OFFSHORE NORTHERN SHRIMP
Pandalus borealis

THE FISHERY

Offshore shrimp fishing started in the early 1970's and takes place in the waters north of Iceland. Catch levels were low during the first decade but increased steadily from 1982 until it peaked in 1997 at 62 thous. tonnes. After 1997, the catch decreased sharply and reached a minimum of 600 tonnes in 2006 (Figure 1). The average annual catch in 2014-2020 was 3300 tonnes and has decreased since 2012 when 7350 tonnes were landed. The landed catch in 2020 was 1960 tonnes, which is the lowest catch since 2006-2008.

In 1988, 152 commercial vessels landed offshore shrimp. The number of commercial shrimp vessels steadily decreased from 1993 to 2006, when only one vessel landed offshore shrimp (Figure 1). The number of vessels increased again until 2013, when 34 vessels landed offshore shrimp, but since 2013 the number of vessels has decreased and in 2020 only 5 vessels landed offshore shrimp.

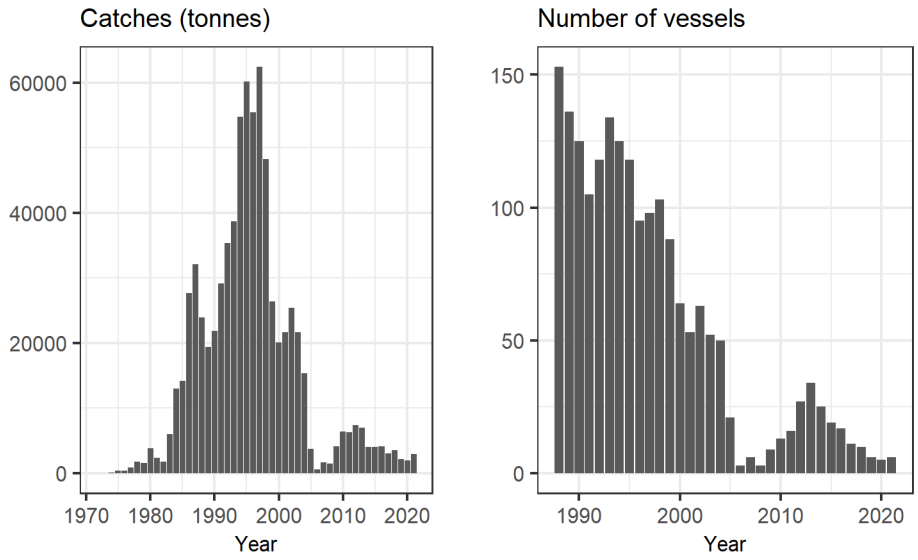

Figure 1. Offshore northern shrimp. Total catch and number of commercial vessels.

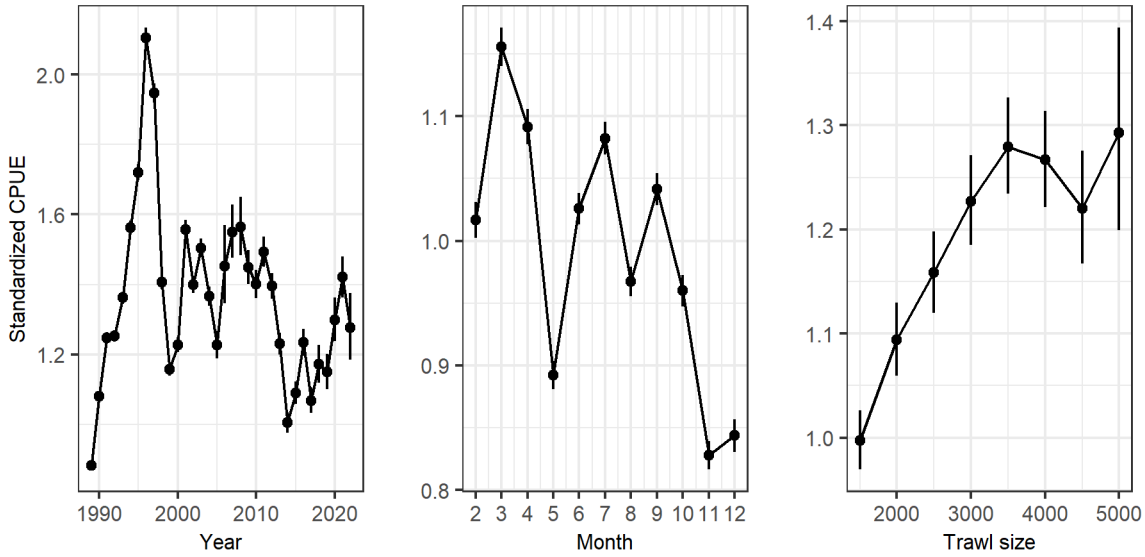

Figure 2. Offshore northern shrimp. Standardized catch per unit effort (CPUE) of shrimp by year, month and trawl size (number of meshes).

Catch per unit effort (CPUE) increased from 1988 to a peak in 1996 but decreased sharply between 1996 and 1999 (Figure 2). CPUE fluctuated between 2001 and 2012 and decreased in the following years. In 2019 and 2020, CPUE increased again to levels seen in 1992 to 1997. CPUE is highest in March but decreases in the summer and is lowest in November and December. CPUE increases with increasing trawl size but is stable at sizes 2500-5000 meshes.

CPUE increases with increasing biomass index (Figure 3). The consistency between CPUE and total biomass index was relatively good between 1989 and 2002 (Figure 3). However, since 2003 the CPUE has indicated better state of the stock compared with the total biomass index. Both indices decreased between 2010 and 2015.

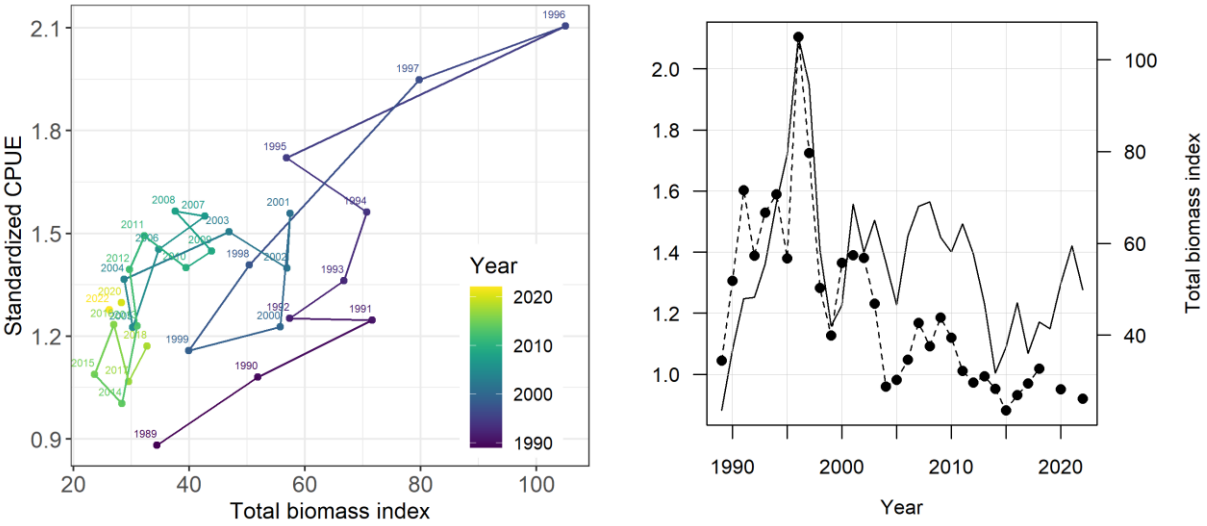

Figure 3. Offshore northern shrimp. On the left: Relationship between standardized catch per unit effort (CPUE) and total biomass index. To the right: Standardized CPUE (solid line, left axis) and total biomass index (broken line, right axis).

The main distribution of the fishery has varied over time (Figure 4). In 1988-2005, the main fishing ground was larger compared with 2006-2020. At that time, a high proportion of the catch was taken from Norðurkantur and around Kolbeinsey (north and northeast of the Vestfirðir peninsula). Since 2006, the main catches were caught in areas north of Skjálfandi and Öxarfjörður fjords and shrimp fishing has not taken place northeast and east of Iceland. The offshore shrimp fishing in 2021 took place from March to October.

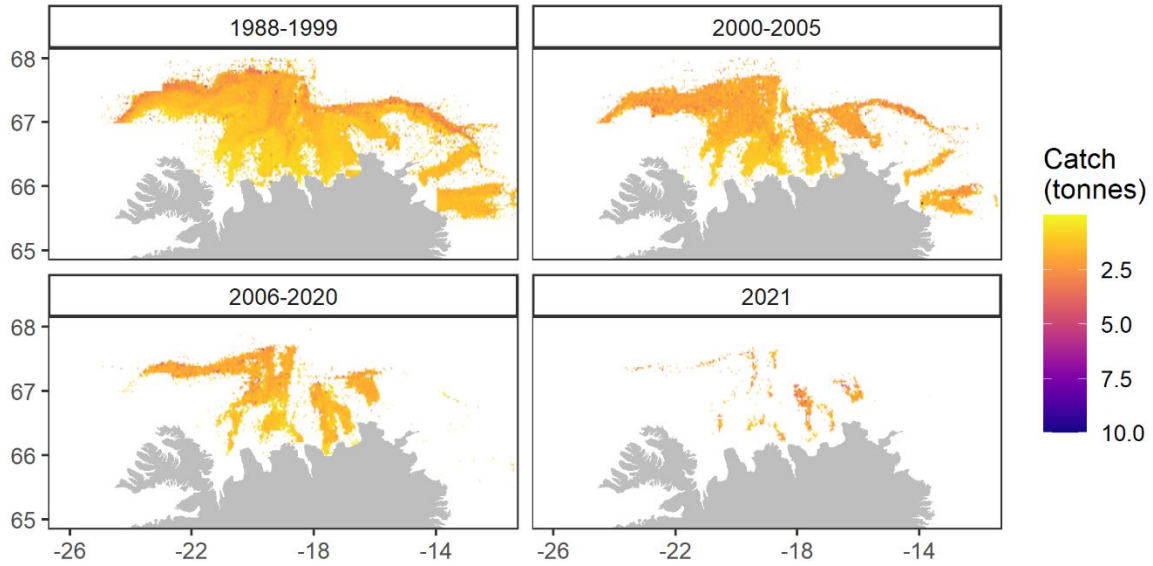

Figure 4. Offshore northern shrimp. Spatial distribution of catch 1980-2021.

SURVEY DATA

The annual offshore Icelandic shrimp survey has been conducted since 1988. Originally, the number of stations were about 190, but in 2006 the number of stations was reduced to 92 covering the same area as before with less density of stations. Since 2014 the survey includes 86 fixed stations at depths to 700 m. The survey indices are calculated based on all available stations within the area that has been sampled annually since 1988. All information on sampling procedure can be found in Jónsdóttir et al. (2017). No survey was conducted in 2019 and 2021.

The density of shrimp has decreased after 1996, when the biomass index was highest. Since 2004, density has been low east and northeast of Iceland (Figure 5). In 2020 and 2022, higher abundance was east of Iceland compared with 2018 but lower abundance was at the western part of the area.

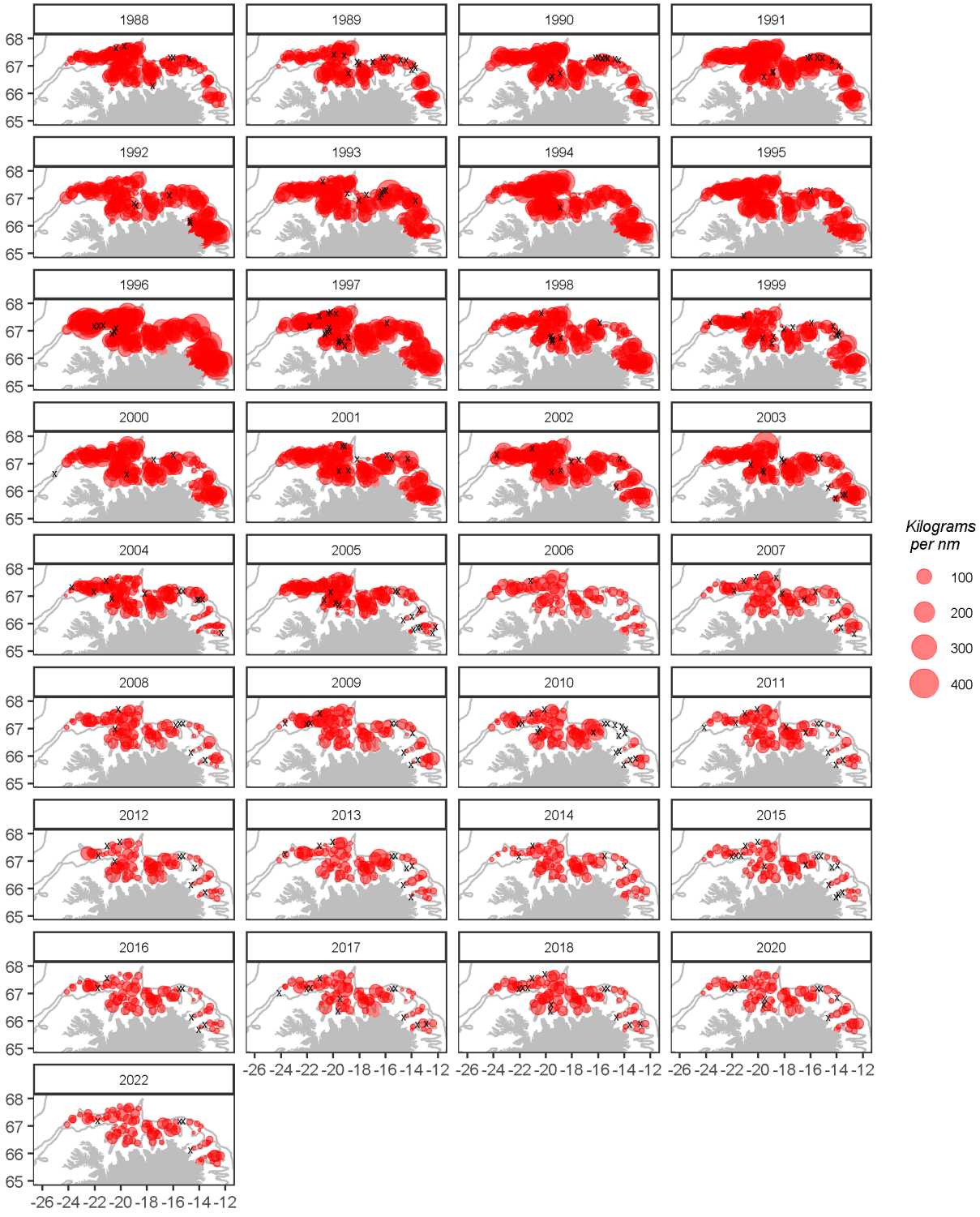

Figure 5. Offshore northern shrimp. Distribution and abundance in the annual shrimp survey. x indicates no shrimp.

INDICES

Four indices are used to assess the state of the offshore shrimp stock: total biomass, fishable biomass, female biomass, and juvenile biomass. Juveniles include all individuals equal to and below 13 mm carapace length, while the fishable biomass include all individuals equal to and above 15.5 mm carapace length. The fishable biomass index is used for calculation of the advice. Individuals between 13 and 15.5 mm carapace length are divided between the juvenile and fishable biomass indices. The female biomass includes all females and is defined as the spawning stock biomass.

The total biomass index and the fishable index increased until 1996, after which they declined until 2004 (Figure 6). The indices increased slightly in 2006-2009, but decreased between 2009 and 2011, and have remained relatively stable since then, with the exception of 2015, when they reached historically low levels. The indices have been decreasing since 2018 and are at similar levels observed in 2015-2017. The fishable index was above the reference level where the state of the stock is considered critical. The fishable index value of 20% of the mean of the mean of the three highest indices (I_{lim}) is used as a proxy for B_{lim}. The female index has fluctuated during the study period with a general downward trend. The juvenile index increased from 1988 to 1994. Since then it has decreased, reached historically low levels in 2020 but increased slightly in 2022.

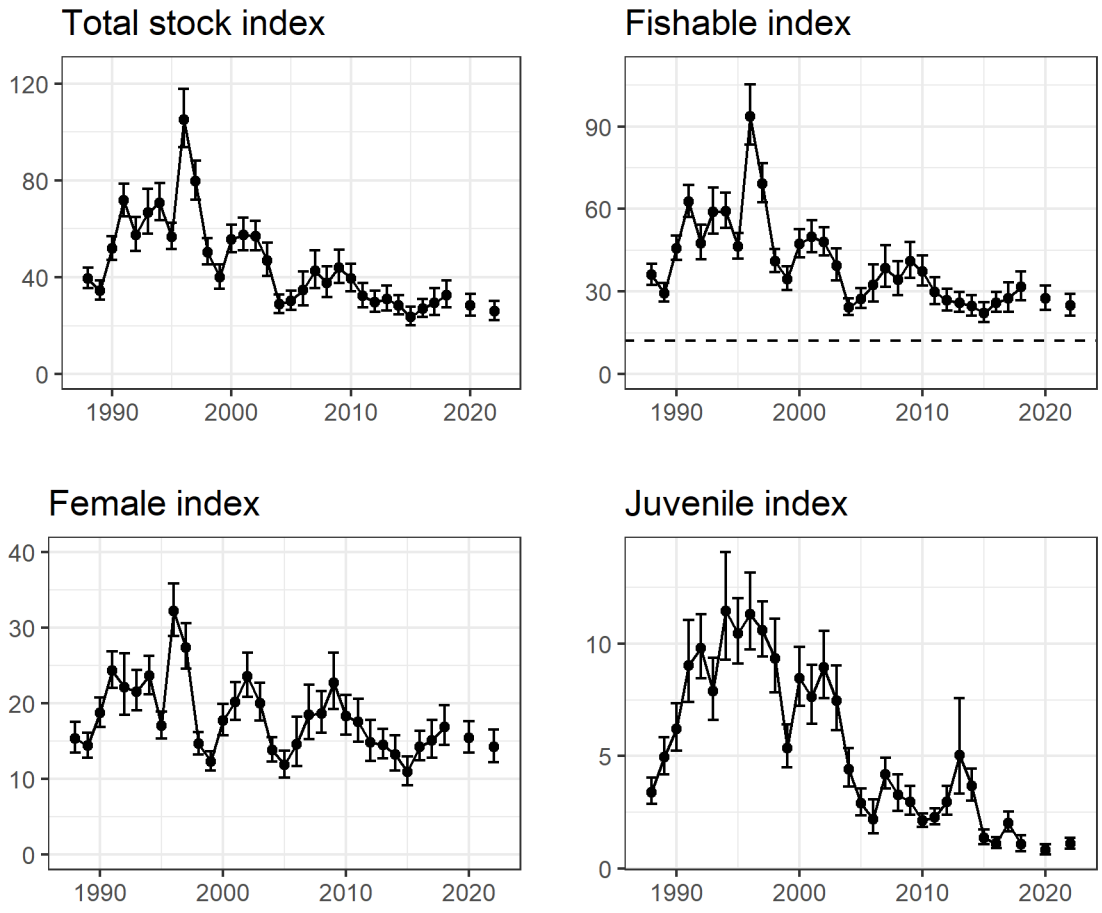

Figure 6. Offshore northern shrimp. Stock biomass index, fishable biomass index, female biomass index and juvenile biomass index. The horizontal line indicates a I_{lim} which is a proxy for B_{lim} (20% of the mean of the three highest indices).

LENGTH DISTRIBUTION

Because of slower growth in the offshore area compared with inshore areas, it is difficult to estimate age and hence, cohorts, of offshore shrimp. The number of males has decreased and has been around or below average since 2004. Since 2015 the smallest individuals were missing in the survey (Figure 7).

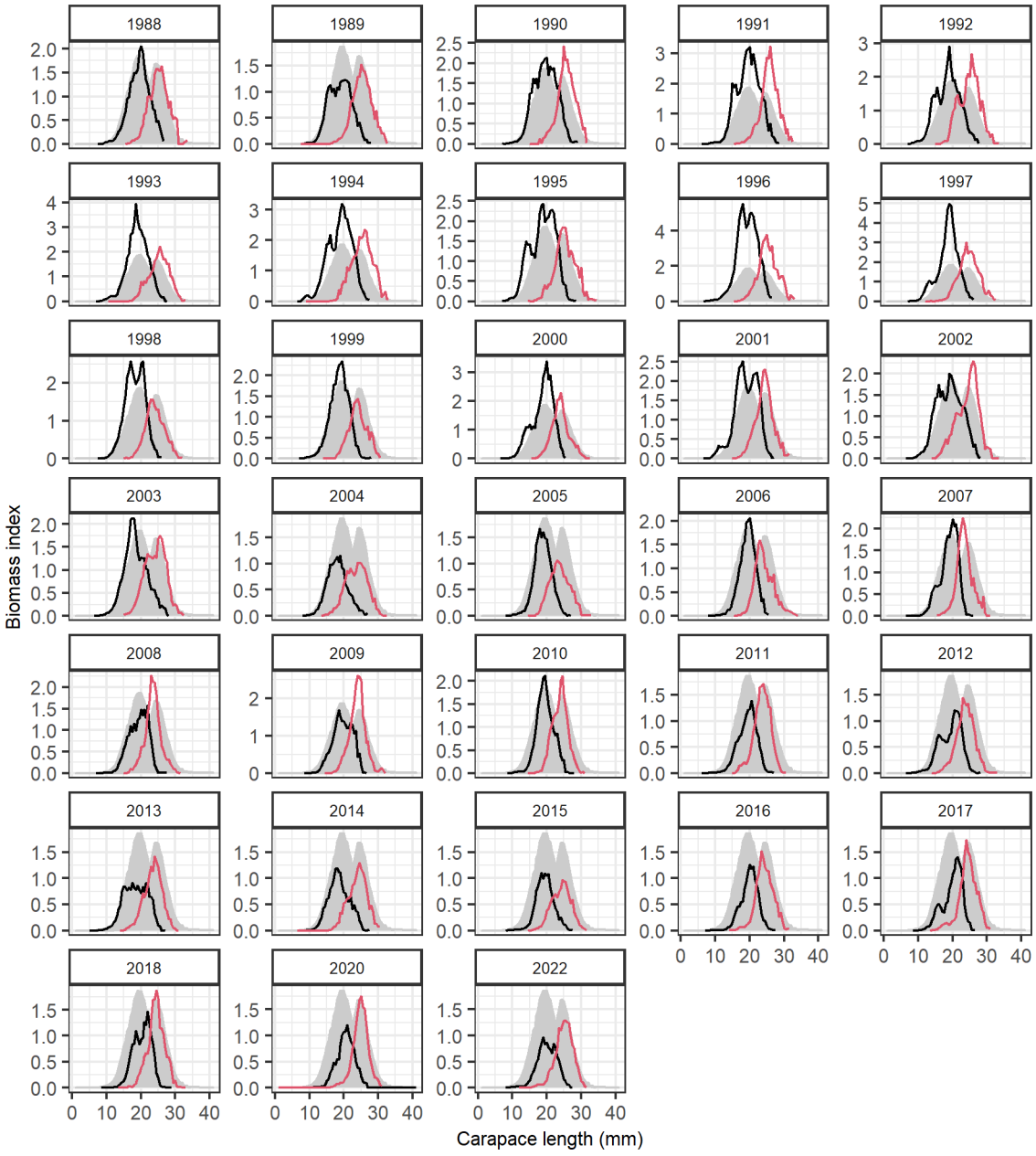

Figure 7. Offshore northern shrimp. Length distribution. The black line indicates males and the red line females. The grey area is the mean length distribution of both sexes for the whole study period.

ABUNDANCE OF COD AND GREENLAND HALIBUT

Abundance index of juvenile cod varied without a trend but was very high in 2015 (Figure 8). The abundance index of older cod was very low between 1988 and 1995 but increased in 1996 and since 2003 it has remained high. The cod abundance index has remained high since 2014, with highest values in 2016-2018.

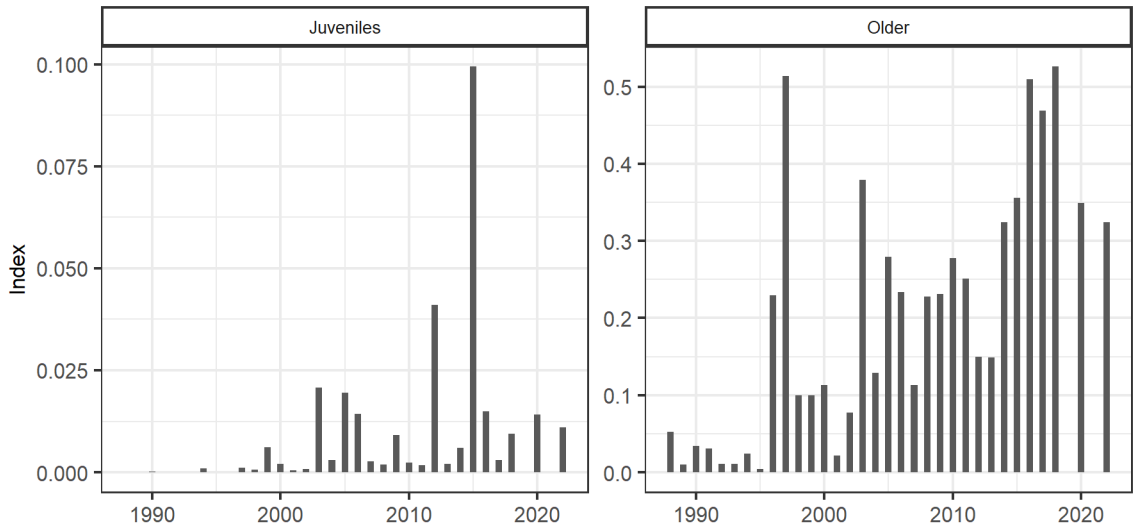

Figure 8. Cod. Abundance indices in the annual offshore shrimp survey. Juveniles are <1 year old (< 16 cm) while older is 1 year old and older.

Juvenile Greenland halibut are rare in the survey (Figure 9). The abundance of older Greenland halibut decreased from 1990 to 2005. It increased until 2011 when it started to decrease again. The Greenland halibut abundance remained relatively stable from 2014-2022.

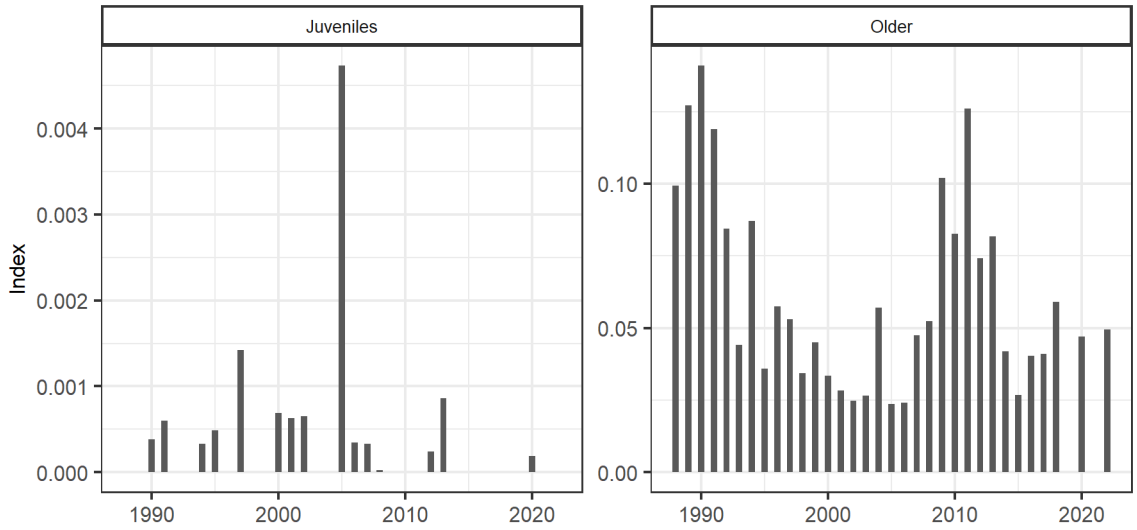

Figure 9. Greenland halibut. Abundance indices in the annual offshore shrimp survey. Juveniles are <1 year old (< 14 cm) while older is 1 year old and older.

MANAGEMENT

The Ministry of Industries and Innovation is responsible for management of the Icelandic fisheries and implementation of legislation. The Marine Research Institute (MRI) first recommended TAC for offshore shrimp in 1987 and the fishery has been managed with TAC since then, except for the quota years 2010/2011 to 2013/2014, when the offshore shrimp fishery was open to all boats without a national TAC.

The quota year from 1 September to 31 August took an effect on 1 September 1991.

Table 1. Offshore northern shrimp. Fishable biomass index, state of the stock (relative to the mean of the three highest indices), advice, catch (tonnes in calendar year) and F_{proxy}.

Year	Biomass index	Relative state	Rec. TAC	National TAC	Catch	F_{proxy}
1988	36 052	0.48	30 000	30 000	24 500	0.68
1989	29 476	0.39	20 000	20 900	20 900	0.71
1990	45 622	0.61	22 000	24 600	24 400	0.53
1991	62 597	0.83	28 000	-	30 700	0.49
1991/92			35 000	40 000	34 200	
1992/93	47 557	0.63	35 000	40 000	41 800	0.88
1993/94	58 841	0.78	40 000	52 000	53 200	0.89
1994/95	59 253	0.79	60 000	62 000	61 200	1.03
1995/96	46 292	0.62	40 000	63 000	65 000	1.40
1996/97	93 704	1.25	55 000	60 000	57 300	0.61
1997/98	69 124	0.92	70 000	75 000	60 900	0.88
1998/99	41 001	0.55	40 000	40 000	30 700	0.75
1999/00	34 570	0.45	20 000	20 000	20 700	0.60
2000/01	47 278	0.63	25 000	25 000	22 100	0.47
2001/02	49 827	0.66	35 000	35 000	27 400	0.55
2002/03	47 910	0.64	30 000	30 000	24 300	0.51
2003/04	39 460	0.53	20 000	20 000	18 000	0.46
2004/05	24 344	0.32	5 000[1)]	10 000	5 100	0.21
2005/06	27 348	0.36	10 000	10 000	800	0.03
2006/07	32 479	0.43	7 000	7 000	1 600	0.05
2007/08	38 530	0.51	7 000	7 000	1 300	0.03
2008/09	34 313	0.46	7 000	7 000	3 200	0.09
2009/10	40 920	0.54	7 000	7 000	6 300	0.15
2010/11	37 279	0.50	7 000	-	6 300	0.17
2011/12	29 913	0.40	7 000	-	7 300	0.24
2012/13	26 714	0.36	5 000	-	7 400	0.28
2013/14	25 976	0.35	5 000	-	5 100	0.20
2014/15	24 658	0.33	5 000	5 000	4 100	0.17
2015/16	22 243	0.30	4 000	4 000	4 300	0.19
2016/17	25 879	0.34	4 100	4 100	3 100	0.12
2017/18	27 479	0.37	5 000	5 000	3 500	0.13
2018/19	31 603	0.42	5 852	5 852	2 500	0.08
2019/20	-	-	4 682[2)]	4 682	1 700	-
2020/21	27 443	0.37	5 136	5 136	3 200	0.12
2021/22	-		5 136	5 136		
2022/23	25 112	0.33				

[1)] 2004/05: No recommended TAC but unchanged effort estimated to yield 15 000 tonnes.

[2)] 2019/20: Advice based on lowering previous years' advice by 20% (precautionary approach due to lack of survey data).

REFERENCES

Jónsdóttir, I.G., Bragason, G.S., Brynjólfsson, S.H., Guðlaugsdóttir, A.K., Skúladóttir, U. 2017. Northern shrimp research in Icelandic waters, 1988-2015. Marine and Freshwater Research Institute, Reykjavík, Iceland. HV 2017-007.