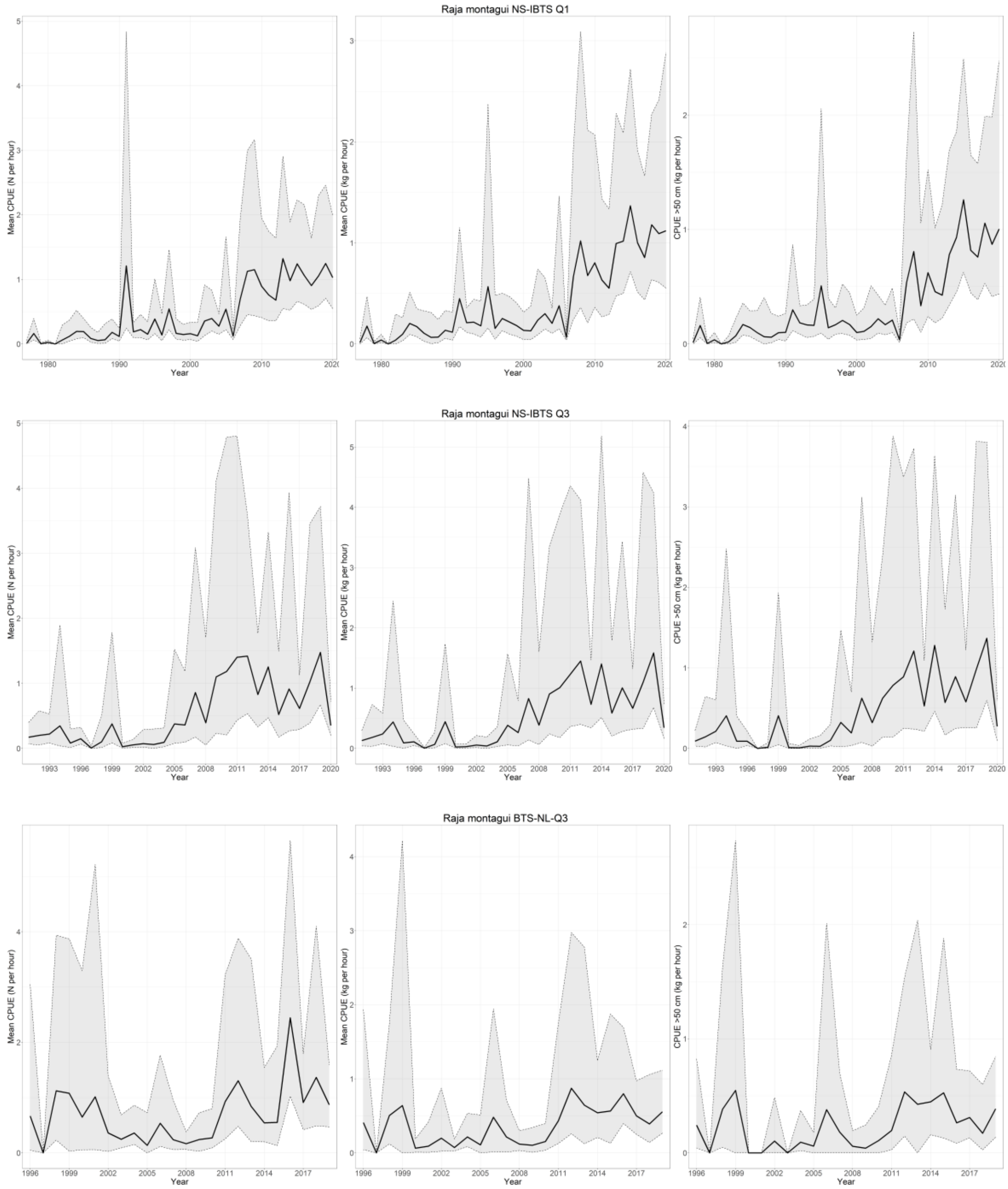

Figure 15.6.4. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. *Raja montagui*. Abundance index (n.h^{-1}), biomass index (kg.h^{-1}) and exploitable biomass (kg.h^{-1}), with 95% confidence intervals, during the North Sea IBTS (in roundfish areas 1–7) and BTS surveys in the years 1977–2020. Data for BTS-BEL-Q3 extracted from national database. Other data extracted from the DATRAS database, see Section 15.6.4 for details on data source.

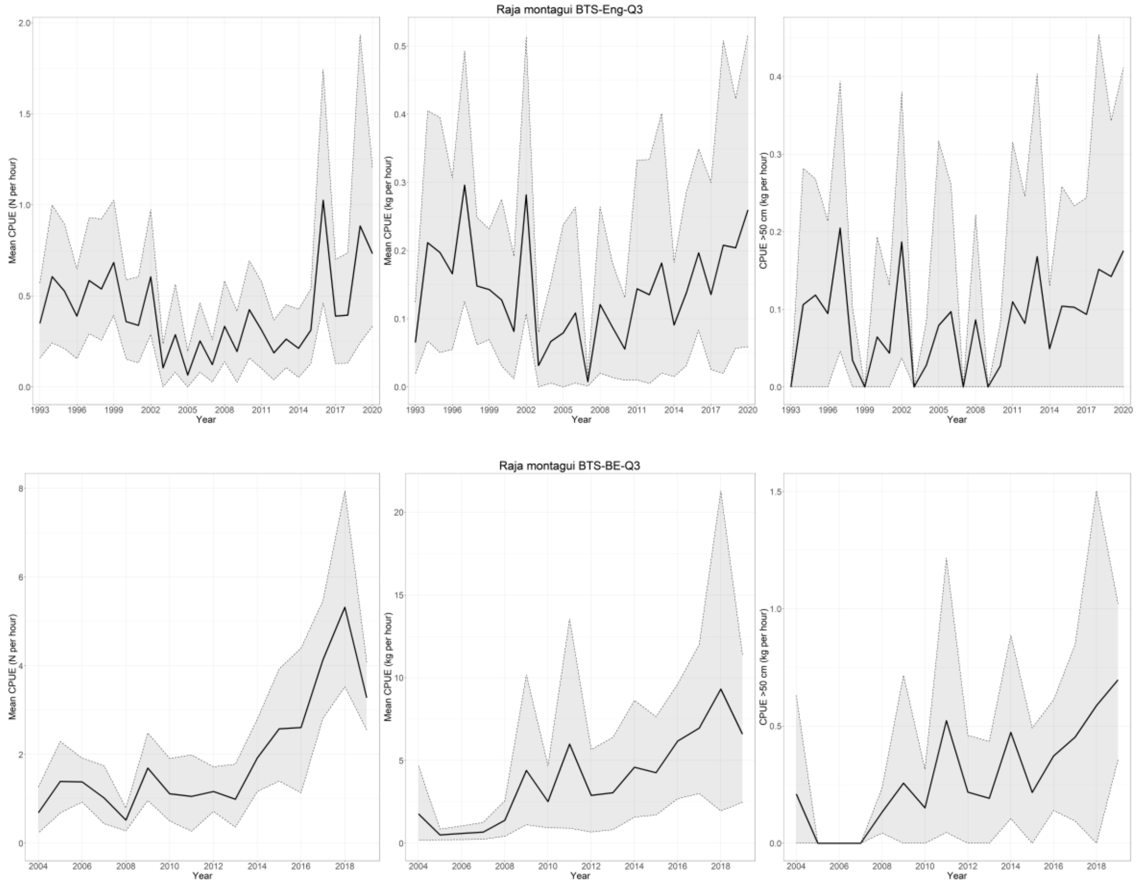

Figure 15.6.4 (continued). Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. *Raja montagui*. Abundance index (n.h^{-1}), biomass index (kg.h^{-1}) and exploitable biomass (kg.h^{-1}), with 95% confidence intervals, during the North Sea IBTS (in roundfish areas 1–7) and BTS surveys in the years 1977–2020. Data for BTS-BEL-Q3 extracted from national database. Other data extracted from the DATRAS database, see Section 15.6.4 for details on data source.

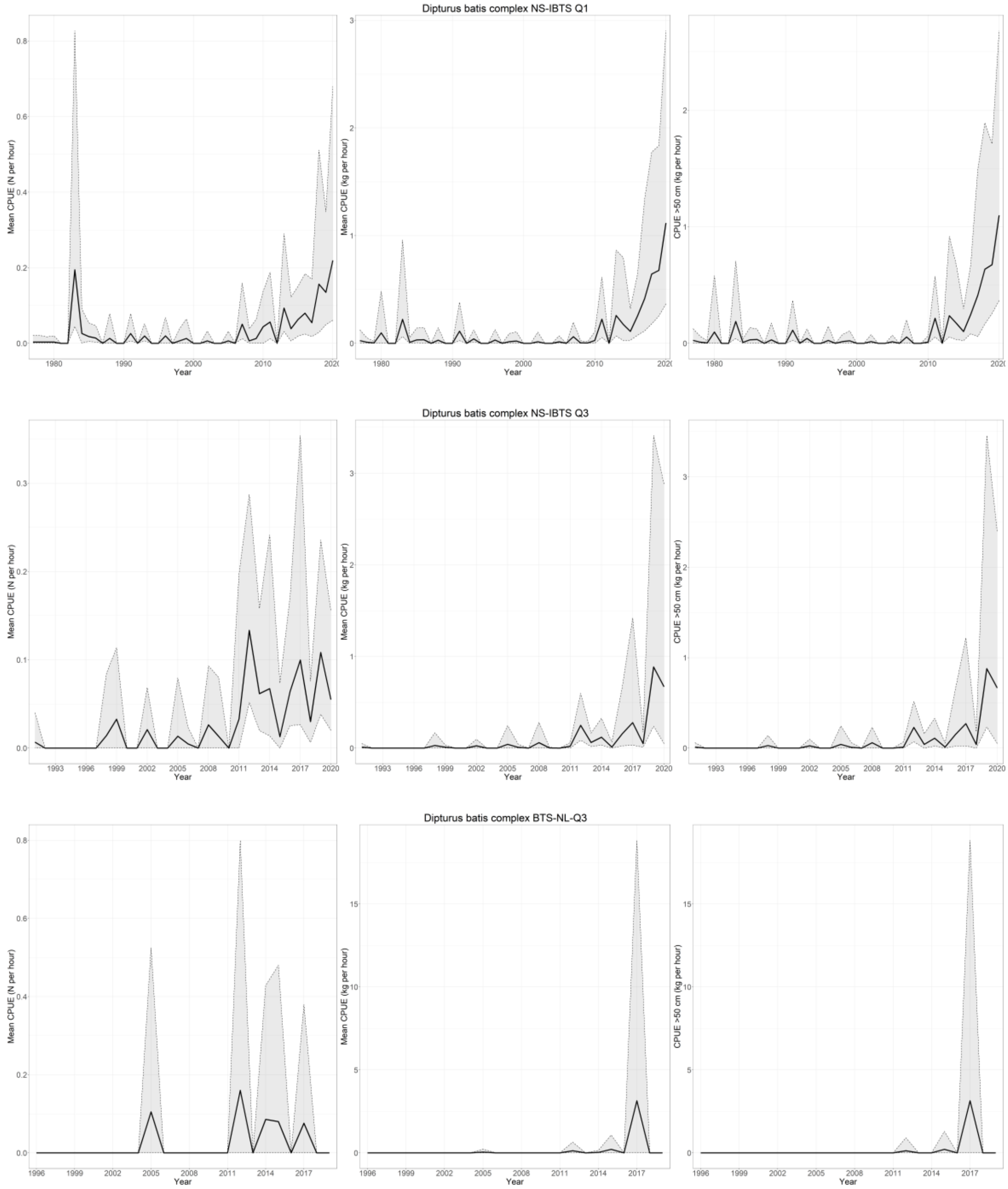

Figure 15.6.5. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. 'Common skate complex'. Abundance index (n.h^{-1}), biomass index (kg.h^{-1}) and exploitable biomass (kg.h^{-1}), with 95% confidence intervals, during the North Sea IBTS (in roundfish areas 1–7) and BTS surveys in the years 1977–2020. Data extracted from the DATRAS database (selected for CPUE per length per haul) on 8 June 2021.

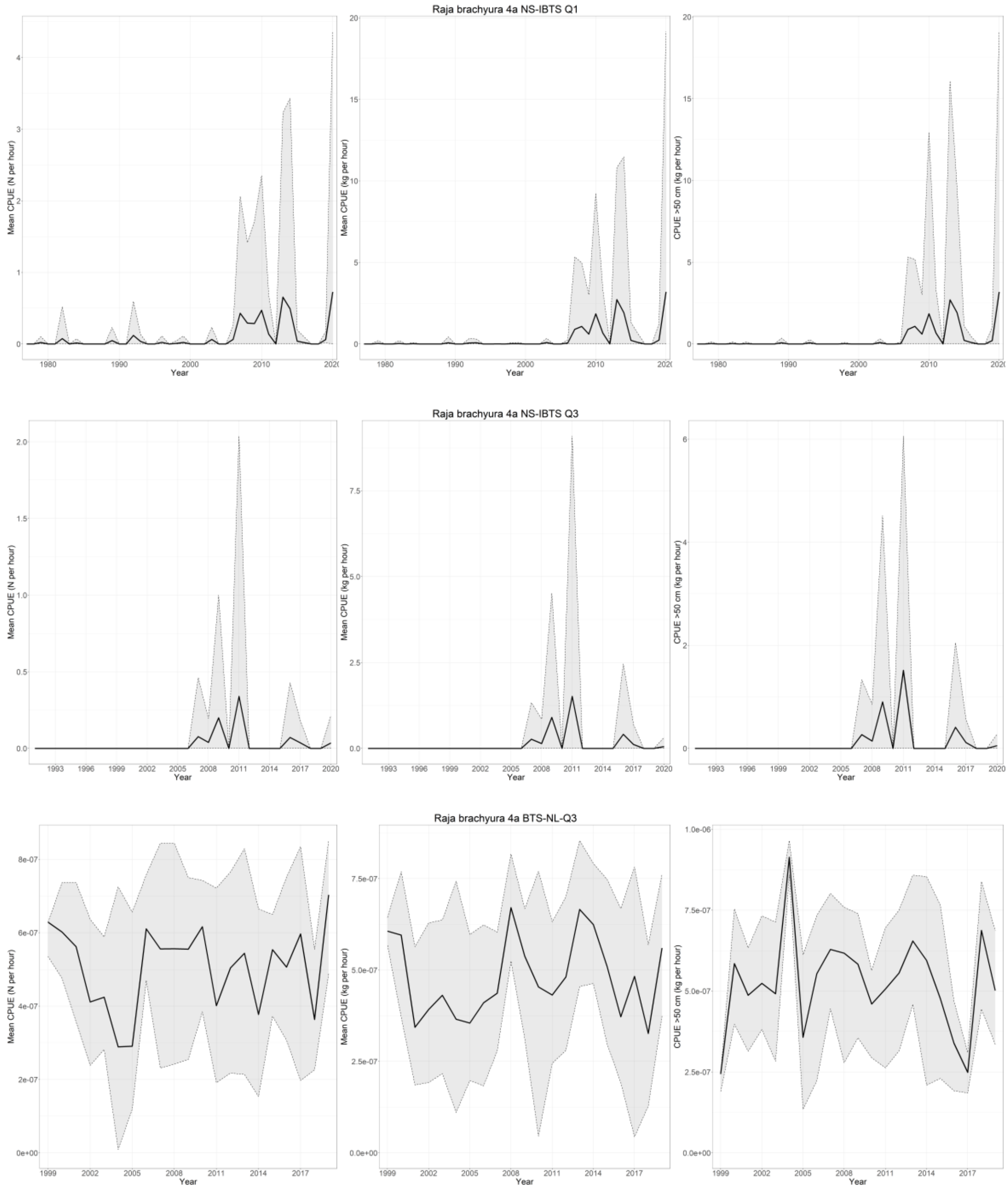

Figure 15.6.6. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. *Raja brachyura* in 4.a. Abundance index (n.h^{-1}), biomass index (kg.h^{-1}) and exploitable biomass (kg.h^{-1}), with 95% confidence intervals, during the North Sea IBTS (in roundfish areas 1–7) and BTS surveys in the years 1977–2020. Data extracted from the DATRAS database (selected for CPUE per length per haul) on 8 June 2021.

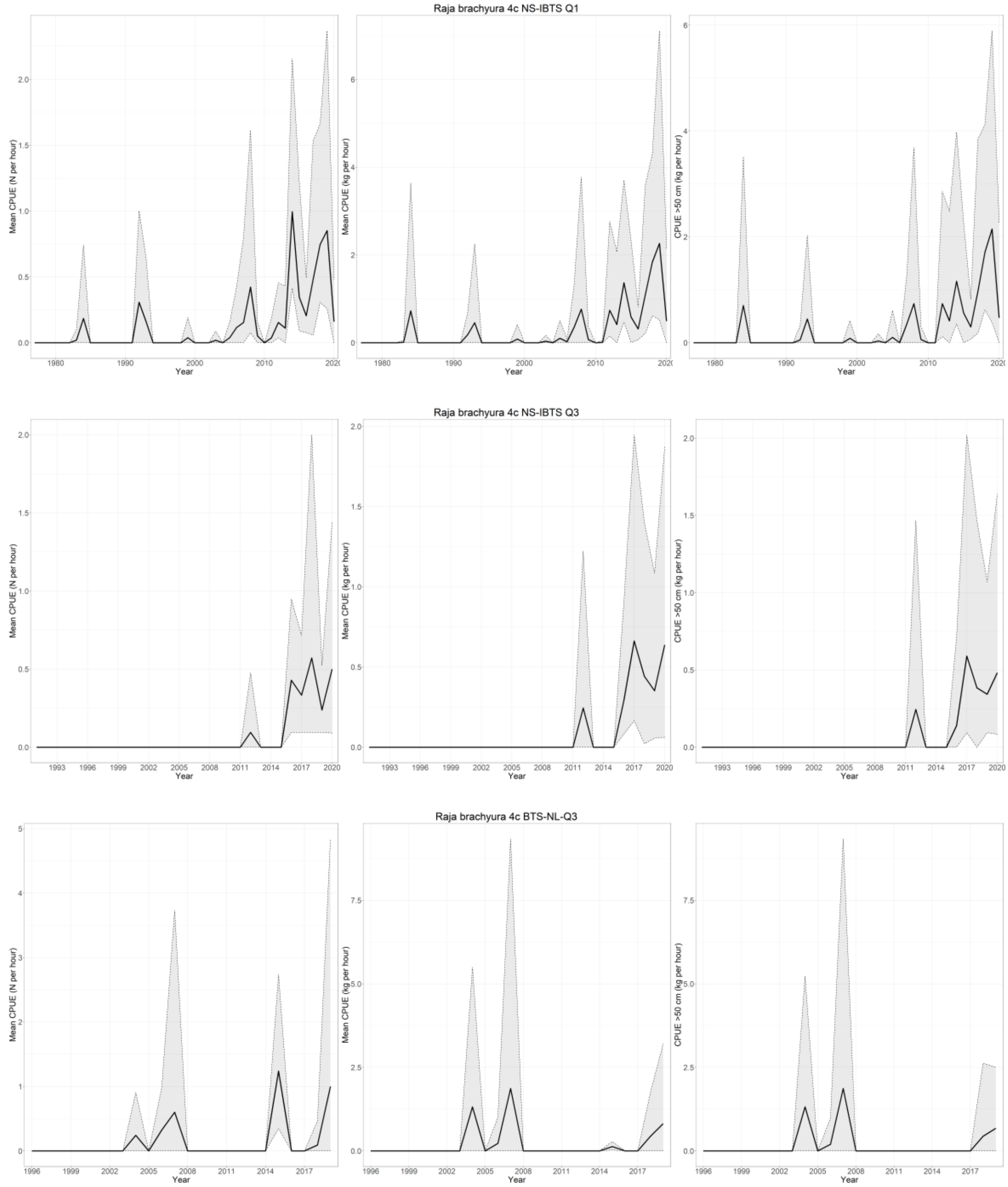

Figure 15.6.7. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. *Raja brachyura* 4.c. Abundance index (n.h^{-1}), biomass index (kg.h^{-1}) and exploitable biomass (kg.h^{-1}), with 95% confidence intervals, during the North Sea IBTS (in roundfish areas 1–7), BTS, and CGFS-Q4 surveys in the years 1977–2020. Data for BTS-BEL-Q3 extracted from national database. Other data extracted from the DATRAS database, see Section 15.6.4 for details on data source.

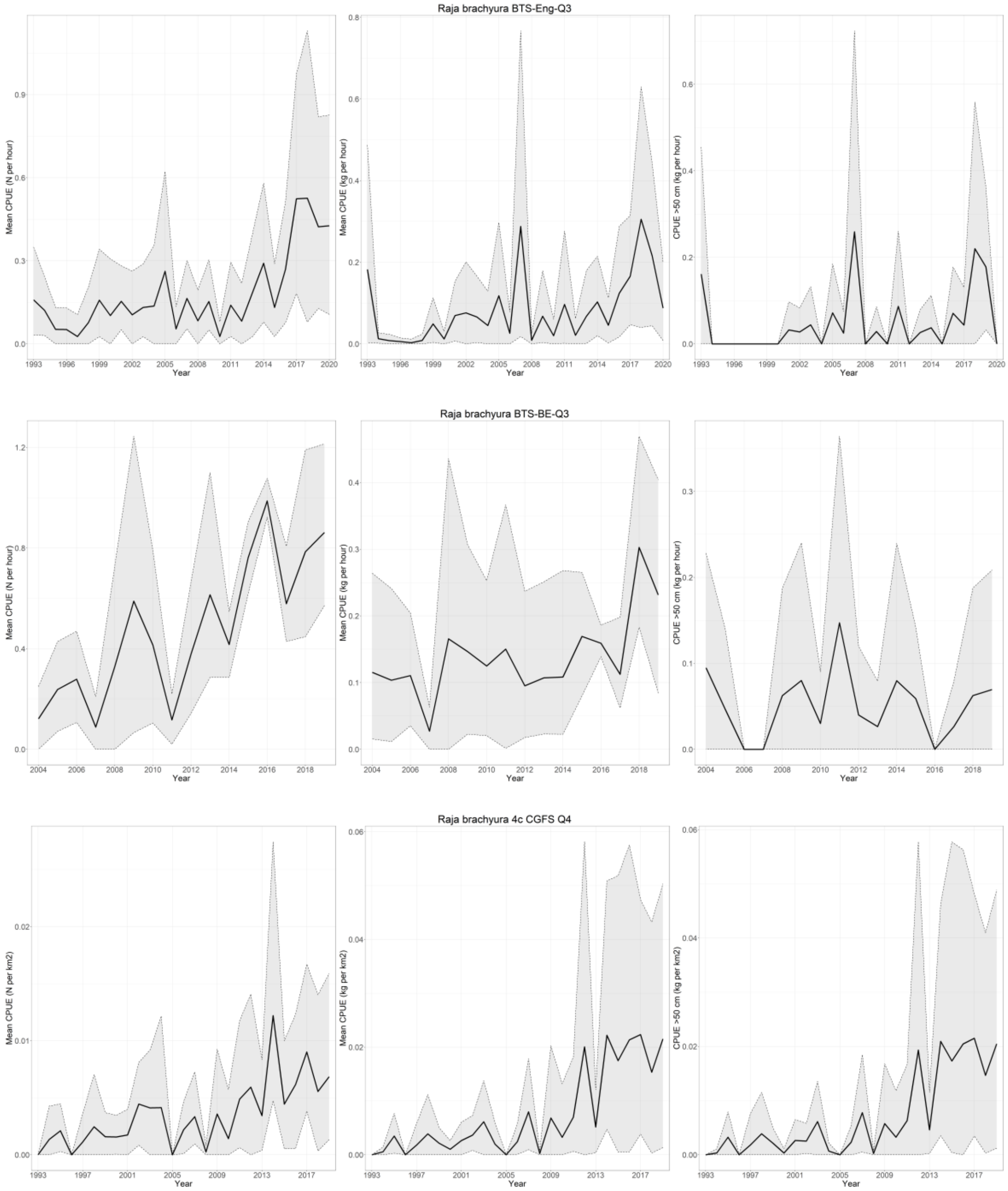

Figure 15.6.7 (continued). Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. *Raja brachyura* 4.c. Abundance index (n.h^{-1}), biomass index (kg.h^{-1}) and exploitable biomass (kg.h^{-1}), with 95% confidence intervals, during the North Sea IBTS (in roundfish areas 1–7), BTS, and CGFS-Q4 surveys in the years 1977–2020. Data for BTS-BEL-Q3 extracted from national database. Other data extracted from the DATRAS database, see Section 15.6.4 for details on data source.

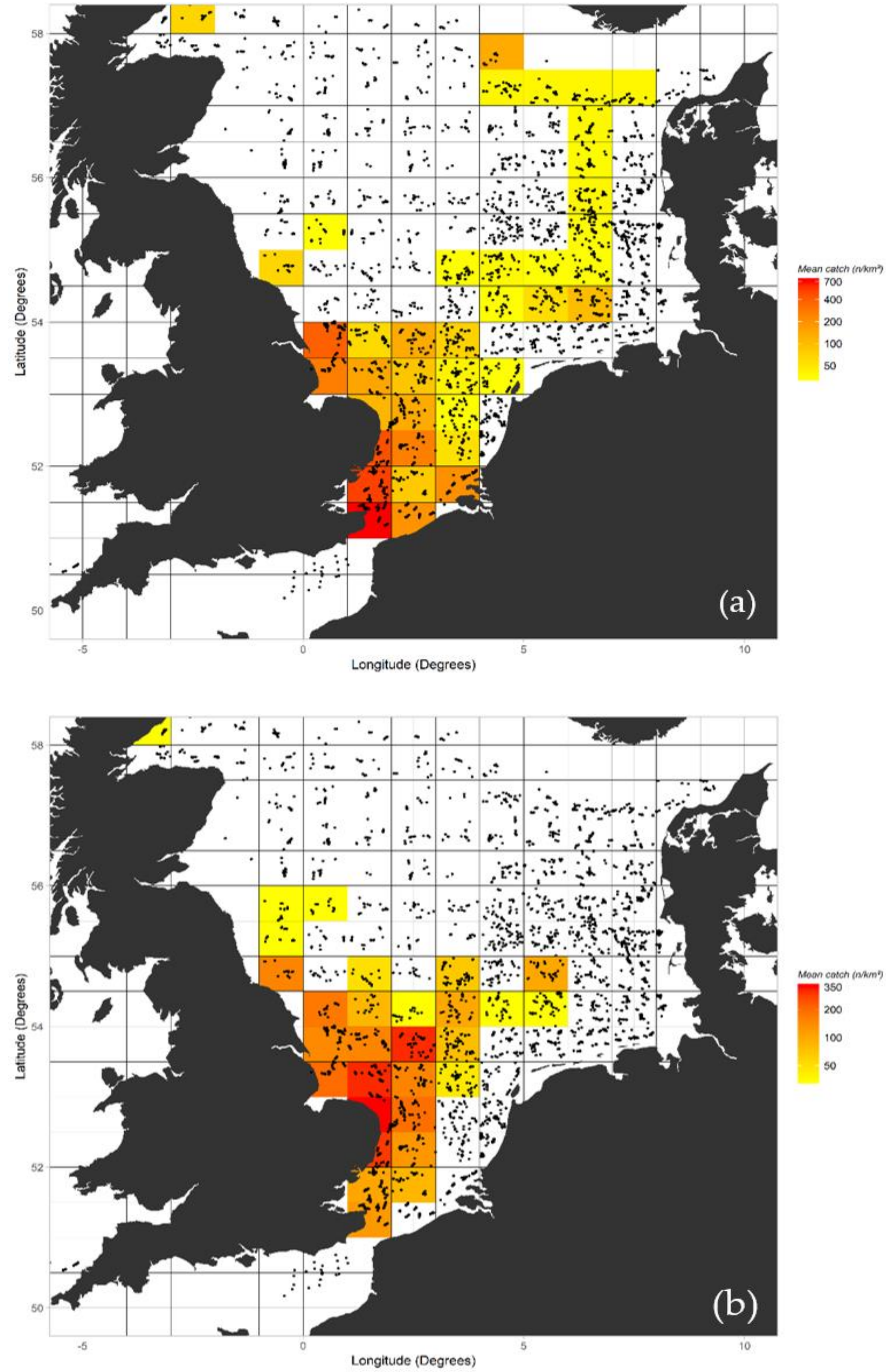

Figure 15.6.8. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Average (a) thornback ray and (b) spotted ray catches (n.km²) from all BTS surveys (German, Dutch and Belgian) in the central-southern North Sea (ICES Areas 27.4.b and 27.4.c) for the period 2004–2018. Black dots show the different shooting positions from the survey hauls over the entire period. Data extracted from DATRAS, except for the Belgian data between 2004 and 2009 which were provided from the national database at ILVO.

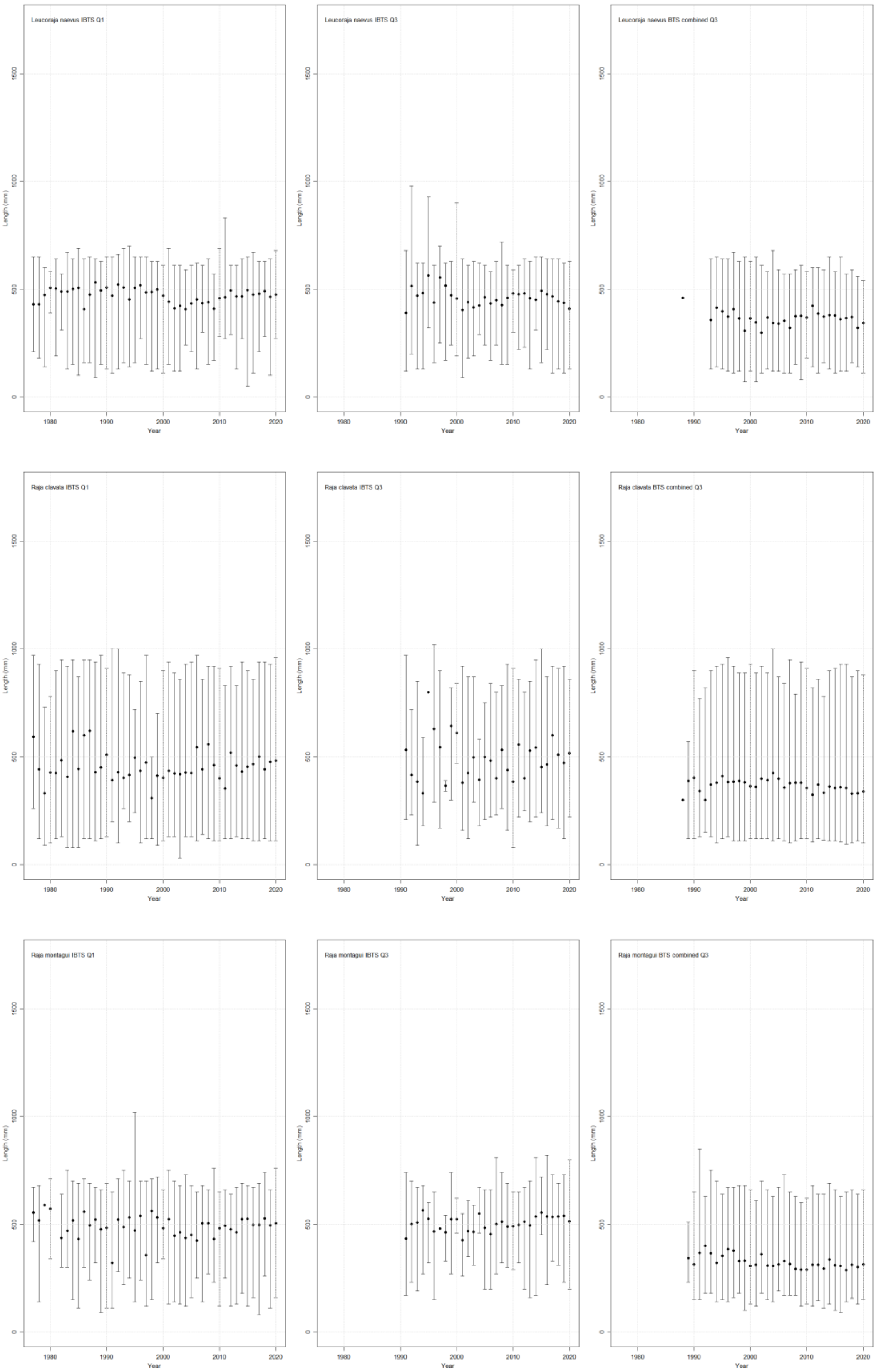

Figure 15.6.9. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Average length (dots) and length range during the North Sea IBTS (roundfish areas 1–7) and BTS surveys. Data extracted from the DATRAS database (selected for CPUE per length per hour) on 8 June 2021. NOTE: There are still some incorrect data in DATRAS, with some length records of all species (except *R. clavata*) that are above L_{max}.

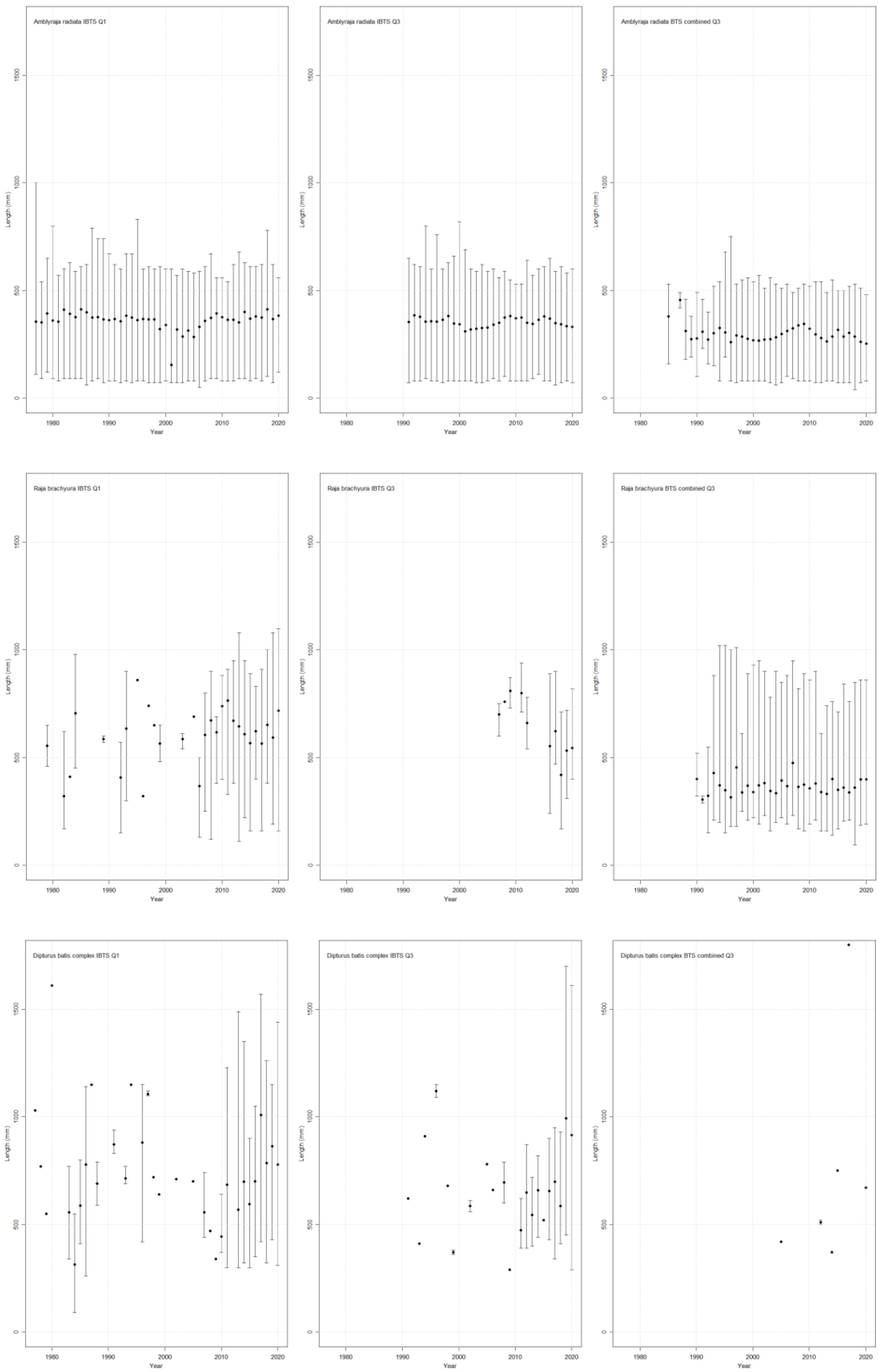

Figure 15.6.9 (continued). Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Average length (dots) and length range during the North Sea IBTS (roundfish areas 1–7) and BTS surveys. Data extracted from the DATRAS database (selected for CPUE per length per hour) on 8 June 2021. NOTE: There are still some incorrect data in DATRAS, with some length records of all species (except *R. clavata*) that are above L_{max}.

Figure 15.6.10. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Distribution plots of the main demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and Eastern Channel. Plots are based on IBTS-Q1, IBTS-Q3, and BTS data. Plots cover four periods: 1997–2002 (left panels), 2003–2008 (centre-left panels), 2009–2014 (centre right panels) and 2015–2020 (right panels). All data are extracted from DATRAS. Data for IBTS are extracted as CPUE per length per hour) on 8 June 2021. CGFS-Q4 data are not included in the plots. Bubble scale is equal in all panels.

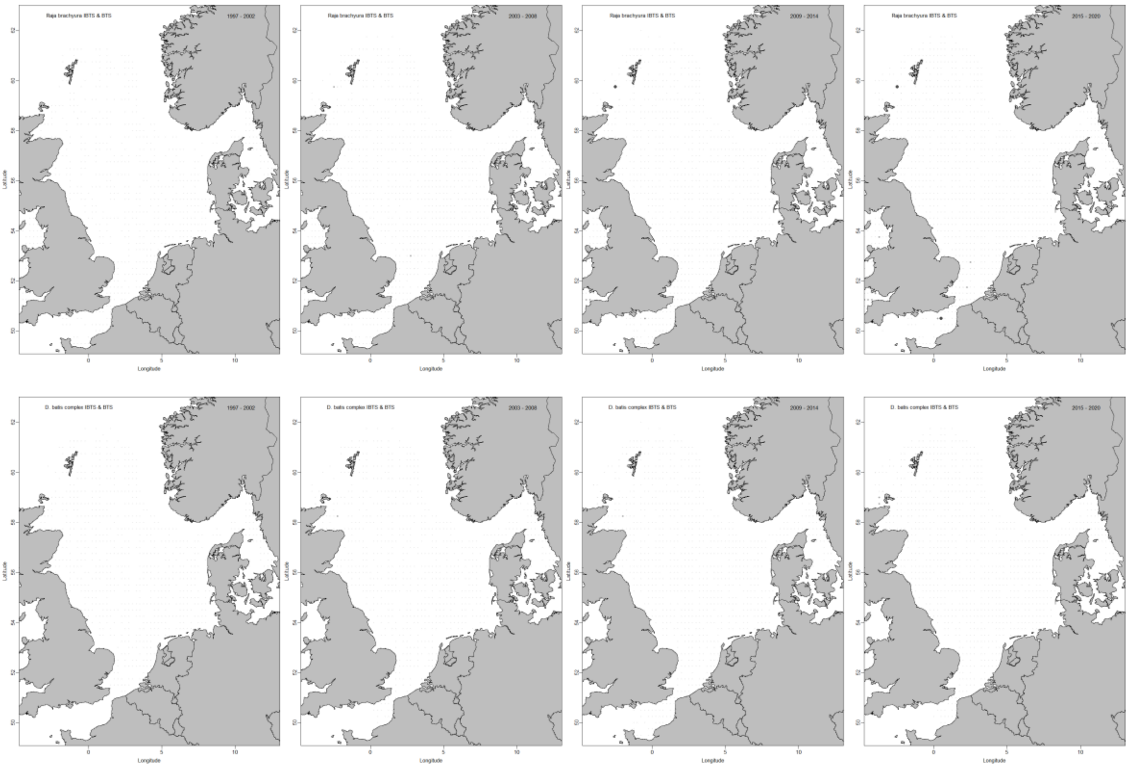

Figure 15.6.10 (continued). Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Distribution plots of the main demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and Eastern Channel. Plots are based on IBTS-Q1, IBTS-Q3, and BTS data. Plots cover four periods: 1997–2002 (left panels), 2003–2008 (centre-left panels), 2009–2014 (centre right panels) and 2015–2020 (right panels). All data are extracted from DATRAS. Data for IBTS are extracted as CPUE per length per hour) on 8 June 2021. CGFS-Q4 data are not included in the plots. Bubble scale is equal in all panels.

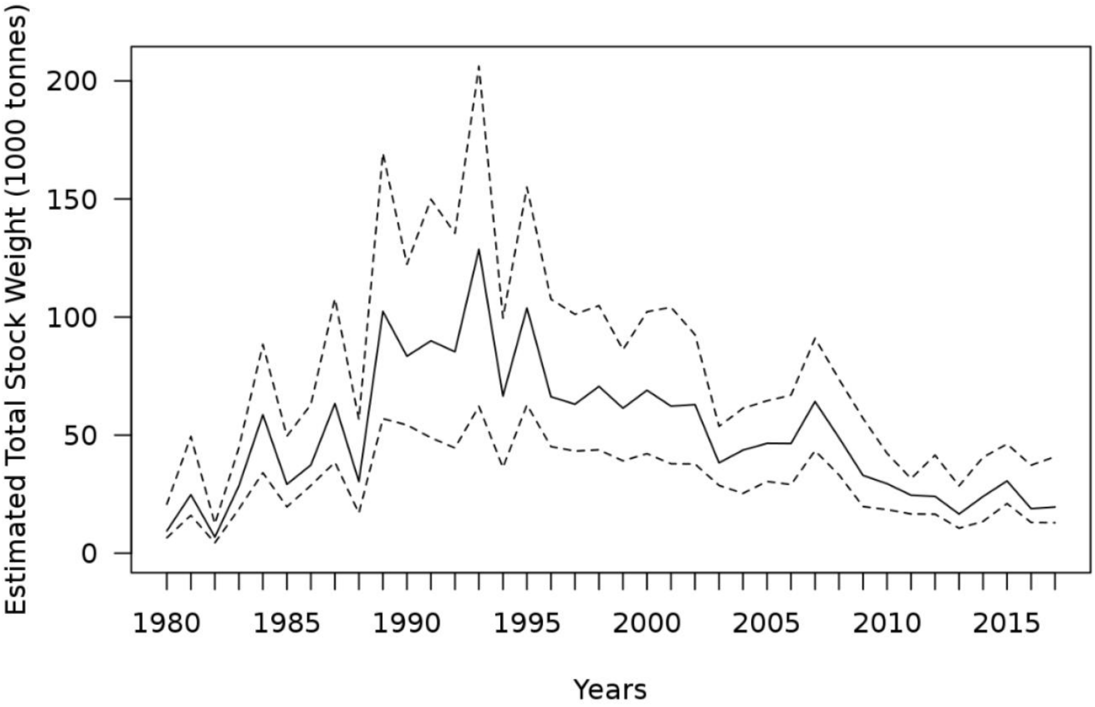

Figure 15.8.1. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Estimated total stock weight of starry ray (*Amblyraja radiata*) (median – solid line, in 1000 tones) and associated uncertainty (0.025 and 0.975 quantile – lower and upper dotted line). Source: van Overzee *et al.* 2019.