13 Demersal elasmobranchs in the Barents Sea

13.1 Ecoregion and stock boundaries

The ecology of the Barents Sea ecosystem (ICES Subarea 1, extending into the eastern parts of Subarea 2) has been described comprehensively by Jakobsen and Ozhigin (2012).

Lynghammar *et al*. (2013) reviewed the occurrence of chondrichthyan fish in the Barents Sea ecoregion. The skate species reported from the offshore areas of this ecoregion include thorny skate *Amblyraja radiata*, Arctic skate *Amblyraja hyperborea*, round skate *Rajella fyllae*, spinytail skate *Bathyraja spinicauda*, common skate complex (*Dipturus batis* and/or *D. intermedius*, but see Section 26.1), sailray *Rajella lintea*, long-nosed skate *Dipturus oxyrinchus,* shagreen ray *Leucoraja fullonica* and thornback ray *Raja clavata* (Andriashev, 1954; Dolgov, 2000; Dolgov *et al*., 2005a; Wienerroither *et al*., 2011; Knutsen *et al*., 2017 WD), but few occur at high abundance. All skate species occurring in offshore areas also occur in more coastal areas, with the exception of *A. hyperborea, D. oxyrinchus* and *R. lintea* (Williams *et al*., 2008). The spatial distribution of chondrichthyan fishes in the Barents Sea, as observed in recent surveys, has been described by Wienerroither *et al*. (2011, 2013).

The stock boundaries are not known for the skates in this area, nor the potential movements of species between coastal and offshore areas. Further investigations are necessary to determine potential movements and migrations between elasmobranch populations within this ecoregion and with adjacent areas.

Amblyraja radiata is the dominant skate species, comprising 96% by number and about 92% by biomass of skates caught in surveys or as bycatch. The next most abundant species are *A. hyperborea* and *R. fyllae* (3% and 2% by number, respectively), and the remaining species are scarce (Dolgov *et al*., 2005a; Drevetnyak *et al*., 2005).

The species composition of skates caught in the Barents Sea differs from those recorded in the Norwegian Deep and northeastern Norwegian Sea (Skjaeraasen and Bergstad, 2000, 2001). Although *A. radiata* is the dominant species in both areas, the proportion of warmer-water species (*B. spinicauda* and *R. lintea*) is lower, and the proportion of cold-water species (*A. hyperborea*) is higher in the Barents Sea.

In terms of other elasmobranchs, sharks known to occur in the Barents Sea include spurdog (Section 2), velvet belly lanternshark (Section 5), porbeagle shark (Section 6), Greenland shark (Section 24) and, in the southern part of the area, blackmouth catshark (Section 25). One chimaeroid (*Chimaera monstrosa*) also occurs.

13.2 The fishery

13.2.1 History of the fishery

All skate species in the ecoregion may be taken as bycatch in demersal fisheries, but there are at present no fisheries targeting skates in the Barents Sea. Detailed data on catches of skates from the Barents Sea are available from bycatch records and surveys, as shown for the periods1996–2001 and 1998–2001, respectively, by Dolgov *et al.* (2005a, 2005b). Bottom-trawl fisheries targeting cod *Gadus morhua* and haddock *Melanogrammus aeglefinus*, and longline fisheries targeting cod, blue catfish *Anarhichas denticulatus* and Greenland halibut *Reinhardtius hippoglossoides* have a skate bycatch, which is generally discarded.

Dolgov *et al.* (2005b) estimated the total catch of skates taken by the Russian fishing fleet operating in the Barents Sea and adjacent waters in 1996–2001, and found that it ranged from 723 to 1891 tonnes (average of 1250 tonnes per year). *A. radiata* accounted for 90–95% of the total skate bycatch. *A. radiata* is also the predominant skate in catches of the Norwegian Reference Fleet operating in ICES Subarea 1, and accounts for around 90% of the catches (Albert *et al*., 2016 WD).

13.2.2 The fishery in 2021

No new information. Since 2012, reported Norwegian skate landings have increased sharply and both in 2015 and 2017 they doubled compared to the previous year (157 tonnes to 369 tonnes, 374 tonnes to 704 tonnes, respectively). The reason for this increase is unknown. Norwegian landings have fluctuated for the last four years with 582, 849, 670 and 821 tonnes in 2018, 2019, 2020 and 2021, respectively. Germany reported between <0.1 tonnes and 5 tonnes landed for the years 2013–2018, but none in 2019–2021.

13.2.3 ICES advice applicable

ICES does not provide advice on the status of skate stocks in this ecoregion.

13.2.4 Management applicable

There are no TACs for any of the skate species in this ecoregion. Norway has a general ban on discarding. Since 2010, all dead or dying skates and other fish in the catches should be landed, whereas live specimens can be released (discarded).

13.3 Catch data

13.3.1 Landings

For ICES Subarea 1, landings data are limited and only available for all skate species combined (Table 13.1). Landings from the most westerly parts of the Barents Sea ecoregion fall within Subarea 2 (see Section 14). Russia and Norway are the main countries landing skates from the Barents Sea, and Figure 13.1 shows their landings from 1973 to 2021. However, Russian landings are not available since 2011.

Elasmobranch landings from ICES Subarea 1 are low, but there have been large fluctuations in Russian landings. The peak in Russian landings in the 1980s corresponded to an experimental fishery for skates, where the bycatch (mainly comprised of *Amblyraja radiata*) was landed (Dolgov, personal communication, 2006).

Based on data from the Norwegian Reference fleets, and the expert judgement detailed in Albert *et al*. (2016 WD), Norwegian landings by species and species groups from ICES Subarea 1 were estimated for years 2012-2015 (Table 13.2). Landings tend to be restricted to the larger specimens of *Raja clavata*, *Bathyraja spinicauda* and *Amblyraja hyperborea*.

13.3.2 Discards

Based on interviews of the Norwegian Reference Fleet and landing sites, the expected discards of skates varied extensively between species and is assumed almost 100% for specimens <50 cm total length. For *Rajella fyllae* and *Amblyraja radiata,* nearly all specimens are probably discarded,

whereas the discards of *Raja clavata* by the coastal fleet is expected to be negligible (Albert *et al*., 2016 WD).

13.3.3 Quality of catch data

Recent reported data on skate catch and landings from the Barents Sea are almost exclusively from Norway, and species information from the Norwegian Reference Fleet (Table 13.2) may be indicative of the species composition of total catch and landings. The estimation of total skate catches and landings by species relied on some strong assumptions, e.g. that data from the Coastal and Oceanic Reference Fleets operating in the Barents Sea are representative for vessels below and above 21 m respectively, and that the relative species composition of skate catches in these two reference fleets has been stable over the last ten years. These assumptions were made due to limited availability of data. With increased data and extended time series, these assumptions should be relaxed by including running averages over shorter time periods, e.g. 3–5 years.

For years 2012-2015, even after allocating skate landings to species based on data from the Reference Fleet, the generic "Skates and rays" category still accounted for more than 50% of the total skate landings (Table 13.2). In 2021, about 90% of skate landings were still reported as Rajidae the rest being reported as Raja clavata.

In addition, the splitting of catches by species should be validated by independent surveys. The best way to do this is probably to include skates on the list of species to sample from selected landing ports. Skates are mostly landed as wings in Norway, which can make conventional species identification more difficult (although skate identification could be confirmed with genetic barcoding). Programmes for market sampling of skate landings could usefully be undertaken.

13.3.4 Discard survival

No data available to WGEF for the fisheries in this ecoregion.

13.4 Commercial catch composition

Generally, larger skates are more often caught in longline fisheries than in trawl fisheries (Dolgov *et al*., 2005b).

Vinnichenko *et al.* (2010 WD) reported that catches of skates in Russian trawl and longline bottom fisheries in 2009 (60–400 m depths) were dominated by *A. radiata* (90–95%). Information on length and sex composition can be found in ICES (2014). Other species occurring were *R. fyllae*, *A. hyperborea*, *B. spinicauda* and *R. lintea*. These findings are supported by data from the Norwegian Reference Fleet (Vollen, 2010 WD; Albert *et al*., 2016 WD).

Dolgov *et al.* (2005b) reported the mean length and the sex ratio for four species of skate in the Barents Sea. The sex ratio was 1:1 in commercial catches for all skate species except *A. hyperborea*, of which males dominated in the longline fishery (see ICES, 2007 for further information).

13.5 Commercial catch and effort data

Some CPUE data are available for *A. radiata*, *A. hyperborea*, *R. fyllae* and the common skate complex in trawl and longline fisheries, respectively. Total catches of skates in Russian fisheries in the Barents Sea and adjacent areas for the years 1996–2001 were summarized in ICES (2007).

Catch data from other nations are limited and analyses of more recent Russian data are required.

13.6 Fishery-independent surveys

13.6.1 Russian bottom trawl survey (RU-BTr-Q4)

For the offshore areas, data from October–December surveys (RU-BTr-Q4) were available for the years 1996–2003 (Dolgov *et al.*, 2005b; Drevetnyak *et al.*, 2005; summarized in ICES, 2007). These studies described the distribution and habitat utilization of skates (*A. radiata*, *A. hyperborea*, *R. fyllae*, *D. batis* complex, *B. spinicauda* and *R. lintea*) in the Barents Sea.

Vinnichenko *et al.* (2010 WD) reported on catches of *A. radiata* from the 2009 Russian bottom-trawl survey in October–December (RU-BTr-Q4). The overall length range was 8–61 cm total length (TL). Themean length of males (41.6 cm TL) was larger than that of females (38.8 cm TL), and the sex ratio was about 1.02:1.

13.6.2 Norwegian coastal survey (NOcoast-Aco-Q4)

The distribution and diversity of elasmobranch species in the northern Norwegian coastal areas were assessed by Williams *et al.* (2008). The results were summarized in ICES (2007, 2008). New data from, for example, the Norwegian coastal survey should be analysed and presented to the WGEF when sufficient data becomes available.

13.6.3 Deep stations from multiple Norwegian surveys (NO-GH-Btr-Q3 and others)

Vollen (2009 WD) reported on elasmobranch catches from deep trawl hauls (400–1400 m) along the continental slope (62–81°N) in 2003–2009. The area investigated covered the Norwegian Sea ecoregion, as well as the border between the Norwegian Sea and Barents Sea ecoregions (see Section 14 of ICES, 2009).

13.6.4 Joint Russian-Norwegian surveys (BS-NoRu-Q1 (BTr), Eco-NoRu-Q3 (Aco)/Eco-NoRu-Q3 (Btr))

Two joint Russian–Norwegian surveys are conducted in the Barents Sea. The surveys run in February (BS-NoRu-Q1 (BTr)), in the southern Barents Sea northwards to the latitude of Bear Island, and August–September (Eco-NoRu-Q3 (Aco)/Eco-NoRu-Q3 (Btr)), covering the whole of the Barents Sea including waters near Spitsbergen and Franz Josef Land. The Norwegian part of the February survey started in 1981, but data on elasmobranchs are missing for some years. The August–September survey started in 2003. All skate species are recorded during these surveys, and length data are collected. Some biological data are also collected on Russian vessels. However, due to initial species identification problems, species-specific data should only be used from the years 2006–2007 onwards (applies also to Norwegian data).

Vinnichenko *et al.* (2010 WD) analysed data on elasmobranch species from the joint surveys in 2009. The results were reported in Section 13 of ICES (2014). Wienerroither *et al*. (2011, 2013) used data from the August–September (Q3) survey (2004–2009) and February (Q1) survey (2007–2012) to describe the spatial distribution of chondrichthyan fishes in the Barents Sea. For some species, length composition data are also available. The information on the main skate species is summarized below. It should be noted that length distributions are not directly comparable between the two surveys due to differences in sampling design and coverage in time and area.

A. radiata: The most common skate species in the Barents Sea. Widely distributed in the surveyed area, except in Arctic waters (Figure 13.2). Size distribution was similar in the two surveys, ranging from 5–65 cm (Figure 13.3). Based on a simple swept area model utilizing the Q3 data, the stock appeared to vary in both biomass and number of individuals, without showing any apparent trend (Knutsen, *et al*., 2017 WD).

A. hyperborea: The species was found in deeper waters along the shelf edge towards the Norwegian Sea and Polar basin, and in Arctic water in the deeper parts of the eastern Barents Sea (Figure 13.2). The length range was 6 to 85 cm. Only few specimens <38 cm were caught during the Q1 survey, although this size class was very numerous in the Q3 survey (Figure 13.3). The stock increased in biomass and numbers between 2007 and 2014. For subsequent years, the estimates were at a smilar level as before 2007 (Knutsen *et al*. 2017 WD).

B. spinicauda: During the Q1 survey, the species was found in larger parts of the central basin. During the Q3 survey, the distribution was more towards the western part of the surveyed area (Figure 13.2). Recorded lengths ranged from 6 to 183 cm (Figure 13.3). The largest specimen exceeded the reported maximum length of 172 cm. Fewer small and more large individuals were caught in the Q1 survey than in the Q3 survey. Generally, the stock appeared to be relatively stable in terms of biomass, and number of individuals (Knutsen *et al*., 2017 WD).

R. fyllae: The species was found in warm-water areas in the southwestern part of the surveyed area, and along the slope west of Svalbard/Spitsbergen (Figure 13.2). The length distribution ranged from 6–60 cm, with two peaks around 10–15 and 46–50 cm (Figure 13.3). Although there were some annual fluctuations in number of individuals in the Barents Sea, the general trend was stable, as was the trend for biomass (Knutsen *et al*., 2017).

13.6.5 Quality of survey data

Species identification for skates is a major issue, especially with some of the earlier data. Williams (2007) gave a detailed description of identification issues for *A. radiata* vs. *R. clavata* in the Norwegian Sea ecoregion.

Furthermore, the occurrence of the common skate complex (possibly confused with *B. spinicauda*) adds potential identification errors (see also Section 26.1). The depth distribution of the two species in Dolgov *et al*. (2005a) and *L. fullonica* in the Barents Sea has been questioned by Lynghammar *et al.* (2014), as no specimens could be obtained for genetic analyses since 2007. Consequently, appropriate quality checks of these survey data are required prior to use in assessments.

In order to improve quality of current survey data, better identification practices using appropriate identification literature needs to be put in place. Ongoing work to improve future sampling at IMR includes workshops to educate staff as well as improved field guides and keys used for species identification. A workshop series in 2019 established the basis for an updated identification guide to be used for surveys and by the reference fleet.

13.7 Life-history information

Length data for *A. radiata*, *A. hyperborea*, *R. fyllae*, common skate complex and *B. spinicauda* are available in Dolgov *et al.* (2005a; 2005b) and Vinnichenko *et al.* (2010 WD; see ICES, 2007; 2010). Some biological information is available in the literature (e.g. Berestovskii, 1994). Sampling of elasmobranch egg cases has been included in Norwegian trawl surveys from mid-2009, and may provide future information on egg-laying (spawning) grounds.

13.8 Exploratory assessment models

No exploratory assessments have been conducted, due to the limited data available. Analyses of survey trends may allow to evaluate the status of the more frequent species, although species identification issues need to be addressed first.

13.9 Exploratory assessment models

No assessments have been conducted.

13.10 Quality of assessments

No assessments have been conducted.

13.11 Reference points

No reference points have been proposed.

13.12 Conservation considerations

See Section 12.11.

13.13 Management considerations

Landings of skates in this ecoregion have steadily increased in the recent years, with high levels in 2019 and 2021. There are no TACs for any of the demersal skate stocks in this region.

The elasmobranch fauna of the Barents Sea comprises relatively few species. The most abundant skate in the area is *A. radiata*, which is widespread and abundant in this ecoregion and adjacent waters. This species dominated the large historical Russian landings, but is otherwise generally discarded.

Data from the Norwegian Reference Fleet indicate that the most commonly landed skates today are larger specimens of *Raja clavata*, *Batyhraja spinicauda* and *Amblyraja hyperborea.* These are not abundant in the Barents Sea and the information on stock status is limited.

Further studies are required, particularly for the larger-bodied skates, which may be more vulnerable to overfishing.

13.14 References

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Table 13.1. Demersal elasmobranchs in the Barents Sea. Total landings (t) of skates from ICES Subarea 1 (1973–2021); "n.a." = no data available, "." = zero catch, "+" = <0.5 tonnes.

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Belgium	.	.	.	1	.	.	.	.	.	.	.	.	.	.
France	.	.	.	81	49	44	.	.	.	.	.	.	.	.
Germany	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Iceland	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Norway	.	.	.	1	3	4	8	2	2	2	1	10	11	3
Portugal	.	.	100	11	1	.	.	+	.	.	.	.	.	.
USSR/Russian Fed.	n.a.	n.a.	n.a.	n.a.	n.a.	1126	168	93	3	1	n.a.	563	619	2137
Spain	.	.	.	.	.	.	.	.	.	.	.	.	.	.
UK(E&W)	78	46	49	33	70	9	8	4	+	1	.	+	+	+
UK(Scotland)	.	.	1	2	2	.	.	.	.	.	.	.	.	.
Total	78	46	150	129	125	1183	184	99	5	4	1	573	630	2140
	1987	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Belgium	.	.	.	.	.	.	.	.	.	.	.	.	.	.
France	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Germany	.	.	.	.	.	.	.	2	.	.	.	.	.	.
Iceland	.	.	.	.	.	.	1	.	.	+	1	.	.	4
Norway	14	7	4	1	5	24	29	72	9	27	3	13	21	12
Portugal	.	.	.	.	.	.	.	.	.	.	.	.	.	.
USSR/Russian Fed.	2364	2051	1235	246	n.a.	399	390	369	n.a.	n.a.	399	790	568	502
Spain	.	.	.	.	.	.	.	.	7	.	.	.	.	.
UK(E&W)	2	.	+	.	.	.	.	.	.	.	.	.	+	.
UK(Scotland)	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	2380	2058	1239	247	5	423	420	443	16	27	403	803	589	518

Table 13.1 (continued). Demersal elasmobranchs in the Barents Sea. Total landings (t) of skates from ICES Subarea 1 (1973–2020); "n.a." = no data available, "." = zero catch, "+" = <0.5 tonnes.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Belgium	.	.	.	.	.	.	.	.	.	.	.	.	.	.
France	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Germany	.	.	.	.	.	.	+	.	.	+	.	.	+	+
Iceland	.	.	.	3	3	.	.	.	.	.	.	1	8	.
Norway	30	26	2	1	4	13	4	72	15	9	31	109	172	157
Portugal	.	.	.	+	.	.	.	.	.	.	.	.	.	.
USSR/Russian Fed.	218	173	38	69	37	48	24	6	2	1	n.a.	n.a.	n.a.	n.a.
Spain	.	.	.	.	.	.	.	.	.	.	.	.	.	.
UK(E&W)	.	.	.	.	.	.	.	.	.	.	+	.	.	.
UK(Scotland)	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	248	199	40	73	44	61	28	78	17	10	31	110	180	157

	2015	2016	2017	2018	2019	2020	2021
Belgium	.	.	.	.	.	.	.
France	.	.	.	.	.	.	.
Germany	5	2	+	2	.	.	.
Iceland	.	.	.	.	.	.	.
Norway	369	374	704	582	849	670	821
Portugal	.	.	.	.	.	.	.
USSR/Russian Fed.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	.	.	.	.	.	.	.
UK(E&W)	.	.	.	.	.	.	.
UK(Scotland)	.	.	.	.	.	.	.
Total	374	376	704	584	849	670	821

Table 13.2. Demersal elasmobranchs in the Barents Sea. Estimated Norwegian landings (t) of skates and rays by species in ICES Subarea 1. Source: Albert *et al.* (2016 WD).

Species	2012	2013	2014	2015
Amblyraja hyperborea	10	17	2	14
Bathyraja spinicauda	13	22	3	19
Dipturus oxyrinchus	1	1	0	1
Raja clavata	10	13	25	50
Rajidae indet.	76	116	127	285
Total	108	170	157	368

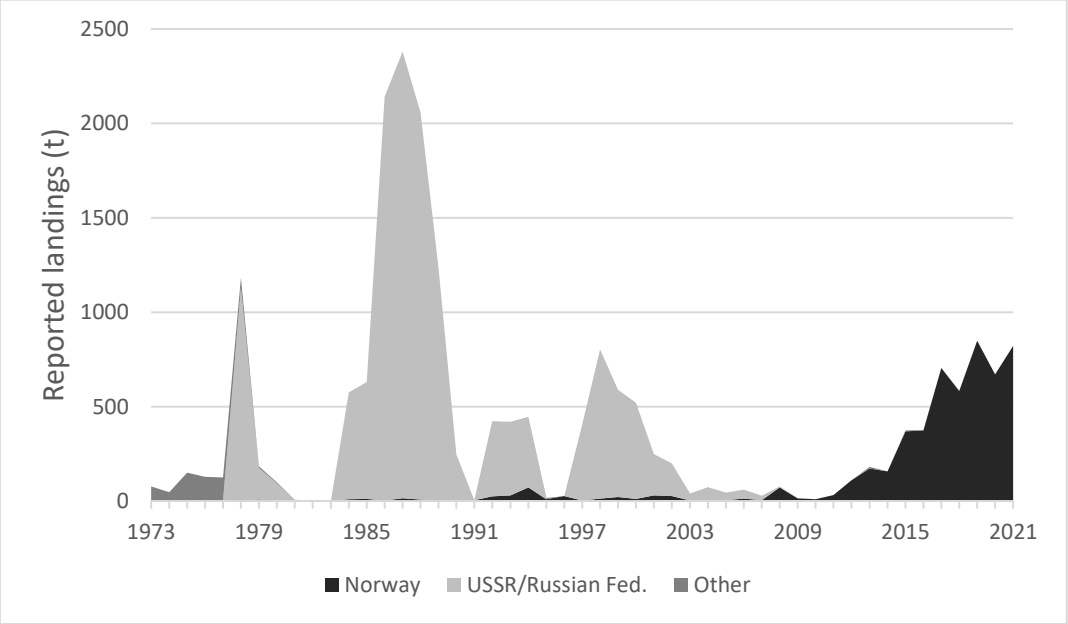

Figure 13.1. Demersal elasmobranchs in the Barents Sea. Reported landings (t) of skates from ICES Subarea 1 (1973–2021).

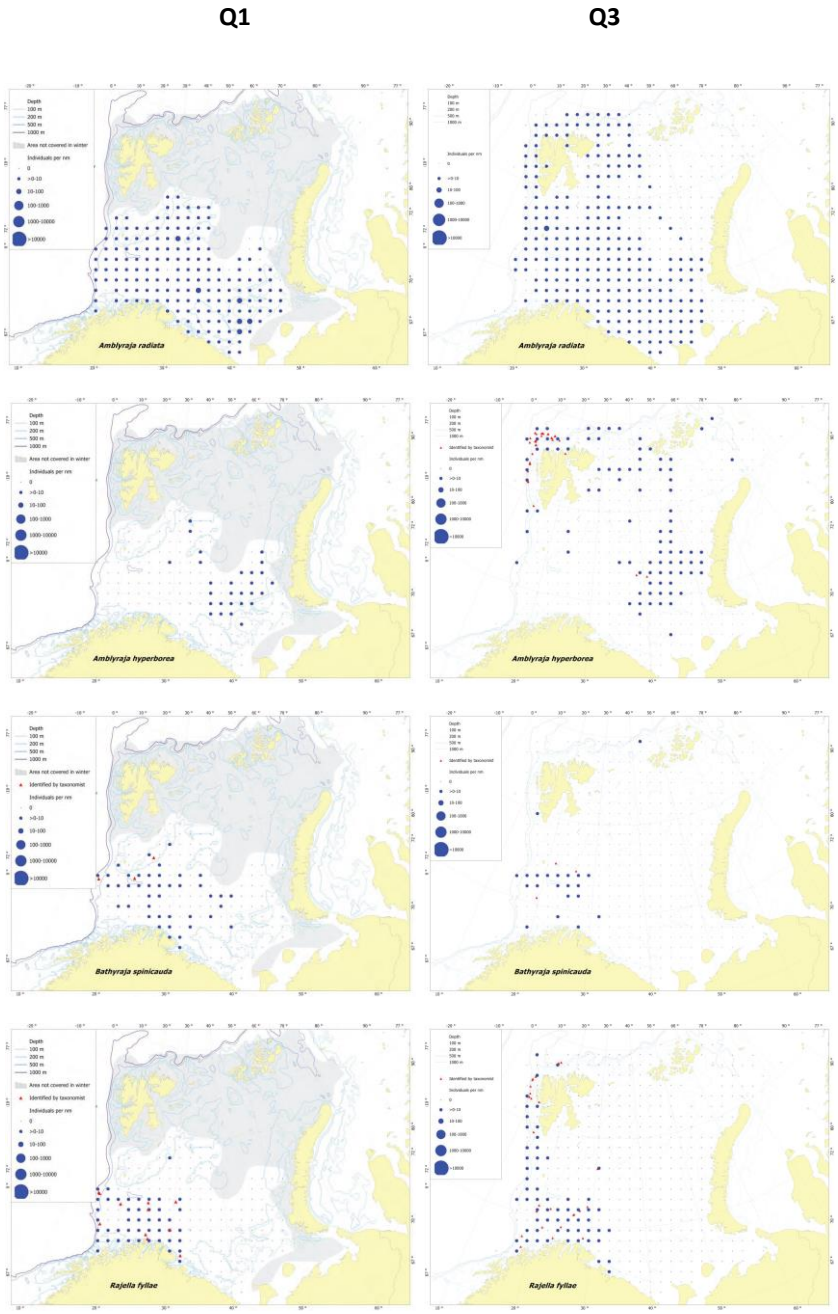

Figure 13.2. Demersal elasmobranchs in the Barents Sea. Spatial distribution of *A. radiata*, *A. hyperborea*, *B. spinicauda* and *R. fyllae* (top to bottom) in Q1 (left) and Q3 (right) Joint Russian–Norwegian surveys. Source: Wienerroither *et al*. (2011, 2013).

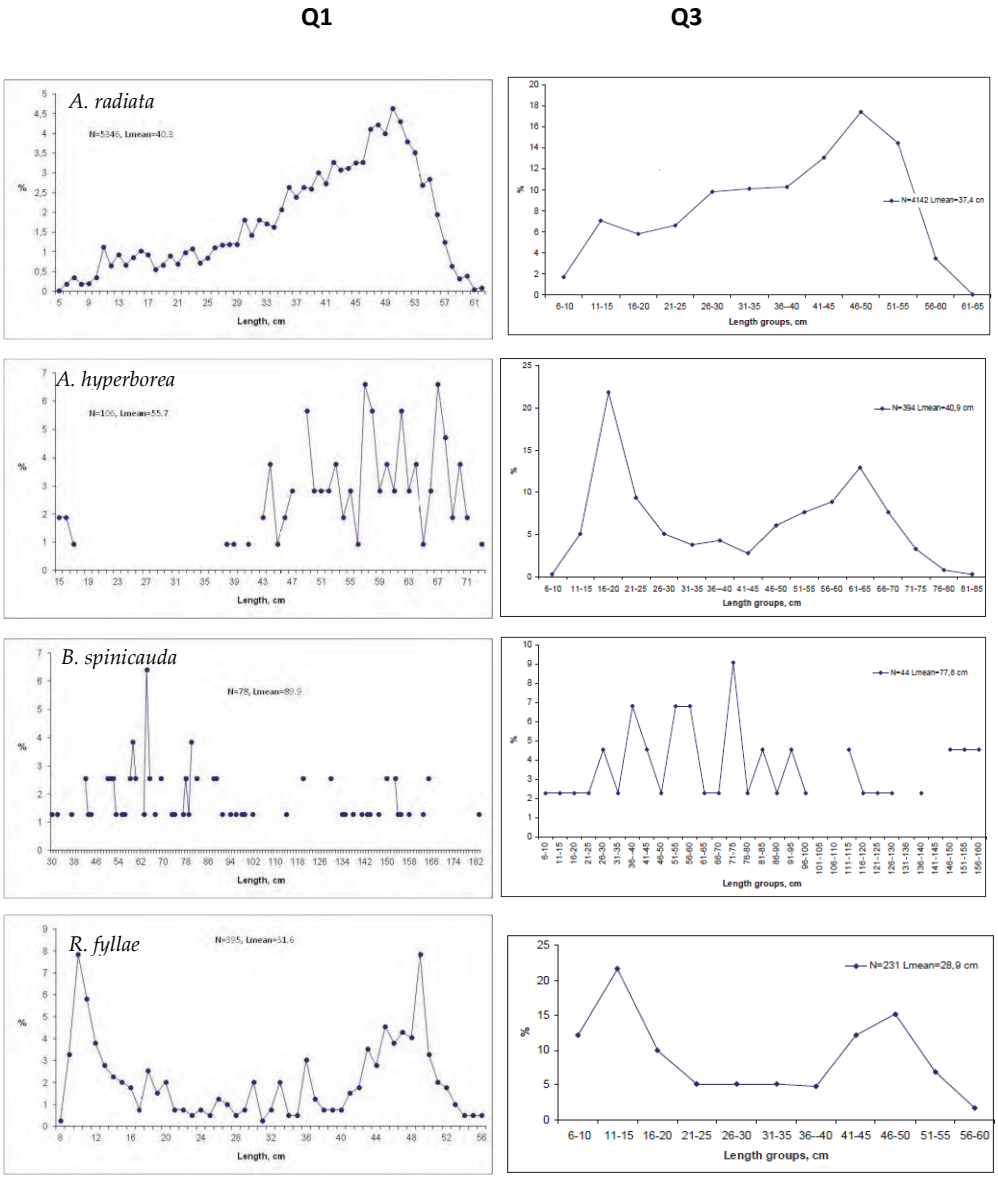

Figure 13.3. Demersal elasmobranchs in the Barents Sea. Length distributions of *A. radiata*, *A. hyperborea*, *B. spinicauda* and *R. fyllae* (top to bottom) in Q1 (left) and Q3 (right) Joint Russian–Norwegian surveys. Note that length distributions are not directly comparable between the two surveys. Source: Wienerroither *et al*. (2011, 2013).