

14 Demersal elasmobranchs in the Norwegian Sea

14.1 Ecoregion and stock boundaries

The occurrence of chondrichthyan species in the Norwegian Sea ecoregion was reviewed by Lynghammar *et al.* (2013). In coastal areas, thorny skate *Amblyraja radiata* is the most abundant skate species (Williams *et al.*, 2008). While more abundant in the north, this species is common at all latitudes along the Norwegian coast.

Other species that have been confirmed in the coastal area are thornback ray *Raja clavata*, common skate *Dipturus batis* complex, sailray *Rajella lintea*, Norwegian skate *Dipturus nidarosiensis*, sandy ray *Leucoraja circularis*, shagreen ray *Leucoraja fullonica*, round skate *Rajella fyllae*, arctic skate *Amblyraja hyperborea* and spinytail skate *Bathyrāja spinicauda*. Long-nose skate *Dipturus oxyrinchus* is distributed mainly along the southern section of coastline, south of latitude 65°N. Records of *R. brachyura* and *R. montagui* need to be confirmed by voucher specimens, although they are present in catch statistics (Lynghammar *et al.*, 2014).

In deeper areas of the Norwegian Sea, *A. radiata* and *A. hyperborea* are the two most numerous species, but *B. spinicauda* and *R. fyllae* also occur regularly, particularly north of 70°N (Skjaeraasen and Bergstad, 2001; Vollen, 2009 WD).

Sharks in the Norwegian Sea ecoregion include spurdog *Squalus acanthias* (Section 2) velvet belly *Etmopterus spinax* (Section 5), porbeagle *Lamna nasus* (Section 6), basking shark *Cetorhinus maximus* (Section 7), Greenland shark *Somniosus microcephalus* (Section 24), and black-mouth catshark *Galeus melastomus* and lesser-spotted dogfish *Scyliorhinus canicula* (Section 25).

Stock boundaries are not known for the species in this area, neither are the potential movements of species between the coastal and offshore areas. Further investigations are necessary to determine potential migrations or interactions of elasmobranch populations within this ecoregion and adjacent areas.

14.2 The fishery

14.2.1 History of the fishery

There are no fisheries targeting skates in the Norwegian Sea, though they are caught in various demersal fisheries targeting teleost species.

14.2.2 The fishery in 2014

No new information.

14.2.3 ICES advice applicable

ICES does not provide advice for the skate stocks in this ecoregion, although some stocks of North Sea skates may extend into the southern parts of the Norwegian Sea.

14.2.4 Management applicable

There are no TACs for any of the skate stocks in this ecoregion.

Norway has a general ban on discarding. Since 2010 all dead or dying skates in the catches should be landed, whereas live specimens can be discarded.

14.3 Catch data

14.3.1 Landings

Landings data for skates are provided for the years 1973–2014 (Table 14.1; Figure 14.1). For ICES Subarea II, landings data are limited and, for skates, not species disaggregated. This subarea covers all of the Norwegian Sea ecoregion, but also includes the most westerly parts of the Barents Sea ecoregion (Section 13).

Overall landings throughout time have been low, ca. 200–300 t per year for all fishing countries, with moderate fluctuations. The peak in the late 1980s resulted from Russian fisheries landing over 1900 t of skates in 1987, subsequently dropping to low levels two years later. This peak was a consequence of an experimental fishery, when skate bycatch was landed, whereas normally they are discarded (Dolgov, pers. comm.). Russia and Norway are the main countries landing skates from the Norwegian Sea.

Landings data (usually not discriminated at species level) have been provided by Norway, France, and Scotland in recent years. Russian landings have not been available since 2011.

14.3.2 Discard data

Vollen (2010 WD) reported on catch and discards by the Norwegian Reference Fleet in ICES Subarea II. More detailed results are given in Section 14.4.2.

14.3.3 Quality of catch data

Catch data are not species disaggregated.

14.3.4 Discard survival

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

14.4 Commercial catch composition

14.4.1 Species and size composition

In 2009, Russian landings of skates were taken as bycatch during the longline and trawl demersal fisheries at depths ranging from 50–900 m deep in February–November. The main skate caught was *A. radiata*, with *fyllae*, *A. hyperborea* and *B. spinicauda* found in minor quantities (Vinnichenko *et al.*, 2010 WD).

A. radiata (27–58 cm Lt) were recorded in the commercial bottom-trawl catches, comprising mostly males of 41–55 cm and females of 36–50 cm (Figure 14.2a). The proportion of small individuals was lower than in the Barents Sea. The mean length of females (43.7 cm) was smaller than that of males (45.0 cm). Males were slightly more abundant in catches (sex ratio of 1.1:1).

Vinnichenko *et al.* (2010 WD) presented data on *A. radiata* compiled from samples taken by scientific observers on commercial fishing vessels, the Russian survey and the joint Russian–Norwegian surveys. These are presented in Section 14.6.4.

14.4.2 Quality of the data

Information on the species composition of commercial catches is required.

Data from the Norwegian Reference Fleet demonstrated that elasmobranch catches in ICES Subarea II were dominated by *A. radiata* and *R. clavata* (Table 14.2; Vollen, 2010 WD), although misidentification problems may exist. For vessels in the Oceanic Reference Fleet, elasmobranch bycatch differed between bottom trawl, bottom gillnet and longline. Whereas *A. radiata* made up the bulk of trawl and longline catches (55% and 79% by numbers, respectively), *R. clavata* dominated in gillnet catches (82%). This was probably influenced by the dominance of trawl and longline vessels further north, and more southerly fishing grounds for gillnetters, but potential misidentification issues should also be investigated. Catches of *A. radiata* were higher in Subarea II than in Subarea I for trawl catches (61 kg per 100 trawl hours for Subarea II; 43 kg per 100 trawl hours for Subarea I), but lower for longline catches (119 kg per 10 000 hooks vs. 135 kg per 10 000 hooks, respectively).

Data from the Coastal Reference Fleet indicated that *D. batis* complex (possibly misidentified) and unidentified skates dominated the landed catches in this area (39% and 33% by weight, respectively). Discards were dominated by unidentified skates (32% by weight). As opposed to the Oceanic Reference Fleet, *A. radiata* was only sporadically recorded in this area.

14.5 Commercial catch and effort data

Limited data available (but see above).

14.6 Fishery-independent surveys

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

Vinnichenko *et al.* (2010 WD) reported catches from the 2009 survey were dominated by *A. radiata* of 10–56 cm L_T (Figure 14.2b). In the size distribution, different size/age classes of the skate were very distinct. The mean length of males (37.7 cm) and females (37.4 cm) were similar and males slightly predominant (sex ratio = 1.05:1).

A. hyperborea of 17–91 cm L_T were recorded in the catches (Figure 14.2d; specimens >131 cm were not considered here as they are thought to be typing errors or species misidentifications). Predominating were males of 46–50 cm and 61–75 cm, and females in the 56–65 cm and 76–80 cm length classes. The mean length of males (65.1 cm) and females (65.8 cm) were similar. Mostly males were caught (sex ratio = 5:1).

14.6.2 Norwegian coastal survey (NOcoast-Aco-4Q)

The distribution and diversity of elasmobranchs in northern Norwegian coastal areas, based on survey data from 1992–2005, were summarized by Williams *et al.* (2008). The southern portion of the coastal area studied was incorporated within the Norwegian Sea ecoregion, and the Barents Sea was defined as the border between Norwegian Directorate of Fisheries Statistical Areas 04 and 05.

Thirteen skate species and four species of shark were recorded inhabiting the coastal region (Table 14.3). Regularly occurring skates were *A. radiata*, *A. hyperborea*, *D. batis* complex, *D. nidarosiensis*, *D. oxyrinchus*, *Raja clavata*, *Rajella fyllae*, *L. fullonica*. Occasional or single observations were made of *B. spinicauda*, *R. lintea* and *L. circularis* (also *R. montagui*, *R. brachyura* were nominally recorded, but see Section 14.6.5). Four species of shark were identified: *E. spinax*, *G. melastomus* and *S. acanthias*, as well as one specimen of *S. microcephalus*.

Although no clear shifts in abundance over time were detected for any species, more robust assessment is necessary to better identify temporal trends in abundances.

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

Vollen (2009 WD) reported on elasmobranch catches from 3185 deep trawl hauls (400–1400 m) along the continental slope (62–81°N) from the Barents Sea to the Skagerrak. Data were combined from multiple deep-water surveys during the period 2003–2009. Data from the Skagerrak are excluded in this section, whereas parts of the Barents Sea ecoregion are included. Overall, nine species (six skates and three sharks) were recorded. *A. radiata* and *A. hyperborea* were the dominant species north of 62°N (ICES Subarea II), whereas *E. spinax* was most numerous in the Norwegian Deep (Division IIIa). *B. spinicauda* and *R. fyllae* also occurred frequently in the catches in all areas. Reports of *R. clavata* were considered to be misidentifications of other species. Results were reported in more detail in ICES (2009).

14.6.4 Joint Russian–Norwegian survey (BS-NoRu-Q1 (BTr), Eco-NoRu-Q3 (Aco)/Eco-NoRu-Q3 (Btr))

Two joint Russian–Norwegian surveys are conducted in the Barents Sea, one during February (BS-NoRu-Q1 (BTr)), in the southern Barents Sea northwards to the latitude of Bear Island, and another in August–September (Eco-NoRu-Q3 (Aco)/Eco-NoRu-Q3 (Btr)), covering much 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 skates are recorded during these surveys, and data on length distributions as well as some biological data (on board of Russian vessels) are collected. As a result of initial problems with the species identification, species-specific data should only be used from the years 2006–2007 onwards (for Norwegian data). Analyses of data from these surveys are not complete, but some data from the 2009 surveys were presented by Vinnichenko *et al.* (2010 WD).

A. radiata was the dominant species in the August–September survey. Individuals varied from 5–61 cm L_T (Figure 14.2c), with most specimens 33–37 cm (Vinnichenko *et al.*, 2010 WD).

Vinnichenko *et al.* (2010 WD) also presented data on *A. radiata* compiled for both samples taken by scientific observers on commercial fishing vessels, the Russian survey and the joint Russian–Norwegian surveys. Males prevailed in the samples (1.7:1). Most males and females (over 70%) were immature, the rest were in developing stages or were mature (Figure 14.3). Unlike in the Barents Sea, no individuals at the active stage were reported in the area. The main prey were bottom decapods (spider crabs *Hyas* spp. and northern shrimp *Pandalus borealis*) and fish (capelin *Mallotus villosus* and Atlantic hookeyar sculpin *Artediellus atlanticus*), which accounted for 47% and 31% by weight, respectively (Figure 14.4).

14.6.5 Quality of survey data

The difficulties associated in identifying skate species are a concern when considering the validity of the data used for any assessment. Identification problems between *A. radiata* and *R. clavata* were highlighted by Williams (2007) and summarized in ICES (2007). Despite sampling since 2007, Lynghammar *et al.* (2014) did not obtain any specimens of the *D. batis* complex, *L. fullonica*, *R. brachyura* or *R. montagui* in the Nor-

wegian Sea: giving more credence to earlier misidentification issues. The two former species have been confirmed to exist in the area in historical times, whilst the two latter species have never been confirmed. *R. montagui* from central Norway was known from a museum specimen, but Lynghammar *et al.* (2014) identified it as *R. clavata*.

In order to achieve a better quality of survey data in future, identification practices, using appropriate identification literature, needs to be put in place. Ongoing work to improve future sampling at the Institute of Marine Research includes workshops to educate staff as well as improved guides and keys used for species identification.

14.7 Life-history information

Some length data are available for *A. radiata* and *A. hyperborea* (Vinnichenko *et al.*, 2010 WD; ICES, 2010). Some biological information is available in the literature (e.g. Berestovskii, 1994). Sampling of elasmobranch egg-cases was included in Norwegian trawl surveys from mid-2009, and may provide future information on nursery grounds.

14.8 Exploratory assessment models

No assessments have been conducted, as a consequence of insufficient data.

14.9 Quality of assessments

No assessments have been conducted, as a consequence of insufficient data. Analyses of survey trends may allow to evaluate the status of the more frequent species, although taxonomic irregularities need to be addressed first.

14.10 Reference points

No reference points have been proposed for any of these skate stocks.

14.11 Conservation considerations

The International Union for Conservation of Nature and Natural Resources (IUCN Red List of Threatened species (IUCN, 2014) listings for species occurring in this area include (assessment year in parentheses):

“Critically endangered”: *D. batis* complex (2006);

“Endangered”: *L. circularis* (2014);

“Vulnerable”: *L. fullonica* (2014);

“Near threatened”: *B. spinicauda* (2006), *D. nidarosiensis* (2014), *D. oxyrinchus* (2014) and *R. clavata* (2005).

Demersal elasmobranchs listed on the Norwegian Red List (Gjøsæter *et al.*, 2010), excluding species assessed as “Least concern”, are *D. batis* complex (“Critically endangered”) and *B. spinicauda*, *D. nidarosiensis* and *L. fullonica* (all “Near threatened”).

14.12 Management considerations

There are no TACs for any of the skates in this ecoregion. The demersal elasmobranch fauna of the Norwegian Sea comprises several species that occur in the Barents Sea (Section 13) and/or the North Sea (Section 15). Further investigations are required,

and could also offer valuable additional information for managing the neighbouring ecoregions.

14.13 References

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Table 14.1. Demersal elasmobranchs in the Norwegian Sea. Total landings (t) of skates from ICES Subdivisions II, IIa and IIb from 1973–2014. “n.a.” = no data available, “.” = means zero catch, “+” = < 0.5 tonnes. Countries with only occasional catches are not included in the landings table: Denmark (1994), Belgium (1 tonne 1975), Sweden (+ in 1975), Netherlands (1979), Iceland (2001, 2011), Estonia (2002, 2005), and Ireland (2007).

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Faroe Islands	.	.	.	5	2	1	1	.	.	.	.	.	.	4
France	.	.	1	68	61	18	2	1	12	109	2	6	5	11
Germany	+	1	52	12	59	114	84	85	53	7	2	112	124	102
Norway	201	158	89	34	99	82	126	191	137	110	96	150	104	133
Portugal	.	.	.	34	39	.	.	.	.	.	.	.	.	.
USSR/Russ. Fed.	.	.	.	.	.	302	99	39	.	.	.	537	261	1633
Spain	.	.	.	.	.	.	.	.	.	.	28	.	17	5
UK – E, W & NI	65	18	14	20	90	10	6	2	+	+	.	5	1	2
UK - Scotland	2	1	.	+	1	+	.	.	.	.	.	.	+	+
Other	.	.	1	.	.	.	2	.	.	.	.	.	.	.
Total	268	178	157	173	351	527	320	318	202	226	128	810	512	189
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Faroe Islands	.	15	.	42	.	2	.	.	.	.	.	.	.	.
France	21	42	8	56	11	15	9	7	8	6	8	5	.	5
Germany	95	76	32	52	.	+	.	.	.	.	.	.	.	2
Norway	214	112	148	216	235	135	286	151	239	198	169	214	239	244
Portugal	.	.	.	.	.	.	22	11	.	10	28	46	10	6
USSR/Russ. Fed.	1921	1647	867	208	n.a.	181	112	257	n.a.	n.a.	77	139	247	400
Spain	.	9	.	.	.	.	.	.	3	.	3	15	6	.
UK - E, W & NI	4	.	2	1	+	1	+	+	1	4	.	+	1	+
UK – Scotland	2	+	+	+	+	+	+	.	+	+	+	+	1	1
Other	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Total	2257	1902	1057	575	246	334	429	426	251	218	285	419	504	658
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Faroe Islands	.	.	2	12	15	13	9	13	4	3	n.a.	.	n.a.	n.a.
France	4	7	2	7	8	2	4	2	1	3	1	1	.	.
Germany	.	2	2	7	1	.	.	.	.	1	.	.	.	2
Norway	233	118	111	142	133	146	189	259	257	250	197	121	147	105
Portugal	3	.	8	2	1	14	13	2	.	.	.	.	.	.
USSR/Russ. Fed.	113	38	6	50	20	16	20	.	8	2	n.a.	n.a.	n.a.	n.a.
Spain	7	11	32	.	2	.	.	.	.	.	.	.	.	.
UK - E, W & NI	.	.	.	.	.	+	.	.	.	.	.	.	1	.
UK – Scotland	1	3	3	.	2	4	1	1	+	.	.	.	1	.
Other	4	5	.	.	4	.	1	.	.	.	2	.	.	.
Total	365	184	166	220	186	195	237	277	270	259	200	122	149	107

Table 14.2. Demersal elasmobranchs in the Norwegian Sea. Species composition of elasmobranch catches in ICES Subarea II by the Norwegian Oceanic (2008–2009) and Coastal Reference Fleet (2007–2008). Data for the Oceanic Reference Fleet refer to the total catch of elasmobranchs as percentage of biomass and percentage of numbers. Data for the Coastal Reference Fleet are percentage in numbers of landed catch and discarded catch. Adapted from Vollen (2010 WD).

Species	Oceanic Reference Fleet			Oceanic Reference Fleet			Coastal Reference Fleet	
	Total catch (% biomass)			Total catch (% numbers)			Landed	Discarded
	Lines	Nets	Trawls	Lines	Nets	Trawls	Nets	Nets
Skates								
<i>Bathyraja spinicauda</i>	0.5		0.4	0.2		0.5		
<i>Amblyraja hyperborea</i>	5.4			2.9			0.1	
<i>Amblyraja radiata</i>	79.5	6.3	55.1	78.9	7.8	54.5		1.8
<i>Dipturus batis complex</i>	0.2			0.1			38.7	0.4
<i>Dipturus oxyrinchus</i>	+		0.1	+		0.1	0.7	7.4
<i>Dipturus nidarosiensis</i>								+
<i>Leucoraja fullonica</i>	0.2	11.4	1.5	0.1	0.9	2.8		
<i>Raja clavata</i>		74.5	9.4		82.2	9.4	6.5	0.8
<i>Rajella fyllae</i>	2.2	0.6	3.2	3.8	1.1	5.5	0.7	1.1
<i>Skates indet</i>	3.6			5.0			33.4	18.2
<i>Rajella lintea</i>	0.2			0.1				2.0
Sharks								
<i>Etmopterus spinax</i>	1.0			3.3				4.2
<i>Somniosus microcephalus</i>								0.5
<i>Squalus acanthias</i>	0.2	0.3	+	0.1	0.4	0.1	7.9	7.3
<i>Cetorhinus maximus</i>								0.2
<i>Lamna nasus</i>							10.8	0.1
<i>Galeus melastomus</i>	1.4			2.2			0.1	11.3
<i>Scyliorhinus canicula</i>								0.3
<i>Galeorhinus galeus</i>								+
Chimaeras								
<i>Chimaera monstrosa</i>	5.6	6.9	30.3	3.4	7.5	27.2	1.1	44.5
Total skates	91.8	92.8	69.7	91.0	92.1	72.7	80.1	31.7
Total sharks	2.6	0.3	0.0	5.6	0.4	0.1	18.8	23.8
Total chimaeras	5.6	6.9	30.3	3.4	7.5	27.2	1.1	44.5

Table 14.3. Catch data (number of individuals per species) for the Norwegian Sea ecoregion from the Annual Autumn Bottom-trawl Surveys of the North Norwegian Coast, from 1992 to 2005. Adapted from Williams *et al.* (2007 WD).

Species	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total catch	Total % of positive samples	Catch rate (No. per survey)
<i>Amblyraja radiata</i>	7	44	23	15	8	41	9	16	9	6	10	10	19	9	226	11%	17.4
<i>Bathyraja spinicauda</i>	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0%	0.1
<i>Rajella fyllae</i>	0	4	0	0	0	1	0	0	0	0	5	6	4	0	20	1%	1.5
<i>Raja clavata</i>	0	4	15	1	0	2	3	6	0	0	0	0	2	0	33	2%	2.5
<i>Dipturus batis</i> complex	0	2	0	1	3	7	7	1	1	1	1	0	0	0	24	1%	1.8
<i>Leucoraja fullonica</i>	0	0	0	0	0	0	0	4	3	9	3	0	0	1	20	1%	1.5
<i>Leucoraja circularis</i>	0	0	0	0	0	0	0	0	1	0	1	9	5	7	23	1%	1.8
<i>Raja montagui</i> *	0	0	0	0	0	0	0	2	1	0	1	0	1	0	5	<1%	0.4
<i>Dipturus oxyrinchus</i>	0	0	54	3	2	30	2	0	0	1	2	6	4	2	106	5%	8.2
<i>Dipturus nidarosiensis</i>	0	0	0	0	1	1	0	0	0	3	1	0	1	0	7	<1%	0.5
<i>Amblyraja hyperborea</i>	0	0	1	0	0	0	0	0	0	0	4	0	1	0	6	<1%	0.5
<i>Raja brachyura</i> *	0	0	4	0	0	0	0	0	0	0	0	0	0	0	4	<1%	0.3
<i>Rajella lintea</i>	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	<1%	0.1
<i>Galeus melastomus</i>	0	24	1883	1197	105	1269	189	480	258	812	1196	275	640	48	8376	24%	644.3
<i>Etmopterus spinax</i>	0	829	8453	473	1061	2733	584	3881	1485	1401	2417	785	2305	1369	27 776	33%	2136.6
<i>Squalus acanthias</i>	0	21	51	26	20	5	106	168	12	68	43	21	104	17	662	8%	50.9
<i>Somniosus microcephalus</i>	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	<1%	0.1
Number of samples	17	163	106	77	74	96	78	81	76	56	78	65	77	63			

*Probably misidentifications, the occurrence of the species in the area has not been confirmed (see Section 14.6.5).

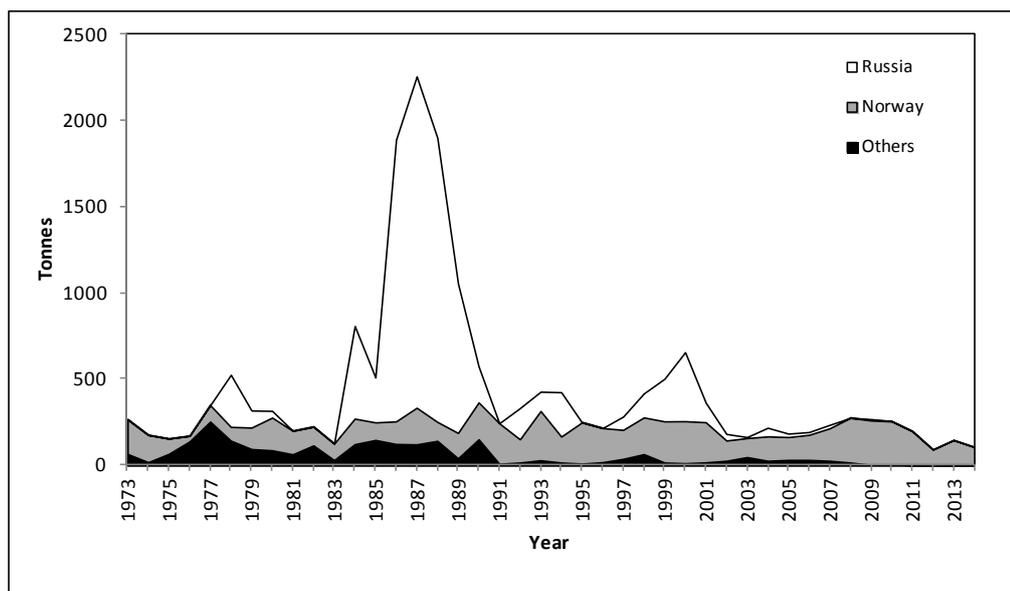


Figure 14.1. Demersal elasmobranchs in the Norwegian Sea. Total landings (t) of skates from ICES Subdivisions II, IIa and IIb from 1973–2014.

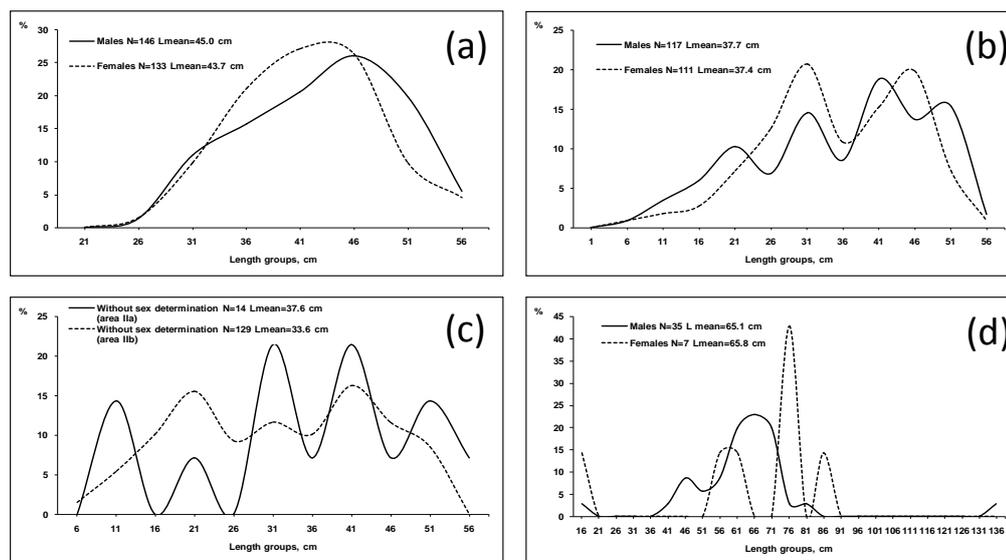


Figure 14.2. Demersal elasmobranchs in the Norwegian Sea showing the length composition of *A. radiata* in (a) commercial bottom-trawl catches in the Norwegian Sea in 2009, (b) Russian demersal survey (October–December 2009) and (c) the Norwegian Sea based on data from the joint Russian–Norwegian ecosystem survey (August–September 2009); and (d) length composition of *A. hyperborea* in the Norwegian Sea (Division IIb) from the Russian demersal survey (October–December 2009). Specimens exceeding 131 cm are probably typing errors or misidentifications. Source: Vinnichenko *et al.* (2010 WD).

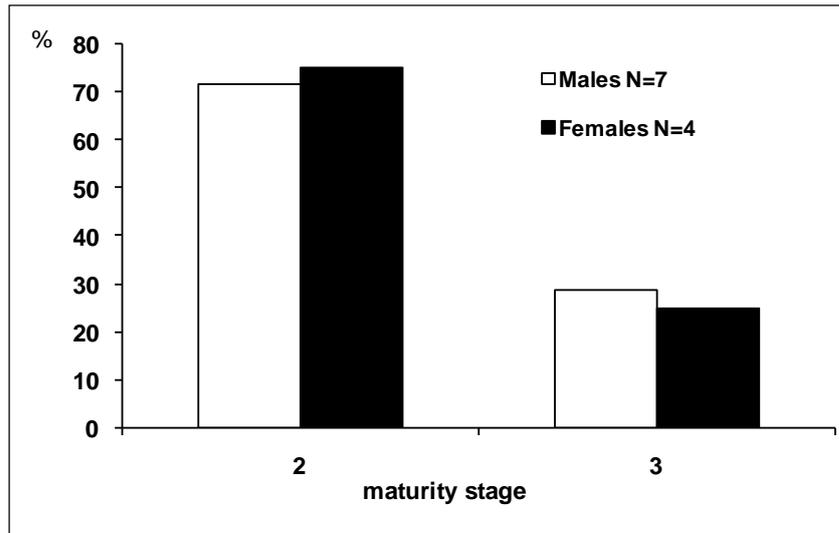


Figure 14.3. Demersal elasmobranchs in the Norwegian Sea. Proportion of *A. radiata* by maturity stage as recorded in bottom trawl catches in the Norwegian Sea in 2009. Source: Vinnichenko *et al.* (2010 WD).

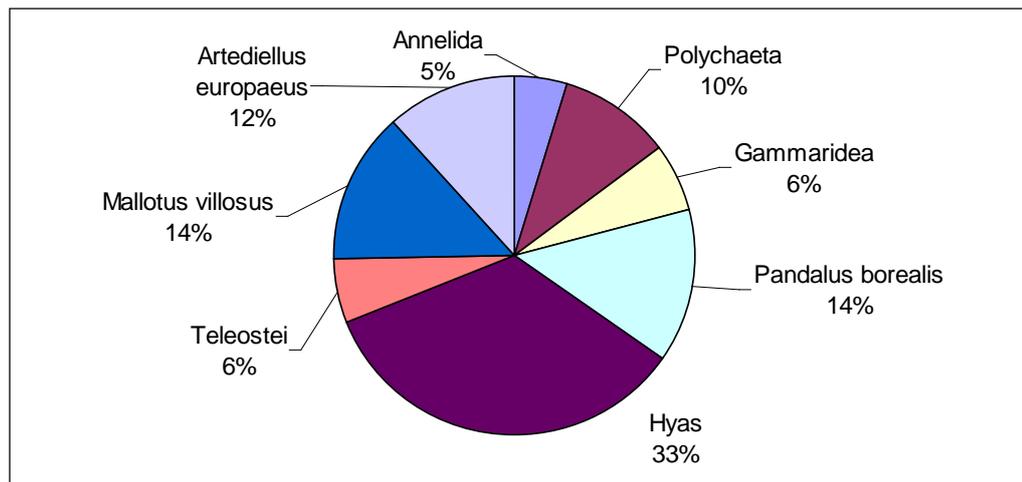


Figure 14.4. Demersal elasmobranchs in the Norwegian Sea. Food composition of *A. radiata* in the Norwegian Sea in November 2009 (% by weight; N=11 stomachs, 9.0% empty stomachs). Source: Vinnichenko *et al.* (2010 WD).