

# NORTHERN SHRIMP IN ÍSAFJARÐARDJÚP, FEBRUARY SURVEY – RÆKJA Í ÍSAFJARÐAR-DJÚPI, FEBRÚAR KÖNNUN

## *Pandalus borealis*

### COMMERCIAL FISHING

Shrimp fishing started in Ísafjarðardjúp in the 1930's. The catch fluctuated between 1000 and 3100 tonnes between 1978 and 2002. No fishing was allowed in 2003-2010 due to low biomass indices, but since 2011 annual catches have been 500-1100 tonnes (Figure 1). The fishing season has been from early winter (following the survey in October) until 30<sup>th</sup> April. Catch per unit effort (CPUE) remained relatively stable between 1978 and 2002. Since 2011 CPUE has been higher, mainly due to increased density of shrimp within the innermost part of the fjord.

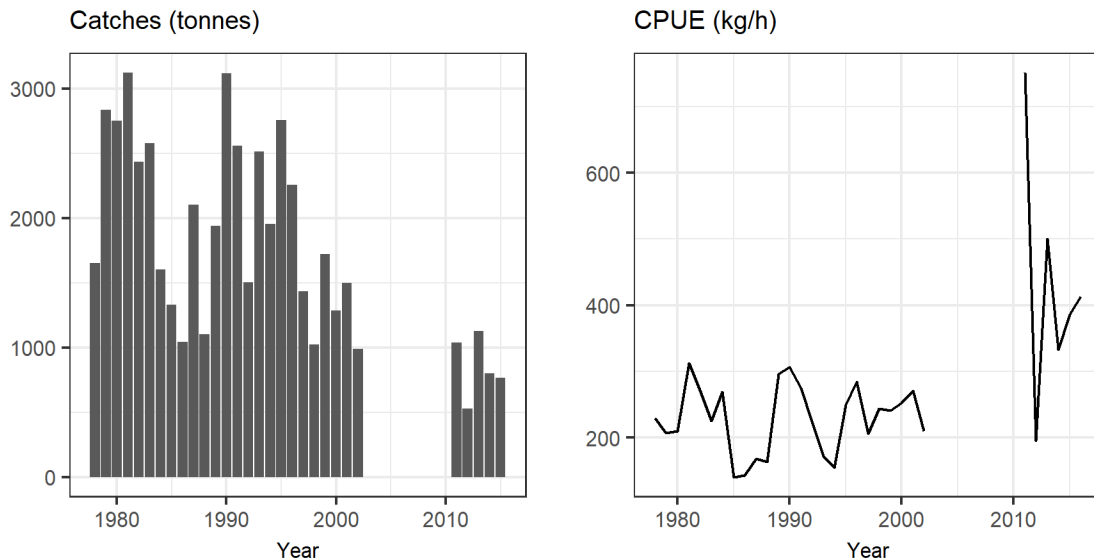


Figure 1. Total catch and catch per unit effort in Ísafjarðardjúp.

Mynd 1. Heildarafli og afli á sóknareiningu í Ísafjarðardjúpi.

The distribution of the fishery has varied over time (Figure 2). Since 2012, there have been two main fishing areas; at the innermost part of the fjord and the outermost part.

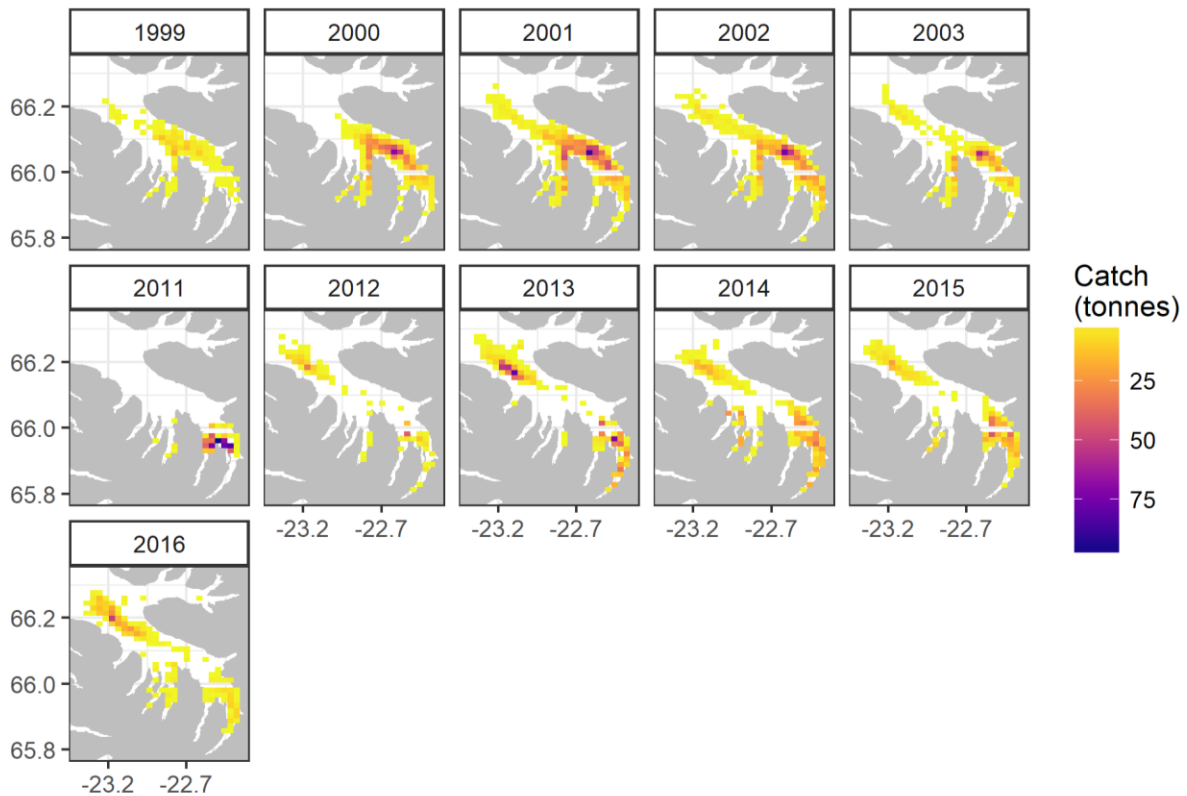


Figure 2. Distribution of shrimp catch in Ísafjarðardjúp from 1999 to 2016.

*Mynd 2. Dreifing rækjuafla í Ísafjarðardjúpi 1999-2016.*

## ICELANDIC SHRIMP SURVEY

The annual Icelandic shrimp survey has been conducted in the autumn since 1988 in Ísafjarðardjúp. The last survey was conducted from 29<sup>th</sup> October to 4<sup>th</sup> of November 2017 and included 26 fixed stations and 10 random stations at 49-133 m depth. An additional survey was conducted on 17<sup>th</sup>, 22<sup>nd</sup> and 28<sup>th</sup> of February 2018 and included 21 fixed stations and 23 random stations. Survey in February was conducted annually until 2004. Since then, it has only been conducted occasionally. Due to diurnal vertical migration of shrimp, all tows are carried out during the daylight hours. All information on sampling procedure can be found in the report 'Northern shrimp research in Icelandic waters, 1988-2015' (Jónsdóttir et al. 2017).

From 1988, shrimp was found within the inner part of the fjord as well as in Jökulfirðir. However, following the decrease in biomass index the distributional area of shrimp decreased both in the autumn and in the February survey (Figure 3). Since 2011, shrimp has been found within a small area at the innermost part of the fjord and in less density at the outermost part of the fjord.

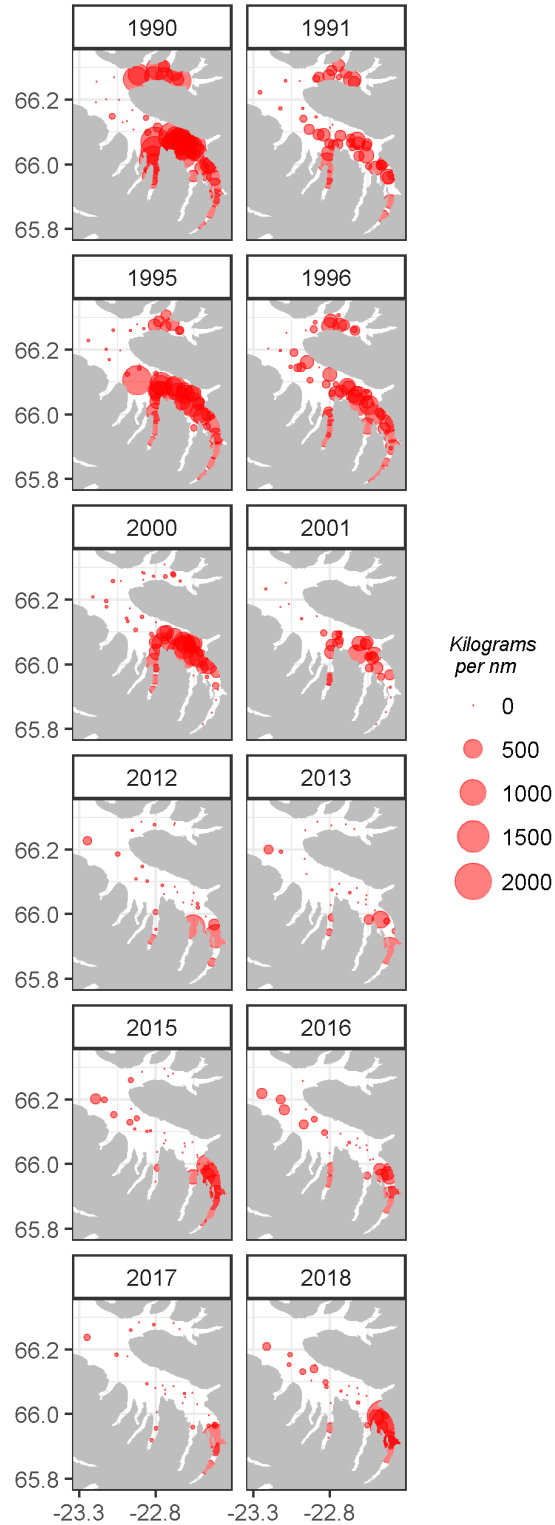


Figure 3. Distribution and abundance of shrimp in the annual shrimp survey in autumn (first column) and in February the year after (second column).

Mynd 3. Útbreiðsla og magn rækju í stofnmælingu að hausti (fyrri dálkur) og í febrúar ári seinna (seinni dálkur).

## SURVEY INDICES

Four indices are used to assess the state of the 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. 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 equivalent to the spawning stock biomass of various fish species.

All the indices, except the juvenile index, decreased steadily from 1990 to 2004 when they were at historically low levels (Figure 4). In 2011, the indices increased and fluctuated for three years. Since 2013 the indices have decreased and in 2017 the fishable index was below the reference level where the state of the stock is considered critical. In February 2018, the fishable index was higher compared to November 2017.

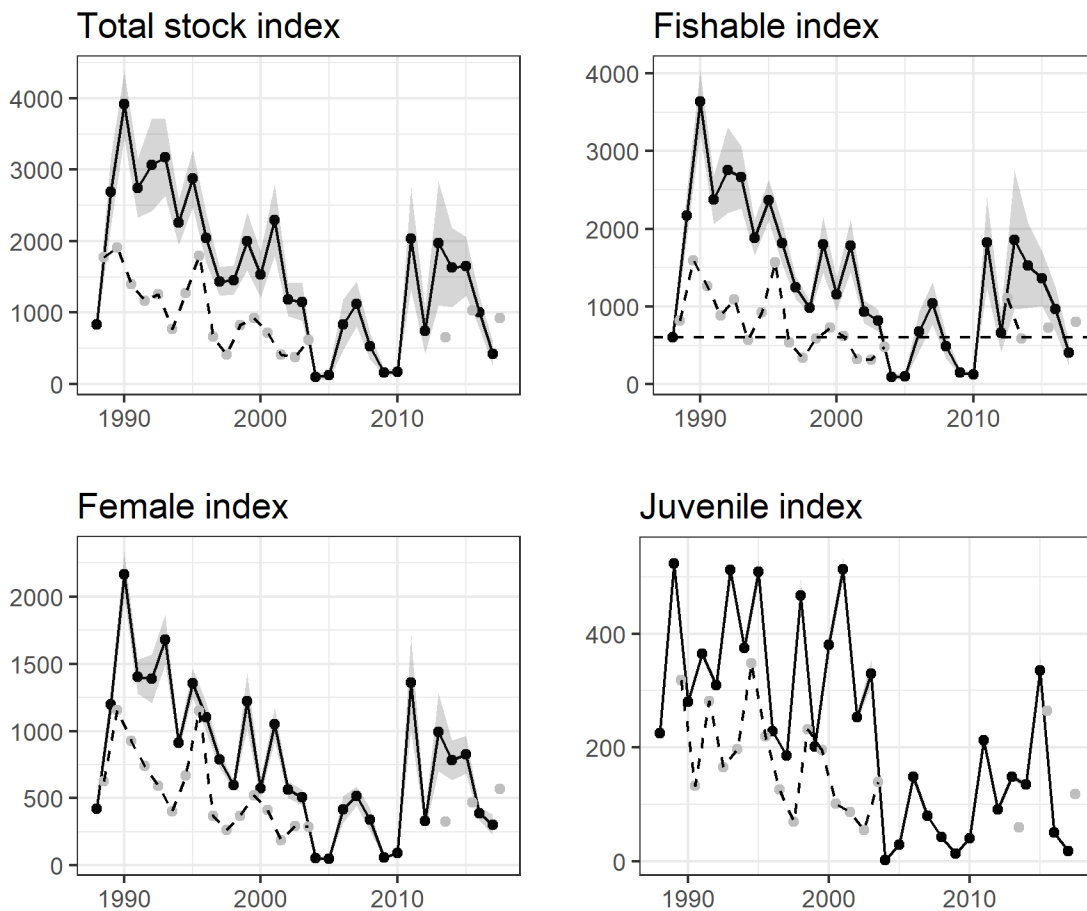


Figure 4. Stock biomass index, fishable biomass index, female biomass index, and juvenile biomass index of shrimp in autumn (solid line) and in February (broken line). The horizontal line indicates a value where the state of the stock is considered critical in autumn ( $l_{lim}$ ).

*Mynd 4. Heildarstofnsvísitala, veiðistofnsvísitala, kvendýravísitala og vísitala ungrækju í Ísafjarðardjúpi að hausti (heil lína) og í febrúar (brotin lína). Lárétt lína sýnir viðmiðunargildi fyrir ástand stofnsins að hausti ( $l_{lim}$ ).*

## LENGTH DISTRIBUTION OF SHRIMP

From 2013 to 2015 the length distribution was close to the long term mean. In 2016 and 2017, the number of females were lower than the long term average (Figure 5). Furthermore, the number of males were low in 2017.

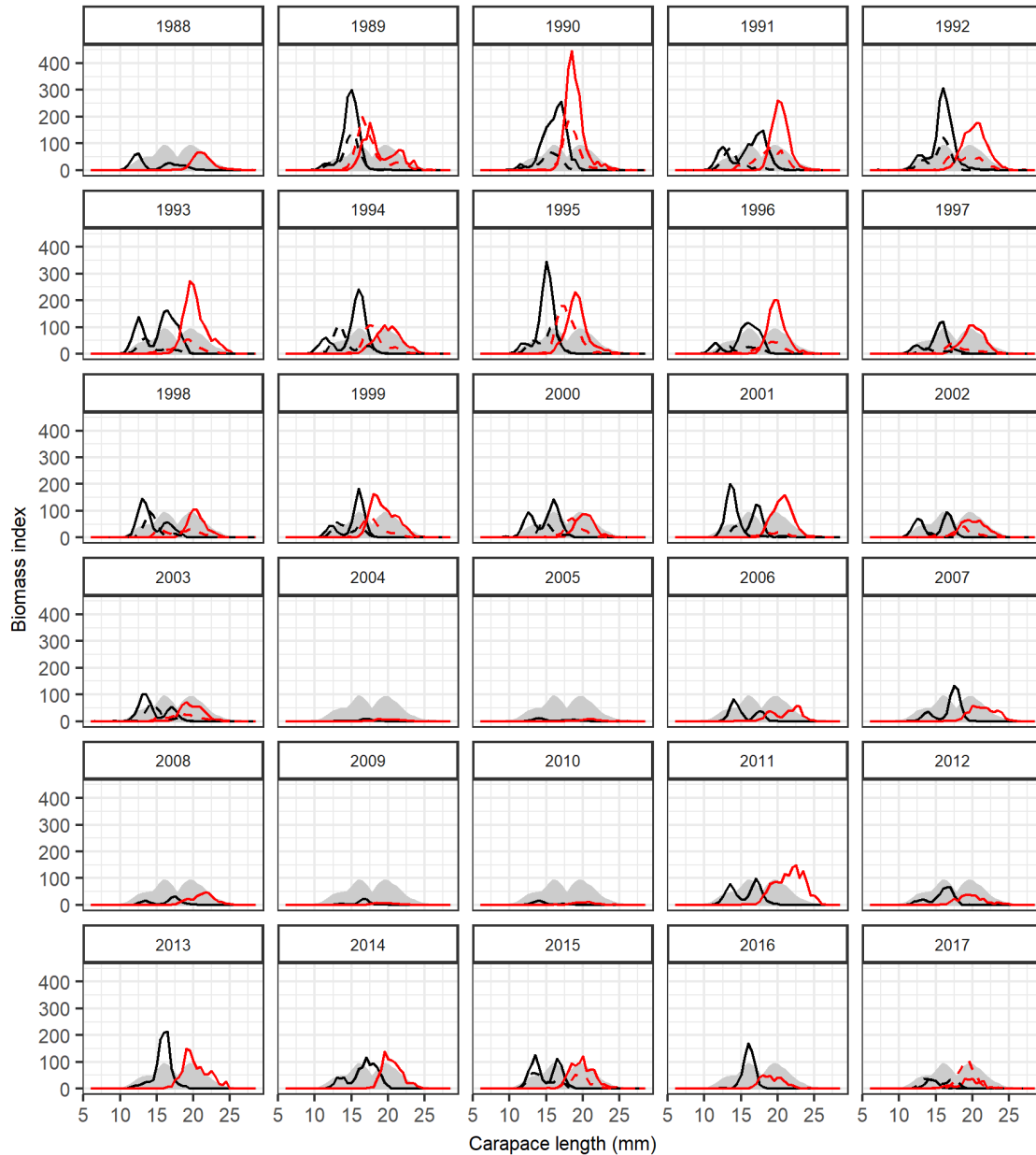


Figure 5. Length distribution of shrimp. The black line indicates males, and the red line females. The grey area is the mean length distribution of both sexes in autumn for the whole study period. Solid line is autumn survey and broken line is survey in February same winter.

*Mynd 5. Lengdardreifing rækju í stofnmælingu í Ísafjarðardjúpi 1988-2017. Svört lína sýnir karldýr, græn lína ókynproska kvendýr og sú rauða kynproska kvendýr. Gráa svæðið sýnir meðallengdardreifingu beggja kynja að hausti allt rannsóknatímabilið. Heil lína er úr haustmælingu en brotalína úr febrúarmælingu sama vetur.*

## ABUNDANCE OF COD AND HADDOCK

Abundance of cod fluctuated between 1994 and 2010. In 2011 it increased and was in general at higher levels compared with before 2011. However, in 2017 the cod abundance index was very low. The haddock abundance index increased steadily from 1994 to 2005 and has since then fluctuated at higher levels (Figure 6). The haddock index has been high in February since 2003.

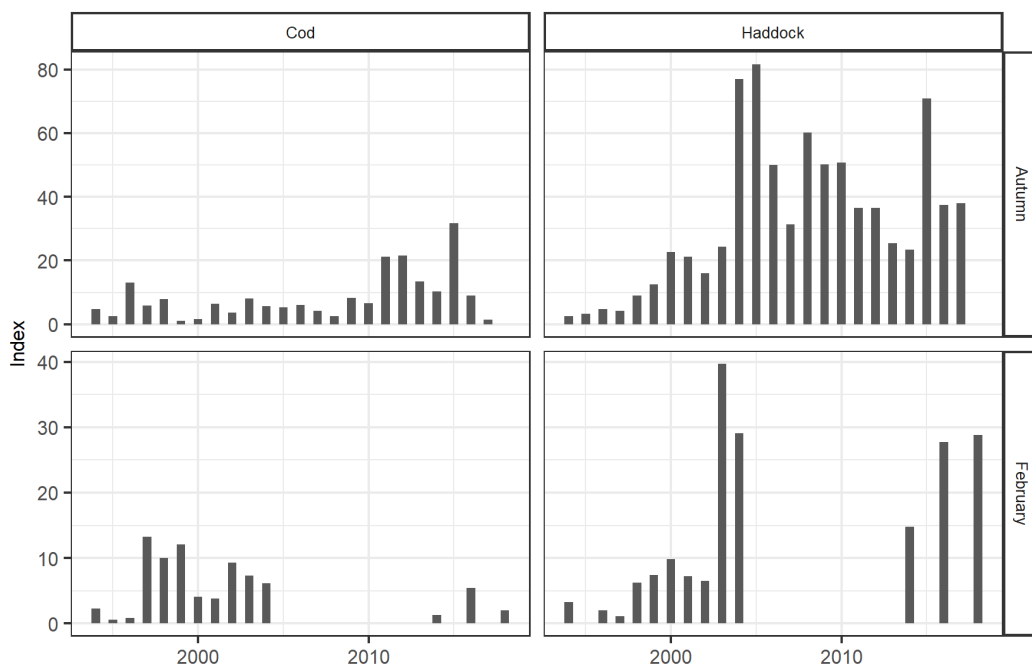


Figure 6. Abundance indices of cod and haddock in autumn and February.

*Mynd 6. Vísitala þorsks og ýsu í stofnmælingu rækju í Ísafjarðardjúpi að hausti og í febrúar.*

## BASIS FOR THE ADVICE

The Icelandic autumn shrimp survey is used as a biomass indicator. The target  $F_{\text{proxy}}$  (catch/survey biomass index) of 0.5 used as a multiplier on the autumn survey harvestable biomass is considered precautionary based on the historical relationship between catch and survey indices of inshore shrimp stocks.

The state of the stock is considered critical if the autumn fishable biomass index is below  $60_4$  (equivalent to a relative state of 0.2; the biomass index divided with the mean of the three highest indices). The biomass index value of  $60_4$  can therefore be considered a proxy for  $B_{\text{lim}}$  or an  $I_{\text{lim}}$ . If the fishable autumn biomass index is below  $60_4$ , zero catch is advised. If the fishable autumn biomass index is above  $I_{\text{lim}}$ , the advice is based on multiplying the most recent autumn fishable biomass index value with the target  $F_{\text{proxy}}$ .

In October 2017, the fishable biomass index was below  $60_4$ . Hence, MFRI advised zero catch for the quota year 2017/2018 in Ísafjarðardjúp. The relationship between the autumn survey and the sporadic February survey is confounded by various factors, namely in previous years considerable amount of shrimp was

caught between the surveys, seasonal aggregation of shrimp related to temperature and differences in the depth distribution where shrimp is found in the two surveys. The differences between the autumn and the February survey makes direct comparison of the results in terms of biomass estimates difficult. Based on precautionary considerations the target  $F_{proxy}$  used on the February survey is therefore lowered by 20% compared to the target used when giving advice based on the autumn survey. Considering the results in February 2018, where the fishable biomass index was above 604, MFRI has reevaluated the state of the stock and advices that catch in Ísafjarðardjúp should be no more than 320 tonnes in the quota year 2017/2018.

**Table 1.** Fishable biomass index (BI), state of the stock (relative to the mean of the three highest indices), advice, catch (tonnes in fishing year) and  $F_{\text{proxy}}$

*Tafla 1. Veiðistofnsvísitala, ástand stofns (vísitala miðað við meðaltal þriggja hæstu vísitölu gilda), ráðgjöf, afli og vísitala veiðihlutfalls ( $F_{\text{proxy}}$ )*

Quota Year	BI Autumn	Relative state	BI February	Rec. TAC	Catch	$F_{\text{proxy}}$
1988/1989	607	0.20	815			1.81
1989/1990	2169	0.70	1595			0.89
1990/1991	3636	1.17	1262	3000	3309	0.86
1991/1992	2377	0.76	882	2500	2554	1.07
1992/1993	2759	0.89	1094	2500	2501	0.91
1993/1994	2663	0.86	573	2500	2511	0.94
1994/1995	1885	0.61	927	2100	1955	1.04
1995/1996	2370	0.76	1569	2700	2756	1.16
1996/1997	1814	0.58	539	2300	2254	1.25
1997/1998	1249	0.40	338	1450	1435	1.15
1998/1999	988	0.32	591	1000	1025	1.04
1999/2000	1799	0.58	727	1800	1722	0.96
2000/2001	1153	0.37	618	1200	1287	1.11
2001/2002	1782	0.57	326	1500	1497	0.87
2002/2003	931	0.30	319	1000	989	1.07
2003/2004	819	0.26	479	0	0	-
2004/2005	94	0.03	-	0	0	-
2005/2006	100	0.03	-	0	3	-
2006/2007	680	0.22	-	0	3	-
2007/2008	1044	0.34	-	0	9	-
2008/2009	489	0.16	-	0	2	-
2009/2010	151	0.05	-	0	1	-
2010/2011	129	0.04	-	0	0	-
2011/2012	1823	0.59	-	1000	1040	0.57
2012/2013	663	0.21	1105	500	527	0.79
2013/2014	1858	0.59	590	1100	1128	0.61
2014/2015	1532	0.48	-	750	801	0.52
2015/2016	1365	0.42	732	700	767	0.56
2016/2017	967	0.31	-	484	491	0.51
2017/2018	404	0.13	806	320		