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20 Icelandic slope *Sebastes mentella* in 5.a and 14

20.1 Stock description and management units

The stock structure of *Sebastes mentella* in the Irminger Sea and adjacent water is described in Chapter 18 and Stock Annex. The *S. mentella* on the continental shelf and slope of Iceland is treated as separate biological stock and management unit. Only the fishable stock of Icelandic slope *S. mentella* is found in Icelandic waters, i.e. mainly fish larger than 30 cm. The East Greenland shelf is most likely a common nursery area for the three biological stocks described in Stock Annex, including the Icelandic slope one.

20.2 Scientific data

Only the fishable stock of Icelandic slope *S. mentella* is found in Icelandic waters. The Icelandic autumn survey on the continental shelf and slope in Division 5.a, covering depths down to 1 500 m, does, therefore, not cover the whole distribution of the stock. Data for Icelandic slope *S. mentella* from the Autumn Survey is available from 2000–2016. No survey was conducted in 2011. A description of the autumn survey is given in Stock Annex for the species.

The total biomass index and the abundance indices from the autumn survey were highest in 2001. After a decrease in 2003 the index increased again in 2006 but gradually decreased until 2013 and to similar level as in 2003 when it was lowest in the time series (Table 20.2.1 and Figure 20.2.1a and b). The biomass index increased again and was in 2014 and 2015 similar as in 2004, but decreased again in 2016 to a level similar to that observed in 2007–2013 (Table 20.2.1 and Figure 20.2.1a and b). The biomass index of fish 45 cm and larger was at lowest level in 2007 but increased again in 2009 where it was at similar level until 2013 (Figure 19.2.1c). The biomass index of 45 cm and larger fish has increased since then and was in 2015 at the highest in the time series. In 2016 the index decreased to a similar level as in 2014.

The abundance index of fish 30 cm and smaller has in 2007–2016 been at lowest level (Figure 20.2.2d). The length of the Icelandic slope *S. mentella* in the autumn survey is between 25 and more than 50 cm. Since 2000, the mode has shifted to the right, that is, from 36–39 cm in 2000 to about 42–43 cm in 2012–2016 (Figure 20.2.2). Very little Icelandic slope *S. mentella* smaller than 35 cm was observed in the surveys in recent years.

Otoliths have been sampled since 2000 and otoliths from the 2000, 2009 and 2010 surveys have been age read. Figure 20.2.3 shows that the 1985 and the 1990 year classes are the most abundant ones in this samples.

20.3 Information from the fishing industry

20.3.1 Landings

Total annual landings of Icelandic slope *S. mentella* from ICES Division 5.a 1978–2016 are presented in Table 20.3.1 and from 1950–2015 in Figure 20.3.1. Annual landings gradually decreased from a record high of 57 000 t in 1994 to 17 000 t in 2001. Landings in 2001–2010 fluctuated between 17 000 t and 20 500 except in 2003 and 2008 when annual landings were 28 500 t and 24 000 respectively. The landings in 2013–2016 between 8 700–9 500 t and the decrease is related to lower TAC for the species.

20.3.2 Fisheries and fleets

Most of the fishery for Icelandic slope *S. mentella* in 5.a is a directed bottom trawl fishery taken by bottom trawlers along the shelf and slope west, southwest, and southeast of Iceland at depths between 500 and 800 m (Figure 20.3.2). The proportion of Icelandic slope *S. mentella* catches taken by pelagic

trawls 1991–2000 varied between 10 and 44% of the total landings (Table 20.3.2). In 2001–2016, no pelagic fishery occurred or it was negligible except in 2003 and 2007 (see Stock Annex). In general, the pelagic fishery was mainly in the same areas as the bottom trawl fishery (Figure 20.3.3).

A notable change in the catch pattern is that catches taken in the southeast fishing area has been gradually decreasing since 2000 and in recent years very little Icelandic slope *S. mentella* was taken on these fishing grounds (Figure 20.3.2). This area has historically been an important fishing area for Icelandic slope *S. mentella*.

20.3.3 Sampling from the commercial fishery

The table below shows the 2016 biological sampling from the catch and landings of Icelandic slope *S. mentella* in ICES Division Va. This is considered to be adequate sampling from the fishery. Otoliths from the commercial catch have been collected, but no systematic age reading is done.

YEAR	NATION	GEAR	LANDINGS (T)	NO. SAMPLES	NO. LENGTH MEASURED
5.a	Iceland	Bottom trawl	9 536	83	12 685

20.3.4 Length distribution from the commercial catch

Length distributions of Icelandic slope *S. mentella* in 5.a from the bottom trawl fishery show an increase in the number of small fish in the catch in 1994 compared to previous years (Figure 20.3.5). The peak of about 32 cm in 1994 can be followed by approximately 1 cm annual growth in 1996–2002. The fish caught in 2004–2016 peaked around 39–42 cm. The length distribution of Icelandic slope *S. mentella* from the pelagic fishery, where available, showed that in most years the fish was on average bigger than taken in the bottom trawl fishery (Figure 20.3.5).

20.3.5 Catch per unit effort

Trends in raw CPUE and effort are shown in Figure 20.3.6. CPUE gradually decreased from 1978 to a record low in 1994, but has since then slightly increased annually to 2000. The CPUE estimate in 2016 was at similar level as in late 1980s and about 40% higher than it was in 1994. The CPUE has been stable since 2010. From 1991 to 1994, when CPUE decreased, the fishing effort increased drastically. Since then, effort decreased and is now at similar level as in the early 1980s.

20.3.6 Discard

Although no direct measurements are available on discards, it is believed that there are no significant discards of Icelandic slope *S. mentella* in the Icelandic redfish fishery.

20.4 Methods

No analytical assessment was conducted on this stock.

20.5 Reference points

There are no biological reference points for the species. Previous reference points established were based upon commercial CPUE indices, but are now considered to be unreliable indicators of stock size.

As described in section 1.3 MSY proxy reference points need to be defined for the Icelandic slope *S. mentella* stock. ICES suggested four methods for this purpose, and all methods were tested on the stock. One of the method did not work for the stock: the Length-Based Spawner Per Recruit method. The

other three methods, the Length Based Indicators, Mean Length Z, and SPiCT model, indicated that Icelandic slope *S. mentella* is exploited at reasonable level. The parameter uncertainty was however high.

The conclusion of NWWG was that, based on the caveats listed below and the declines seen in the autumn survey and little or no recruitment over the past decade, the determination of the stock status in relation to reference points should not be based on any of the suggested methods.

The caveats to consider in relation to the Icelandic slope *S. mentella* stock when concluding on the length based indicators and the SPiCT model.

- *S. mentella* is a long-lived and slow growing species. It will take long time for overfishing to result in changes in length frequency and these changes will be minor.
- If there are few year classes in the fishery the effect of overfishing the stock is more likely observed on biomass rather than length, especially on a slow growing species.
- Only the fishable stock is found in Icelandic waters and nursery areas are most likely on the East Greenland shelf. That is, the stock found on the Icelandic slope is not a closed unit.
- Surveys suggest that recruitment has been very low since 2006. In general, recruitment is sporadic in redfish. Strong recruitment to the stock seems to occur at time intervals of 5–10 years and these contribute to a stable fishery (Figure 20.2.3).
- The schooling behaviour of *S. mentella* means that the fishery can target a diminishing stock in a small area without seeing any effect on the length distribution.
- Any changes in length could just as well be related to migration.

20.6 State of the stock

The Group concludes that the state of the stock is on a low level. With the information at hand, current exploitation rates cannot be evaluated for the Icelandic slope *S. mentella* in Division 5.a.

The fishable biomass index of Icelandic slope *S. mentella* from the Icelandic autumn survey shows that the biomass index for 2004–2013 has decreased to similar level as in 2003 when it was at lowest level, increased again in 2014 and 2015, but decreased to the 2004-2013 level. The survey was not conducted in 2011. Standardised CPUE indices show a reduction from highs in the late 1980s, but there is an indication that the stock has started a slow recovery since the middle of 1990s, when CPUE was close to 50% of the maximum. The CPUE index gradually increased from 1995 -2010 to a similar level as in the late 1980s and has since then been at that level.

In 2000–2008, good recruitment was been observed in the German survey on the East Greenland shelf (growth of about 2cm/yr) which is assumed to contribute to both the Icelandic slope and pelagic stock at unknown shares. The German survey and the Greenland shrimp and fish shallow water survey both show no new recruits (>18 cm) and no juveniles are present (<18 cm). This suggests that the fishery in coming years will be based on the same cohorts.

20.7 Management considerations

S. mentella is a slow growing, late maturing deep-sea species and is therefore considered vulnerable to overexploitation and advice has to be conservative.

The CPUE has slightly increased annually since a record low in 1994, especially in recent 3-4 years and is now 40% higher than in 1994. It is, however, not known to what extent CPUE series reflect change in stock status of Icelandic slope *S. mentella*. The nature of the redfish fishery is targeting schools of fish using advancing technology. The effect of technological advances is to increase CPUE, but is unlikely to reflect biomass increase.

The advice for 2008–2012 was that a management plan to be developed and implemented which takes into account the uncertainties in science and the properties of the fisheries. ICES suggested that catches of *S. mentella* are set no higher than 10 000 t as a starting point for the adaptive part of the management plan. The advice for 2014 and 2015 were 9 875 t based on the DLS approach (Category 3.2).

The Icelandic slope *S. mentella* fishery southeast of Iceland has gradually ceased since 2000 and very little fishing is conducted in this area. This fishing area was prior to 2000 very important fishing area for Icelandic slope *S. mentella*.

The landings increased in Division 5.a between 2002 and 2003 by about 10 000 t when the fishery of pelagic *S. mentella* merged with the Icelandic slope fishery at the redfish line. Those two fisheries merged again in 2007.

There are no explicit management for Icelandic slope *S. mentella* but the species is within the TAC system described in Chapter 7.5. Icelandic authorities gave until the 2010/2011 a joint quota for golden redfish and Icelandic slope *S. mentella* in Icelandic waters, but now give separate quotas for the species.

20.8 Basis for advice

Icelandic slope *S. mentella* is considered a data limited stock (DLS) and should follow the ICES framework for such (Category 3.2). Below is the description of the formulation of the advice for the 2017 fishing year.

Based on the North Western Working Group recommendation, the stock is treated as a stock with survey data, but no proxies for MSY $B_{trigger}$ or F values, are known. This means that the catch advice for 2018 is based on the survey adjusted status quo catch equation:

$$C_{y+1} = C_{y-1} \left(\frac{\sum_{i=y-x}^{y-1} I_i/x}{\sum_{i=y-z}^{y-x-1} I_i/(z-x)} \right)$$

where I is the survey index, x is the number of years in the survey average, $z=5$ and C_{y-1} is the advice last year. The biomass is estimated to have increased by 14.0% between average of 2012–2014 and 2015 and 2016 (average of the two years). This implies an increase of catches of 14.0% in relation to the last year advice (12 922 t), corresponding to catch of no more than 14 733 t. A precautionary buffer of 20% consistent with the ICES approach is applied which gives catch of no more than 11 786 t.

20.9 Regulation and their effects

There are no explicit management for Icelandic slope *S. mentella*. The species is managed under the ITQ system (see Chapter 7.5.1). Icelandic authorities gave until the 2010/2011 fishing year a joint quota for golden redfish (*S. norvegicus*) and Icelandic slope *S. mentella*. The separation of quotas was implemented in the fishing year that started September 1, 2010.

A general description of management and regulation of fish populations in Icelandic waters is given in Chapter 7.5 and in Stock Annex A.2 with emphasis on Icelandic slope *S. mentella* where applicable.

Table 20.2.1 Total biomass index of Icelandic slope *S. mentella* in the Icelandic Autumn Groundfish survey 2000-2016. No survey was conducted in 2011.

YEAR	ICELAND	CV
2000	134 407	0.145
2001	161 733	0.182
2002	95 059	0.140
2003	63 179	0.127
2004	96 465	0.171
2005	109 196	0.250
2006	123 059	0.166
2007	82 062	0.183
2008	80 011	0.141
2009	93 653	0.174
2010	77 852	0.154
2011		
2012	74 604	0.145
2013	70 055	0.156
2014	103 051	0.191
2015	107 423	0.174
2016	80 855	0.123

Table 20.3.1 Nominal landings (in tonnes) of Icelandic slope *S. mentella* 1978-2016 ICES Division 5.a.

YEAR	ICELAND	OTHERS	TOTAL
1978	3 693	209	3 902
1979	7 448	246	7 694
1980	9 849	348	10 197
1981	19 242	447	19 689
1982	18 279	213	18 492
1983	36 585	530	37 115
1984	24 271	222	24 493
1985	24 580	188	24 768
1986	18 750	148	18 898
1987	19 132	161	19 293
1988	14 177	113	14 290
1989	40 013	256	40 269
1990	28 214	215	28 429
1991	47 378	273	47 651
1992	43 414	0	43 414
1993	51 221	0	51 221
1994	56 674	46	56 720
1995	48 479	229	48 708
1996	34 508	233	34 741
1997	37 876	0	37 876
1998	32 841	284	33 125
1999	27 475	1 115	28 590
2000	30 185	1 208	31 393
2001	15 415	1 815	17 230
2002	17 870	1 175	19 045
2003	26 295	2 183	28 478
2004	16 226	1 338	17 564
2005	19 109	1 454	20 563
2006	16 339	869	17 208
2007	17 091	282	17 373
2008	24 123	0	24 123
2009	19 430	0	19 430
2010	17 642	0	17 642
2011	11 738	0	11 738
2012	11 965	0	11 965
2013	8 761	0	8 761
2014	9 500	0	9 500
2015	9 311	0	9 311
2016 ¹⁾	9 536	0	9 536

1) Provisional

Table 20.3.2 Proportion of the landings of Icelandic slope *S. mentella* taken in ICES Division 5.a by pelagic and bottom trawls 1991-2016.

YEAR	PELAGIC TRAWL	BOTTOM TRAWL
1991	22%	78%
1992	27%	73%
1993	32%	68%
1994	44%	56%
1995	36%	64%
1996	31%	69%
1997	11%	89%
1998	37%	63%
1999	10%	90%
2000	24%	76%
2001	3%	97%
2002	3%	97%
2003	28%	72%
2004	0%	100%
2005	0%	100%
2006	0%	100%
2007	17%	83%
2008	0%	100%
2009	0%	100%
2010	0%	100%
2011	0%	100%
2012	0%	100%
2013	0%	100%
2014	0%	100%
2015	0%	100%
2016	0%	100%

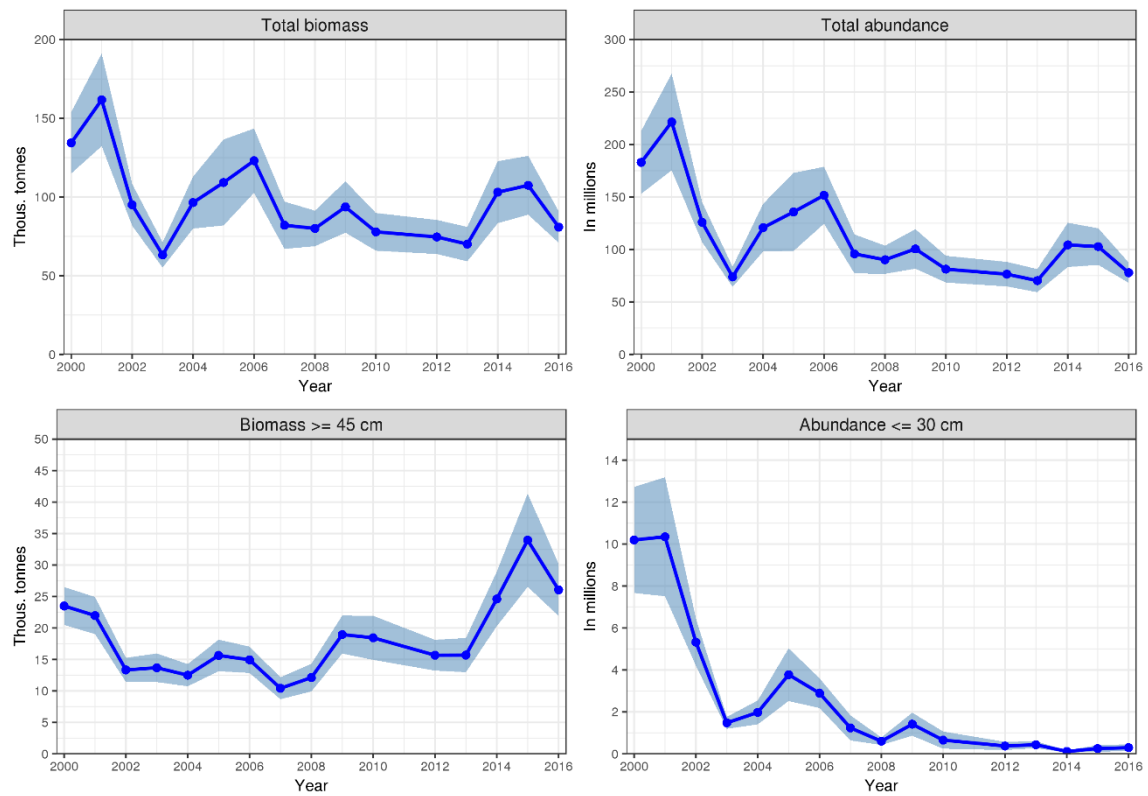


Figure 20.2.1 Survey indices of the Icelandic slope *S. mentella* in the autumn survey in ICES Division 5.a 2000-2016. No survey was conducted in 2011. The figure shows the total biomass index, total abundance index in millions of fish, biomass index of fish 45 cm and larger and abundance index of fish 30 cm and smaller.

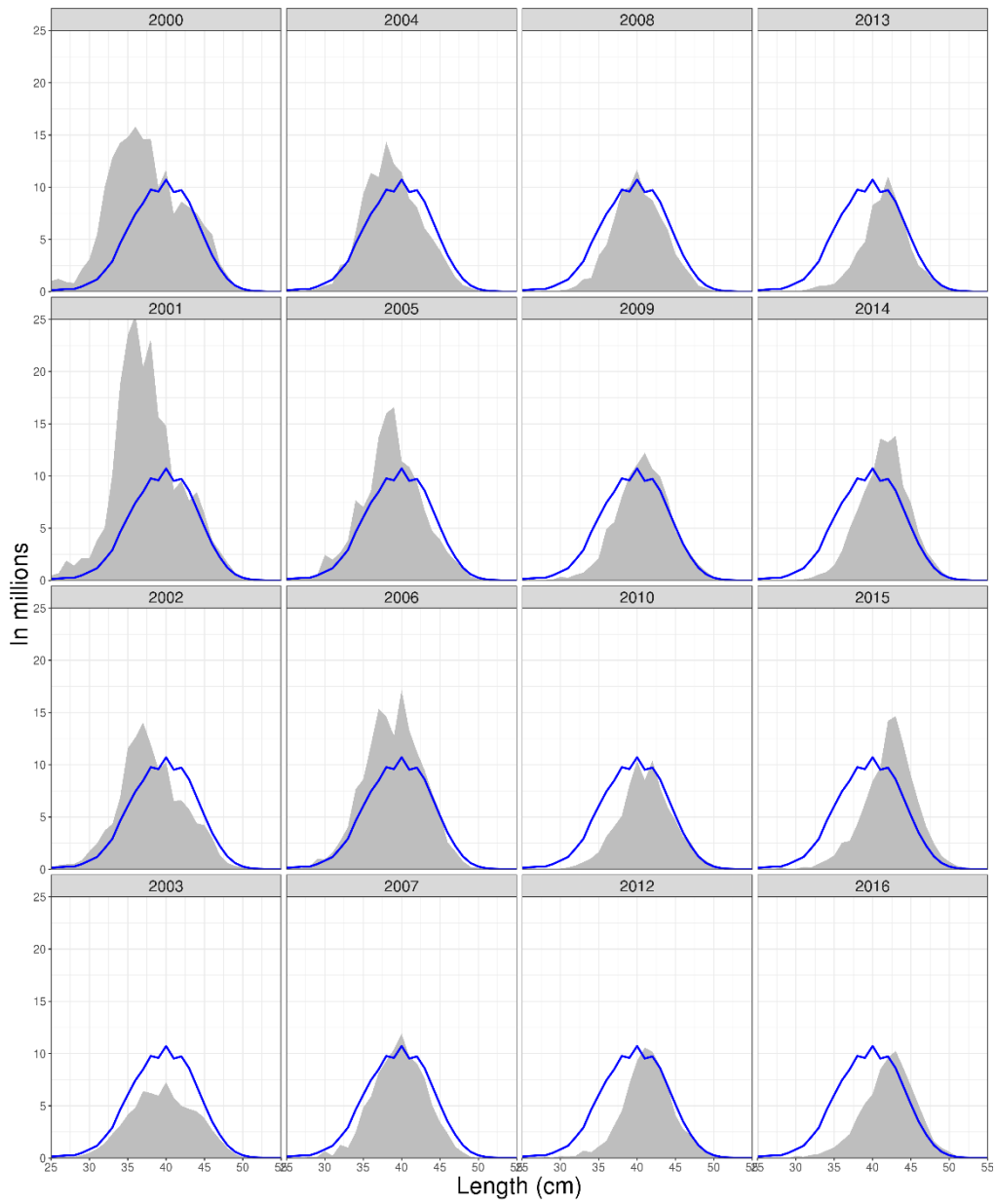


Figure 20.2.2 Length distribution of Icelandic slope *S. mentella* in the Autumn Groundfish Survey in October 2000-2016 in ICES Division 5.a. No survey was conducted in 2011. The blue line is the mean of 2000-2016.

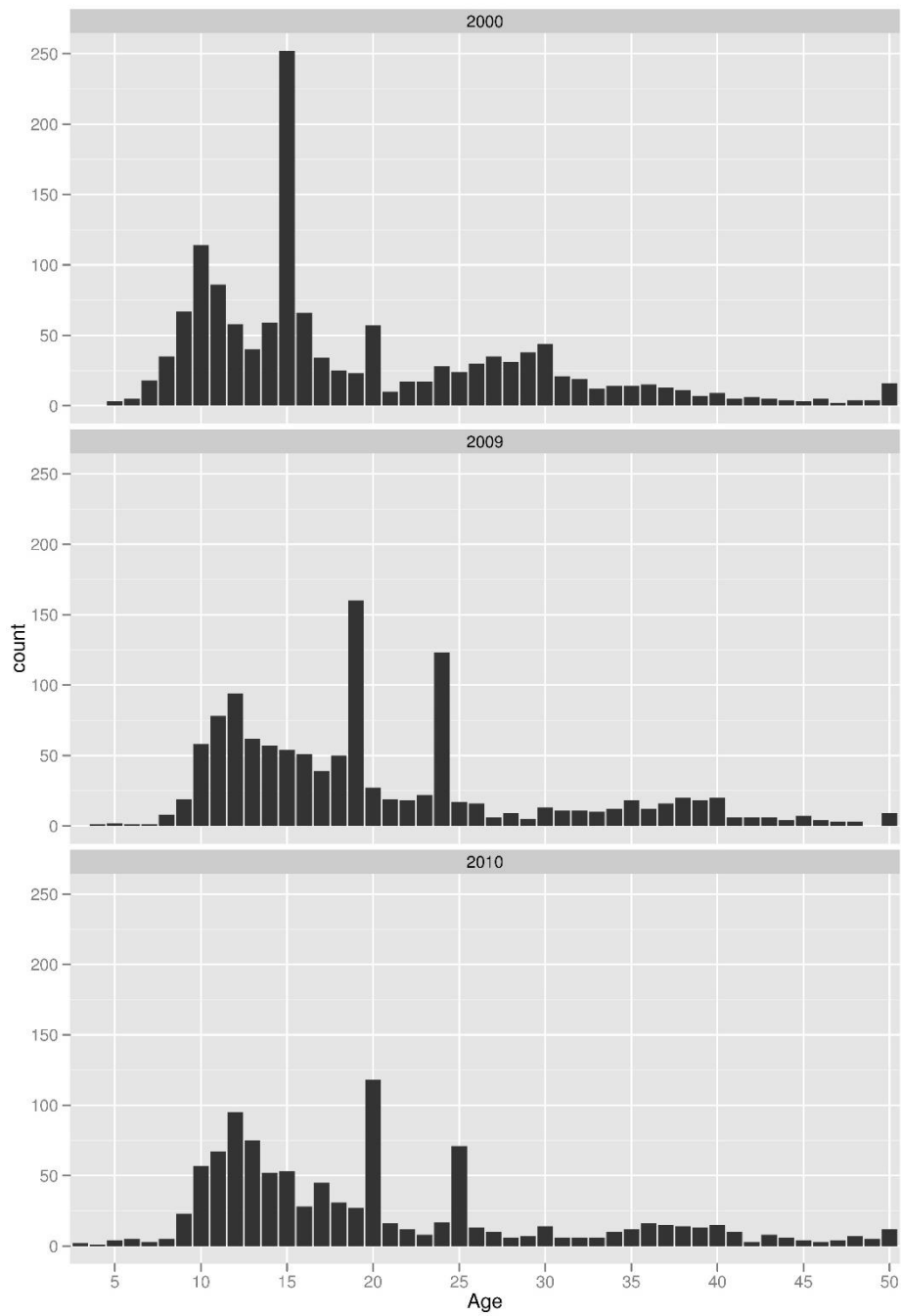


Figure 20.2.3 Age distribution of Icelandic slope *S. mentella* from the Autumn Survey in 2000 (n = 1 405), 2009 (n = 1 101), and 2010 (n = 1 206). The age class 50 are the combined age-classes of 50 years and older.

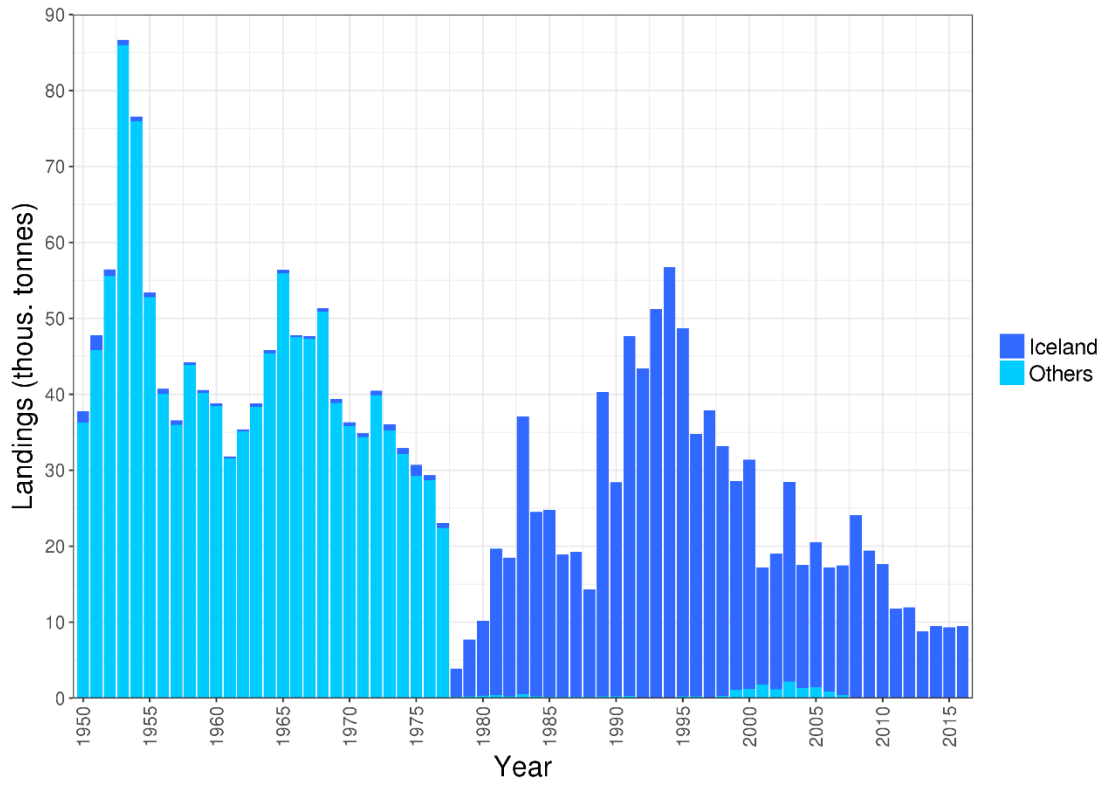


Figure 20.3.1 Nominal landings (in tonnes) of Icelandic slope *S. mentella* from Icelandic waters (ICES Division 5.a and Subarea 14) 1950–2016.

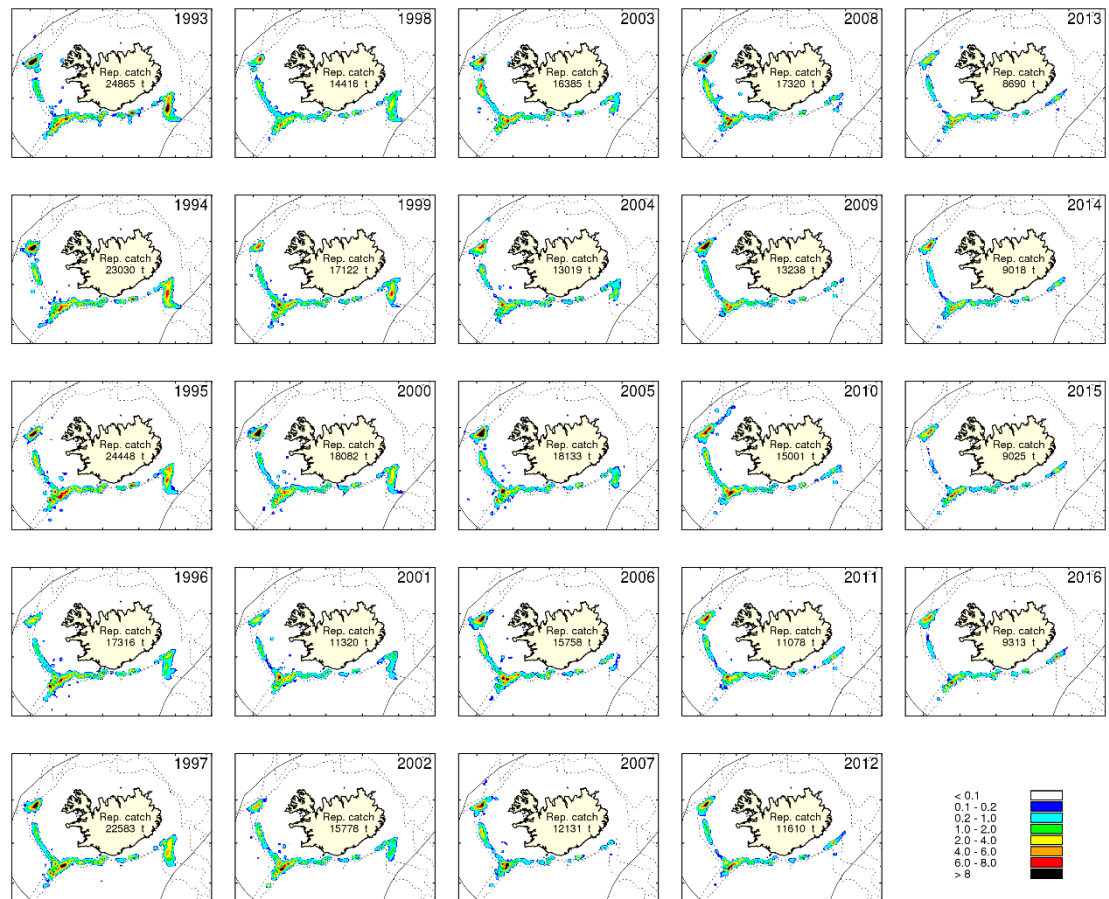


Figure 20.3.2 Geographical location of the Icelandic slope *S. mentella* catches in Icelandic waters (ICES Division 5.a and Subarea 14) 1993–2016 as reported in log-books of the Icelandic fleet using bottom trawl. The blue line indicates part of the management unit for the deep-pelagic redfish stock. The dotted line represents the 500 m isobaths.

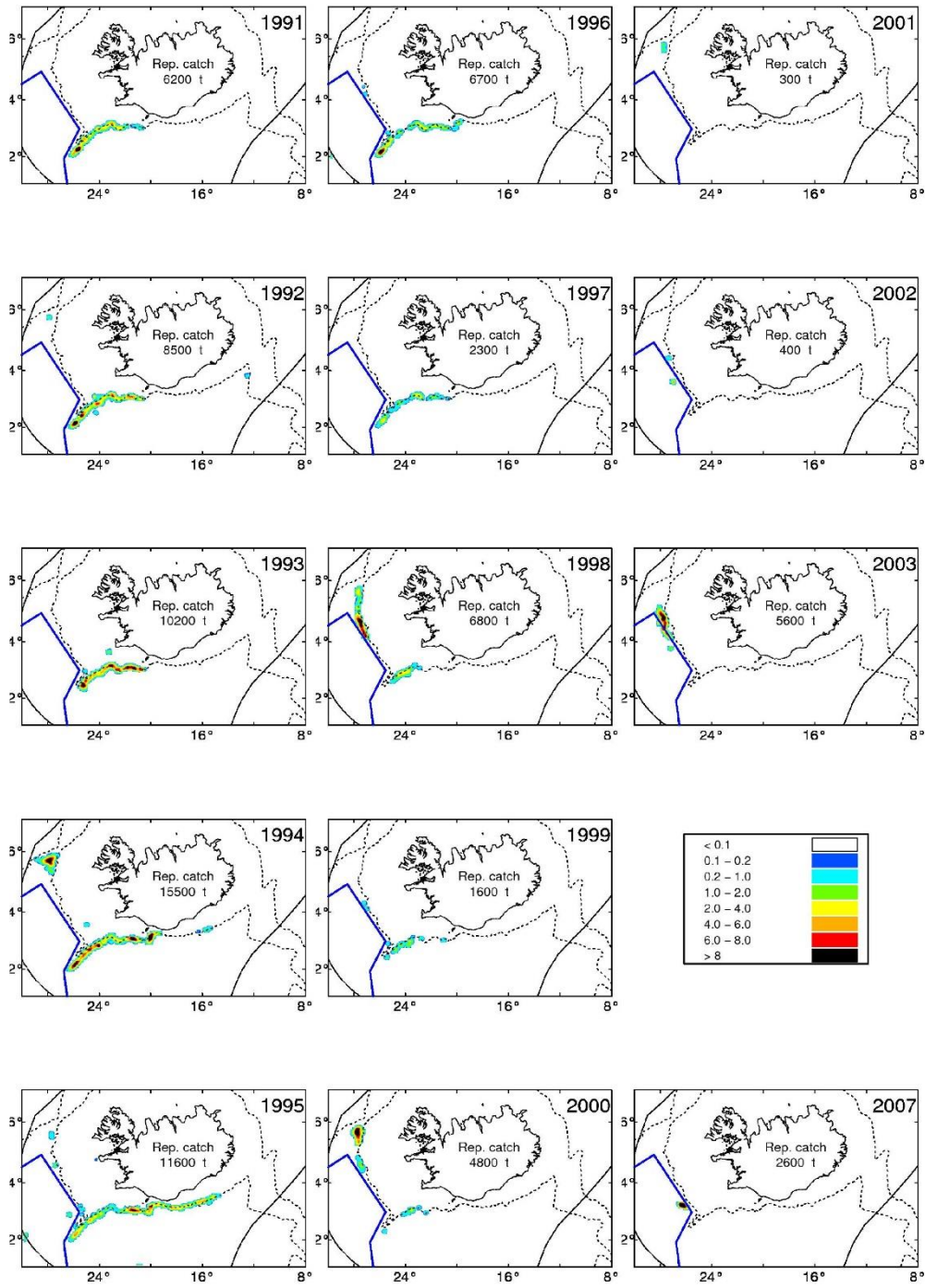


Figure 20.3.3 Geographical location of the Icelandic slope *S. mentella* catches in Icelandic waters (ICES Division 5.a and Subarea 14) 1991-2003 and 2007 as reported in log-books of the Icelandic fleet using pelagic trawl. The blue line indicates part of the proposed management unit for the deep-pelagic redfish stock. The dotted line represents the 500 m isobaths.

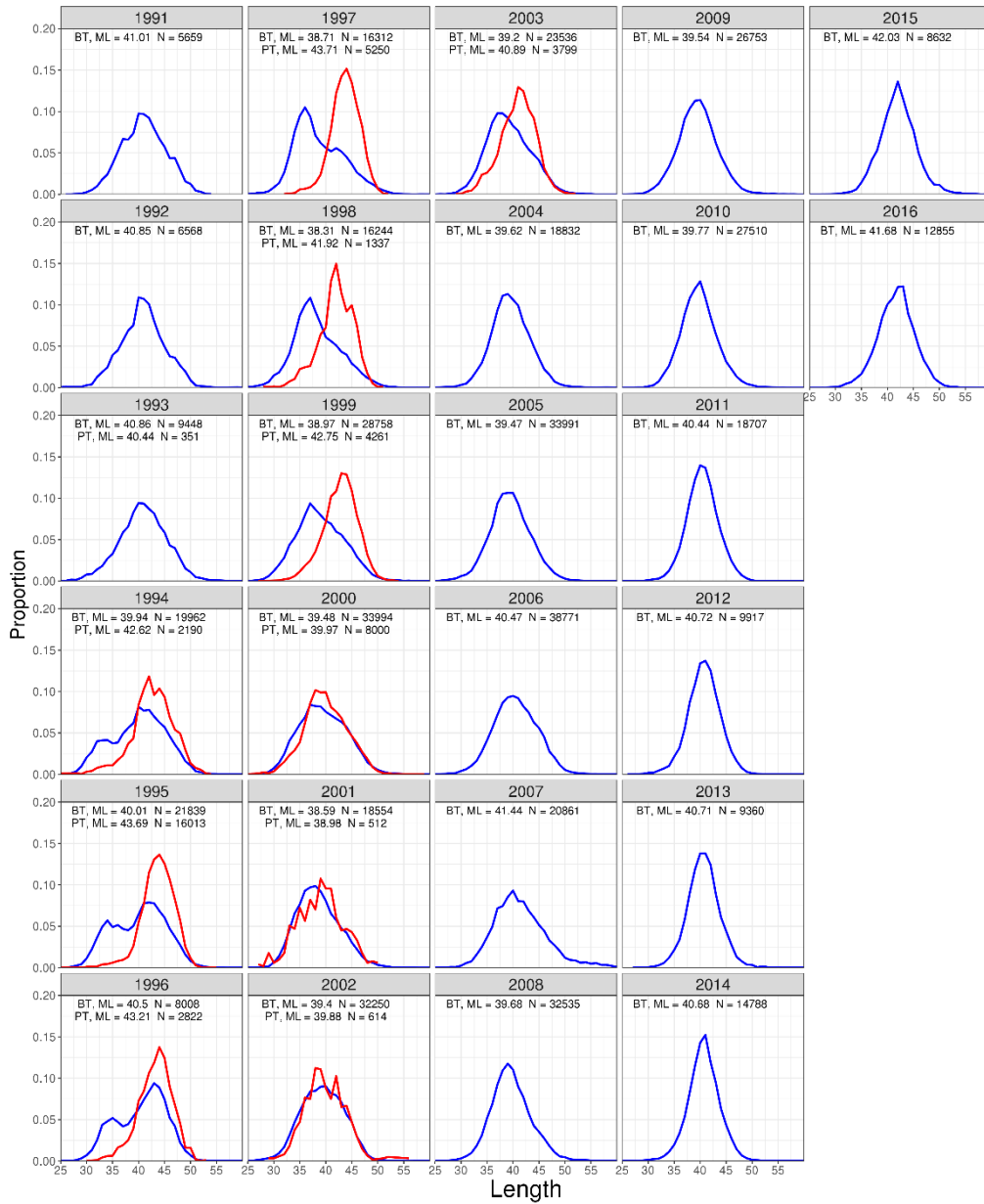


Figure 20.3.5 Length distributions of Icelandic slope *S. mentella* from the Icelandic landings taken with bottom trawl (blue line) and pelagic trawl (red line) in Icelandic waters (ICES Division 5.a and Subarea 14) 1991–2016.

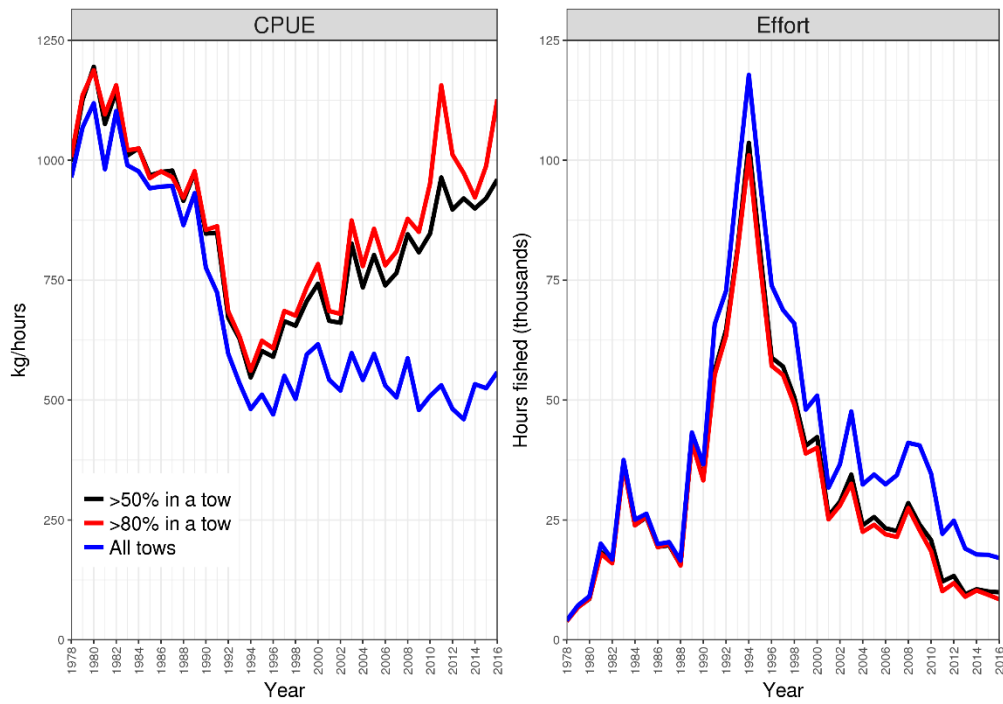


Figure 20.3.6 CPUE and effort of Icelandic slope *S. mentella* from the Icelandic bottom trawl fishery in Icelandic waters (ICES Division 5.a and Subarea 14) 1978–2016.

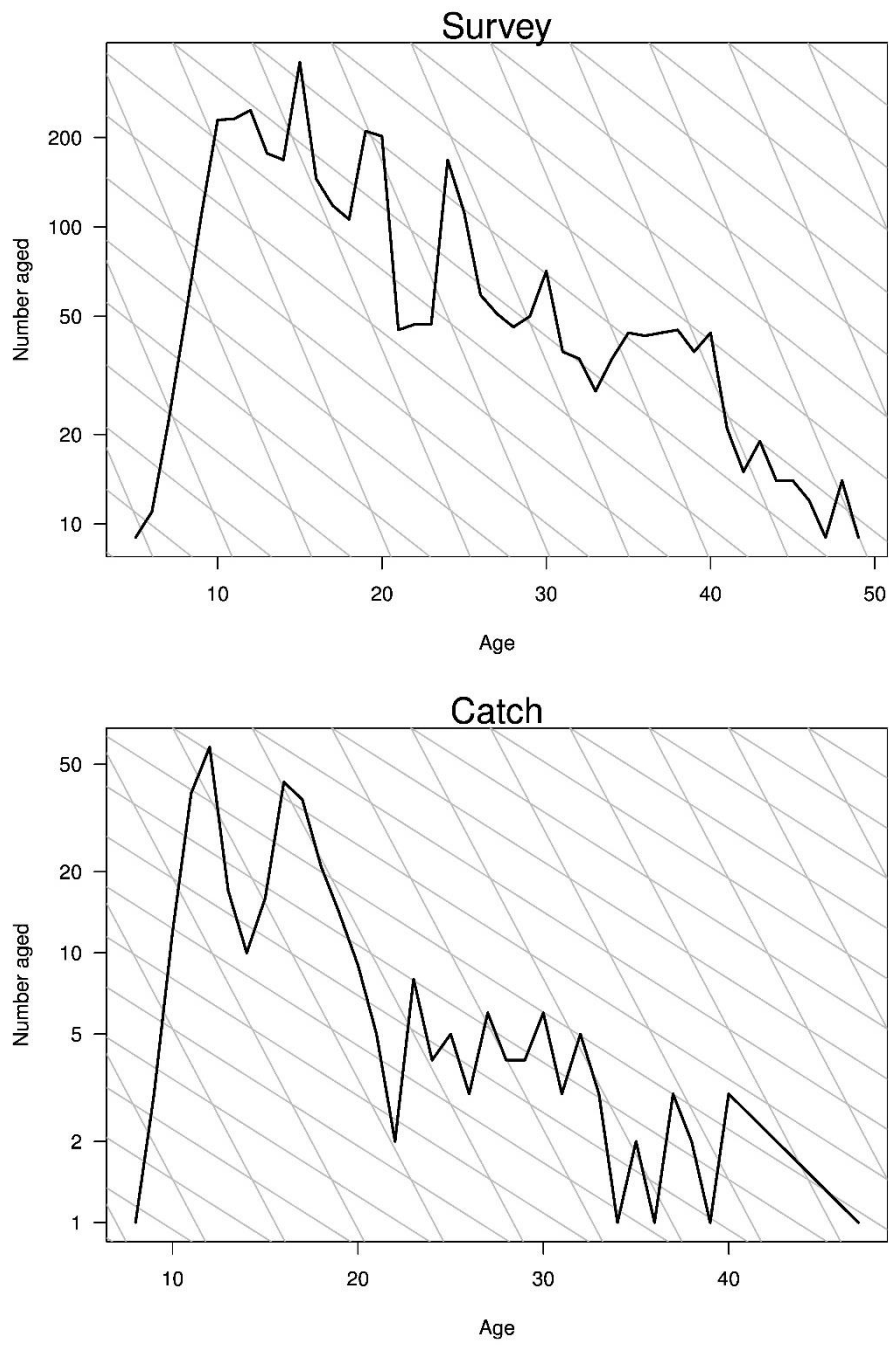


Figure 20.5.1. Icelandic slope *S. mentella*. Number aged plotted on log-scale. Grey lines correspond to $Z=0.1$ and $Z=0.3$.