2.3.9 Introduction to the redfish (*Sebastes* spp.) complex in ICES subareas 5, 6, 12, and 14 (Iceland and Faroes grounds, north of Azores, and east of Greenland)

Introduction

Species of the genus *Sebastes* are common and widely distributed in the North Atlantic. They are found off the coast of Great Britain, along Norway and Spitzbergen, in the Barents Sea, off the Faroe Islands, Iceland, East and West Greenland, and along the east coast of North America from Baffin Island to Cape Cod.

Three species of redfish are commercially exploited in ICES subareas 5, 6, 12, and 14: *Sebastes norvegicus* (formerly *S. marinus*), *S. mentella,* and *S. viviparus*. The latter has minor commercial value in Icelandic waters and is exploited in two small areas south of Iceland at depths of 150–250 m (Table 2.3.9.1).

Nominal landings and splitting of the landings into species

The official statistics reported to ICES do not divide all the catch by species/stocks. The splitting of the landings into species and stocks was performed with a set of criteria (Section 7.1 in ICES, 2007). Information from various sources is used to split demersal landings into species. In Division 5.a, when no direct information is available on the catches for a given vessel, landings are allocated based on logbooks and samples from the fishery. The average relative abundance of *S. norvegicus* and *S. mentella* in biological samples from each cell (one fourth of an ICES statistical square) is used to attribute unknown catches from that cell to individual species. For other areas, samples from the landings are used as the basis for dividing the demersal redfish catches between *S. norvegicus* and *S. mentella*.

A comparison of the number of vessels fishing the deep and shallow stocks as reported to NEAFC by VMS with the numbers visible on satellite images indicates that unreported effort has been significant. During the observation days in June 2002 to 2006 (in the main fishing season), the effort could have been 15–33% higher than reported to NEAFC, and thus the unreported catch could be in that order of magnitude. The information available for 2007 indicated that unreported effort could add around 20% to the reported effort. No information has been available since then, but unreported effort in recent years is expected to be much less than in previous years.

Stock identity and management units of *Sebastes mentella*

The Workshop on Redfish Stock Structure (WKREDS; ICES, 2009) reviewed the stock structure of *Sebastes mentella* in the Irminger Sea and adjacent waters. Based on the outcome of the WKREDS meeting, ICES concluded that there are three biological stocks of *S. mentella*:

- a “Deep Pelagic” stock (>500 m; NAFO subareas 1–2 and ICES subareas 5, 12, and 14) – primarily pelagic habitats, including demersal habitats west of the Faroe Islands;
- a “Shallow Pelagic” stock (< 500 m; NAFO subareas 1–2 and ICES subareas 5, 12, and 14) – extending to ICES subareas 1 and 2, but primarily pelagic habitats, including demersal habitats east of the Faroe Islands;
- an “Icelandic slope” stock (ICES Division 5.a and Subarea 14) – primarily demersal habitats.

This conclusion is mainly based on genetic information, i.e. microsatellite information, and supported by analysis of allozymes, fatty acids, and other biological information on stock structure, such as some parasite patterns.

Adult redfish on the Greenland shelf have been attributed to several stocks and there remains a need to investigate the affinity of the adult *S. mentella* in this region. The East Greenland shelf is most likely a common nursery area for the three biological stocks.

The demersal *S. mentella* in Icelandic waters (in ICES Division 5.a and Subarea 14, the “Icelandic slope stock”) is considered to be one biological stock, separated from the demersal *S. mentella* found on the continental slopes of Greenland (Subarea 14)

https://doi.org/10.17895/ices.advice.18668096

and Faroe Islands (Division 5.b). Regarding the latter component there is insufficient information to allow an assessment for advice. The advice on the "Icelandic slope stock" is found in Section 2.3.11.

ICES advice up to and including 2009 for *S. mentella* fisheries was provided for two distinct management units, i.e. a demersal unit on the continental shelves and slopes and a pelagic unit in the Irminger Sea and adjacent waters. Based on this new stock identification information, ICES recommended three management units as geographic proxies for biological stocks that are partly defined by depth and whose boundaries are based on the spatial pattern of the fishery to minimize mixed-stock catches (Figure 2.3.9.1; ICES, 2010):

- Management unit in the northeast Irminger Sea: ICES Division 5.a and subareas 12 and 14.
- Management unit in the southwest Irminger Sea: NAFO subareas 1 and 2, and ICES Division 5.b and subareas 12 and 14.
- Management unit on the Icelandic slope: ICES Division 5.a and Subarea 14, and to the north and east of the boundary proposed in the management unit in the northeast Irminger Sea.

The pelagic fishery in the Irminger Sea and adjacent waters shows clear distinction between two widely separated grounds fished at different seasons and depths. Spatial analysis of pelagic fishery catch and effort by depth, inside and outside the boundaries proposed for the management units in the northeast Irminger Sea, indicate that the boundaries effectively delineate the pelagic fishery in the northeast Irminger Sea from the pelagic fishery in the southwest Irminger Sea, with a small portion of mixed-stock catches. The northeastern fisheries on the pelagic *S. mentella* occur at the start of the fishing season deeper than 500 m and overlap to some extent with demersal fisheries on the continental slopes of Iceland. The boundary for the deep pelagic *Sebastes mentella* fishery is shown in Table 2.3.9.2.

A schematic illustration of the relationship between the management units and biological stocks is given in Figure 2.3.9.2. New scientific information is currently being reviewed. If additional scientific information becomes available a future review may be appropriate.

The decision to advise on two stocks of pelagic redfish instead of one stock was not unanimous among ACOM members. The Russian Federation still maintains its point of view that there is only one stock of beaked redfish in the pelagic waters of the Irminger Sea and that is why no split catches information about the fisheries is presented to the North-Western Working Group. Russia reiterates its standpoint that studies of the redfish stock structure should be continued with the aim of developing agreed recommendations using all available scientific and fisheries data as a basis.

However, ICES reiterates its previous advice that "Management action should be taken to prevent a disproportional exploitation rate of any one component."

The individual stock summary sheets provide descriptions of these stocks.

Icelandic *Sebastes mentella* fisheries and current management practice

Detailed portrayals of the geographical, vertical, and seasonal distribution of the *S. mentella* fisheries by Icelandic vessels as well as corresponding length distributions are given in Figures 2.3.9.3–2.3.9.6. These figures show that the fisheries within the pelagic *S. mentella* management unit are separated geographically, seasonally, and by depth. These figures also show that the northeastern fisheries on the pelagic *S. mentella* that occur at the start of the fishing season at depths below 500 m overlap to some extent with the fisheries on the continental slopes of Iceland. This overlap was most pronounced in 2003 and 2007 when the Irminger Sea pelagic fishery merged with the continental slope fishery.

Abundance and distribution of 0-group and juvenile redfish

Available data on the distribution of juvenile *S. norvegicus* indicate that the nursery grounds are located in Icelandic and Greenlandic waters. No nursery grounds have been found in Faroese waters. The nursery areas for *S. norvegicus* in Icelandic

waters are found all around Iceland, but are mainly located west and north of the island at depths between 50 and 350 m. The migration of juveniles is along the north coast towards the most important fishing areas off the west coast.

The only known nursery grounds of *S. mentella* are in Greenland waters, mostly at depths between 100 m and 400 m. When the fish located on the nursery grounds near sexual maturity, they start to move out of the area. It is reported that at lengths of around 29–30 cm the fish start to emigrate from the East Greenland shelf. The emigrated young *S. mentella* can be tracked both in the Icelandic shelf fishery and in the open Irminger Sea fishery.

Abundance and biomass indices of juvenile (< 17 cm) redfish (juveniles were only classified to the genus *Sebastes* spp. because of identification difficulties) from the German annual groundfish survey, conducted on the continental shelf and slope off West and East Greenland down to 400 m, show that juveniles were abundant in 1993 and 1995–1998. Figure 2.3.9.7 shows the survey abundance indices for juvenile *Sebastes* spp. ≤ 17 cm.

Demersal *S. mentella* in Division 5.b and subareas 6 and 14

Historically, the *S. mentella* on the East Greenland shelf (Subarea 14) has been included in the demersal catches of Greenland, Iceland, and Faroe Islands. However, adult *S. mentella* in this area have not been attributed to any of the three biological stocks of *S. mentella*. ICES therefore decided to conduct a separate assessment of *S. mentella* in Division 14.b until further information is available to assign origin. The advice is found in Section 2.3.10.

The *S. mentella* on the Faroe Islands shelf has not been assigned to the shallow and deep pelagic *S. mentella* stocks. The catches are, therefore, included here (Table 2.3.9.3). Trends in cpue and effort of the fishery are shown in Figure 2.3.9.8.

Discards and bycatch of small redfish

Information on the bycatch and length distribution of the redfish caught in the shrimp fishery indicated bycatch rates of 0.5% in 2006–2007, most of these being redfish < 15 cm. Sorting grids have been mandatory in the shrimp fisheries in ICES Division 14.b since 2002, and in Division 5.a since 1 September 1995.

Sources

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ICES. 2014. Report of the North-Western Working Group (NWWG), 24 April–1 May 2014, ICES Headquarters, Copenhagen, Denmark. ICES CM 2014/ACOM:07. 902 pp.

Figures and tables

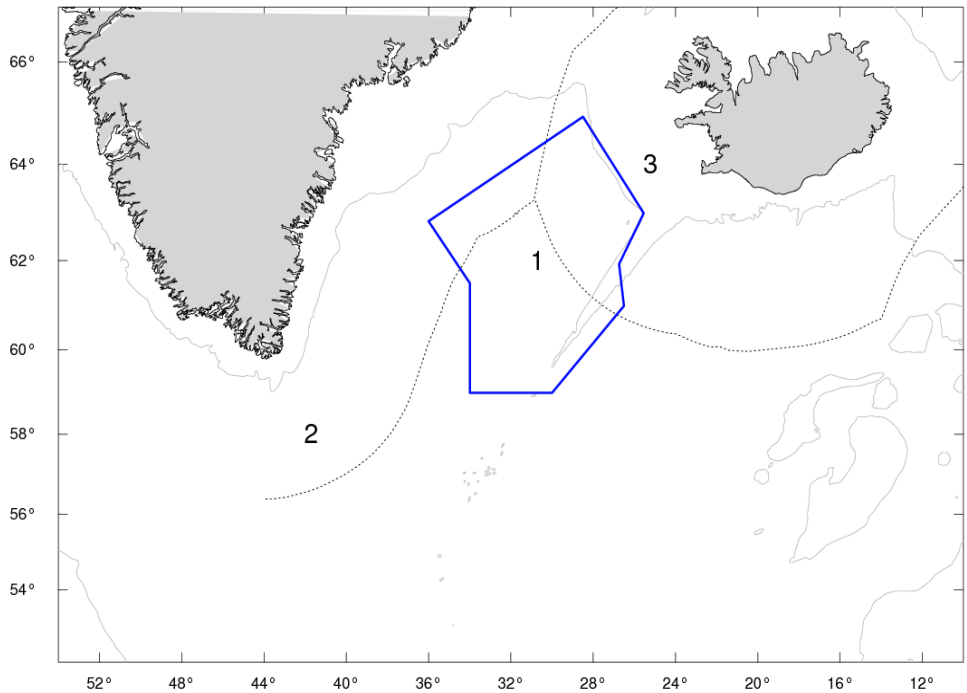

Figure 2.3.9.1 Introduction to the redfish complex in ICES subareas 5, 6, 12, and 14. Proposed management unit boundaries for *S. mentella* in the Irminger Sea and adjacent waters. The polygon bounded by blue lines, i.e. unit 1, indicates the region for the "deep pelagic" management unit in the northwest Irminger Sea; unit 2 is the "shallow pelagic" management unit in the southwest Irminger Sea; and unit 3 is the Icelandic slope management unit. Coordinates of the recommended boundary of the "deep pelagic" management unit (the blue box) are given in Table 2.3.9.2.

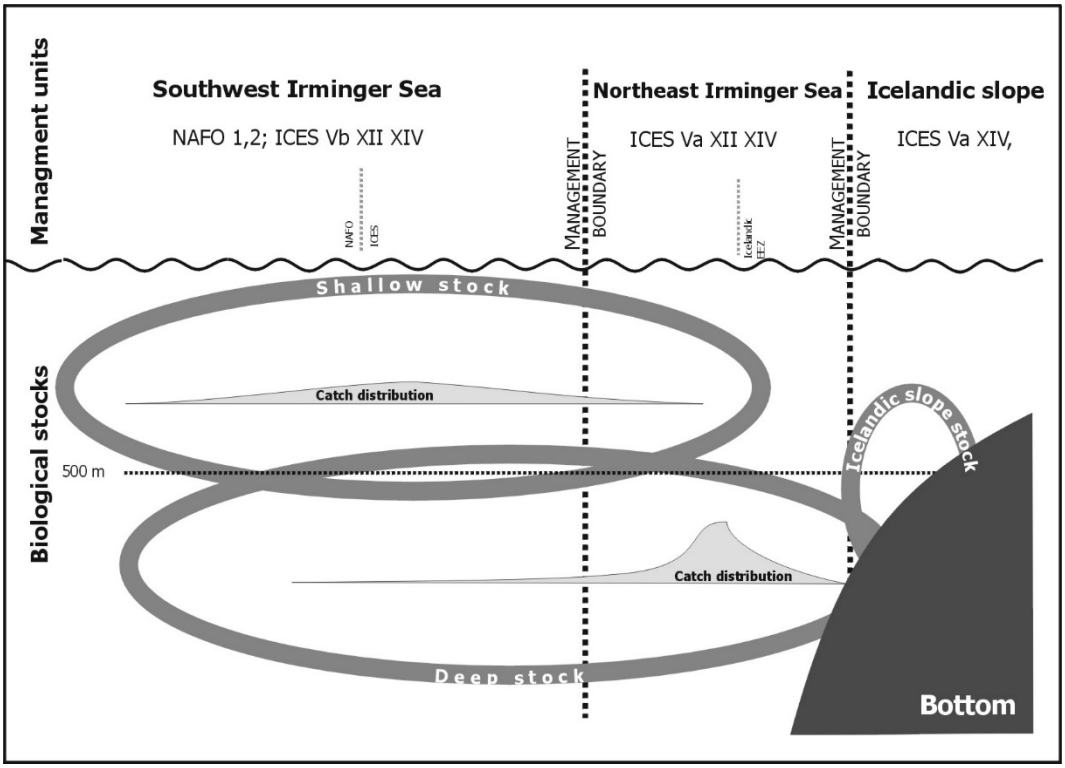

Figure 2.3.9.2 Introduction to the redfish complex in ICES subareas 5, 6, 12, and 14. Schematic representation of biological stocks and recommended management units of *S. mentella* in the Irminger Sea and adjacent waters. The management units are shown in Figure 2.3.9.1. Included is a schematic representation of the geographical catch distribution in recent years. Note that the shallow pelagic stock includes demersal *S. mentella* east of the Faroe Islands and the deep pelagic stock includes demersal *S. mentella* west of the Faroe Islands.

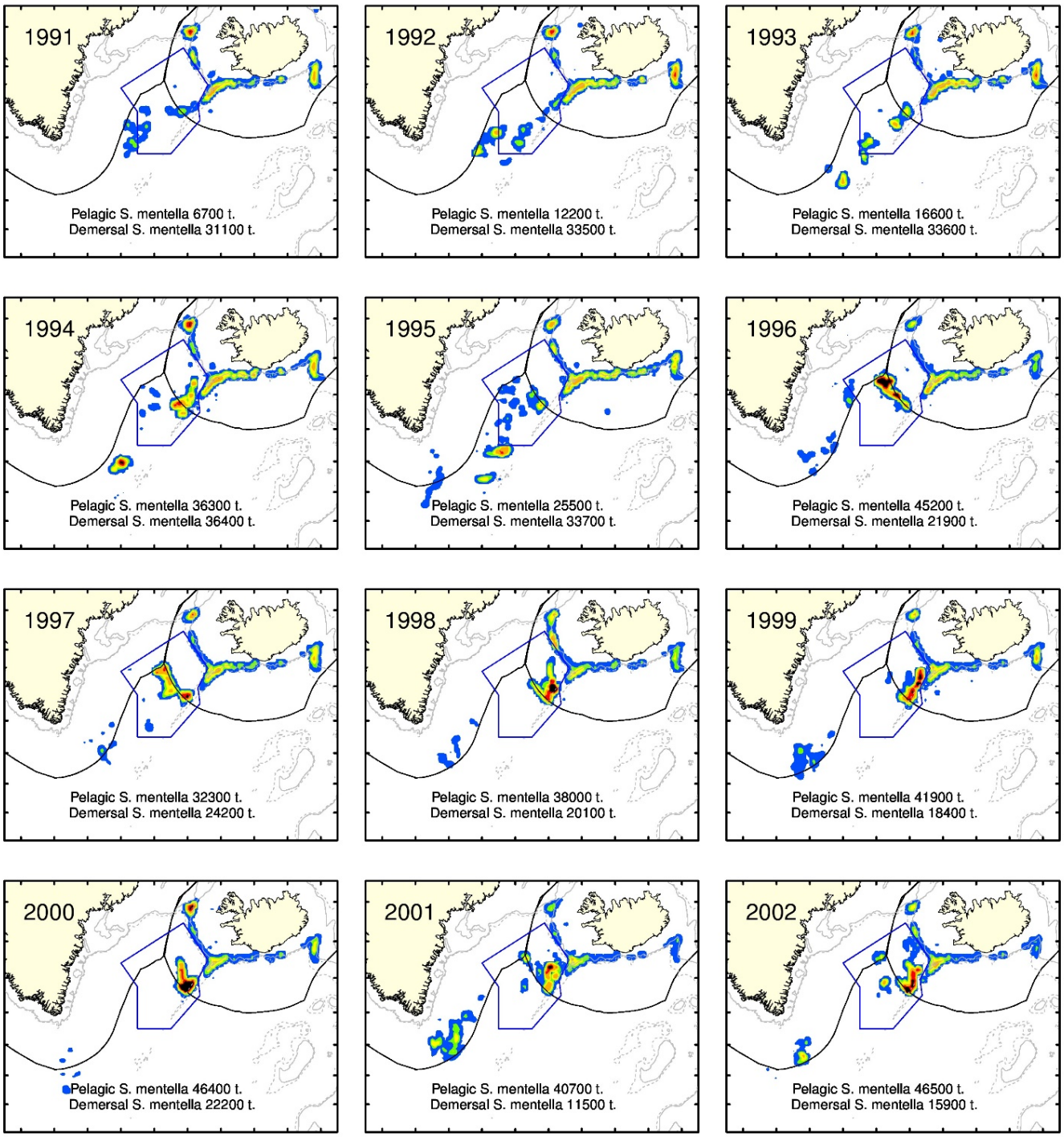

Figure 2.3.9.3 Introduction to the redfish complex in ICES subareas 5, 6, 12, and 14. Geographical distribution of the Icelandic catches of *S. mentella* 1991–2002. The colour scale indicates catches (tonnes NM^{-2}). The blue line marks the recommended geographical boundaries of the "deep pelagic" management unit.

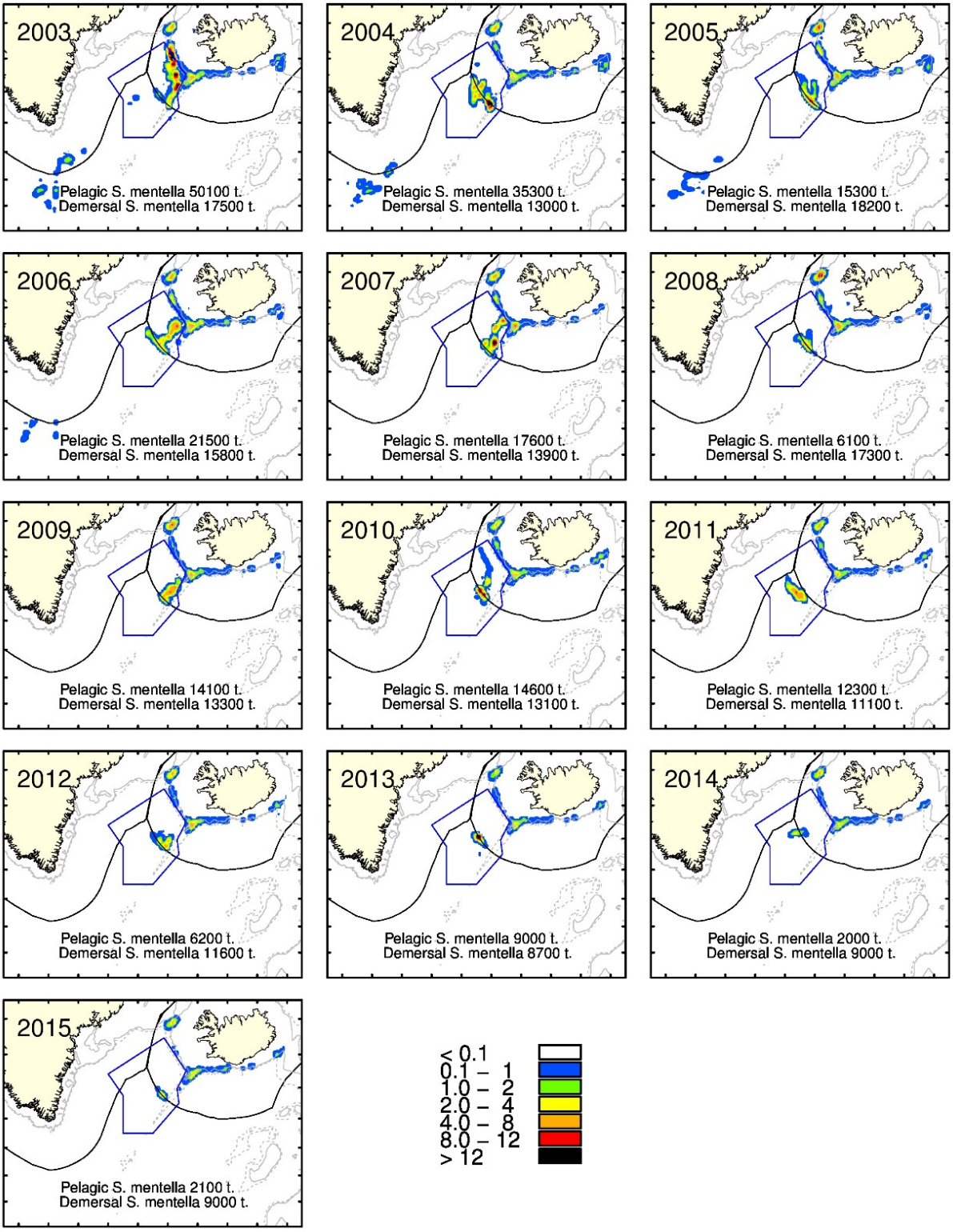

Figure 2.3.9.3 (cont'd) Introduction to the redfish complex in ICES subareas 5, 6, 12, and 14. Geographical distribution of the Icelandic catches of *S. mentella* 2003–2015. The colour scale indicates catches (tonnes NM^{-2}). The blue line marks the recommended geographical boundaries of the "deep pelagic" management unit.

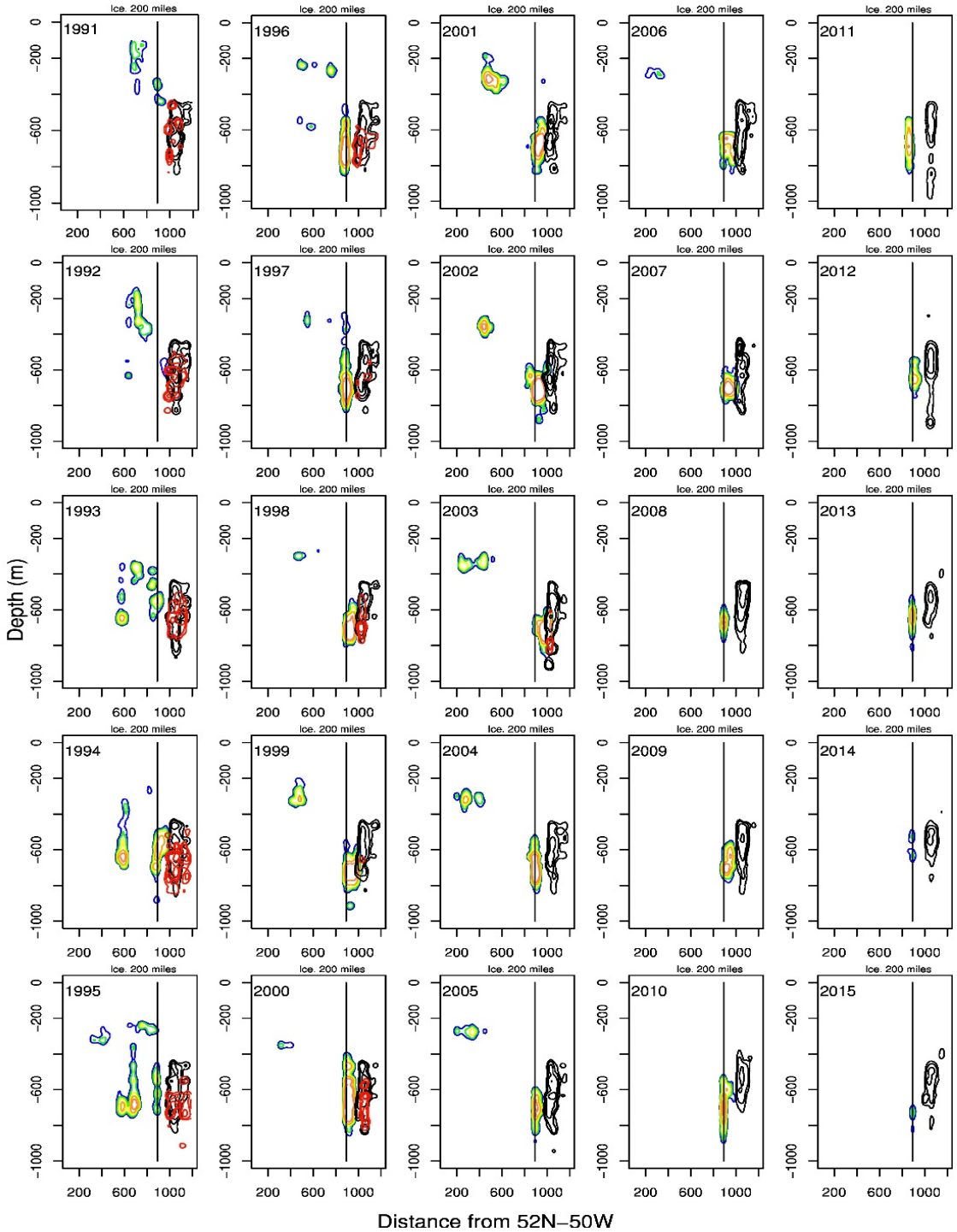

Figure 2.3.9.4 Introduction to the redfish complex in ICES subareas 5, 6, 12, and 14. Location–depth plots for *S. mentella* catches as reported by Icelandic vessels from 1991 to 2015. Location is represented by the distance (in NM in the SW–NE direction) from a fixed position (52°N 50°W). The contour lines indicate relative catches. The coloured contours represent the fishery on pelagic *S. mentella*, the black contours indicate bottom trawl catches of demersal *S. mentella*, and the red contours represent catches of demersal *S. mentella* taken with pelagic trawls. The Icelandic EEZ boundary is shown as a reference.

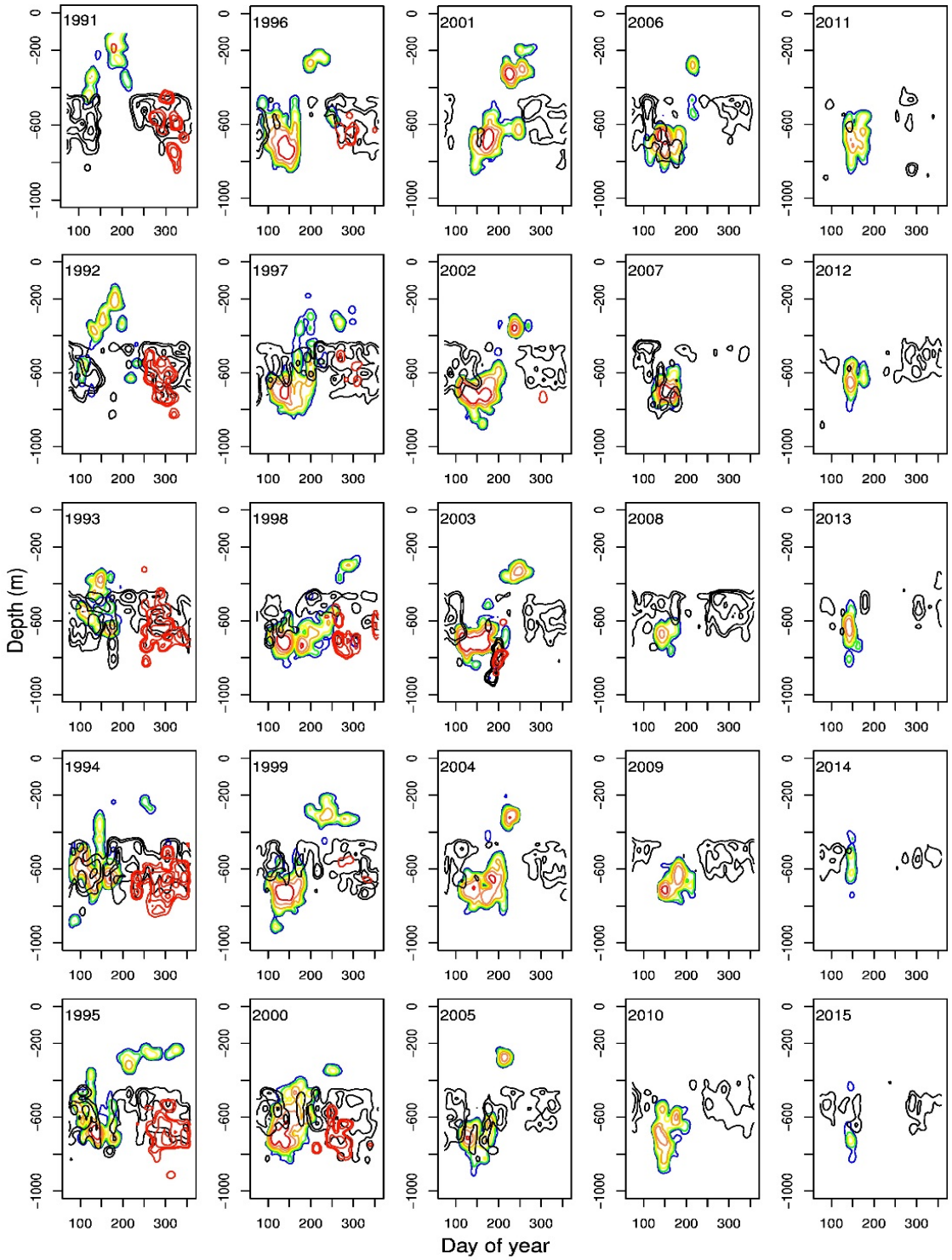

Figure 2.3.9.5 Introduction to the redfish complex in ICES subareas 5, 6, 12, and 14. Depth–time plots for Icelandic *S. mentella* catches from 1991 to 2015, where the *y*-axis is depth, the *x*-axis is day of the year, and the colour indicates the catches. The coloured contours represent the fishery on pelagic *S. mentella*, the black contours indicate bottom trawl catches of demersal *S. mentella*, and the red contours represent catches of demersal *S. mentella* taken with pelagic trawls.

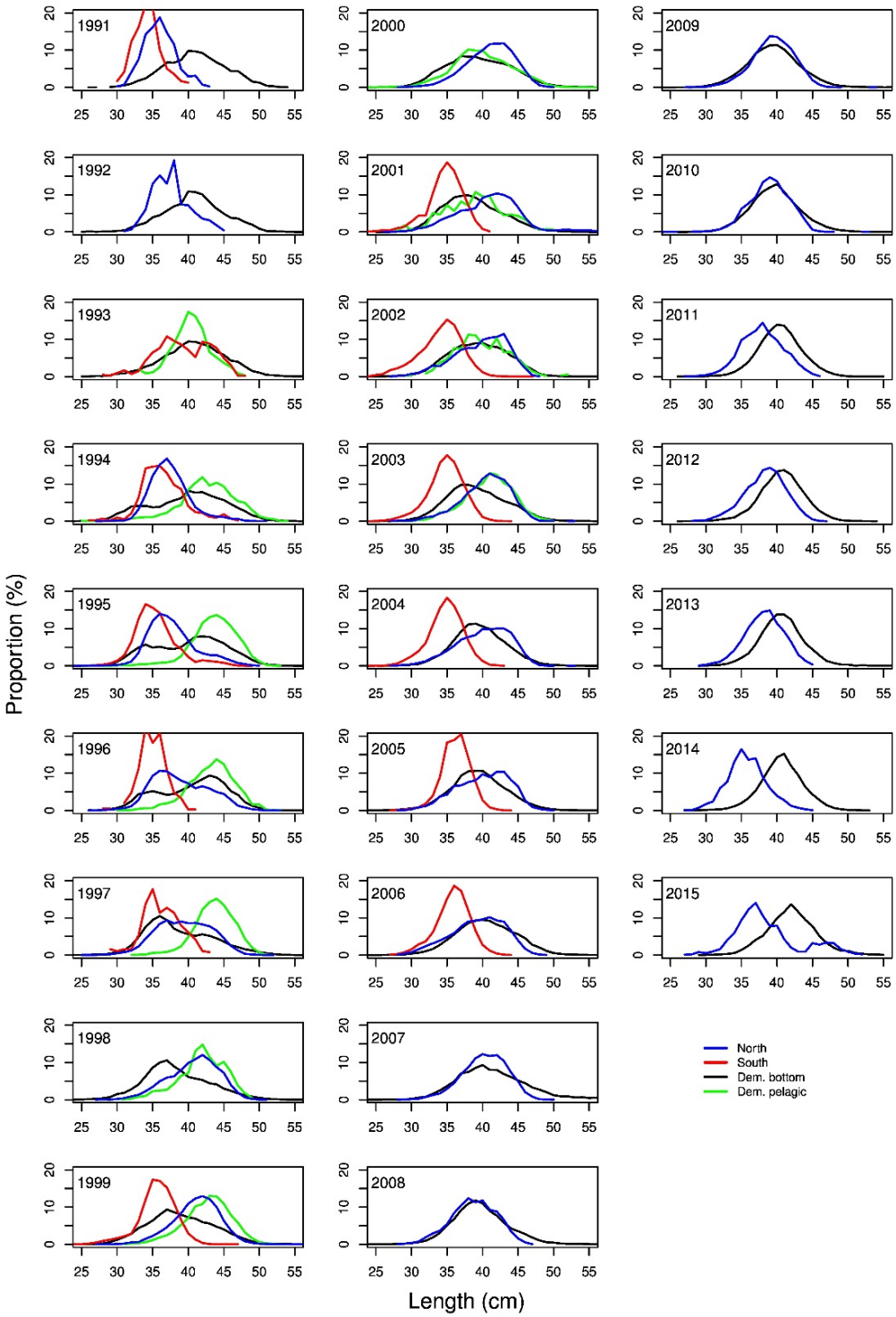

Figure 2.3.9.6 Introduction to the redfish complex in ICES subareas 5, 6, 12, and 14. Length distributions from different Icelandic *S. mentella* fisheries. The blue lines represent the fishery on pelagic *S. mentella* in the northeastern area, the red lines the pelagic fishery in the southwestern area, the black lines indicate bottom trawl catches of demersal *S. mentella*, and the green lines represent catches of demersal *S. mentella* taken with pelagic trawls.

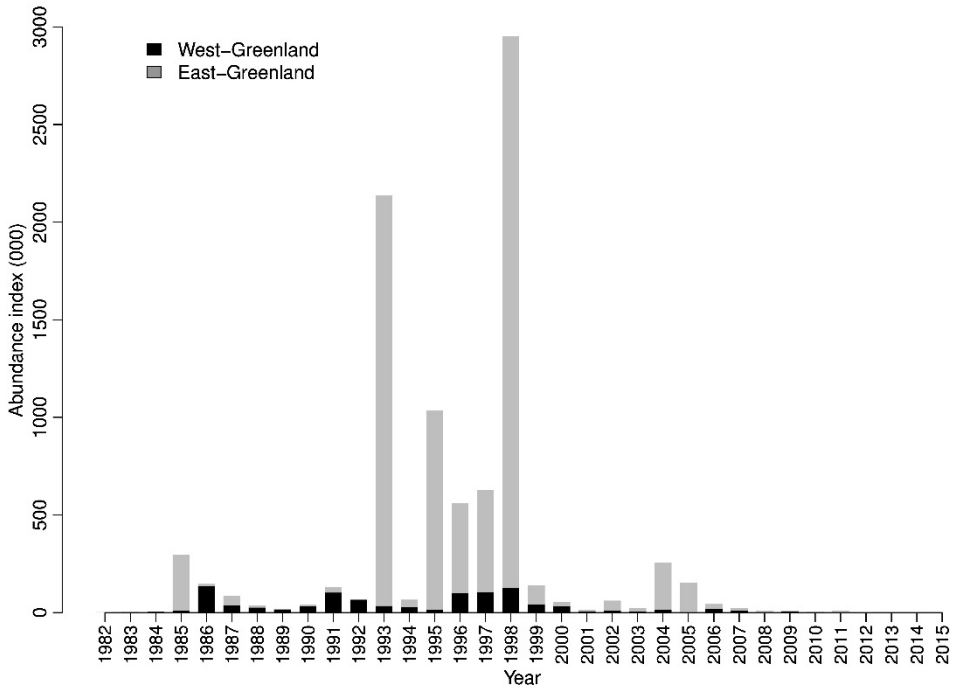

Figure 2.3.9.7 Introduction to the redfish complex in ICES subareas 5, 6, 12, and 14. Survey abundance indices of juvenile *Sebastes* spp. (≤ 17 cm) from the German groundfish survey conducted on the continental shelves off East and West Greenland.

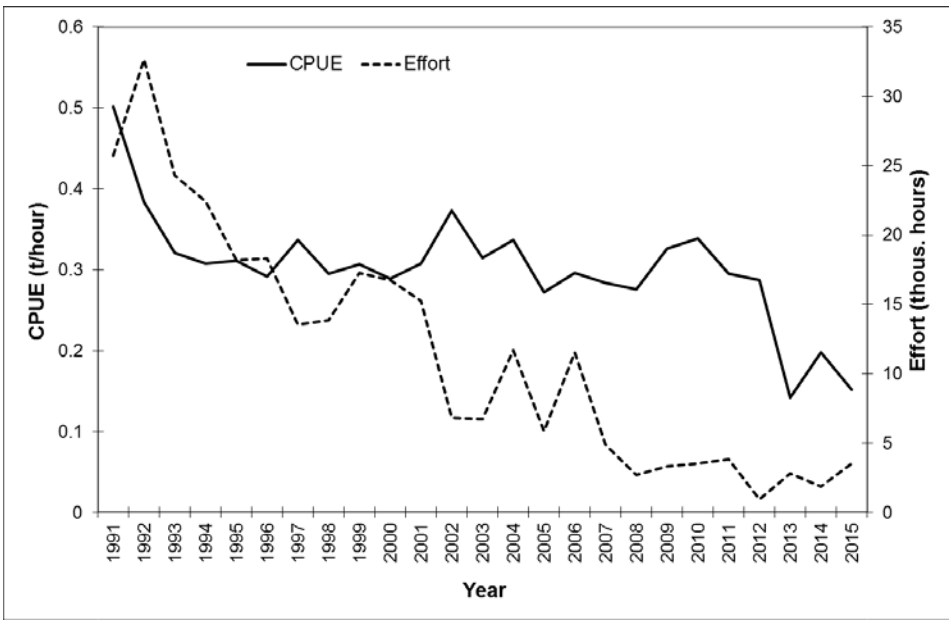

Figure 2.3.9.8 Introduction to the redfish complex in ICES subareas 5, 6, 12, and 14. Demersal *S. mentella* on the continental shelf. Cpue (t hr^{-1}) and fishing effort (in thousands) from the Faroese Otter Board fleet where 70% of the total catch was *S. mentella.*

Table 2.3.9.1 Introduction to the redfish complex in ICES subareas 5, 6, 12, and 14. Landings of *S. viviparus* in Division 5.a.

Year	Landings (t)
1996	22
1997	1159
1998	994
1999	498
2000	227
2001	21
2002	20
2003	3
2004	2
2005	4
2006	9
2007	24
2008	15
2009	37
2010	2602
2011	1427
2012	535
2013	532
2014	550
2015	468

Table 2.3.9.2 Introduction to the redfish complex in ICES subareas 5, 6, 12, and 14. Coordinates of the recommended boundary of the "deep pelagic" management unit.

Point no.	Latitude	Longitude	Latitude	Longitude
1	64.75000	−28.50	64°45'N	28°30'W
2	62.83333	−25.75	62°50'N	25°45'W
3	61.91667	−26.75	61°55'N	26°45'W
4	61.00000	−26.50	61°00'N	26°30'W
5	59.00000	−30.00	59°00'N	30°00'W
6	59.00000	−34.00	59°00'N	34°00'W
7	61.50000	−34.00	61°30'N	34°00'W
8	62.83333	−36.00	62°50'N	36°00'W
9	64.75000	−28.50	64°45'N	28°30'W

Table 2.3.9.3 Introduction to the redfish complex in ICES subareas 5, 6, 12, and 14. Nominal landings (tonnes) of demersal *S. mentella* 1978–2015 in ICES Division 5.b and Subarea 6.

Year	Division 5.b	Subarea 6
1978	7767	18
1979	7869	819
1980	5119	1109
1981	4607	1008
1982	7631	626
1983	5990	396
1984	7704	609
1985	10560	247
1986	15176	242
1987	11395	478
1988	10488	590
1989	10928	424
1990	9330	348
1991	12897	273
1992	12533	134
1993	7801	346
1994	6899	642
1995	5670	536
1996	5337	1048
1997	4558	419
1998	4089	298
1999	5294	243
2000	4841	885
2001	4696	36
2002	2552	20
2003	2114	197
2004	3931	6
2005	1593	111
2006	3421	179
2007	1376	1
2008	750	50
2009	1077	0
2010	1202	0
2011	1126	0
2012	263	0
2013	398	0
2014	370	0
2015*	537	0

* Provisional.