26 Common skate

26.1 Available data relating to skates of the genus *Dipturus*

This updated section addresses the ToR from 2021 "*Evaluate available data at species-specific level within the common skate-complex (Dipturus spp.) stock units in order to further increase our understanding of each individual species and their current status*".

Given that identification issues relating to the common skate complex may also extend to long-nosed skate *Dipturus oxyrinchus* and Norwegian skate *D. nidarosiensis*, data relating to these species have also been considered where available.

26.1.1 Background

The flapper skate *Dipturus intermedius* (Parnell, 1837) was, as *Raia intermedia*, described originally by Parnell (1837), from specimens caught in the Firth of Forth, on the Scottish east coast. A more detailed description was given in a subsequent account of the fishes of the Firth of Forth (Parnell, 1838). Parnell (1838) considered flapper skate to be "*the connecting link"* between *Raia batis* [=*Dipturus batis*] and *'Raia oxyrhynchus'*, though it should be noted that, based on his description of *R. oxyrhynchus,* Parnell (1838) was discussing white skate *Rostroraja alba* rather than long-nosed skate *Dipturus oxyrinchus.*

Parnell (1838) highlighted the following distinguishing features:

Dipturus intermedius: "*… the upper surface of the body being perfectly smooth, without granulation, and of a dark olive colour spotted with white; in the anterior part of each orbit being furnished with a strong spine pointing towards the tail; in the dorsal fins being more remote from each other, and in the anterior margins of the pectorals rather more concave, giving the snout a sharper appearance*".

Dipturus batis: "*… the upper surface of the body is rough to the touch, of a uniform dusky grey without spots; the orbits without spines; the dorsals nearly approximate, and the anterior margins of the pectorals nearly straight*".

In a revision of the European skates, Clark (1926) synonymised flapper skate with the common skate, and this perception continued in the scientific literature and field guides (e.g. Stehmann and Bürkel, 1984) for much of the 20th century and early 21st century, over which time data for the two species could have been confounded, including survey data, biological investigations (e.g. Heintz, 1962; Du Buit, 1976) and landings data (e.g. Silva *et al.*, 2012).

Iglésias *et al.* (2010), after undertaking genetic and morphological studies of the large skates being landed in France, confirmed that what was known as 'common skate' was indeed a complex, with this paper suggesting the two species be known as blue skate *Dipturus* cf. *flossada* (Risso, 1826) and flapper skate *Dipturus* cf. *intermedia* (Parnell, 1837).

Iglésias *et al.* (2010) also provided morphometric data and described other morphological features that could help separate the two species, although it should be noted that some of these features are not apparent in juvenile stages. In terms of morphometrics, Iglésias *et al.* (2010) observed that, proportionally, *Dipturus intermedius* had a longer preorbital length; eyes larger; distance from the anterior margin of the orbit to the posterior end of the spiracle is longer; narrower inter-orbital distance; longer inter-spiracular distance; longer inter-dorsal space; and longer snout. The distinguishing morphological features and contrasting life-history parameter, as reported by Iglésias *et al.* (2010), are summarised in Table 26.1.

A subsequent study by Griffiths *et al.* (2010) confirmed the genetic differences within the common skate complex, and provided initial geographical information, with what would equate with flapper skate occurring in the shelf seas west of Ireland, west of Scotland and Shetland Islands, and what would equate with common blue skate occurring on the Rockall Bank, west of Ireland and Celtic Sea. The two species, therefore, have a degree of spatial overlap.

Subsequent taxonomic accounts (e.g. Ebert and Stehmann, 2013[1]; Weigmann, 2016) recognised that the common skate complex comprised two species. However, given that '*batis*' was a Linnean name, this part of the nomenclature was retained, with the scientific name for flapper skate based on the original description by Parnell (1837).

The nomenclature of the common skate complex was stabilised by Last *et al.* (2016), using the names common blue skate *Dipturus batis* (L., 1758) and flapper skate *Dipturus intermedius* (Parnell, 1837). Following this taxonomic revision, an FAO code was introduced for flapper skate (DRJ) which allowed for separation from common blue skate (RJB), although earlier data reported under the latter code would clearly relate to both species.

ICES had previously been requested to provide further information on the distributions of the two species, which was through a Special Request to the EC (ICES, 2012). Whilst some of the current locations of the individual species are becoming better documented, there is still uncertainty in their broader distributions, especially in northern areas (Subarea 2), Icelandic waters (Division 5.a), the Mid-Atlantic Ridge (Division 12), Azores (Division 10) and southern geographical limits in the Biscay-Iberian area (Divisions 8–9).

That *Dipturus intermedius* is most frequent around the western and eastern coasts of Scotland has been supported by the increasing number of scientific studies from these areas (Wearmouth and Sims, 2009; Neat *et al.*, 2015; Benjamins *et al.*, 2018a, 2018b, 2021; Phillips *et al.*, 2021), and, whilst *Dipturus batis* is the more abundant species in the Celtic Sea (Bendall *et al.*, 2012; Brown-Vuillemin *et al.*, 2020), there have also been studies on this species from Scottish waters (e.g. Beard, 1890).

Whilst *"Dipturus batis"* have nominally been reported from more northerly waters of the ICES area, including the Norwegian Sea and Barents Sea (Andriyashev, 1954; Dolgov *et al.*, 2005a, 2005b; Williams *et al.*, 2008), published species-specific data following the recent taxonomic revision are more limited. For example, *D. batis* was not included in the recent atlas of Barents Sea fishes (Wienerroither *et al.*, 2013). In addition to potential, earlier confusion with other *Dipturus* spp., there is also potential for confusion between the common skate complex with spinetail ray *Bathyraja spinicauda*, which also attains a large size (170–180 cm), and the ventral surface of which has a grey margin (Ebert and Stehmann, 2013). The probable incorrect identifications of the common skate complex in northern Norwegian waters was also highlighted by Lynghammar *et al.* (2014), though that study confirmed the occurrence of *D. intermedius* in Norwegian waters.

There have also been nominal records of "*Raja batis*" or "*Dipturus batis"* from the Mid-Atlantic Ridge (e.g. Hareide and Garnes, 2001) and Azores. In terms of the Azores, Santos *et al.* (1997) had previously stated that "*The occurrence of this species in the region needs further documentation*", and whilst there have been subsequent studies referring to the complex (e.g. Menezes *et al.*, 2006; Rosa *et al.*, 2006; Santos *et al.*, 2020), it is uncertain which of the species occurs there.

Whilst earlier accounts generally indicted that "*Dipturus batis*" occurred in the Mediterranean Sea, recent studies have provided limited information regarding whether the complex occurs there (Capapé *et al.*, 2006; Cariani *et al.*, 2017; Serena *et al.*, 2020). Indeed, despite numerous published accounts from the Mediterranean Sea confirming the presence of both *Dipturus oxyrinchus*

[1] Ebert and Stehmann (2013) also recognised an as yet undescribed *Dipturus* sp. from the deeper waters of the NE Atlantic, that is characterised by having notably long and pointed anterior pelvic fin lobes.

(Yigin & Ismen, 2010; Kadri *et al.*, 2015; Mulas *et al.*, 2015; Bellodi *et al.*, 2017; Melis *et al.*, 2018) and *Dipturus nidarosiensis* (Cannas *et al.*, 2010; Follesa *et al.*, 2012; Ramírez-Amaro *et al.*, 2017; Carbonara *et al.*, 2019; Geraci *et al.*, 2019), there seem to no published data that confirms whether either *Dipturus batis* or *Dipturus intermedius* occur in the area. Whilst some recent papers from Mediterranean samples have considered *D. batis* (e.g. Turan, 2008; Benmeslem *et al.*, 2019), the accuracy of the species identification is uncertain and the former study likely relates to *D. oxyrinchus*. In terms of potential historical occurrence, the re-examination of any relevant museum specimens could usefully be undertaken. With increased uncertainty regarding the contemporary occurrence of the 'common skate complex' in the Mediterranean, an improved appraisal of historical information is required, especially since the earlier proposed nomenclature for blue skate (*Dipturus* cf. *flossada*) was based on a description from the Mediterranean coast of France (Risso, 1926; Table 26.2). It is also noteworthy that genetic studies suggest that *Dipturus oxyrinchus* from the Mediterranean and Atlantic are genetically distinct (Griffiths *et al.*, 2011).

The information and distributional data in the available IUCN Red List assessment for common skate (Dulvy *et al.*, 2006) related to the species complex, and separate Red List assessments for common blue skate and flapper skate are currently being finalised. However, the exact distributions of both species remain unclear. Given that many data sources have confounded the two species (and it should also be recognised that taxonomic misidentifications may also affect other members of the genus, including long-nosed skate *Dipturus oxyrinchus* and Norwegian skate *Dipturus nidarosiensis*), improved speciation and validation of the distributional data for all species are required.

The biological stock units for both *D. batis* and *D. intermedius* are also little known, with ICES providing advice for the members of the complex at the ecoregion level. Whilst tagging data are limited, available data do not indicate large-scale movements (e.g. Sutcliffe, 1994; Fitzmaurice *et al.*, 2003; Bird *et al.*, 2020), with Fitzmaurice *et al.* (2003) reporting the longest minimum distance travelled being 120 miles.

Species Distribution Models have indicated that the distribution of *Dipturus intermedius* (in the waters around Scotland) are, among other factors, influenced by distance from shore and depth (Pinto *et al.*, 2016). This study reported that *D. intermedius* appeared to favour waters of 100–400 m that were also relatively close to land, including sea lochs and around islands. In relation to water temperature, Frost *et al.* (2020) reported that *D. batis* occurred in waters of 7.44–13°C and *D. intermedius* in waters of 4.96–15.5°C, with the latter species occurring over a broader temperature range. However, it should be recognised that this study was based primarily on data from the Rockall Bank, Hebridean Shelf and Celtic Sea, and inclusion of other parts of the species' ranges could usefully be considered in future studies.

26.1.2 Synopsis of Icelandic data

This Section was based on the results presented at a recent ICES ASC by Pálsson & Jakobsdóttir (2018) in a poster entitled "*The Flapper or the Blue? D. batis complex in Icelandic waters*". The data presented in this study included the length-distribution from surveys (Figure 26.1), with the majority of samples <160 cm L_T, which was in accordance with the likely length-frequency distribution of *Dipturus batis*. The estimated lengths-at-maturity (Figure 26.2) were 115 cm (males; n = 294) and 119 cm (females; n = 340), and these values were also consistent with the earlier estimates for *D. batis* given by Iglésias *et al.* (2010). Laboratory examination of some retained specimens also indicated that they matched the descriptions provided by Iglésias *et al.* (2010) for common blue skate.

Consequently, available information indicates that the common skate complex in Icelandic waters (Division 5.a) includes *D. batis* only, and that the species is distributed mainly along the southern coasts of Iceland (Figure 26.3).

26.1.3 Synopsis of Norwegian data

Lynghammar *et al.* (2014) reported on the confirmed presence of one individual of *Dipturus intermedius* from the area (65 kg female caught at 58.633°N, 3.917°E in February 2009; Lynghammar, pers. comm.). There have also been some subsequent records of *D. intermedius* from Norwegian waters, including west off Bud, off Florø, near Vatlandsvåg, in the Flekkefjord and off the coasts of southern Norway; Lynghammar, pers. comm.). These records confirm the presence of *Dipturus intermedius* in Norwegian waters of Division 2.a, Subarea 4 and Division 3.a.

26.1.4 Synopsis of data from CEFAS surveys

26.1.4.1 Data available and methods

Ellis and Silva (2021 WD10) summarised those data relating to *Dipturus* that are held on the CEFAS' Fishing Survey System (FSS) database, from both historic and recent surveys, as well as additional data from recent fishery-dependent surveys (2014–2017). Available data relating to the spatial distribution, length and sex composition, and biological parameters from this WD are provided below.

Data relating to the genus *Dipturus* were extracted from the FSS database (08/06/2021), including data for *Dipturus batis, Dipturus intermedius, Dipturus oxyrinchus* and *Dipturus nidarosiensis* (Table 26.3). These data relate to all records available from east of the Mid-Atlantic Ridge and related to data collected over the period 1901–2021, including lengths and biological information (sex, maturity, wing width) for some of the records. This study analysis was conducted using R software (R Core Team, 2020). These data were largely taken as they were recorded with this study as a preliminary overview of the data currently hold and, therefore, further QA/QC procedures should be undertaken if more detailed analyses are required.

Records were summarised according to how catch was processed (e.g. weighed and measured) to account for differences in historical data compared to recent data. Data for the common skate complex (SKT) only relates to the records where specimens were not identified and/or allocated to a specific species. Although, only recently has FSS been able to accommodate these two species separately (SKG and SKF) when recording the catch, there was a brief recent period where although catch records were recorded to the common skate-complex, when collecting additional information on individual weight and maturity, the identification to species-specific was described on a comments field within the database, and therefore a retrospective re-allocation of these individuals to the particular species was possible (these amendments still need to be made to the original data held on FSS and also on DATRAS) .

Spatial distributions are not shown as such, due to changes in spatial coverage changing over the study period, therefore, only maps of presence (positive hauls) for each species were produced. The hauling positions were used instead of shoot positions as the latter may require further investigation on some outliers (in historical data). Length-frequency distributions were produced for each species, by sex when available, and these were separated by either time period or survey type, depending on the species and quantity of data available.

Length-weight distributions were calculated for total length (L_T, measured to the cm below) and total weight (W_T, g), using the exponential relationship ($W_T = a \times L_T^b$), with conversion factors obtained using a linear regression through natural logarithmic transformation. No outliers were removed from these relationships for this study.

Additionally, the linear relationship between L_T and wing width (D_W, measured to the cm or 0.5 cm below) was also calculated by species where data were available. One record was deemed unsuitable, with potential for correction pending further investigations.

26.1.4.2 Results and discussion

There were 1599 records of *Dipturus* held on FSS (Table 26.4), noting that this refers to station records with accompanying data for the various species. These data, which included fish that had been measured, weighed, counted or observed (noting that data collection on historical surveys was more variable), can be used to examine geographical distribution, in terms of presence only.

The survey coverage has varied over time, with some historical surveys extending into northern areas, whilst recent CEFAS surveys have generally been confined to the North Sea and Celtic Seas ecoregions (Subareas 4 and 7). Consequently, these data cannot be used in isolation to examine temporal changes in species distributions.

Spatial distributions

The distributions of all species shown will not be representative of the wider range and it should be noted that survey hauls with no records of any of the species are not shown here. Furthermore, given the longer-term taxonomic confusion in these species, outlier records should be interpreted with extreme caution.

The available distributional data, by time period, for both members of the common skate complex indicate that they are distributed widely around the British Isles (Figure 26.4). More recent data, which have been separated between the two species (Figure 26.5) show that *D. batis* is recorded relatively frequently in the Celtic Sea and western English Channel, with occasional specimens in the Irish Sea, North Sea and Irish Sea. *Dipturus intermedius* was recorded in the northern North Sea and in the Celtic Sea. It should be noted that the surveys used in this study do not include those waters west of either Scotland or Ireland.

Data for both *Dipturus oxyrinchus* and *D. nidarosiensis* were more limited (Figure 26.6). It should also be noted that it is possible that *Dipturus intermedius* may have been misidentified as one of either of these species, if specimens were simply being viewed as being different from *Dipturus batis*. For example, juvenile *D. intermedius* have a much darker ventral surface than *D. batis*, and so the reported presence of *D. nidarosiensis* in the Celtic Sea could relate to juvenile *D. intermedius* (noting that the lengths of these two specimens were 29 and 37 cm). Indeed, it has not been possible to authenticate any of the nominal records relating to *D. nidarosiensis*. In terms of *D. oxyrinchus*, recent, authenticated captures have been made along the western slope of the Norwegian Deep, with some of the other records, especially those from shallower areas, potentially questionable.

Length-frequency

Length data were available for 3950 individual *Dipturus* (Table 26.5), with the majority of these (61.9%) coming from dedicated surveys on a commercial gillnetter, with various otter trawl surveys in the south-west (DCRDC, Q1SWOTTER, Q4SWIBTS and WCGFS) and beam trawl surveys in the southwest (Q1SWBEAM) accounting for 9.0% and 5.3% of measured individuals, respectively. North Sea surveys (NSGFS, IBTS3E and IBTS4E) accounted for only 1.2%, with various historic surveys (HISTORIC and HISTORWEST, including research vessels and chartered fishing vessels) accounting for 22.5%.

The overall length-range reported at the complex level (SKT; Figure 26.7) was 10–217 cm. However, the smaller individuals recorded are probably misidentified (or from confusion of the use of the generic term 'skate' in earlier logbooks), as these sizes would be below the length-at-

hatching. More recent data collected just on-board RV CEFAS Endeavour (2003–present; SKT, SKF and SKG) indicated that the smallest individuals were 18 cm.

The length-frequency distribution of specimens identified as *Dipturus batis* ranged from 18–136 cm (scientific trawl surveys) and 29–149 cm (chartered surveys on a commercial gillnetter). Scientific trawl surveys generally caught proportionally smaller *D. batis*, generally <120 cm, whilst the commercial netters were more selective for larger individuals, with one peak at ca. 70–110 cm and a main peak at 110–140 cm (Figure 26.8). Data were more limited for *D. intermedius,* which were recorded over a length range of 34–195 cm (Figure 26.9).

Biological parameters

Data relating to the length-weight relationship, including a summary of earlier published data, are summarised (Table 26.6) with data analysed presented in Figure 26.10. Available data on the relationships between total length and disc width, or wing width (Figure 26.11) indicate no obvious difference between *D. batis* and *D. intermedius*, though more data are certainly required to better examine this. Similarly, maturity data are also limited (Figure 26.12), though it should be noted that on-going tag-and-release protocols on CEFAS trawl surveys means that the collection of maturity data for females is particularly limited.

Biological studies on the life-history parameters for both species are limited, with earlier studies potentially confounding the two species (e.g. Du Buit, 1976; Fahy, 1991), and so further biological data collection is required, particularly in relation to sampling of dead bycatch.

26.1.5 Synopsis of French data

26.1.5.1 IFREMER

D. batis and *D. intermedius* are now frequently caught in the Celtic Sea during the EVHOE survey. The distinction between the two species in IFREMER data began in 2018, although species identification has been made on board by scientists from MNHN for previous years. This will ultimately make the derivation of stock size indices for *D. batis* since 2009 possible.

Sample sizes from the onboard observation programme (DCF) are generally too low to derive estimates of discarded *Dipturus* at the scale of the stock. However, the proportion of skippers reporting discards of *D. batis* and *D. intermedius* has been increasing.

An ongoing French project focusing on *D. batis* in the northern Bay of Biscay and Celtic Sea involves self-sampling by voluntary crews of bottom trawlers working in the area. The project started in autumn 2019 with two vessels, and a total of five vessels are now involved. For every fishing operation, the number of individuals caught is reported. *D. batis* are also sexed and measured for some fishing operations on a random basis. In addition, an exemption has been obtained to land samples of large female *D. batis*. These are then examined in order to estimate ovarian fecundity. The project is due to end in June 2021, but self-sampling will be prolonged beyond this date. The data collected will be used to provide estimates of body size distributions and distribution maps.

26.1.5.2 Muséum national d'Histoire naturelle (MNHN)

This section is based on some of the results presented by Barreau and Iglésias (2021 WD12). Between 2006 and 2016, the French National Museum of Natural History (MNHH) has collected data on the common skate complex, including data from fish auctions, opportunistically from fishers and during surveys onboard commercial fishing vessels, mainly in the Celtic Sea. Most data were collected between 2013 and 2016 within a dedicated program "POCHETEAUX". Dead individuals have been dissected when possible. These studies have also provided data for other *Dipturus* spp., but these data are not shown here.

Species distributions (Figure 26.13)

Only one trip took place off North West Scotland, with this trip onboard a vessel specialized in deep-water fishing. Data from this trip showed a higher proportion of *D. intermedius* compared to *D. batis*. In contrast, the other trips were undertaken on the continental shelf of the Celtic Sea, with a higher proportion of *D. batis.* The southernmost individual of *D. intermedius* observed was caught by a fishing boat near the Rochebonne Bank in the Bay of Biscay in May 2014. This specimen was an adult female of 193.4 cm length. Several specimens of *D. batis* were collected in the northern part of the Bay of Biscay. They were reported by professional fishermen or found in auctions in 2014 and 2015 and related to immature individuals (54.6–110.5 cm).

Depth distribution (Figure 26.14)

Common blue skate were recorded during fishing trips at sea over a depth range of 108–630 m (Barreau *et al.*, 2016), but was observed to be more abundant in shelf seas as depths of around 120 m. In contrast, *Dipturus intermedius* had a larger depth range, being observed at depths of 114–1000 m (Barreau *et al.*, 2016). Both species occur on soft (sandy-muddy) bottoms.

Length-frequency distribution (Figure 26.15)

Data on length are represented in 10 cm sizes classes. *Dipturus batis* showed a typical size distribution for a skate population with the presence of two peaks. The first one represents the young individuals, while the second one is due to the accumulation of mature individuals in a larger size class as growth slows down once maturity is attained. The observed length-frequency distribution of *D. intermedius* was more erratic, due to the more restricted sample size. For both species, the larger individuals were mainly female, though the overall sex ratio is close to 1:1.

Length-weight relationships

Data on the relationships between total length and gutted weight were collected by sex and species during the POCHETEAU project (Figure 26.16, Table 26.6). Meaningful data relating to total weight were only available for *Dipturus batis* caught in the Celtic Sea (Figure 26.17, Table 26.6) as the number of *D. intermedius* was too low.

Length-disc width relationship

Tails of skates are often cut of damaged, and so the relationship between total length (L_T) and disc width (D_W) allows the total length of damaged specimens to be estimated. There are also some historical studies or sampling datasets where the disc width rather than the total length was measured. Total length-disc width relationships (mm) were calculated for both species (Figure 26.18) and were defined by the following relationships:

Dipturus batis $D_W = 0.7075\ L_T + 9.3838$ ($n = 1374$, $r^2 = 0.997$)

Dipturus intermedius $D_W = 0.7836\ L_T - 38.255$ ($n = 115$, $r^2 = 0.998$)

Length-at-maturity

Data from Iglésias *et al.* (2010) estimated the length at 50% maturity (L_{50}) at 115.0 cm (male) and 122.9 cm (female) for *D. batis* and 185.5 cm (male) and 197.5 cm (female) for *D. intermedius*. The age at 50% maturity was tentatively suggested as 11 years and 19–20 years for *D. batis* and *D. intermedius*, respectively. More recent studies for *D. batis* were used to estimate the length at 50% maturity, using the package "sizeMat" and the function "gonad_mature" on R software (https://cran.r-project.org/web/packages/sizeMat/index.html). The length at 50% maturity (L_{50}) was estimated at ca. 115 cm for males (Figure 26.19). Two estimates of L_{50} were calculated for female, one based on dissected specimens, and another based on the assumption that all females <90 cm were immature and that female caught alive but not dissected were mature if a flaccid cloaca was observed. L_{50} results of these two approaches were 117.5 cm and 119 cm respectively.

26.1.5.3 POPOC Project

The POPOC project was conducted between November 2019 and June 2021 (2022 WD05). Data on catches (numbers caught, length distribution and sex, at the scale of the fishing operation) were obtained using self-sampling on board French otter trawl vessels which are part of the producers organisation "Les Pêcheurs de Bretagne" (The Fishermen from Brittany). Vessels originated from two ports located in south-west Brittany: Le Guilvinec and Saint-Guénolé.

Data from the POPOC and POCHETEAUX project in combination with samples collected during the EVHOE and other scientific trawl surveys as well as the French onboard observation programme (Obsmer) were used to provide insight in the spatial distribution using presence/absence maps of the species.

Spatial distribution

During international scientific trawl surveys, distinction of the two species is variable between survey and did not start in the same year, therefore data for common skate complex have been merged. For the surveys considered here, the species complex has been observed from the northern part of the Bay of Biscay to north of the Shetland Islands. These species have not been observed in the southern North Sea since 2013 (Figure 26.20). This increase is particularly noticeable in the Celtic Sea (IE-IGFS and EVHOE). In this area, as well as on the Rockall Bank, *D. batis* dominates the catch of the common skate complex in 2019, a year for which the two species were separated in the data (Figure 26.21)

The temporal coverage associated with Obsmer data allows the observation of a gradual spatial extension of the distribution area of *D. batis* in the Celtic Sea. Densities derived for the southern part of the Celtic Sea and north-west of the Bay of Biscay tend to increase since 2009 (Figure 26.22). The comparison with densities derived from data collected during the POCHETEAU project is rendered difficult by the smaller sample size in this latter project, but both data sets indicate a temporally stable area of greater density in the central part of the Celtic Sea, west of the Scillies. The location of this area is confirmed by the self-sampling data collected during the POPOC project (Figure 26.23).

Biomass series from EVHOE

The approximated series of common blue skate biomass from the EVHOE survey indicates a recent increase of the index starting in 2018, after a period of lower stable and relatively uncertain biomass (Figure 26.24).

From the interviews conducted with five skippers, a perceived recent increase in biomass of common blue skate was reported especially in the southern part of the Celtic Sea. All fishers identified 2017 as a turning point in the time series which seems consistent with the increase observed between 2016 and 2018 in the EVHOE index.

26.1.6 Synopsis of Spanish survey data for the Porcupine Bank

Three species of the genus *Dipturus* were reported in Fernández-Zapico *et al.* (2021 WD03, 2022 WD06): *D. batis, D, intermedius* and *D, nidarosiensis*. Some of these data (pre-2011) are presented here at the genus-level. Only results on *D. batis* and *D. nidarosiensis* have been updated *as no D, intermedius* was caught in 2021.

The overall abundance of *Dipturus* spp. is increasing compared to 2020 while the overall biomass is still decreasing in 2021 compared to the previous years (Figure 26.25), with the mean biomass index from the last two years below that of the previous five years (Figure 26.26). As the largest individuals of the last 10 years were almost not found (2021 WD03, 2022 WD06), this trend could be explained by an increase of small and light individuals associated with a decrease of large and

heavy individuals in the catch compare to previous years. However, current catch rates are still above those reported during the first part of the time-series (2001–2011).

Species-specific data were available for more recent years, with this indicating that the biomass and abundance of *D. batis* increased in 2021 to come back to values similar to 2018. However, the abundance and biomass of *D. nidarosiensis* was similar to earlier values (Figure 26.27)

During Porcupine Bank survey in 2020 and 2021, *Dipturus nidarosiensis* was reported from some of the deeper parts of the survey area (457–1355 m deep), to the south of Porcupine Bank. *Dipturus batis* was reported at depths of 196–455 m close to the Bank (Figure 26.28), whereas *D. intermedius* was found in waters of 191–1025 m depth (Figure 26.29)

In 2021, few specimens of *D. nidarosiensis* were recorded falling within the 28–168 cm length range, whilst more specimens of *D. batis* (20–114 cm) were recorded (Figure 26.30). *D. batis* showed a higher abundance in the size of 33 cm. Since 2011, the maximum size recorded for *D. intermedius* is around 140 cm, which corresponds to immature individuals (Figure 26.31). It is noted that the tow duration has been reduced from 30 min to 20 min since 2016, and it is unclear as to whether this reduction in tow duration would impact on the sampling of larger skates.

Available data confirm that both members of the common skate complex occur on and around the Porcupine Bank, with Norwegian skate also occurring in deeper waters. *Dipturus batis* was the main species of the complex occurring in this area.

26.1.7 Synopsis of Portuguese data

This section was based on the results presented by Serra-Pereira *et al.* (2021 WD08). This WD summarize the available information for *Dipturus* spp. from mainland Portugal (Division 9.a), including data from the DCF commercial sampling and from surveys, to inform on landings, spatial distribution, and length ranges for *Dipturus oxyrinchus*. The data presented reinforces the current perception that *D. oxyrinchus* is the main *Dipturus* species occurring in Division 9.a, with some anecdotal observations relating to *D. nidarosiensis.*

Since 2016, Portuguese data for *Dipturus oxyrinchus* (Division 9.a) have been included in the 'Other skates and rays in Subarea 8 and Division 9.a (Bay of Biscay and Atlantic Iberian waters)' stock. No misidentifications with other *Dipturus* spp. have been recorded by the DCF sampling programme of Portuguese landings, so these data are not presented with the common skate *Dipturus batis*-complex (rjb.27.89a).

Misidentifications and/or coding errors in landings data, as observed in other areas, occur in Division 9.a, with Rajidae being commonly landed under incorrect commercial denominations. To address this, IPMA developed a statistical procedure to estimate species-specific landings during the DCF skate pilot study (2011–2013; Figueiredo *et al*., 2020). The output from this procedure is the basis for the annual reported ICES landing estimates from Portugal, since 2008, including those for *D. oxyrinchus.* No other *Dipturus* species have been identified by DCF in landing ports over this time.

The estimated landings of *D. oxyrinchus* from Division 9.a (2008–2020) are presented in Figure 26.32 by fleet segment. Landings from the polyvalent fleet accounted for about 80% (56–99%) of the total landings. For the polyvalent fleet, landings were mostly recorded from the 'Centro' and 'Lisboa e vale do Tejo' regions, more specifically in the landing ports of Peniche and Sesimbra, respectively (Figure 26.33). The same was observed for the trawl landings, although those in the 'Centro' were less representative.

Length data have been collected during the DCF sampling programme. Due to the low number of individuals measured in some years, the length frequency distribution was combined for the

whole time-period (2008–2020) (Figure 26.34). The lengths recorded ranged from 48 to 158 cm, and the overall length-frequency distribution was similar between the two fleets.

Dipturus oxyrinchus is often caught during the Portuguese crustacean trawl survey/*Nephrops* Survey Offshore Portugal (NepS (FU 28–29)), which covers the Portuguese southwestern and southern coasts, along eight sectors (Figure 26.35). This survey has operated since 1997, but was not conducted in 2004, 2010, 2012, 2019 or 2020. More details on the survey characteristics were described in WKSKATE (see Rodríguez-Cabello *et al.*, 2020 WD).

Dipturus oxyrinchus was found at depths of 43–776 m, but was caught more commonly in the southwest (south off Cabo Espichel) at depths of 350–600 m deep, and in the southern region at 400–700 m depth (Figure 26.35– Figure 26.37). The occurrence and spatial distribution of the species varied over the years (Figure 26.36). Lower catches were observed in 2000, 2005, 2008 and the absence in 1999 may be influenced by the use of a net with different characteristics from the standard protocol (i.e., CAM net with 20 mm mesh size).

The length distribution of *D. oxyrinchus* has been variable over the time-series, mainly due it being a rarely recorded species with a wide size range, from 18–160 cm L_T (Figure 26.38). The mean length of the overall time-series was 57 cm, with some years catching more juveniles (e.g. 2016–2018), while in other catching larger individuals (e.g. 2002, 2011, 2012, 2015; Figure 26.39).

During the NepS (FU 28–29) surveys time series, *Dipturus nidarosiensis* was also caught but in very few numbers, with only three individuals identified between 1997 and 2018 (2014: 68.5 cm male, 755 m depth; 2014: 165 cm female, 657 m depth; and 2016: 47.7 cm female, 104 m depth).

26.1.8 Analyses of DATRAS data

This section was initially based on some of the results presented by Barreau and Iglésias (2021 WD12) but overall results have been recalculated with new data download from DATRAS which could explained the differences in number from last year results. Also, new surveys have been added to the results

Exchange format data were downloaded from DATRAS for the years 2010–2021. The number of individuals recorded under *D. batis* (here considered as the complex) has decreased in part of the survey to be better ascribed to either flapper or common blue skate. Some data seems to have been re-ascribed to the good species (Table 26.7). As *Dipturus flossada* is still in use in some survey, the name *Dipturus batis* (*D.* cf. *flossada)* will be use to present results on common blue skate. In EVHOE survey, common blue skate caught in 2020 and 2021 seems to have been ascribed to the accepted Latin name *D. batis* but it will presented as *D. batis* complex as it is difficult to treat each survey individually. It is to be noticed that the Latin name used for the flapper skate is *D. intermedia* in DATRAS data although it should be *D. intermedius*.

Taking into account all *Dipturus spp*. captured, it appears that the number of individuals is increasing each year for flapper skate and common blue skate (Figure 26.40).

The spatial distributions of the two species are now better known from around the British Isles, with the flapper skate mainly around the coasts of Scotland, whilst the common blue skate is observed mostly in the Celtic Sea and on the Rockall Bank (Griffith *et al.*, 2010; Frost *et al.*, 2020), as also confirmed by the available data used here (Figure 26.41).

Available DATRAS data on the depth distribution of the *D. batis* complex were examined for 2010–2021. *D. batis* complex was present from 23 to 928 m depth (Figure 26.42). Common blue skate, *D. batis* (*D.* cf. *flossada*, was recorded at depths of 37–701 m but was more abundant in shelf seas at depths <200 m. *Dipturus intermedius* had a broader depth range (17–882 m) and a slightly shallower median depth.

In order to see if some of the surveys could be relevant to describe temporal trends in the stock, the catch rate in number per hour was calculated for each survey within the last 10 years (Figure 26.43). These preliminary results should not be used to draw conclusions on actual stock trends, as potential changes in gears and survey designs have not been taken into account. They are only informative results on the evolution of the catch per species per survey and to identify which surveys could usefully be subject to closer examination. Common skate complex was observed mainly in BTS since 2013, with records decreasing in the SWC-IBTS/ SCOWCGFS (where improved speciation has occurred since 2012). Common blue skate *D. batis* was recorded mainly on Rockall (SCOROC survey) with the highest catch rates, which increased during the period, as well as IE-IAMS, IE-IGFS and SWC-IBTS/ SCOWCGFS surveys. EVHOE trend is highly decreasing in 2020 and 2021 as the common blue skate is now recorded as *D. batis* and so appears in the top graph.. Flapper skate *Dipturus intermedius* was observed consistently during the IE-IGFS, IE-IAMS and SWC-IBTS/ SCOWCGFS.

Length and sex data were recorded for most of the individuals caught during research vessel surveys (to the cm below). The observed *D. intermedius* size distribution seems coherent with the expected shape described in Iglésias *et al.* (2010), with a high number of relatively small individual and the appearance of a small mod at larger size corresponding to the accumulation of the mature individual into the larger length classes (Figure 26.44). However, the length-frequency distribution of *D. batis (=D.* cf. *flossada*) seems incorrect, with several individual >150 cm. This suggests that misidentifications (or coding/reporting errors) are present in some data sets.

26.1.9 Summary and future work

There is increased interest in the status of both species, and especially *D. intermedius,* in European seas (e.g. Garbett *et al*., 2021). The previous IUCN assessment for the species complex (Dulvy *et al*., 2006) considered a decline in geographic extent among the criteria used. However, given the separation of the two species and increased uncertainty with regards the historical distributions of the two species, more rigorous appraisal of historical information and examination of museum samples are required to inform on the overall distributions of the species.

In terms of historical studies, ichthyological accounts for the period approximately from 1837/1838 (when *D. intermedius* was described) until 1926 (when it was synonymised with *Dipturus batis*), may provide some relevant information. For example, Murie (1903) reported skate (as *Raia batis*) from the Outer Thames area, but noted that flapper skate (as *R. macrorhynchus*) had not been reported from that area. Similarly, Herdman and Dawson (1902) confirmed that blue skate (as *Raia batis*) was in the Irish Sea and, in relation to flapper skate (as *R. macrorhynchus*), noted that it had been reported by fishers from the area but that the authors had not seen any specimens of skate that they considered distinct from blue skate. Day (1880–1884) noted that flapper skate (as *R. macrorhynchus*) had also been observed at Plymouth and from Dublin Bay, but that data were limited. Such information would suggest that *D. batis* was the main species of the complex occurring in the Irish Sea (Division 7.a) and potentially the only species of the complex occurring in the southern North Sea (Division 4.c). Collation of other relevant accounts could potentially provide more information on the distributions of the two species.

Additionally, given that some parasites of elasmobranchs, particularly cestodes, can show a high degree of host-specificity, a critical review of published parasitological studies (e.g. Rees & Llewellyn, 1941; Williams, 1959; Manger, 1972; Kennedy and Williams, 1989; Benmeslem *et al*., 2019) could also usefully be considered.

Survey data are becoming increasingly available for each species within the common skate complex. However, they must be handled with care, as the accepted scientific name of common blue skate *Dipturus batis* (and also the accepted FAO code) can be confused with historical data, field

identification guides produced prior to 2010 do not separate the two species, and identifications on surveys are not fully accurate. Consequently, improved and consistent identification is still required on trawl surveys. Concerning the potential for confusion regarding the name of common blue skate, it would be useful if the scientists in charge on surveys could ensure that more detailed comments confirming the occurrence of each of the species, and that reporting of *D. batis* indeed relates to common blue skate *D. batis*, rather than relating to species-complex. If the exact species is not known, data should be reported at the genus level (i.e. *Dipturus* spp., Aphia ID = 105762).

Since last year, differences between surveys in how they report the specific species within the *Dipturus* complex has been observed. Such differences may cause a bias when data available on DATRAS are to be used. A standardized protocol should be developed to publish species-specific data on DATRAS to ensure that each country is updating the data in the same way.

26.1.10 References

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Table 26.1. Distinguishing features of common blue skate *Dipturus batis* and flapper skate *Dipturus intermedius*. Adapted from Iglésias *et al.* (2010), with more recent data added where relevant (*).

Feature	Common blue skate	Flapper skate
Eye (iris colour)	Pale yellow	Dark olive-green
Eye-spots on pectoral fin	*"Blotch on wing with ocellus with dark centre surrounded by pale ring"*	*"Blotch of grouped pale spots"*
Lateral thorns on tail	Lateral thorns perpendicular	Lateral thorns project anteriorly (towards head)
Dentition	Teeth relatively narrower	Teeth relatively broader
Maximum length	143.2 (to at least 149 cm*)	228.8 cm
Length-at-maturity (female)	122.9 cm	197.5 cm
Length-at-maturity (male)	115 cm	185.5 cm

Table 26.2. Original description of *Raia flossada* Risso, 1826

Cette espèce, la plus remarquable de nos bords par sa grandeur, présente un corps épais, bombé au milieu, d'un gris cendré, parsemé de taches irrégulières blanches et noirâtres, couvert de petite aspérités qui le rendant âpre au toucher; tout le dessous est blanc, tacheté de points noirs; le museau est prolongé en pointe arrondie; les yeux sont proéminents, ovales oblongs, et ont l'iris blanchâtre, avec la prunelle bleue; les narines sont grandes, arquées; la bouche a beaucoup d'ampleur, et ses mâchoires sont munies dans leur milieu de onze rangées de dents coniques, aiguës et crochues, et seulement de chaque côté de sept rangées de dents un peu obtuses; les ouvertures branchiales sont linéaires; les nageoires ventrales sinueuses, à dix-huit rayons chacune; la queue est courte, épaisse, courbée, terminée au sommet, qui est tronqué, par deux nageoires oblongues; elle est bombée en dessus, aplatie en dessous, et munie de chaque côté de quarante-deux aiguillons crochus; la chair de cette raie est blanche et d'un goût fade. La femelle est aussi grosse que le mâle. Long. 1,200, enverg. 0,900. Séj. Grandes profondeurs. App. Avril, mai.
[*This species, the most remarkable of our borders by its size, has a thick body, rounded in the middle, of an ash grey, dotted with white and blackish irregular spots, covered with small denticles which make it harsh to the touch; all below is white, speckled with black dots; the snout is extended in a rounded point; the eyes are prominent, oblong oval, and have a whitish iris, with blue centre; the nostrils are large, arched; the mouth is very full, and its jaws are provided in their middle with eleven rows of conical, sharp, hooked teeth, and only on each side with seven rows of somewhat obtuse teeth; the gill openings are linear; sinuous ventral fins, eighteen rays each; the tail is short, thick, curved, terminating at the top, which is truncated, by two oblong fins; it is rounded above, flattened below, and provided on each side with forty-two hooked spines; the flesh of this ray is white and tasteless. The female is as big as the male. Length: 120 cm, width: 90 cm. Habitat: Great depths. Appearance: April May.*]

Table 26.3. Taxonomic units of the genus *Dipturus* occurring in the North-east Atlantic, including taxa considered in the present analyses. In the subsequent two tables, the FSS species codes have been used, as these better separate the two species from the complex. Information on the undescribed *Dipturus* sp. is provided in Ebert and Stehmann (2013).

Common name	Scientific name	Code (FSS)	Code (FAO)	AphiaID
Common skate complex	*Dipturus batis*-complex	SKT	RJB	-
Common blue skate	*Dipturus batis*	SKG	RJB	105869
Flapper skate	*Dipturus intermedius*	SKF	DRJ	711846
Long-nosed skate	*Dipturus oxyrinchus*	LNS	RJO	105872
Norwegian skate	*Dipturus nidarosiensis*	RNS	JAD	105871
Undescribed *Dipturus* sp.	*Dipturus* sp.	-	-	-
Unidentified *Dipturus* spp.	*Dipturus* spp.	-	-	105762

Table 26.4. Summary of catch records for *Dipturus* spp. held on CEFAS' database in relation to process code (CO = counted only; MO = measured only; OB = observed; WC = weighed and counted; WM = weighed and measured; WO = weighed only) and survey series for the years 1901–2021. These data refer to station records and not the numbers of individual animals caught (see below). Surveys with no records of either of the case study species not included. Current trawl survey monitoring programmes indicated*. See Table 26.3 for list of species codes, including those used on FSS (shown here) and the corresponding FAO codes.

Survey series	Process code	LNS	RNS	SKF	SKG	SKT	Total
ARCTIC	CO					40	40
	OB					15	15
	WO					2	2
DCRDC	WM					24	24
ELASMOS[1]	MO			16	158		174
HISTORIC	CO	4	2			354	360
	MO					277	277
	OB	15				61	76
	WC					32	32
	WM					16	16
	WO					11	11
HISTORWEST	CO	2			1	72	75
	MO					99	99
	OB					3	3
	WC					1	1
	WO					2	2
IBTS3E*[2]	MO					1	1
	WM	2		6	1	13	22
IBTS4E	WM					2	2
MEMFISH	WM					1	1
NSGFS	OB	1				2	3
	WM	6				10	16
Q1SWBEAM*[3]	OB					1	1
	WM			1	65	111	177
Q1SWOTTER	WM			5	63	2	70

Survey series	Process code	LNS	RNS	SKF	SKG	SKT	Total
Q4SWIBTS	WM					21	21
WCGFS	WM	6	2			68	76
YFS	MO					2	2
Total		36	4	28	288	1243	1599

[1] Data collected on chartered commercial fishing vessel

[2] This survey relates to NS-IBTS-Q3

[3] This survey may also be referred to as 'Q1SWECOS', 'BTS-UK-Q1' or 'UK-Q1SWBeam' in other ICES-related documents.

Table 26.5. Summary of number of measured *Dipturus* spp. held on CEFAS' database by survey series (1901–2021). Current trawl survey monitoring programmes indicated*. See Table 26.3 for list of species codes, including those used on FSS (shown here) and the corresponding FAO codes.

Survey series	LNS	RNS	SKF	SKG	SKT	Total
ELASMOS	–	–	30	2416	–	2446
HISTORIC	–	–	–	–	692	692
*Q1SWBEAM	–	–	1	85	125	211
Q1SWOTTER	–	–	7	195	3	205
HISTORWEST	–	–	–	–	195	195
WCGFS	7	2	–	–	83	92
DCRDC	–	–	–	–	31	31
*IBTS3E	2	–	10	1	16	29
Q4SWIBTS	–	–	–	–	27	27
NSGFS	7	–	–	–	10	17
IBTS4E	–	–	–	–	2	2
YFS	–	–	–	–	2	2
MEMFISH	–	–	–	–	1	1
ARCTIC	–	–	–	–	–	0
Total	16	2	48	2697	1187	3950

Table 26.6. Length-weight parameters for members of the common skate complex, including earlier published studies by sex (M: Male; F: Female; C: Sexes combined).

Species	Sex	N	L_T (cm)	Weight (g)	a	B	r2	Source
Total weight (W_T)								
Dipturus batis-complex	C	8	18–49 D_W	88–1886	0.0108	3.0787	–	Coull *et al.* (1988)[5]
	C	32	52–130	700–15960	0.0010	3.391	0.986	Rosa *et al.* (2006)[3]
	F	32	19–135	–	0.0026	3.222	0.99	McCully *et al.* (2012)
	M	30	20–118	–	0.0041	3.123	0.95	
	C	46	19–131	36–13940	0.0038	3.1201	0.996	Silva *et al.* (2013)
	C	37	9.5–210.5[2]	–	0.00740	2.953	0.984	Wilhelms (2013)
	C [1]	140	18–200	26–80000[4]	0.0032	3.1679	0.980	This study
Dipturus batis	C	334	18–136	24–15770	0.003	3.1723	0.996	This study
	F		167	-	0.0024	3.2034	0.996	Barreau *et al.* (2016)
	M		196	-	0.0025	3.192	0.997	
Dipturus intermedius	C	19	34–170	170–33280	0.0017	3.2781	0.998	This study
Gutted weight (W_T)								
Dipturus batis	F	175	–	–	0.0026	3.1555	0.996	Barreau *et al.* (2016)
	M	197	–	–	0.0025	3.1718	0.997	
Dipturus intermedius	F	45	–	–	0.0011	3.3236	0.995	
	M	56	–	–	0.0006	3.4453	0.986	

[1] Includes only data where specimens were not identified to species-specific level.

[2] Minimum size given (9.5 cm) is less than the length-at-hatching.

[3] Data from the Azores, and so there is potential uncertainty in species.

[4] Maximum weight may be underestimated, as the Electronic Data Capture (EDC) system originally had a maximum weight of 80 kg.

[5] Values based on disc width (D_W) and not total length.

Table 26.7. Number of individual *Dipturus* spp. collected during Research Vessels surveys between 2010 and 2021, as reported on DATRAS. Data for the various species names used derived from the ScientificName_WoRMS.

- No survey

Species	Survey	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
Dipturus spp.	NS-IBTS	2	2	1	0	1	2	1	2	0	0	0	0	11
	SP-PORC	0	0	6	0	0	0	0	1	0	0	0	0	7
Dipturus batis complex	BTS	3	1	4	3	10	24	18	56	26	31	1	20	197
	BTS-VIII	-	0	0	0	0	0	0	0	1	0	0	0	1
	EVHOE	1	4	6	16	11	20	25	-	5	0	104	129	321
	IE-IAMS	-	-	-	-	-	-	0	0	0	7	1	0	8
	IE-IGFS	20	14	0	0	0	0	0	0	0	0	0	0	34
	NIGFS	0	0	0	0	1	0	0	0	0	0	1	0	2
	NS-IBTS	14	24	14	7	0	0	0	0	0	1	1	0	61
	PT-IBTS	0	0	-	0	0	0	0	0	0	-	-	4	4
	ROCKALL/SCOROC	-	0	40	0	0	0	0	0	0	0	0	0	40
	SP-NORTH	0	1	0	0	0	0	0	0	0	0	0	0	1
	SP-PORC	6	5	5	15	0	30	8	6	39	0	0	32	146
	SWC-IBTS/SCOWCGFS	82	60	0	0	0	0	0	0	0	0	0	0	142
Dipturus batis (= *D.* cf. *flossada*)	EVHOE	0	0	0	0	0	0	0	-	84	84		0	168
	IE-IAMS	-	-	-	-	-	-	87	35	52	93	66	77	410
	IE-IGFS	5	2	5	13	32	34	47	11	25	53	34	47	308
	NS-IBTS	0	0	0	6	3	4	2	2	8	6	11	9	51
	ROCKALL/SCOROC	-	12	0	29	63	34	67	61	85	98	61	134	644
	SWC-IBTS/SCOWCGFS	0	2	6	0	21	17	26	14	17	10	24	20	157
Dipturus intermedius	BTS	0	0	0	0	0	0	0	0	0	0	0	1	1
	EVHOE	0	0	0	0	0	0	0	-	3	4	0	0	7

Species	Survey	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
	IE-IAMS	-	-	-	-	-	-	185	193	205	277	46	134	990
	IE-IGFS	8	20	33	24	38	20	22	50	63	37	19	46	380
	NS-IBTS	0	0	22	27	10	7	16	19	17	26	19	33	196
	ROCKALL/SCOROC	-	20	0	0	0	0	0	0	0	0	0	0	20
	SWC-IBTS/SCOWCGFS	0	81	234	124	158	97	131	151	94	151	116	83	1420
Dipturus oxyrinchus	IE-IAMS	-	-	-	-	-	-	0	0	0	0	0	3	3
	IE-IGFS	0	0	0	0	0	0	0	0	0	0	2	8	10
	NS-IBTS	0	0	0	0	0	0	0	0	0	2	0	1	3
	PT-IBTS	0	0	-	0	2	0	0	0	0	-	-	3	5
	ROCKALL/SCOROC	-	8	4	3	5	8	0	6	3	2	2	10	51
	SP-ARSA	0	0	0	0	0	0	0	0	51	0	0	-	51
	SP-NORTH	0	0	0	0	0	0	1	0	1	0	0	0	2
Dipturus nidarosiensis	IE-IAMS	-	-	-	-	-	-	8	4	0	3	0	0	15
	ROCKALL/SCOROC	-	0	0	0	0	0	4	0	0	0	0	0	4
	SP-NORTH	0	0	0	0	1	0	0	2	0	0	0	0	3
	SP-PORC	2	1	6	4	0	16	5	6	5	0	0	18	63

- No survey or truncated survey

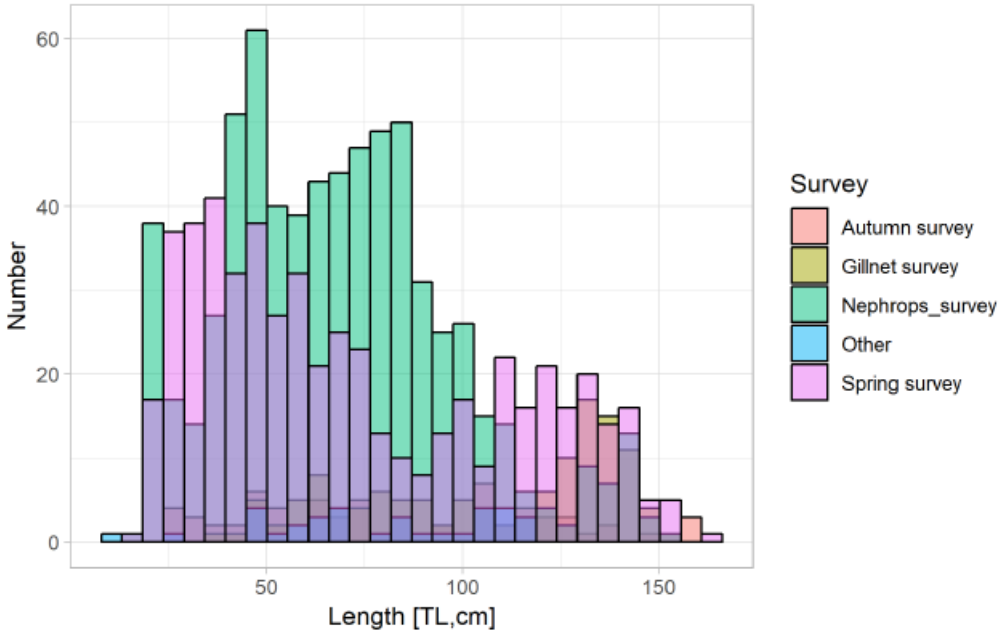

Figure 26.1. Length-frequency of 'common skate' recorded in various Icelandic surveys. The near absence of large individuals would be indicative of *Dipturus batis* being the main species present.

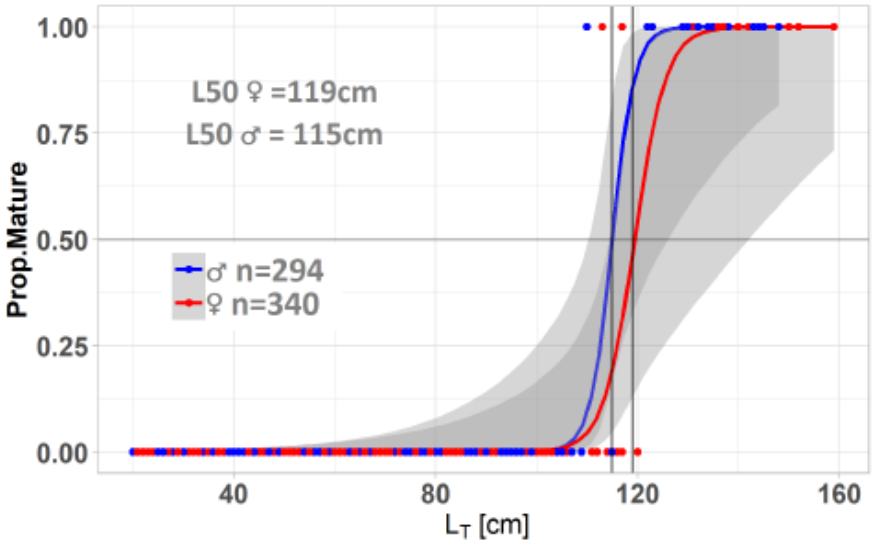

Figure 26.2. Length-at-maturity of 'common skate' recorded in Icelandic surveys. The estimated lengths-at-maturity are consistent with those values provided by Iglésias *et al.* (2010) for *Dipturus* cf. *flossada*, thus being indicative of *Dipturus batis.*

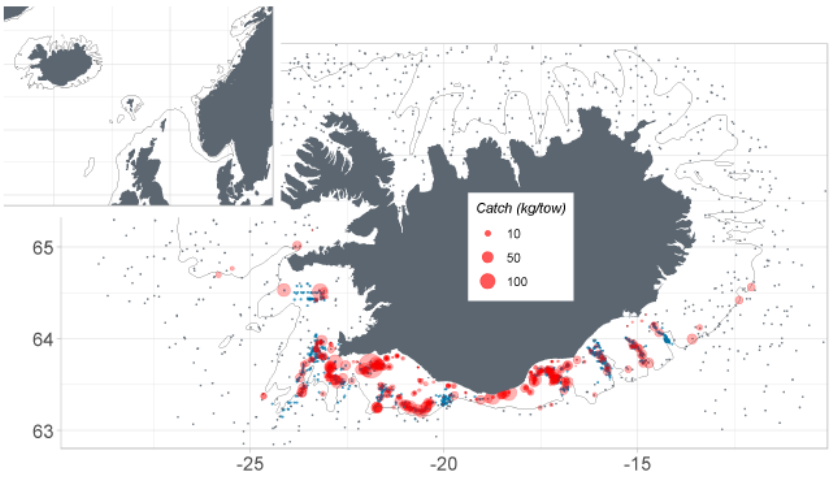

Figure 26.3. Distribution of common skate complex (presumed to be *D. batis*) in Icelandic waters. Grey points: Stations sampled in spring and autumn bottom trawl surveys each year. Red circles indicate the occurrence and catch rates of *D. batis*, with blue circles using data from a *Nephrops* survey (2002–2018).

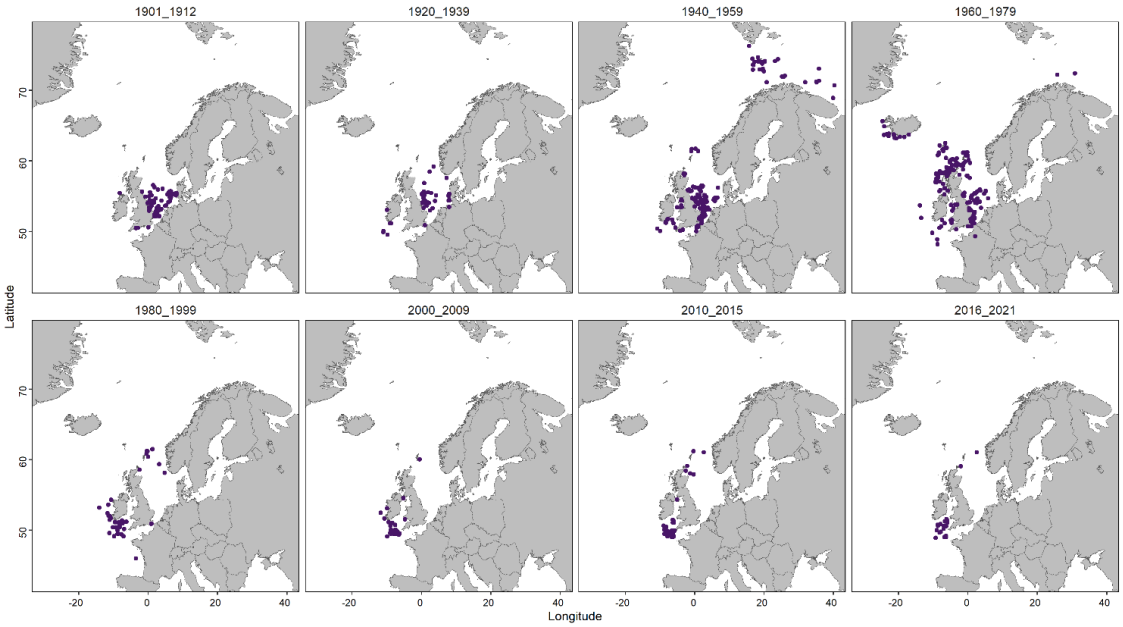

Figure 26.4. Recorded presence of common skate-complex by time period in scientific trawl surveys(?). Note: Latitude and longitude used from hauling positions. Only shown records where specimens were not identified and/or allocated to particular species. Hauls with no records are not shown, and so broadscale changes in distribution over time are not indicated.

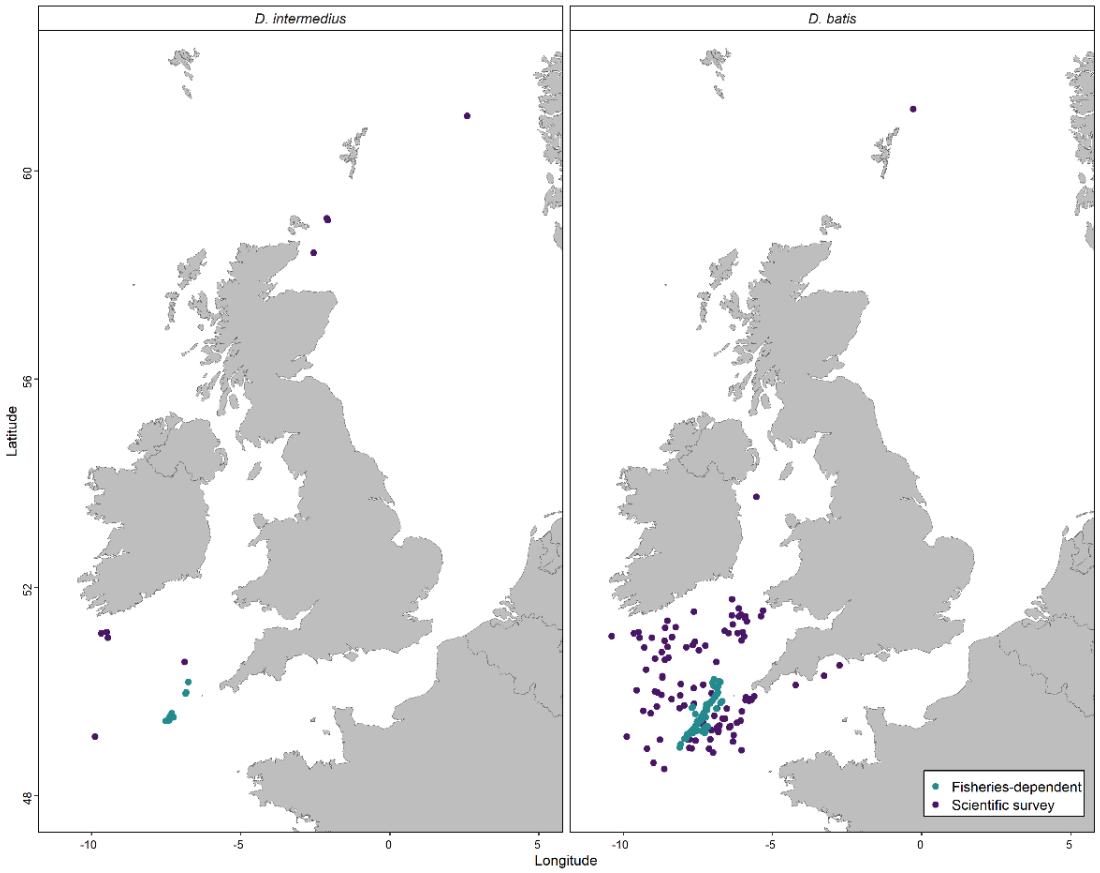

Figure 26.5. Recorded presence of common blue skate *D. batis* and flapper skate *D. intermedius* by survey. Note: Latitude and longitude used from hauling positions.

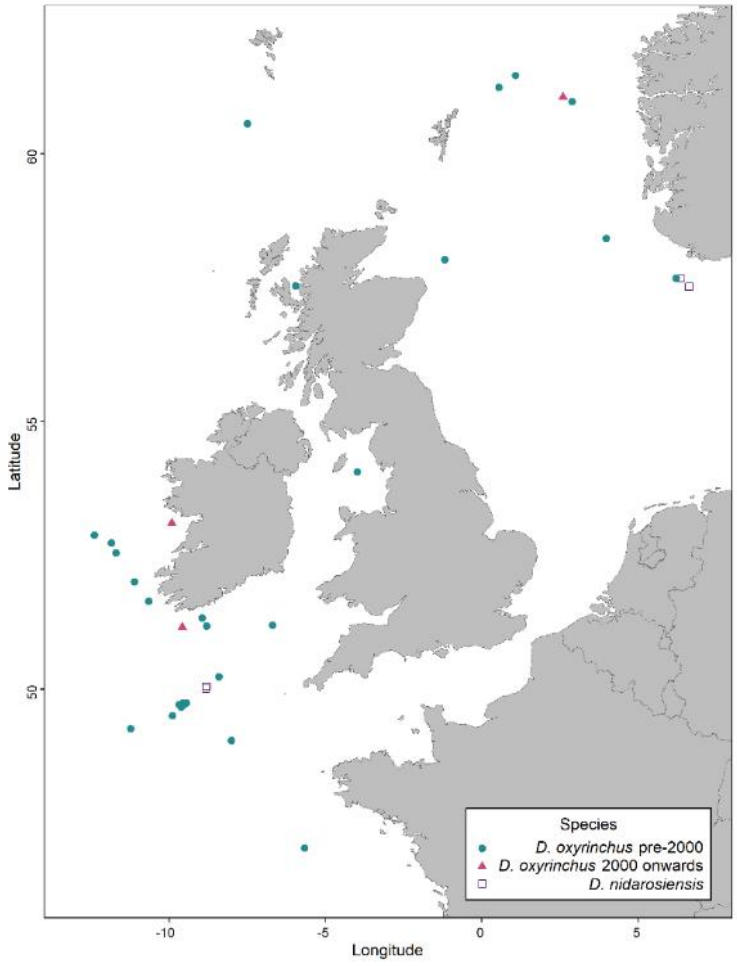

Figure 26.6. Recorded presence of long-nosed skate *D. oxyrinchus* (pre-2000 and 2000 onwards) and Norwegian skate *D. nidarosiensis*. Note: Latitude and longitude used from hauling positions. These two species have only occurred on scientific surveys (fisheries-independent). Note: Given that most of these records were recorded prior to the revised separation of the common skate complex, these data may include misidentified flapper skate. Hence, these data should be interpreted with caution.

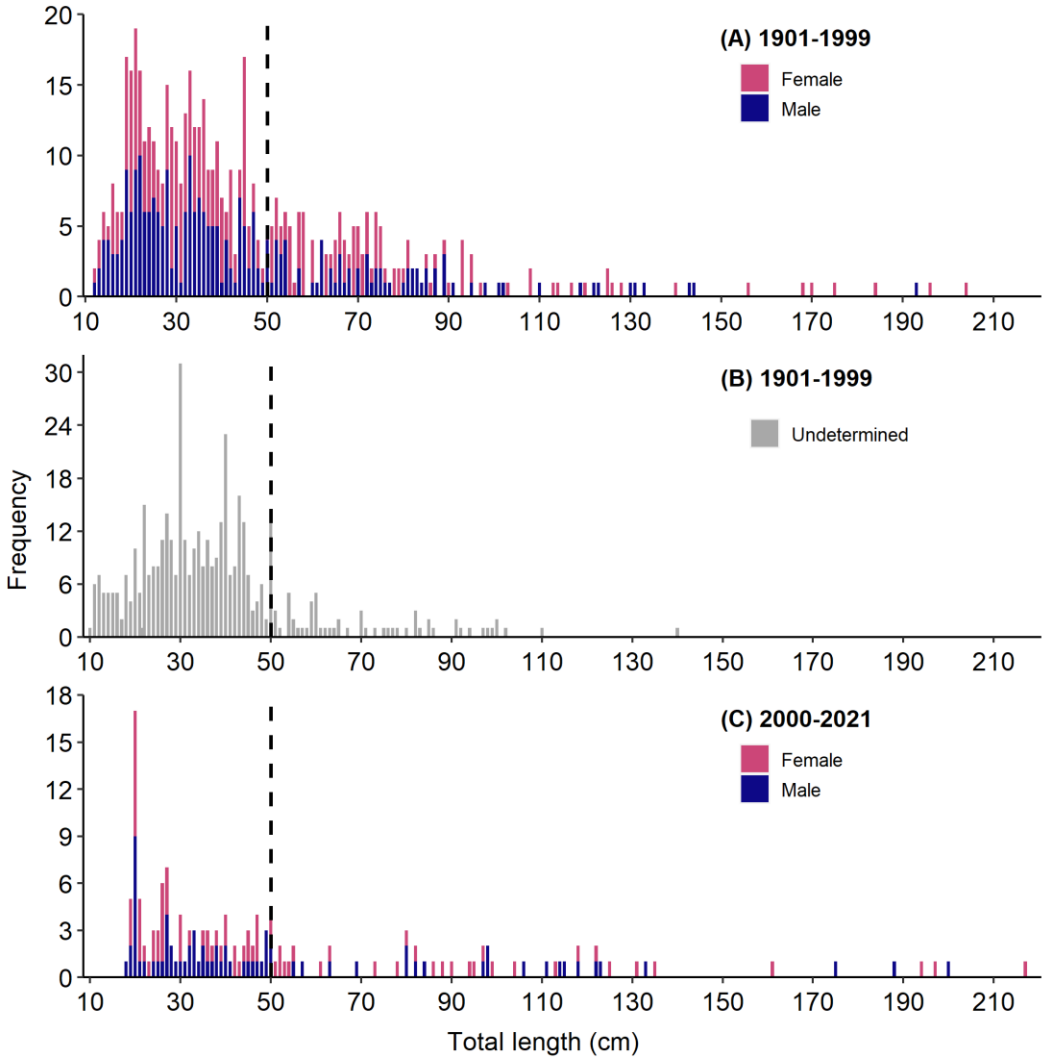

Figure 26.7. Length frequency distribution for common skate-complex *Dipturus batis*-complex by sex for (A) 1901–1999 (Females, n = 291, 12–204 cm L_T; Males n = 258, 12–193 cm L_T), (B) 1901–1999 (Undetermined, n = 425, 10–140 cm L_T) and (C) 2000–2021 (Females, n = 83, 19–217 cm L_T; Males, n = 74, 18–200 cm L_T). Note: Dashed line represents length assumed for 'exploitable biomass' at 50 cm L_T. Data for common-skate complex only considered records where specimens were not identified and/or allocated to species-specific, these were only reported during scientific surveys. Different y-axis to avoid data to be skewed.

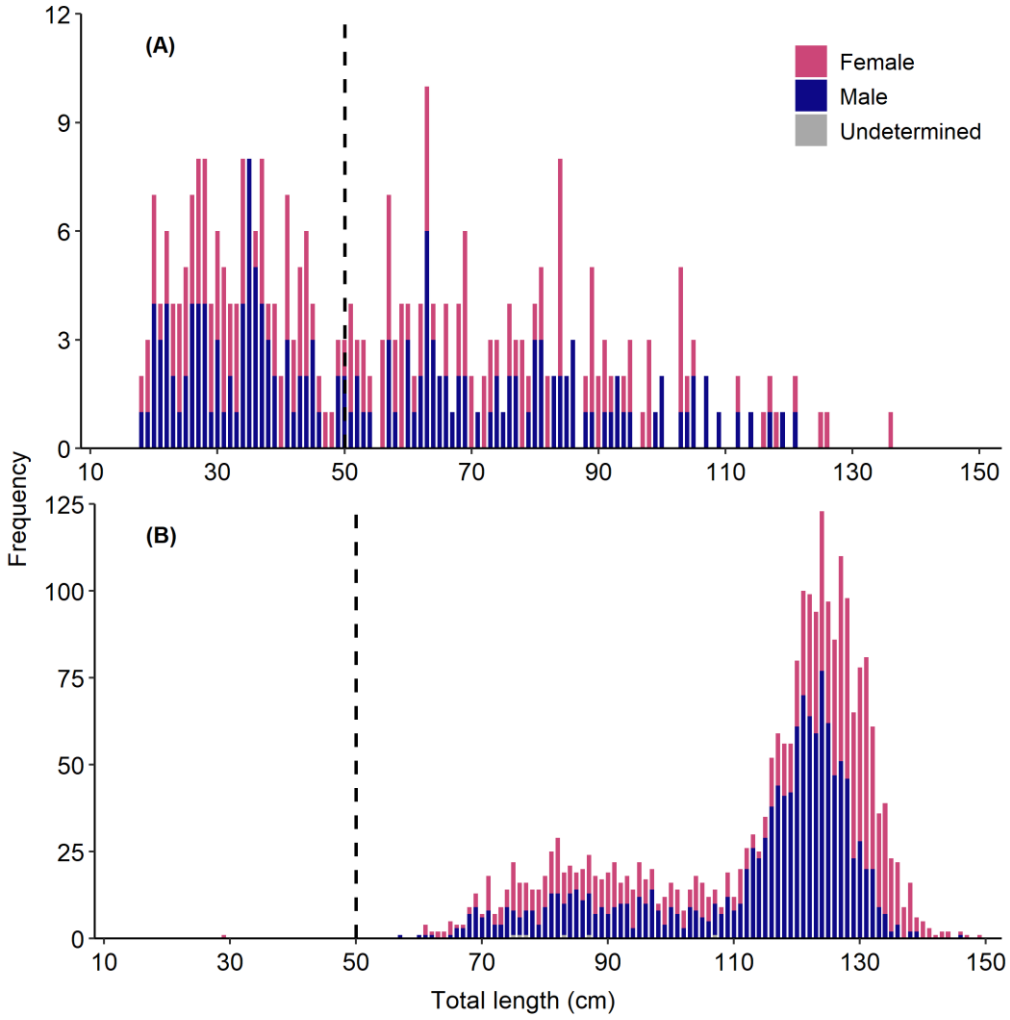

Figure 26.8. Length frequency distribution for common blue skate *D. batis* by sex and survey (A) scientific survey (Females, n = 174, 18–136 cm L_T; Males, n = 161, 18–121 cm L_T) and (B) fisheries-dependent survey (Females, n = 1,113, 29–149 cm L_T; Males, n = 1,297, 57–146 cm L_T; Undetermined, n = 6, 75–107 cm L_T). Note: Dashed line represents length assumed for 'exploitable biomass' at 50 cm L_T. Different y-axis to avoid data to be skewed.

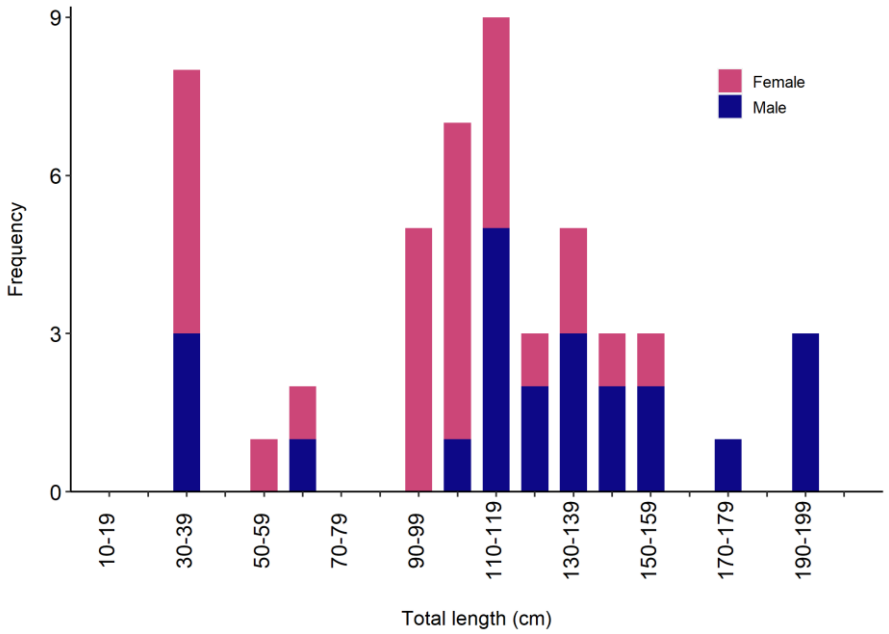

Figure 26.9. Length frequency distribution for flapper skate *D. intermedius* by sex (Females: n = 27, 34–154 cm L_T; Males: n = 23, 34–195 cm L_T). Note: Data aggregated across surveys due to limited available records and in 10 cm bins.

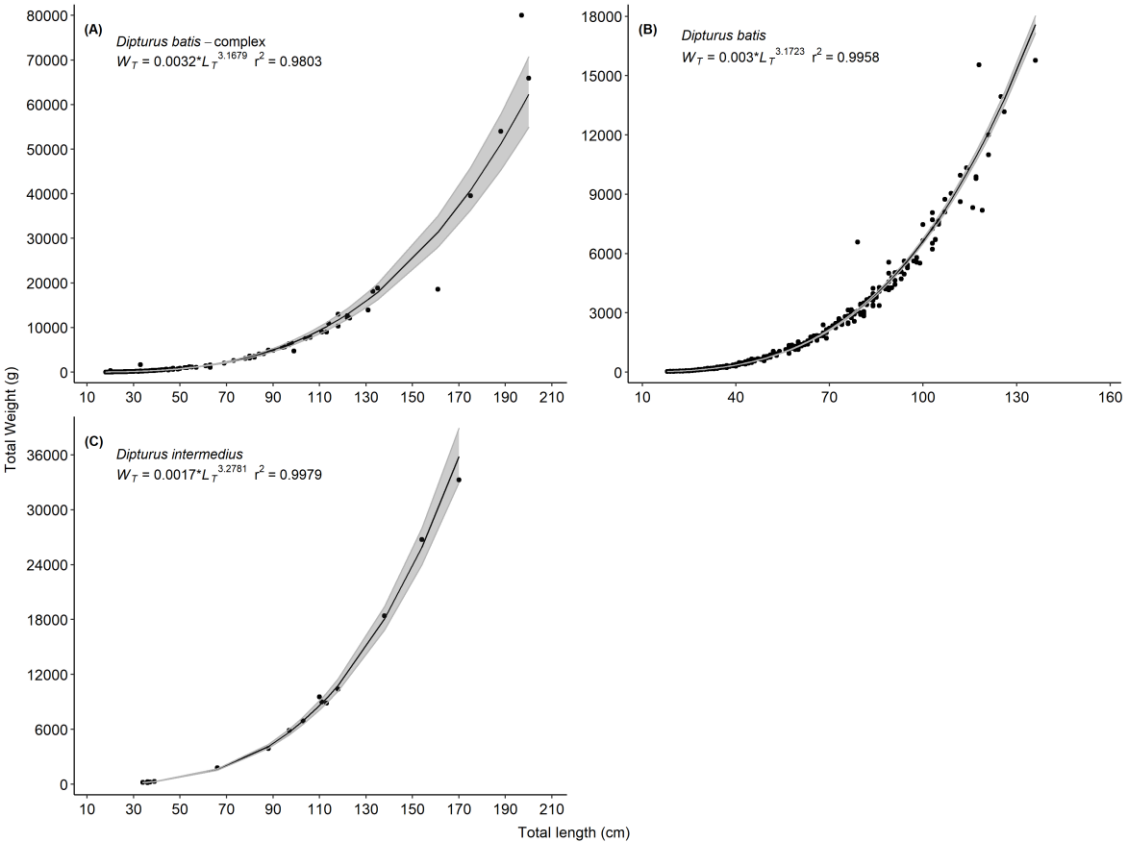

Figure 26.10. Relationships between total weight (W_T, g) and total length (L_T, cm) across years and surveys for (A) common skate-complex (n = 140), (B) common blue skate *D. batis* (n = 334) and (C) flapper skate *D. intermedius* (n = 19). Note: Data for common-skate complex only considered records where specimens were not identified and/or allocated to species-specific (A). Different axes used to avoid data being skewed. See also Table 26.6.

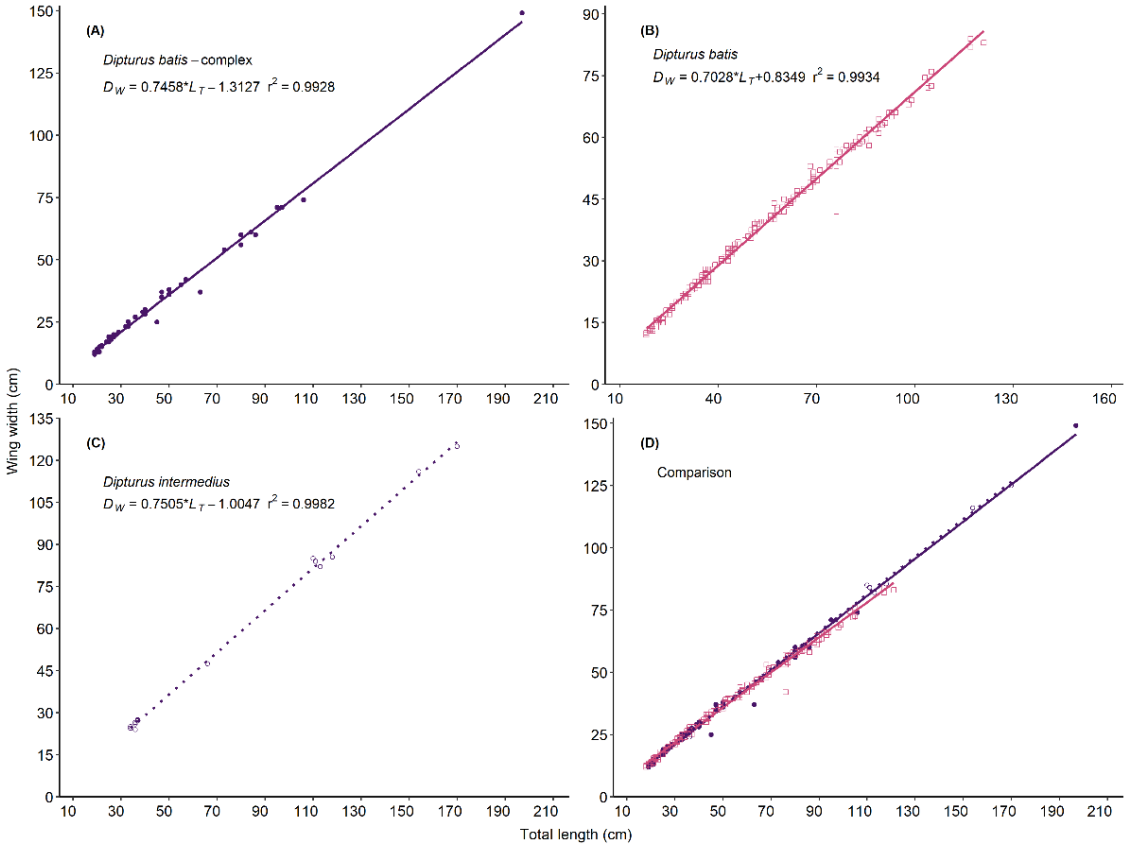

Figure 26.11. Total length (L_T, cm) to wing width (D_W, cm) across years and surveys for (A) common skate-complex (n = 53), (B) common blue skate *D. batis* (n = 204), (C) flapper skate *D. intermedius* (n = 14) and (D) comparison of relationships. Note: Data for common-skate complex only considered records where specimens were not identified and/or allocated to species-specific (A). Different axis to avoid data to be skewed.

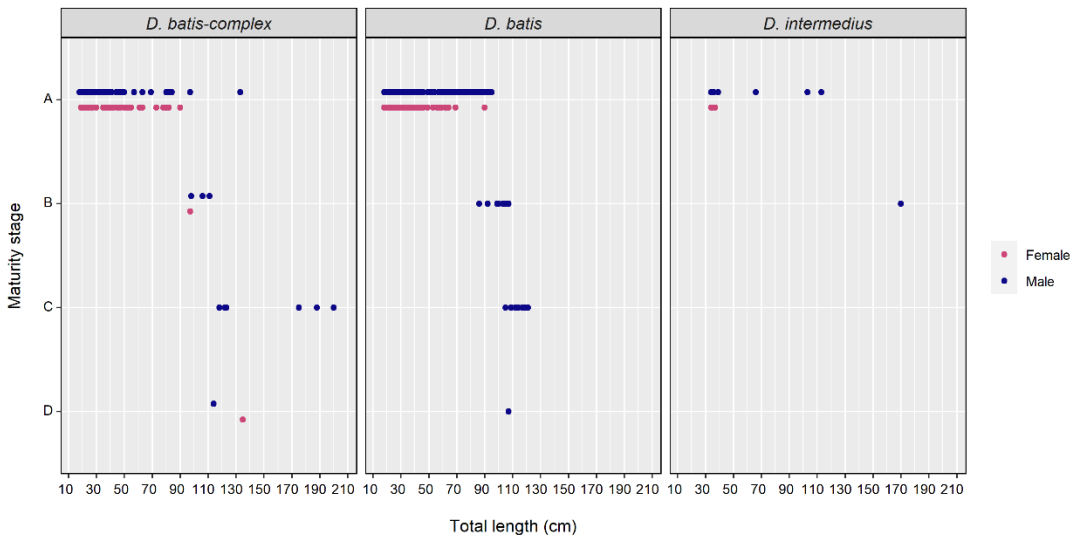

Figure 26.12. Maturity stage by sex and total length (L_T) (A) common skate-complex *D.* batis-complex (n = 53), (B) common blue skate *D. batis* (n = 204) and (C) flapper skate *D.* intermedius (n = 14). Note: Data for common-skate complex only considered records where specimens were not identified and/or allocated to a specific species. Maturity stages: A (Immature), B (Maturing), C (Mature) and D (Active). Other species not shown as limited data but describe in text.

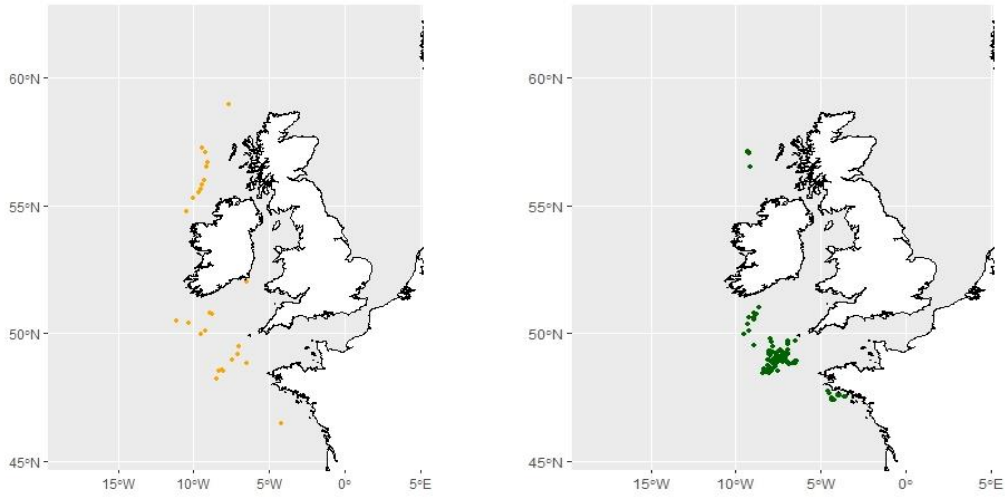

Figure 26.13. Observed occurrence (2006–2016) of flapper skate *Dipturus intermedius* (left, orange circles; n = 95) and common blue skate *Dipturus batis* (right, green circles; n = 1378).

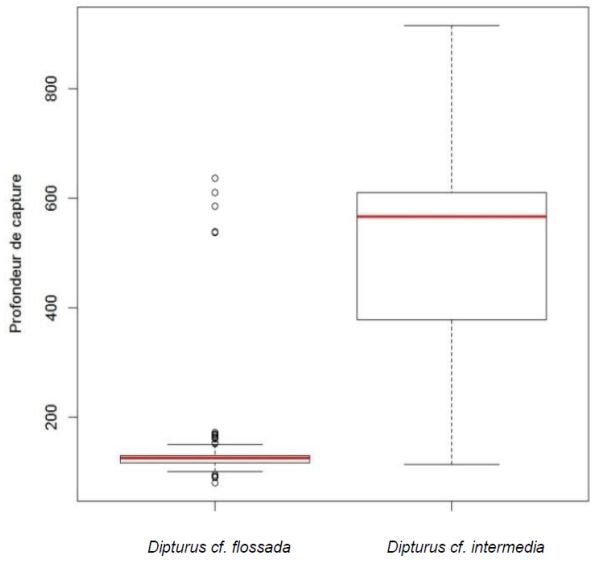

Figure 26.14. Boxplot on depth of capture for *Dipturus batis* (here labelled as "*D. cf. flossada*"; n = 1332) and *D. intermedius* (here labelled as ''*D. cf. intermedia*''; n = 64) recorded during onboard fishing vessels observation program ''POCHETEAU'' including one trip on the edge of the North-west Scotland shelf (2007) and six trips (2013–2015) on the continental shelf of the Celtic Sea. Red line is the median depth of catch. Source: Barreau *et al.* (2016).

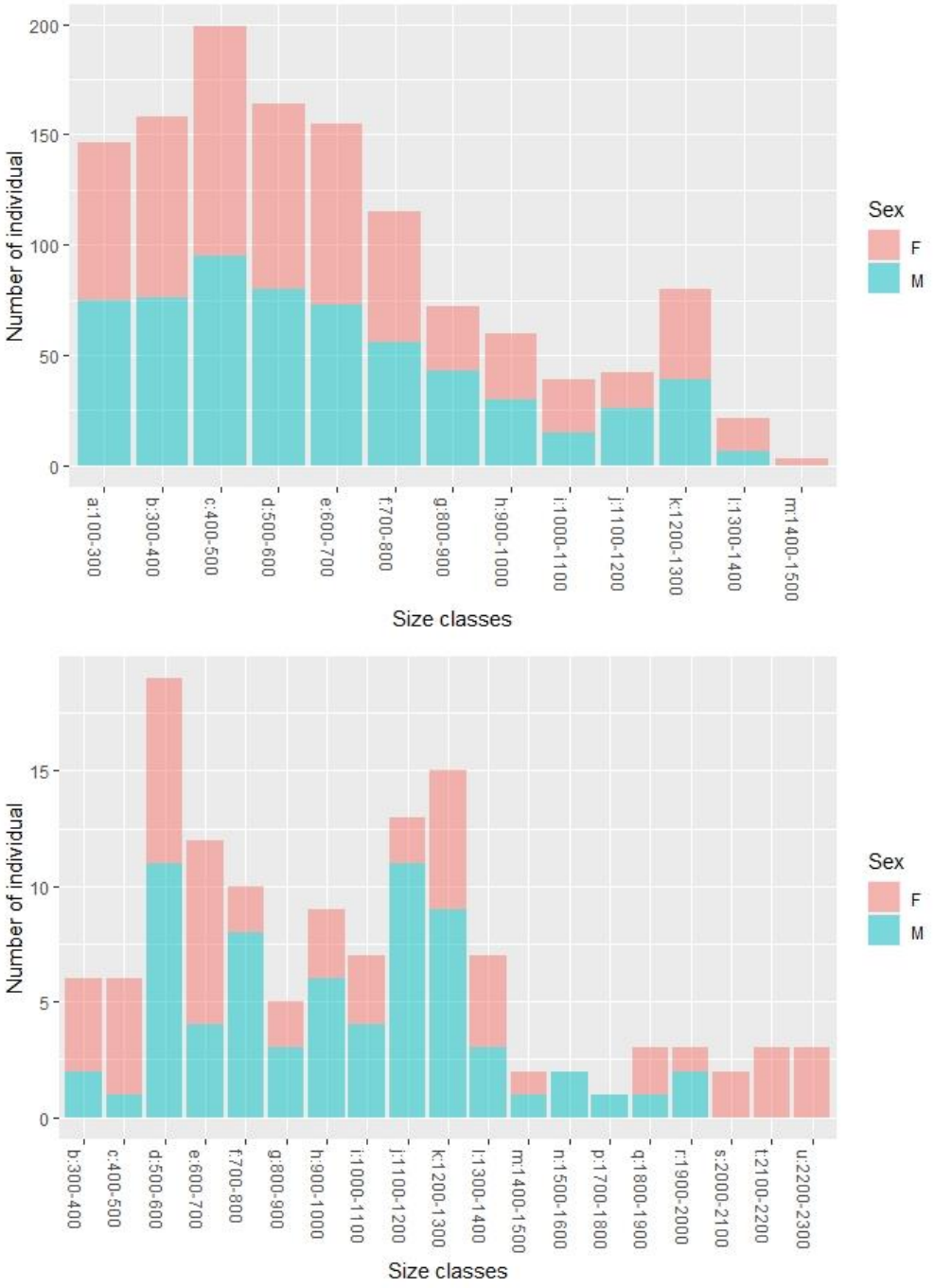

Figure 26.15. Length-frequency distributions (in 10 cm size classes) by sex (red: female; blue: male) of common blue skate *Dipturus batis* (top; n = 1254) and flapper skate *D. intermedius* (bottom; n = 128) observed during the Pocheteau project (2013–2015). Source: Barreau *et al.* (2016).

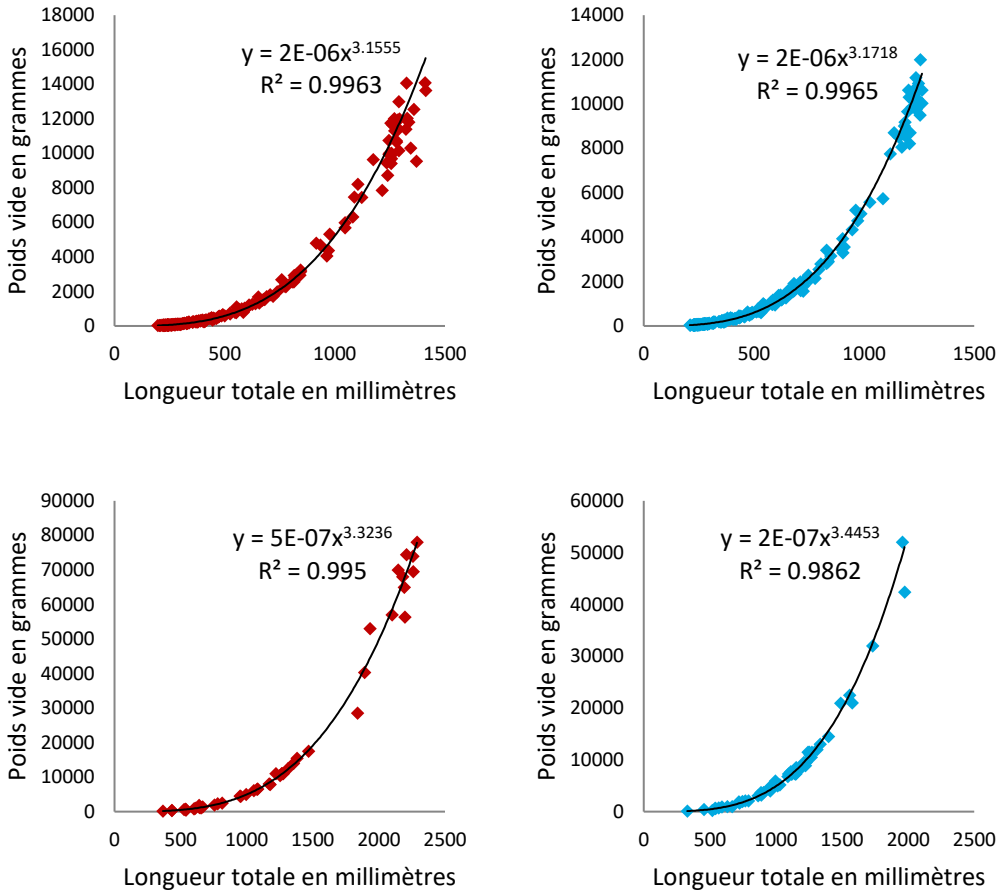

Figure 26.16. Length-gutted weight relationships per sex based for common blue skate *Dipturus batis* (top left: female, n = 175; top right: male, n = 197) and flapper skate *Dipturus intermedius* (bottom left: female, n = 45; bottom right: male, n = 56). Source: Barreau *et al.* (2016). See also Table 26.6.

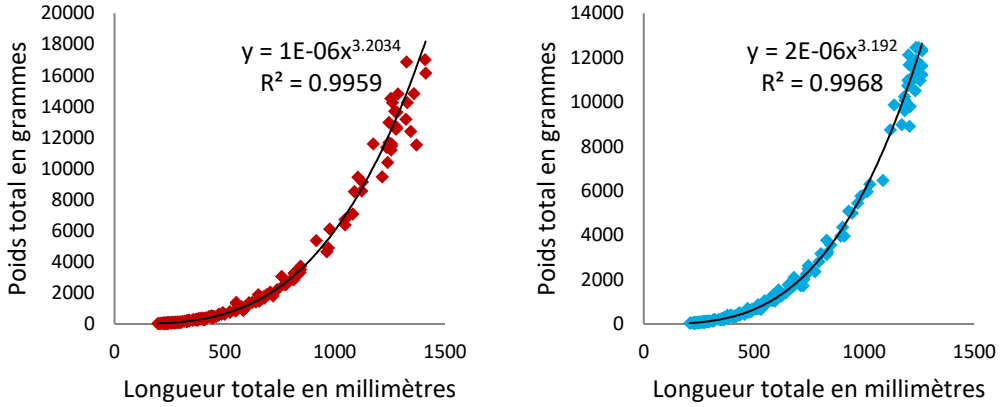

Figure 26.17. Length-total weight relationship per sex for common blue skate *Dipturus batis* (left: female, n = 167; right: male, n = 196). Source: Barreau *et al.* (2016). See also Table 26.6.

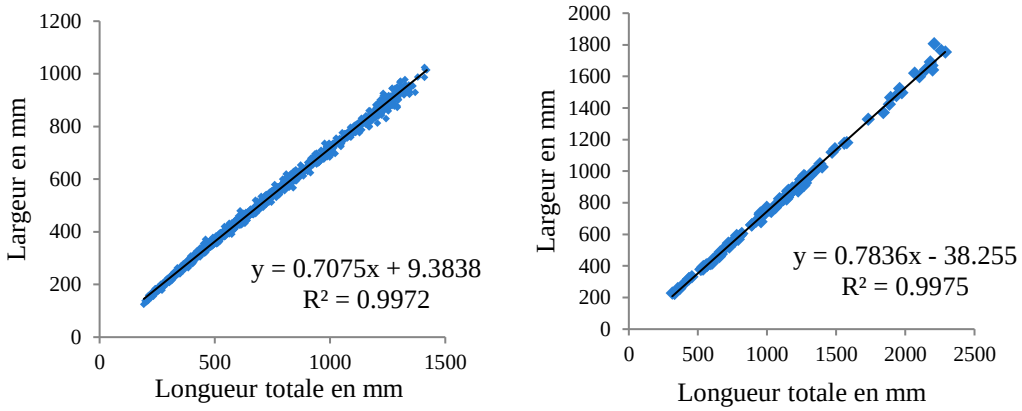

Figure 26.18. Relationship between disc width (largeur, mm) and total length (longueur total, mm), as defined by $y = ax + b$ for common blue skate *D. batis* (left, n = 1374) and flapper skate *D. intermedius* (right, n = 115). Source: Barreau *et al.* (2016).

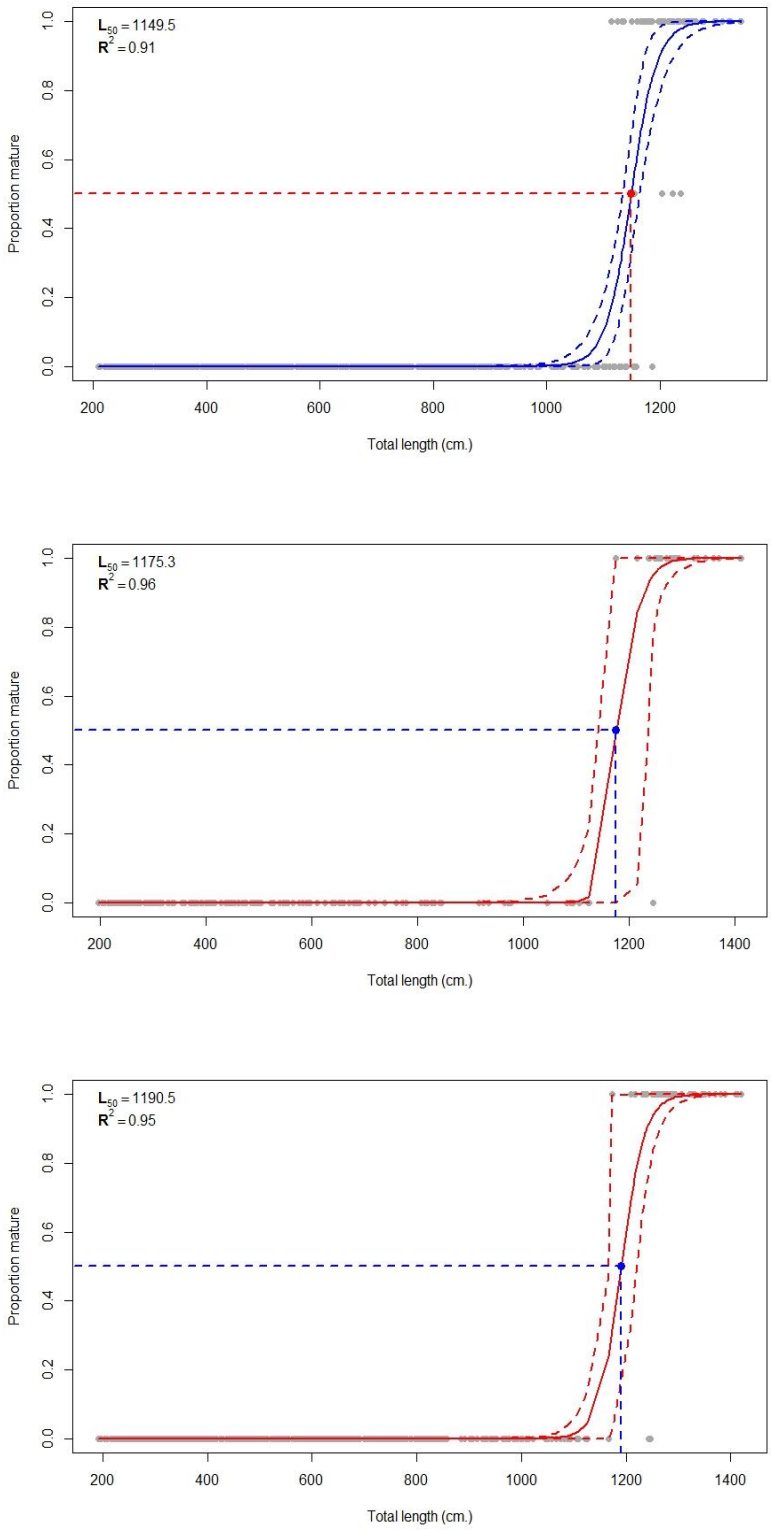

Figure 26.19. Maturity ogives for common blue skate *Dipturus batis* for males (top; n = 756; L_{50} = 114.95 cm), females (centre; n = 184; L50 = 117.53 cm, based on dissected specimens) and females (bottom; n = 694; L_{50} = 119.05 cm, based on the assumption that all females <90 cm are immature and that female caught alive but not dissected were mature if a flaccid cloaca was observed).

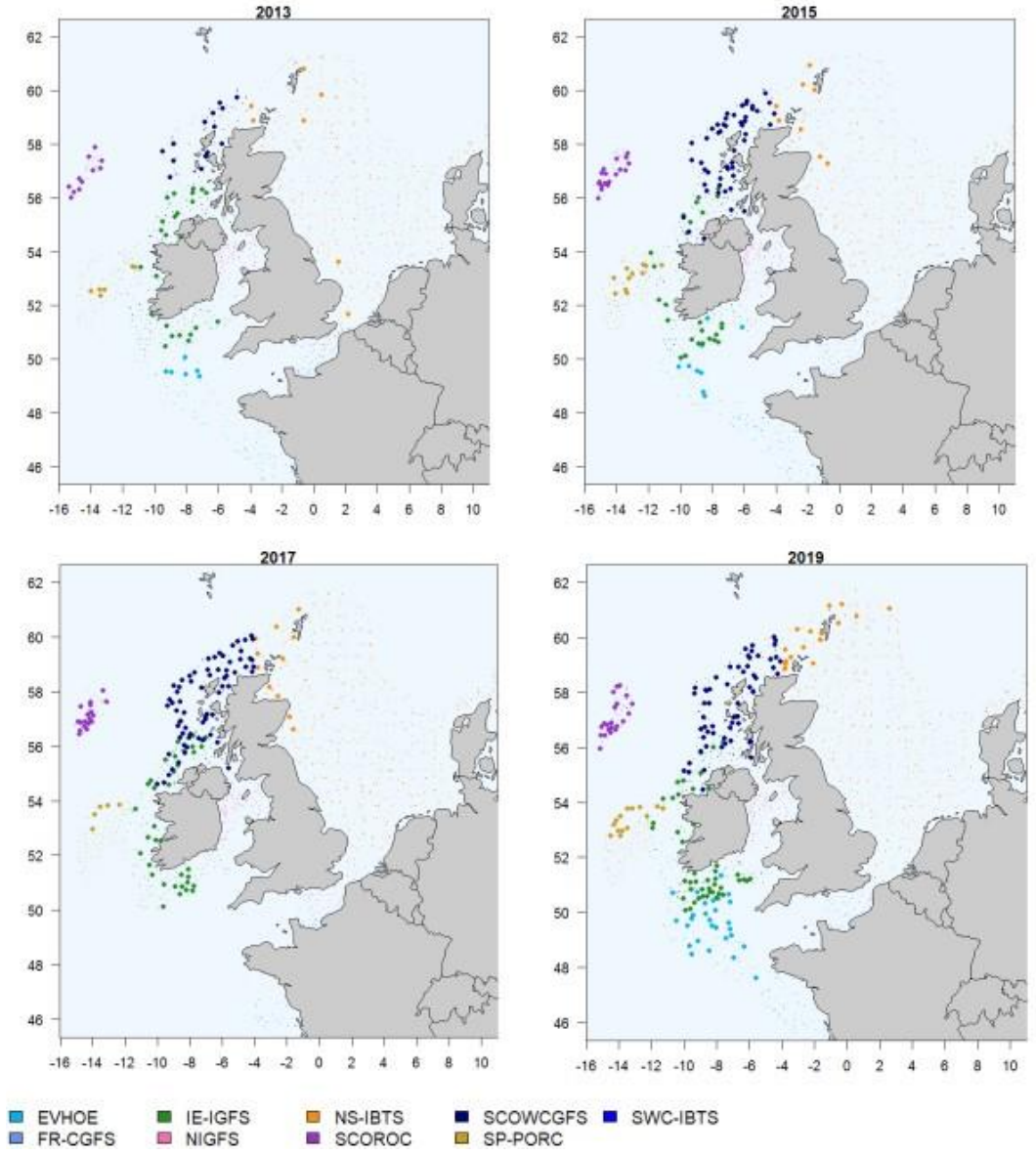

Figure 26.20 Presence-absence of the common blue skate complex (D. batis and D. intermedius) in IBTS surveys (Source: DATRAS) for odd-numbered years between 2013 and 2019. Circles indicates stations where at least one of the species is present while dots signals stations where they were not observed. Each colour corresponds to a particular survey. In 2017, EVHOE-WIBTS-Q4 (light blue) did not cover the Celtic Sea.

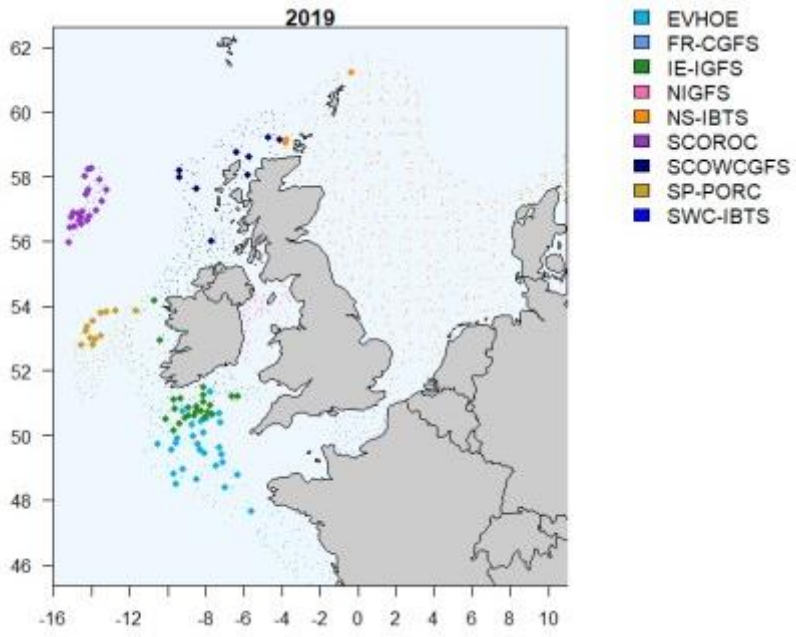

Figure 26.21 Presence-absence of common blue skate complex (D. batis) in IBTS surveys (source: DATRAS) in 2019 Circles indicates stations where the species is present while dots signals stations where they it not observed. Each colour corresponds to a particular survey.

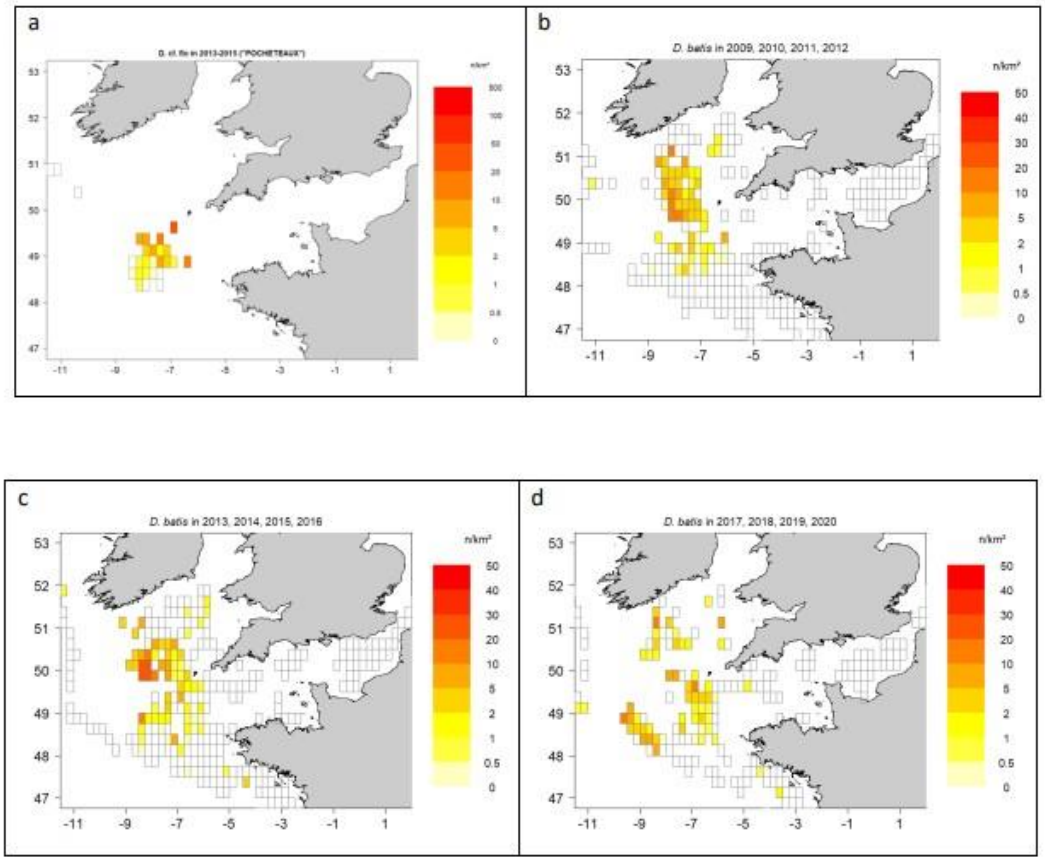

Figure 26.22 Distribution of densities of D. batis in the Celtic Sea in numbers by km², from Obsmer data (b to d) for periods of 4 years in 0.25° lat x 0.25° lon cells, and compared to densities derived from data collected during the POCHETEAUX project (a). Average densities are calculated from otter trawl data. Only cells with a minimum of 3 observed fishing operations are represented.

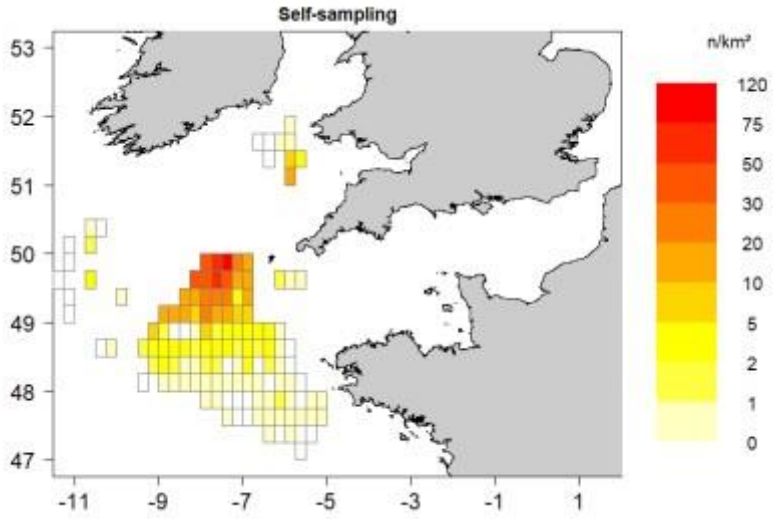

Figure 26.23 Distribution of densities of D. batis in the Celtic Sea in numbers by km², from self-sampling data collected between October 2019 and April 2022 in 0.25° lat x 0.25° lon cells.

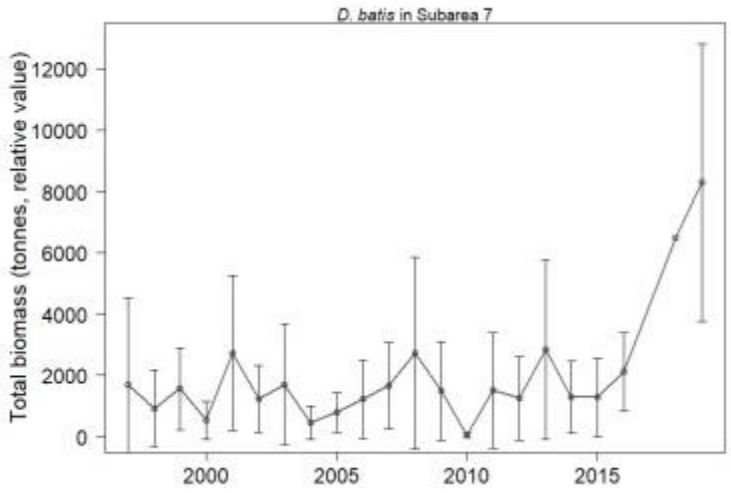

Figure 26.24 Approximated time series of biomass of D. batis in Subarea 7 from the EVHOE survey, with 95% confidence intervals. No confidence interval was calculated for year 2018, for which data include a mixture of individuals identified at the level of the species and other individuals described as belonging to the common skate complex.

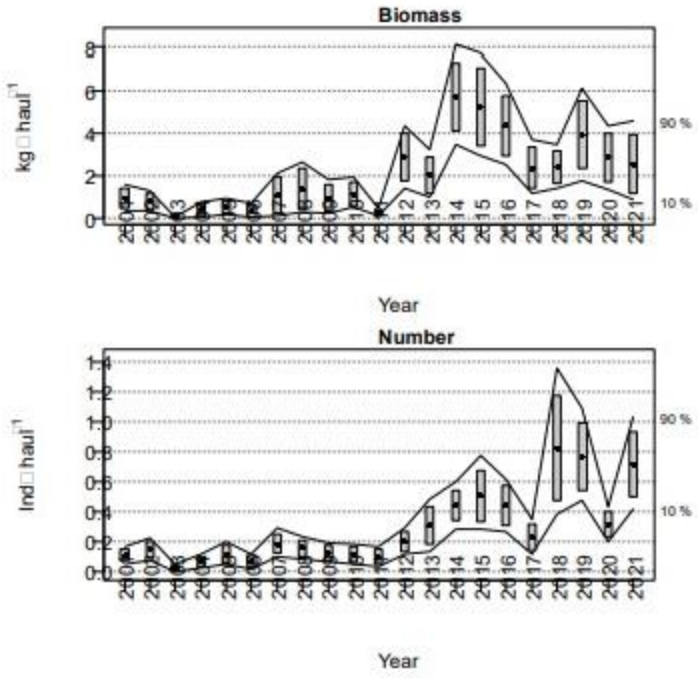

Figure 26.25 Temporal changes (2001-2021) in the biomass and abundance indices of *Dipturus spp.* during the Porcupine Bank survey. Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a= 0.80, bootstrap iterations = 1000).

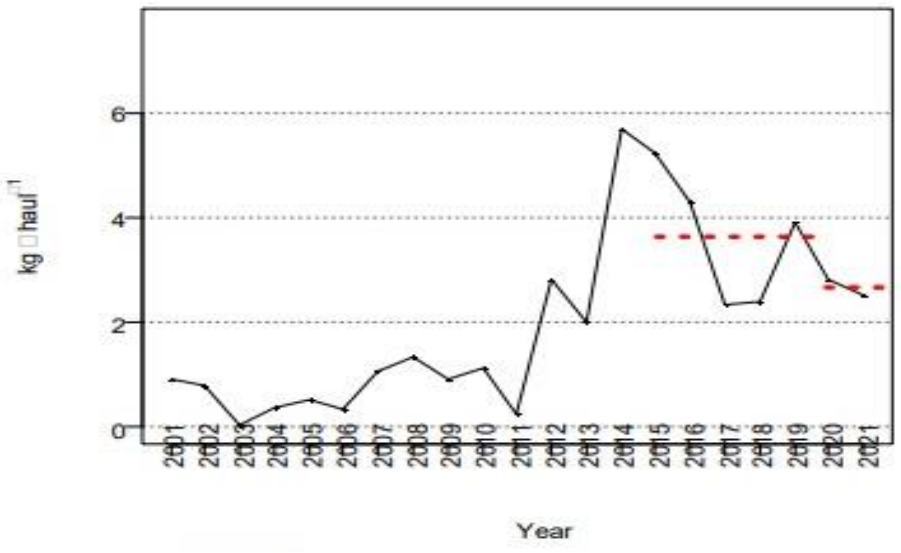

Figure 26.26 Temporal change in the biomass index for *Dipturus spp.*, as recorded during the Porcupine Bank survey (2011–2021). Dotted lines compare the mean stratified biomass in the last two years with five previous years.

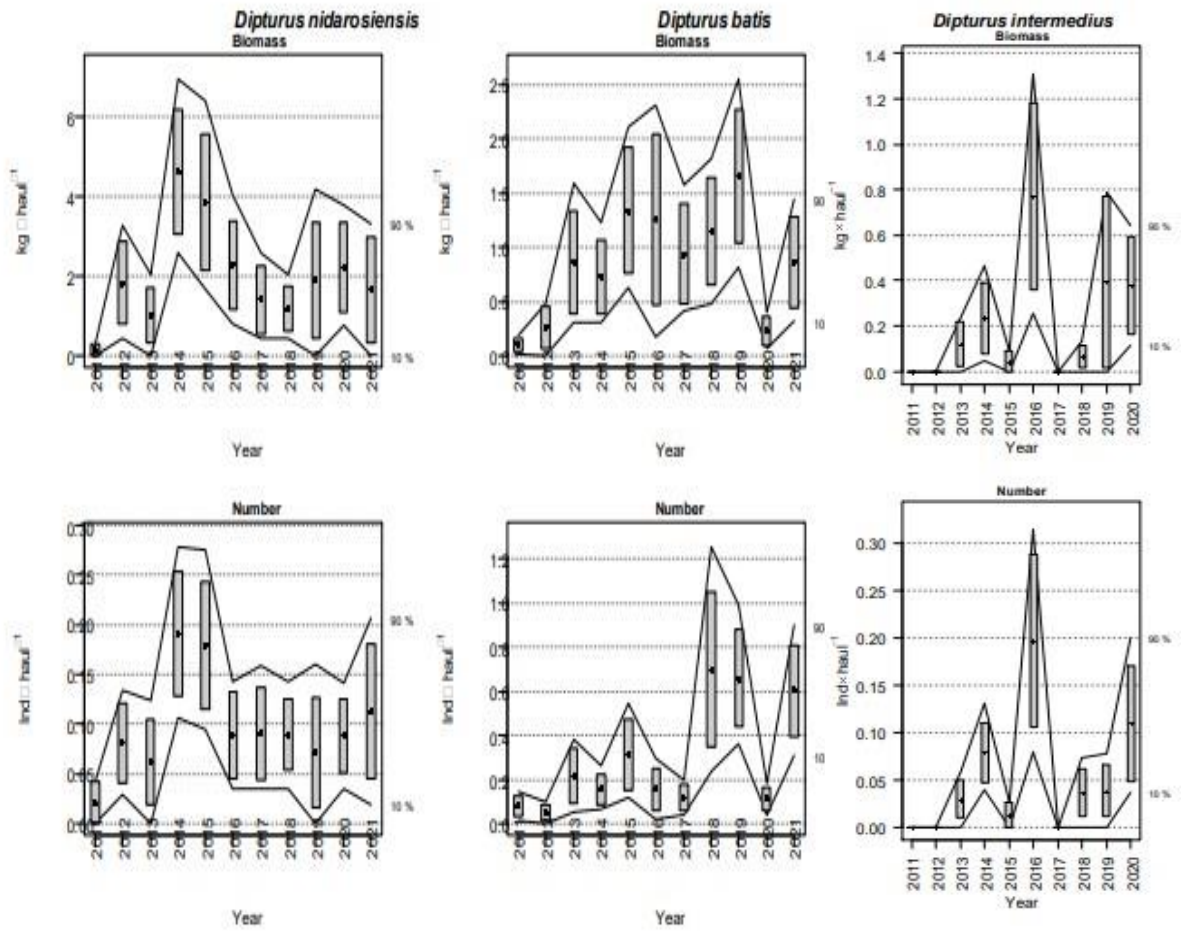

Figure 26.27 Temporal changes in the biomass and abundance indices of *Dipturus nidarosiensis* (2011–2021), *D. batis* (2011–2021) and *D. intermedius* (2010-2020) as recorded in the Porcupine Bank survey (species-specific data available). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000).

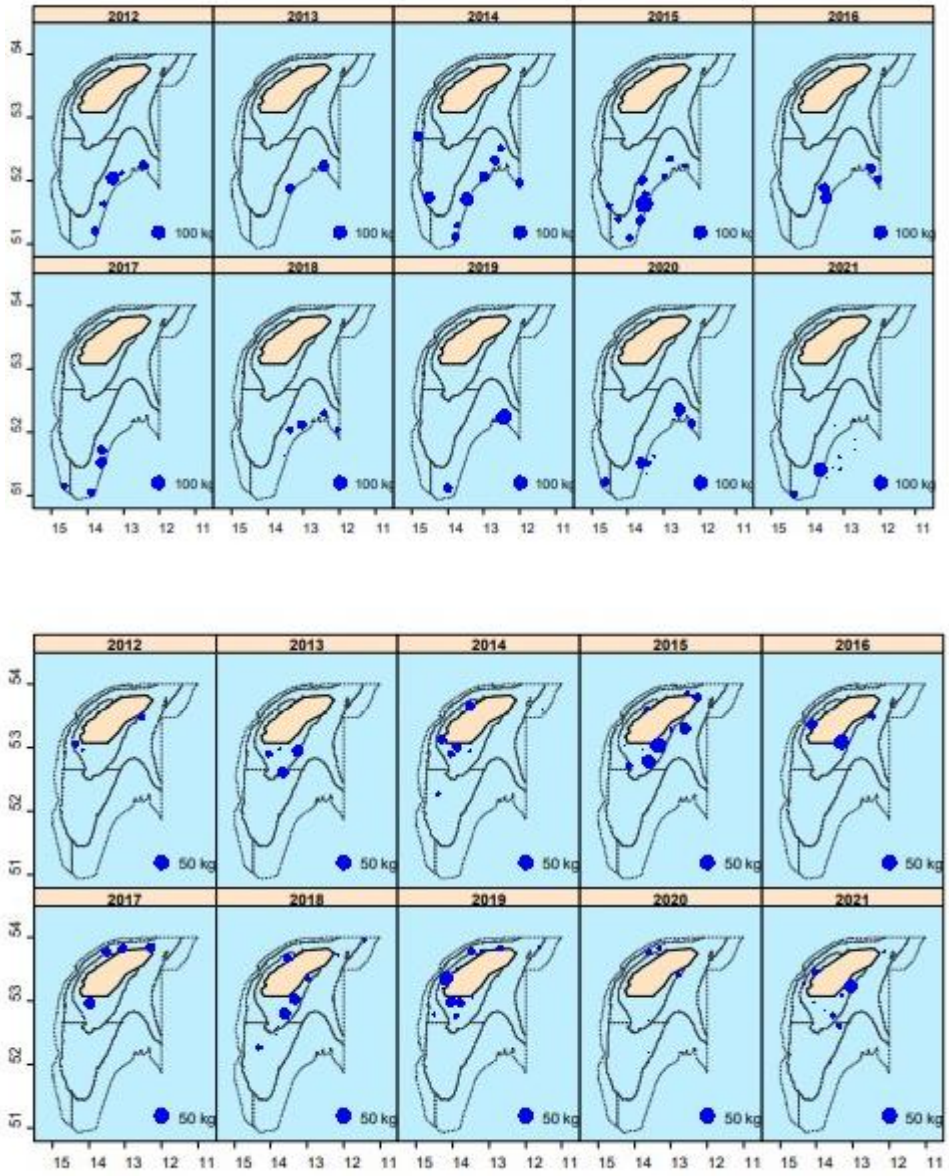

Figure 26.28 Geographic distribution and catch rates (kg.haul^{-1}) of *D. nidarosiensis* (top) and *Dipturus batis* (bottom) during Spanish surveys on the Porcupine Bank (2012–2021).

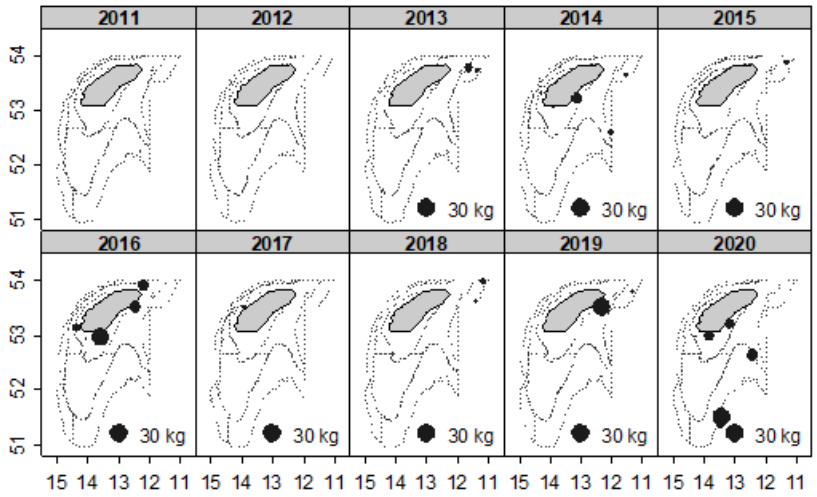

Figure 26.29 Geographic distribution and catch rates (kg.haul^{-1}) of *Dipturus intermedius* during Spanish surveys on the Porcupine Bank (2011–2020).

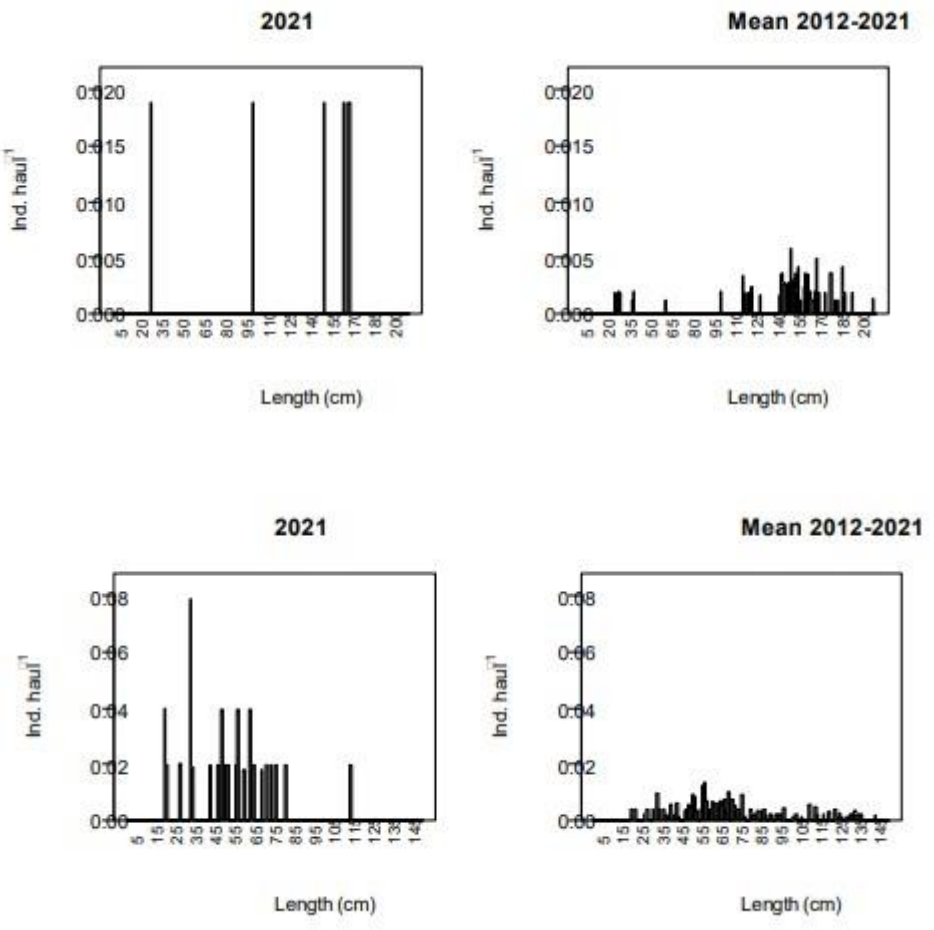

Figure 26.30 Stratified length distributions of *D. nidarosiensis* (top) and *Dipturus batis* (bottom) during Spanish surveys on the Porcupine Bank (2012–2021).

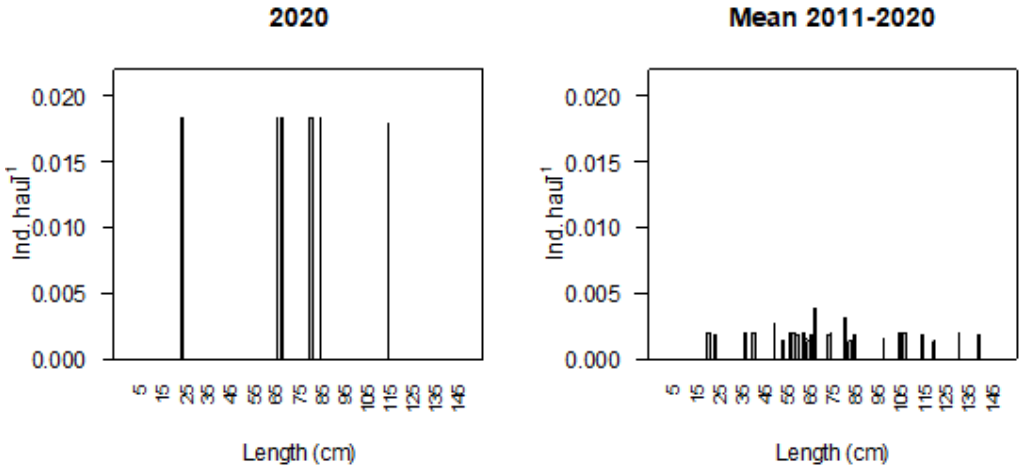

Figure 26.31. Stratified length distributions of *D. intermedius* during Spanish surveys on the Porcupine Bank (2011–2020).

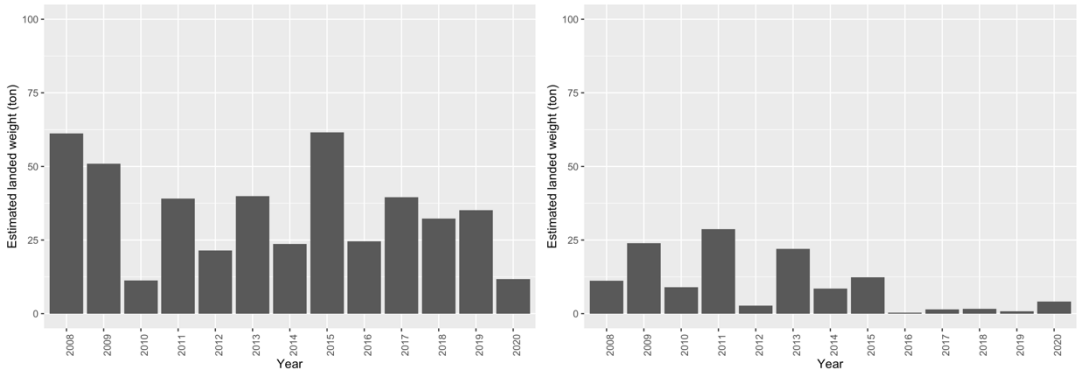

Figure 26.32. Estimated Portuguese landings of *Dipturus oxyrinchus* from Division 9.a by fleet segment: polyvalent (left) and trawl (right).

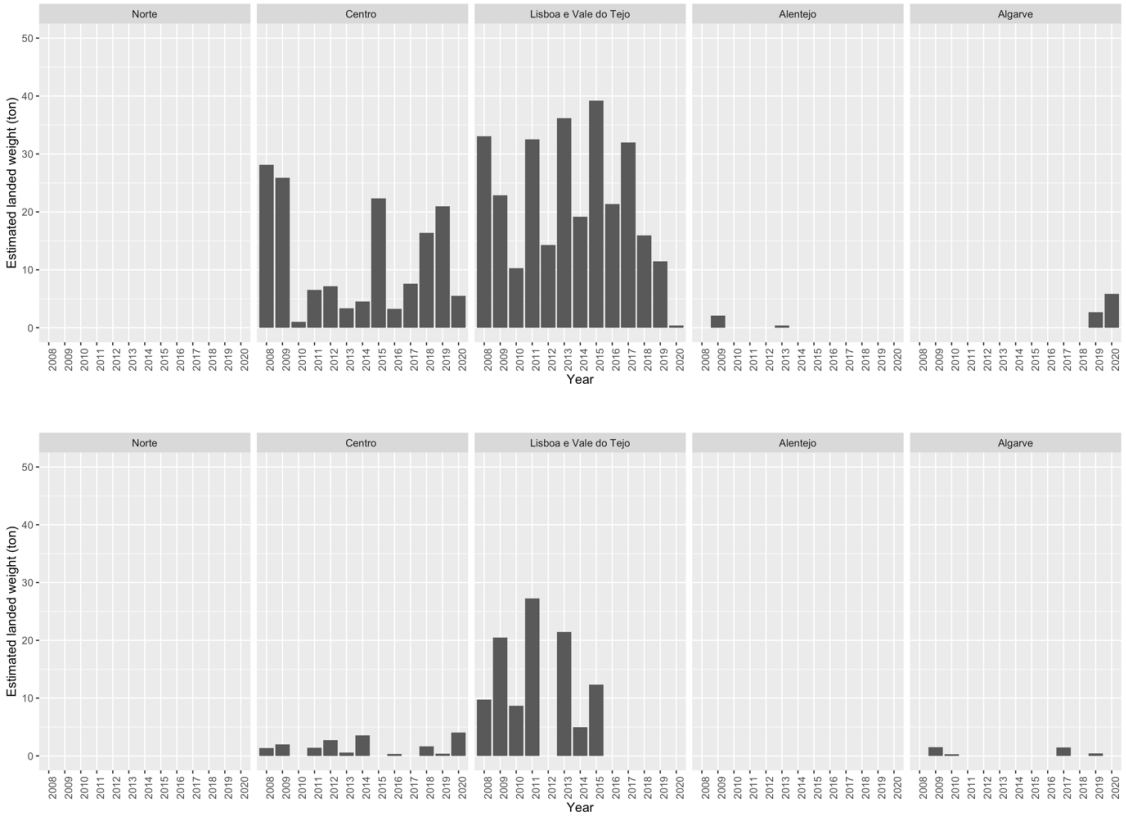

Figure 26.33. Estimated Portuguese landings of *Dipturus oxyrinchus* from Division 9.a by fleet segment (polyvalent: top; trawl: bottom) and region (from north to south).

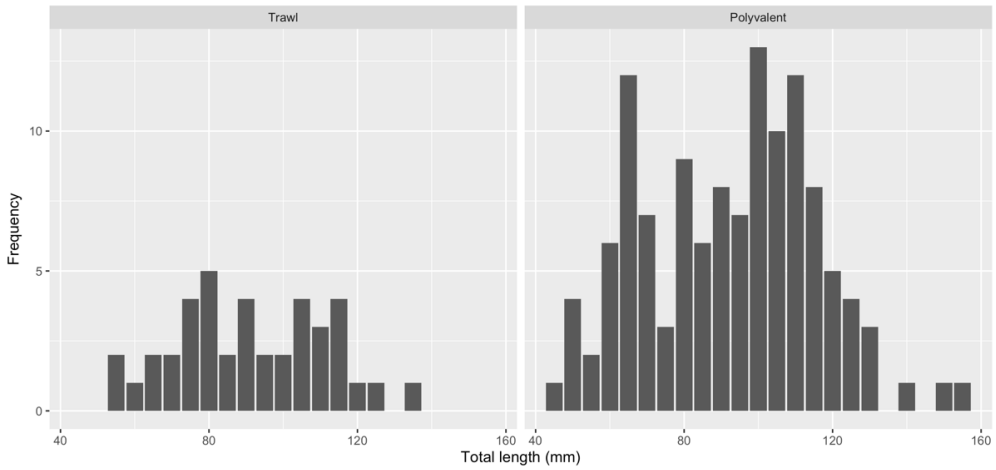

Figure 26.34. Length-frequency distribution of *Dipturus oxyrinchus* sampled in Portuguese landings from Division 9.a (2008–2020) by fleet segment (left: trawl, n = 112; right: polyvalent, n = 401). Data was not raised to the total estimated catch of the fleet.

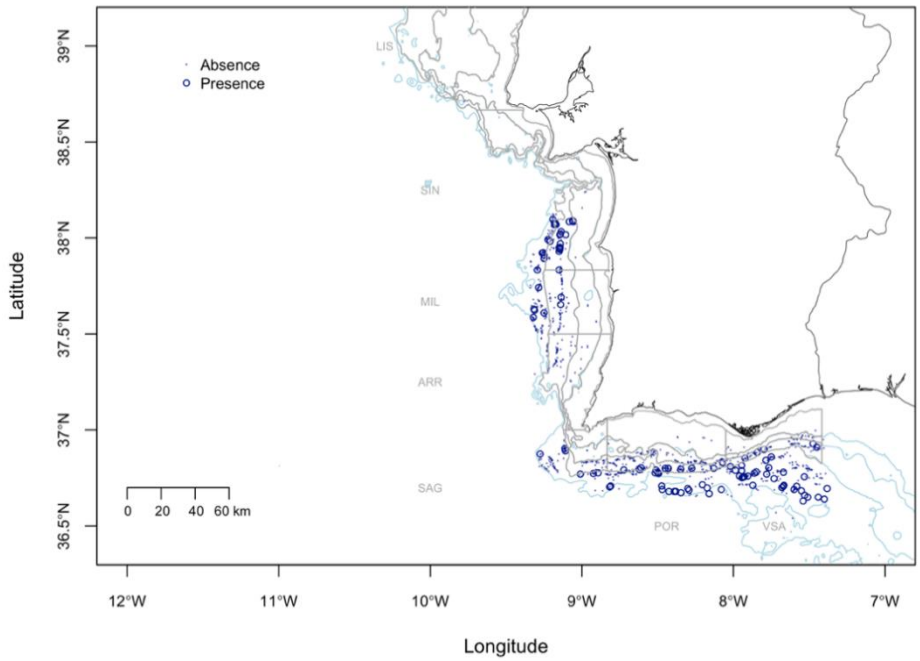

Figure 26.35. Presence/absence distribution of *Dipturus oxyrinchus* sampled in NepS (FU 28–29) from 1997 to 2018.

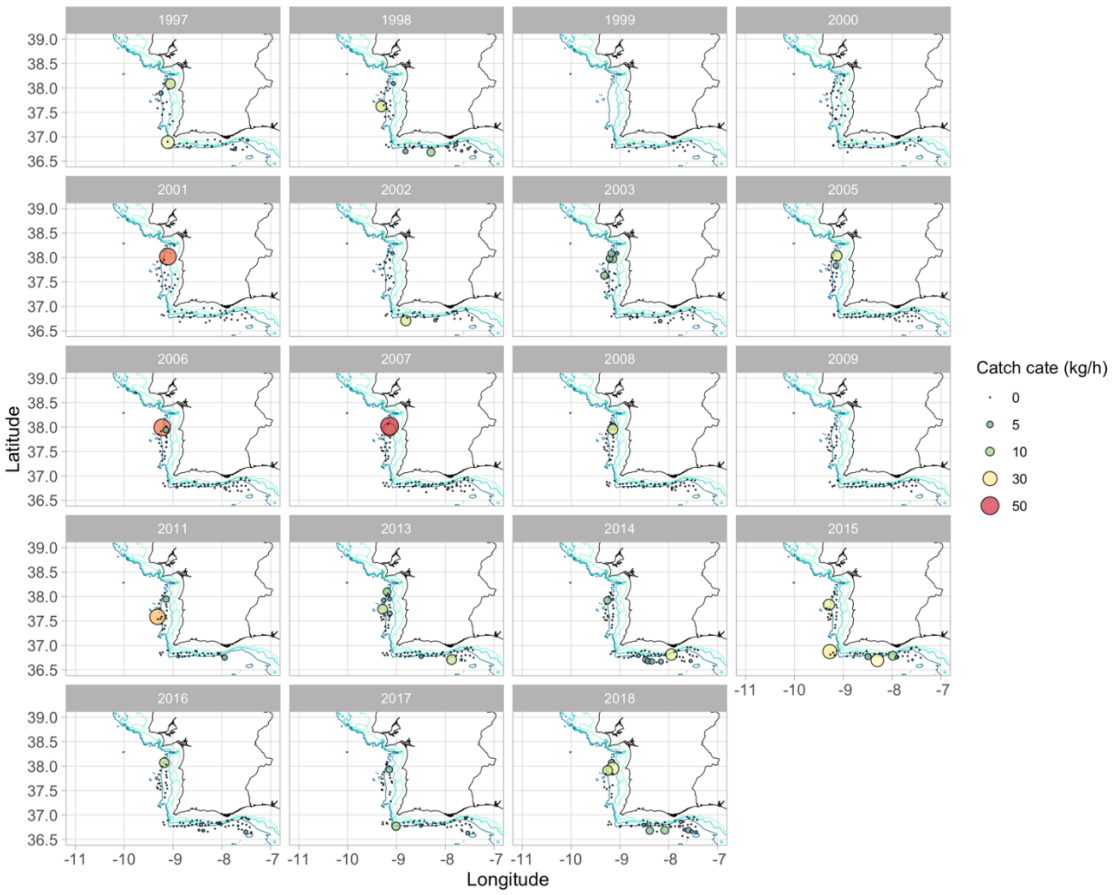

Figure 26.36. Catch distribution (n.h^{-1}) of *Dipturus oxyrinchus* sampled in NepS (FU 28–29) by year, from 1997 to 2018.

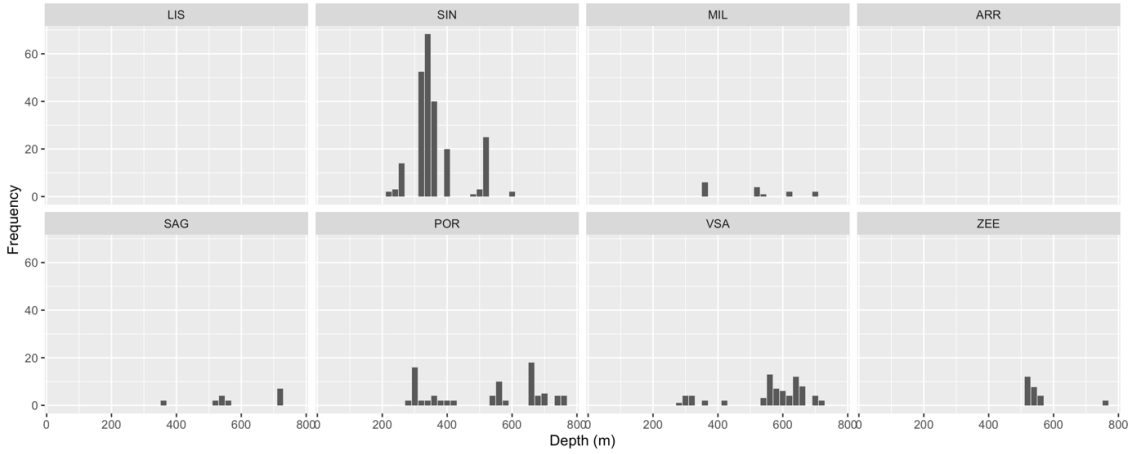

Figure 26.37. Bathymetric range of *Dipturus oxyrinchus* sampled in NepS (FU 28–29) from 1997 to 2018, by sector.

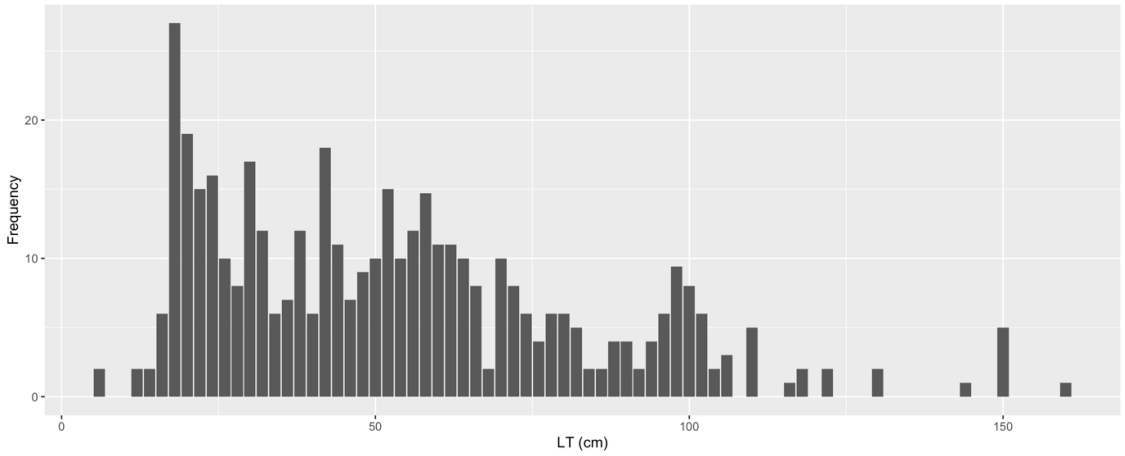

Figure 26.38. Length-frequency distribution of *Dipturus oxyrinchus* during NepS (FU 28–29) for the period 1997–2018.

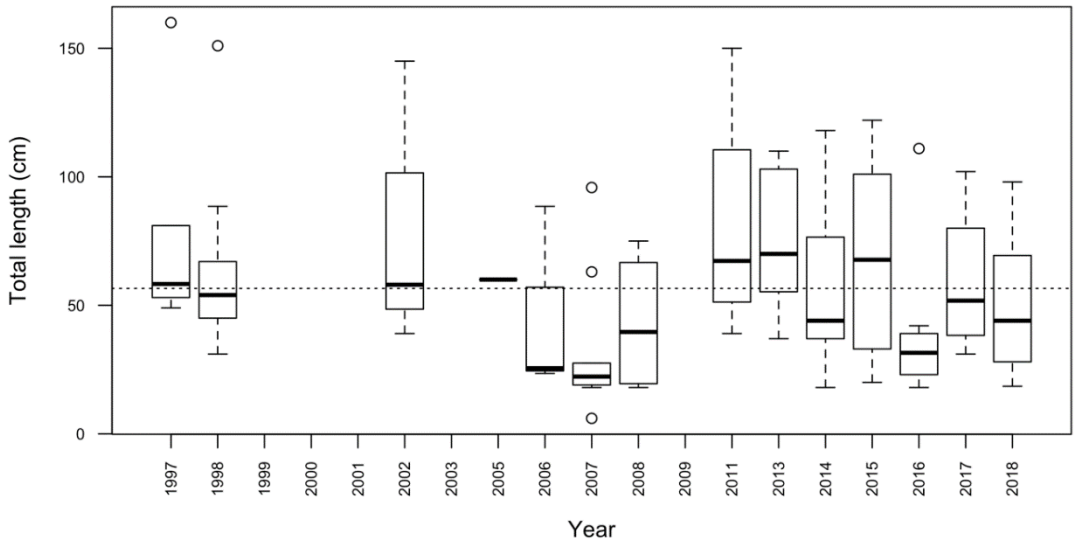

Figure 26.39. Total length variation of *Dipturus oxyrinchus*, by year on NepS (FU 28–29) (dashed line represents the mean annual length for 1997–2018).

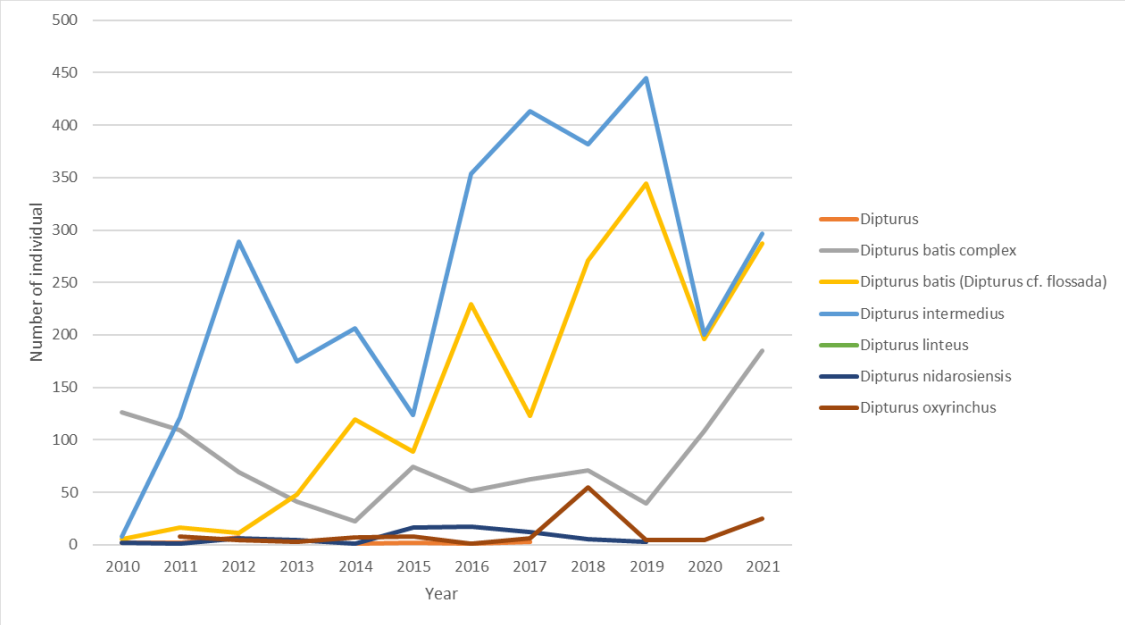

Figure 26.40. Number of individual *Dipturus* records per species (2010–2020) from those research surveys available on DATRAS.

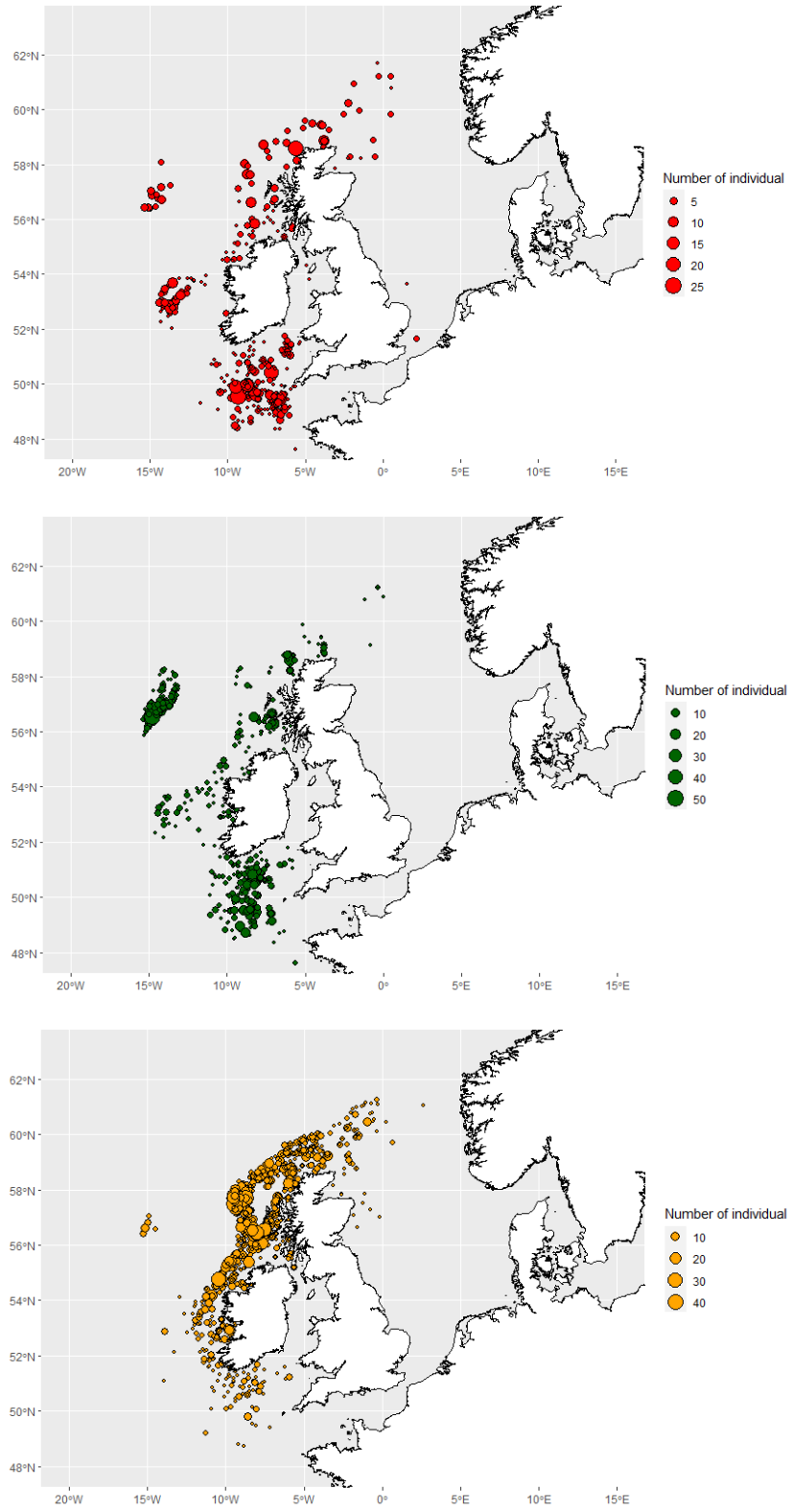

Figure 26.41. Spatial distribution and catch rates of *Dipturus batis*-complex (top, n = 966), *Dipturus batis(Dipturus* cf. *flossada* (centre, n = 1738) and *Dipturus intermedius* (bottom, n = 3014), as recorded during research vessel surveys between 2010 and 2021.

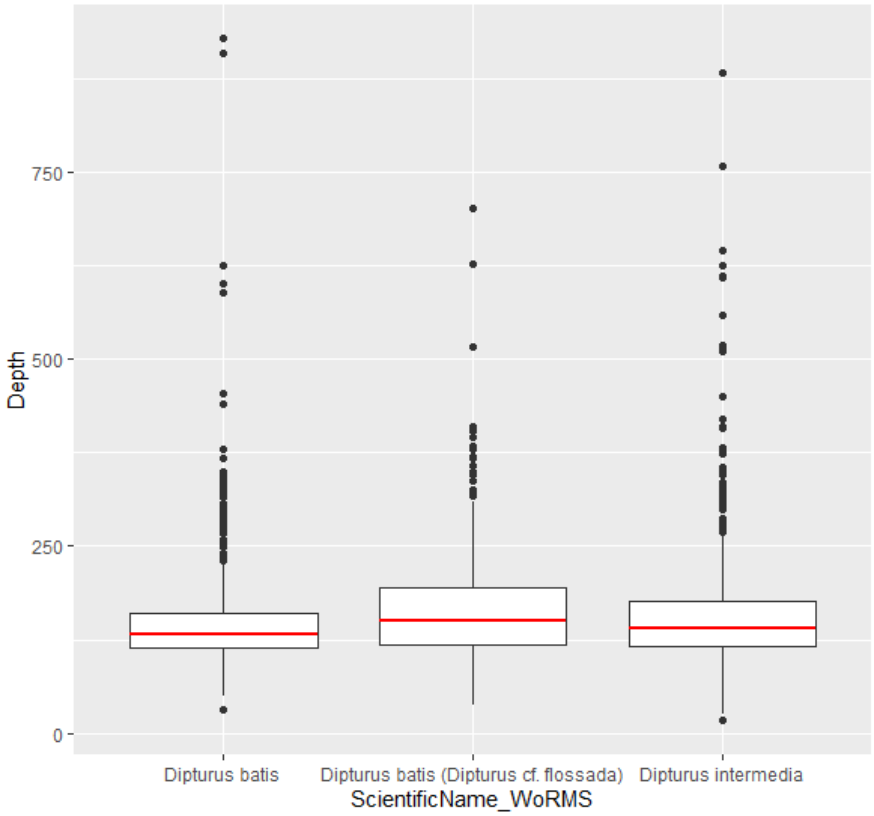

Figure 26.42. Boxplot on depth range (m) for *D. batis* (n = 965), *Dipturus batis (Dipturus cf. flossada)* (n = 1738") and *D. intermedius* (n = 3013) recorded during research vessel trawl surveys between 2010 and 2021. Red line is the median depth of catch.

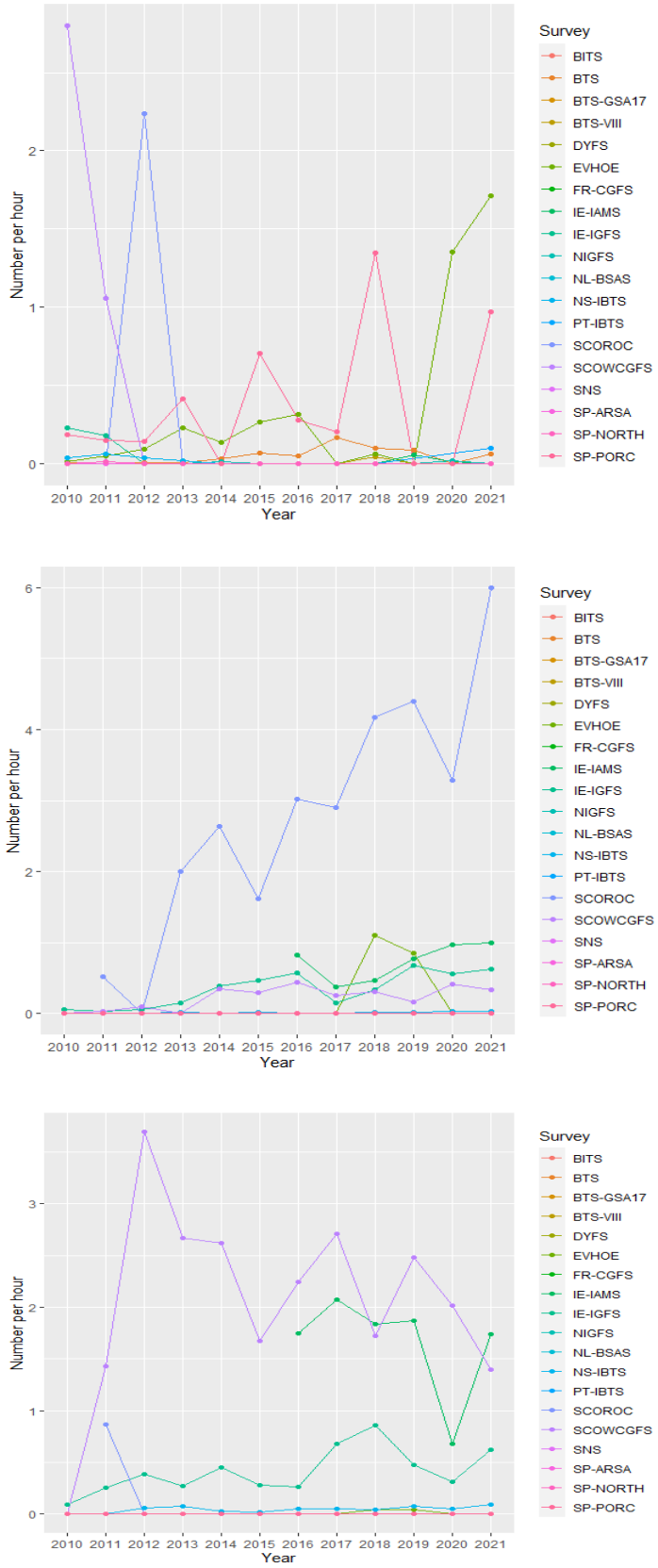

Figure 26.43. Nominal catch rates (number per hour) for *D. batis* complex (top), common blue skate *Dipturus batis(D.* cf. *flossada)* (centre) and flapper skate *Dipturus intermedius* (bottom) as reported during trawl surveys available in DATRAS (2010–2021).

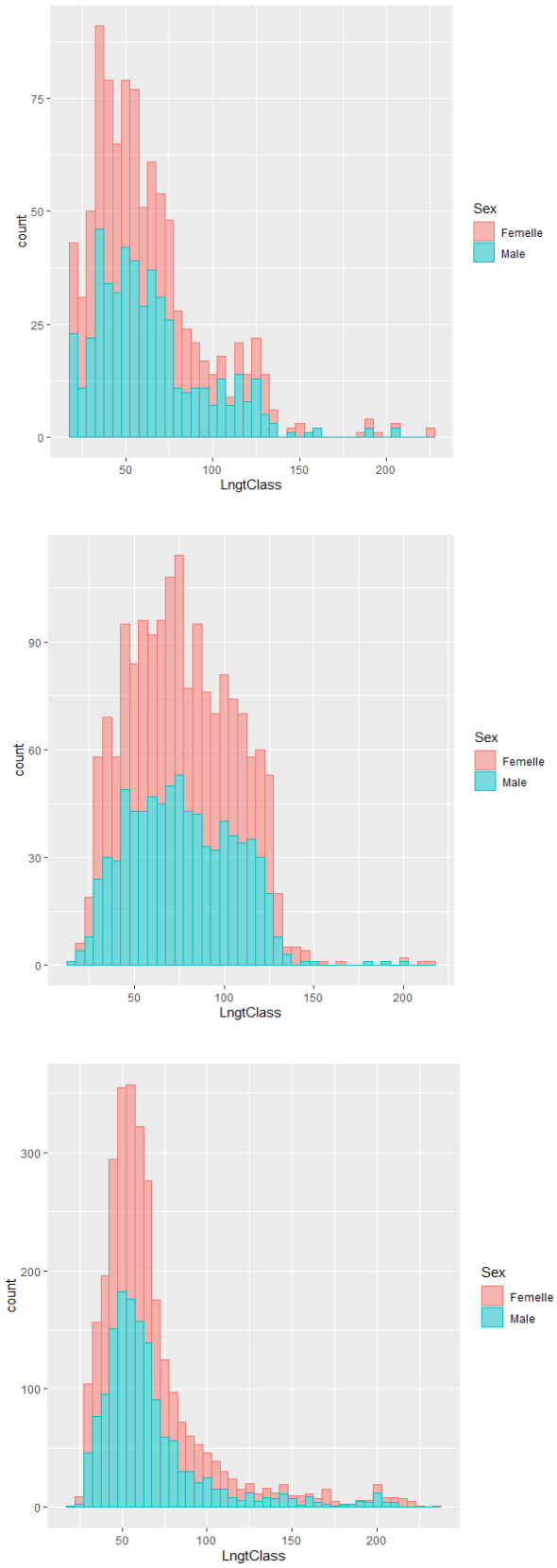

Figure 26.44. Length-frequency distributions of *D. batis* complex (top, n = 956), common blue skate *Dipturus batis* (*D.* cf. *flossada*)(centre, n = 1653) and flapper skate (bottom, n = 3009), as observed in scientific trawl surveys from DATRAS data between 2010 and 2021.