

ICELAND SCALLOP

Chlamys islandica

INTRODUCTION

Iceland scallop (*Chlamys islandica*) has been fished in several fjords and bays around Iceland since 1969, when the fisheries started in Ísafjarðardjúp with catch of 400 tonnes. In the following year, a fishery started in Breiðafjörður which has been the major fishing area ever since. From 1970 until the closure of the fisheries in 2003, a total of 254 thousand metric tonnes were landed from that area. Landings from other areas have been much lower with 18 and 14 thousand tonnes from Húnaflói and Ísafjarðardjúp, respectively. This report will focus only on the stock in Breiðafjörður, as no commercial fishing has taken place in other areas since 2002, apart from roughly 10 tonnes of diver-caught scallops in Ísafjarðardjúp during past four years.

The decline of the stock in Breiðafjörður in 1999-2003, which led to the closure of the fishery, is believed to be caused by several factors (Jonasson et al. 2007). The fishable stock consisted of few year classes and recruitment was scarce. High natural mortality caused by protozoan parasites (gray meat) was evident on all grounds, with annual mortality ratio as high as ~40% in the main fishing ground in the southern part of the fjord. The intensity of the mortality increased with scallop size and was most pronounced in the fishable part of the stock (>60 mm shell height). Total fishing mortality was also high and in combination with the above factors led to a collapse of the stock. In recent years infection levels have been low and muscle condition good.

COMMERCIAL FISHING

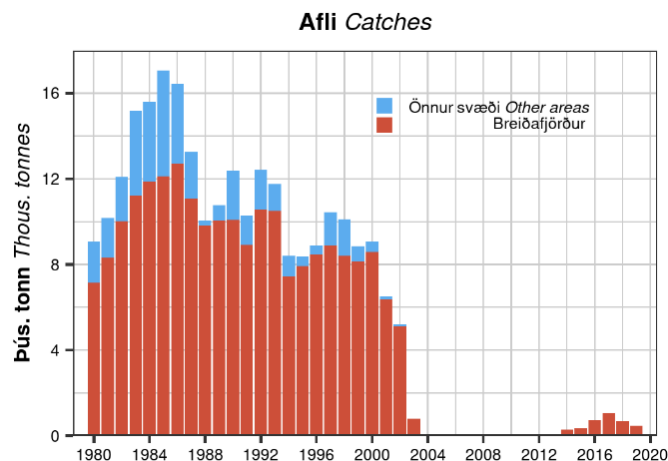


Figure 1. Iceland scallop. Total catch of Iceland scallop in Iceland and within Breiðafjörður.

No fishery for Iceland scallop has been conducted in Breiðafjörður since 2003, except for an experimental fishery during 2014-2019 and minor fishing during ongoing fishing year (2020/21). There were no landings in Breiðafjörður in 2020, but 2.3 tonnes were landed of diver caught scallop from Ísafjarðardjúp.

SURVEY

A drop frame camera survey has been conducted on scallop grounds in Breiðafjörður since 2014. Several tows with dredge are also carried out to get information on shell height and biological samples. Ten camera “drops” are completed on each station and the general rule is to count every other drop or five drops in total. In the camera survey all animals are counted, and the area of the image is known. Scallops have been measured from images since 2018. It could be expected to see higher percentage of small scallops in images than from the dredge due to gear selection. When calculating the ratio of undersized or small scallops, scallops less than 25 mm are excluded. Those small scallops tend to be cryptic and difficult to see when counting from images. Biomass is estimated from the mean number of scallops above 60 mm, based on size distribution from dredges and SH/weight relationship multiplied with the estimated size of fishable grounds.

In April 2014, a pilot camera survey focused mainly on the Breiðasund area (Figure 2) in the southern part of the fjord, where experimental fishing had been planned. There were also stations on conventional fishing grounds in the southern part of the fjord. New and grounds that were not covered with the older dredge survey were also surveyed. Those were in Hvammsfjörður, south of Skálmarnes, west of Látralönd and around Sauðeyjar in northwestern part of the fjord. Large numbers of scallops were found on many of the “new” grounds. Another survey was conducted in December 2014 and covered the area that was fished in the experimental fishing in Breiðasund. During the autumn of 2015–2019, camera surveys were carried out annually on most of the experimental fishing areas. Results from the experimental areas fished in 2019, Breiðasund, Hvammsfjörður, Bjarneyjar, Rúfeyjar and Flatey are presented.

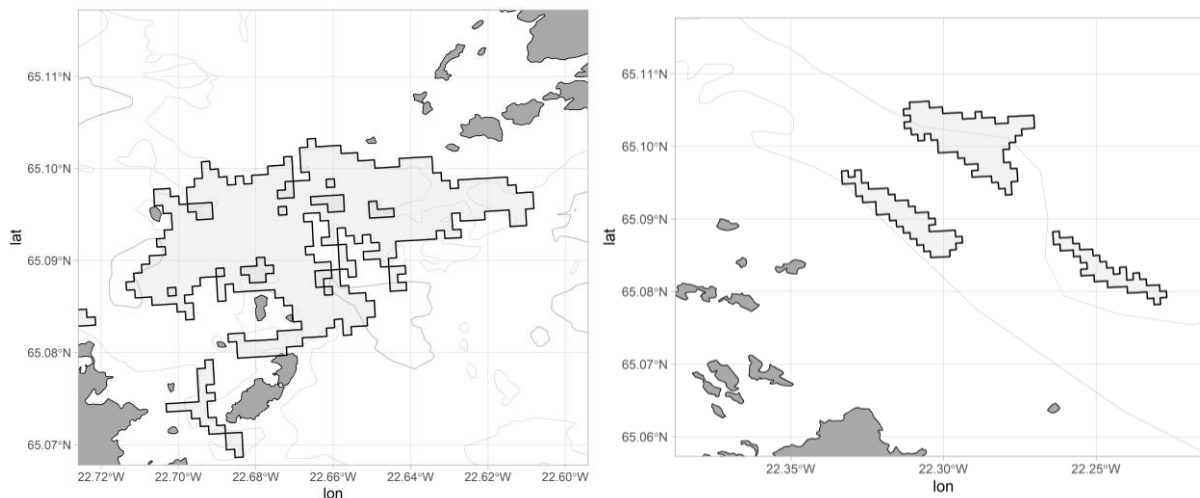


Figure 2. Iceland scallop. Fishing areas in southern part of Breiðafjörður, Breiðasund (left) and Hvammsfjörður (right).

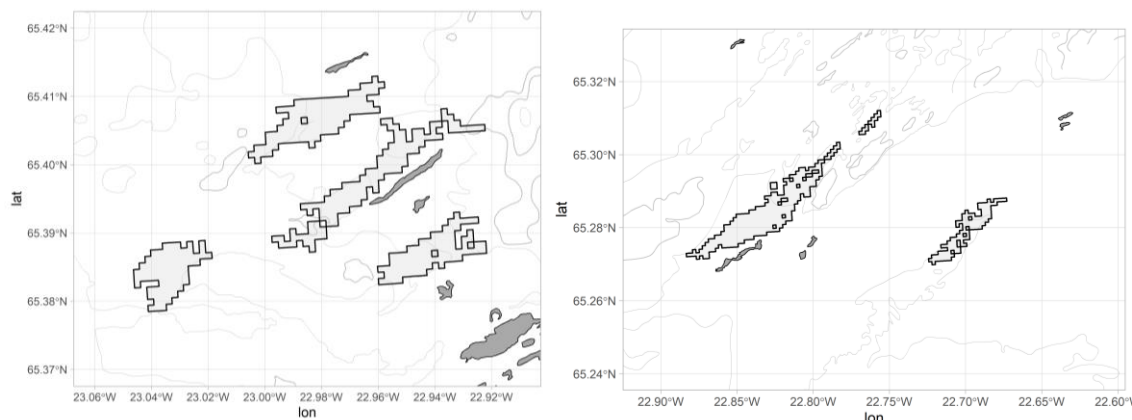


Figure 3. Iceland scallop. Fishing areas in northern part of Breiðafjörður, Flatey region (left) and Bjarneyjar (Western part on image) - Rúfeyjar (Eastern part on image) areas (right).

Within in Breiðasund in southern Breiðafjörður, fishing activity was mainly in western and middle part on conventional grounds (Figure 2). The estimated size of fishing grounds, based on VMS data, was the largest of all areas or 5.64 km² (Table 1). The highest abundance of scallop was seen in April of 2014, 8.86 scallops m² within the fished ground and biomass of 3000 tonnes (Table 1). The average number of scallops dropped considerable after fishing of 280 tonnes during the autumn of 2014, or to 6.24 scallops m². The ground was surveyed again during 2017-2019, and estimated scallop abundance fluctuated between 5.31–6.64 scallops m²(Table 1). Highest mean shell height was in April 2014, 76.1 mm, with peak in old scallops around 80 mm and another peak of 2-3-year old scallops of 15-25 mm (Table 1 and figure 4). A proportion of those young scallops had entered the fishable the stock (+60 mm) during the autumn of 2016. With increasing recruitment, the average shell height decreased in 2017 and 2018. Highest ratio of small scallops was 11.9% in 2018. Both during 2018 and especially in 2019, considerable higher abundance of small scallops was seen with the camera then found in the dredge samples (Figure 4).

Table 1. Iceland scallop. Breiðasund. Number of scallops per m² with standard error, mean shell height (mm) in dredges, ratio of scallops above 60 mm, catch in the area and harvest ratio. The size of fishable area in Breiðasund was estimated 5,64 km².

Year	Mean N	Mean SH	Ratio < 60mm	Biomass	Catch	HR
2014 April	8.86 (±1.01)	76.1	3.8%	3000	281	9,0%
2014 Nov.	6.24 (±0.76)			2112		
2015	-				116	
2016	-				42	
2017	5.76 (±1.28)	71.1	6.4%	1591	143	9,0%
2018	6.64 (±1.48)	70.0	11.9%	1745	97	5,6%
2019	5.31 (±0.78)	71.5	7.8%	1468	101	6,9%

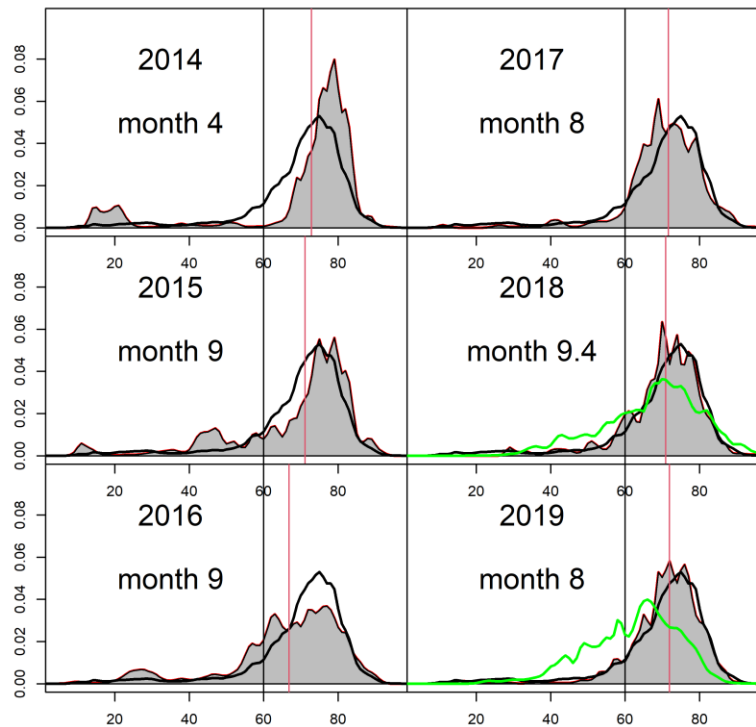


Figure 4. Iceland scallop. Relative size frequency distribution (%) of scallops from experimental fishing area in Breiðasund (east of Stykkishólmur) during 2014–2019 (month sampled indicated). Grey filled area is the distribution of individual year and the black line is the mean of the period. Black vertical line is set at 60 mm which is the minimal landing size and red vertical line is the mean length of each year. Green lines for years 2018 and 2019 are length frequency distributions derived from images within fished grounds in Breiðasund.

Within Hvammsfjörður in southeastern Breiðafjörður, fishing activity was on three subareas, two on the northern slope of the fjord and one on the southern slope (Figure 2). The estimated size of fishing grounds, based on VMS data, was 2.34 km² (Table 2). The highest amount of scallop was seen in 2017, 13.32 scallops m² within the fished grounds and biomass of 1341 tonnes. The average number of scallops fluctuated considerable in the area, it declined to 5.07 scallops in 2018 but increased to 7.22 scallops m² in 2019. Lowest mean shell height was in 2014, 67.1 mm, with a single peak of old scallops at 70 mm, but several younger year-classes (Figure 5). There was high ratio of small scallops (16.3%) a peak of two year's old scallop around 15 mm and one prominent peak around 50 mm.

A proportion of those young scallop had entered the fishable the stock (+60 mm) during the autumn of 2017. Average shell heights increased and was 71.2 mm in 2019, but there was also lower ratio of small scallops in the dredge samples (Table 2). Shell height estimated from images revealed higher abundance of scallops slightly smaller than 60 mm in 2018 and proportionally higher abundance of scallops slightly higher than 60 mm in 2019 (Figure 5).

Table 2 Iceland scallop. Hvammsfjörður. Number of scallops per m² with standard error, mean shell height (mm) in dredges, ratio of scallops above 60 mm, catch in the area and harvest ratio. The size of fishable area in Hvammsfjörður was estimated 2,34 km².

Year	Mean N	Mean SH	Ratio < 60mm	Biomass	Catch	HR
2014	10.49 (±3.17)	67.1	16.3%	990		
2015	-	-	-		116	10.7%
2016	-	-	-		85	
2017	13.32 (±3.24)	68.6	14.3%	1341	104	7,8%
2018	5.07 (±1.02)	68.4	9.1%	504	89	17,7%
2019	7.22 (±2.50)	71.2	3.6%	822	49	6,0%

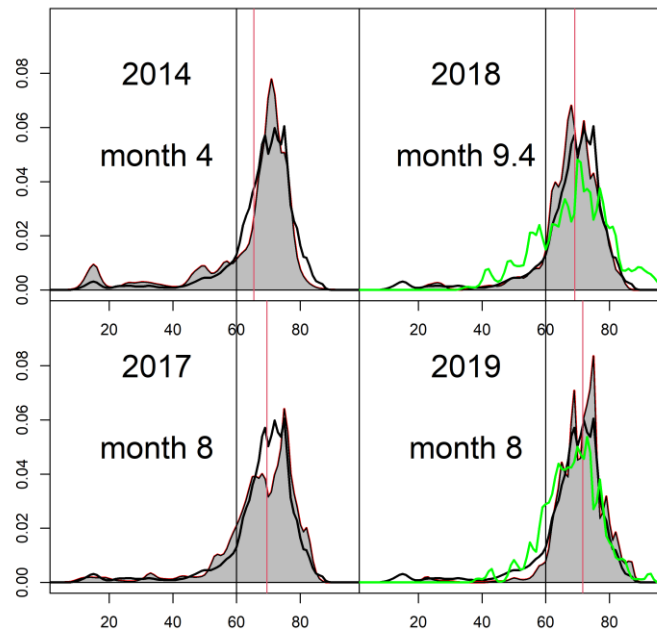


Figure 5. Iceland scallop. Relative size frequency distribution (%) of scallops from experimental fishing area in Hvammsfjörður during 2014–2019 (month sampled indicated). Grey filled area is the distribution of individual year and the black line is the mean of the period. Black vertical line is set at 60 mm which is the minimal landing size and red vertical line is the mean length of each year. Green lines for years 2018 and 2019 are length frequency distributions derived from images within fished grounds in Breiðasund.

In Flatey region in northern Breiðafjörður, fishing activity was recorded on four major subareas (Figure 3). The estimated size of fishing grounds, based on VMS data, was 3.83 km² (Table 3). There was a continuous decline in scallop abundance from 14.62 scallops m² in 2016 to 4.5 scallops m² in 2019 (Table 3). There was a continuous increase in shell height from 2013–2019, with average shell height in 2019, 78.1 mm (Figure 6). That is also reflected in the ratio of small scallop that has decreased from 7.3% to 2.1% between 2016–2019 (Table 3). Shell height estimated from images revealed slightly higher abundance of scallops slightly smaller than 60 mm and between 60 and 65 mm in 2019 (Figure 6).

Table 3. Iceland scallop. Flatey. Number of scallops per m² with standard error, mean shell height (mm) in dredges, ratio of scallops above 60 mm, catch in the area and harvest ratio. The size of fishable area in Flatey was estimated 3.83 km².

Year	Mean N	Mean SH	Ratio < 60mm	Biomass	Catch	HR
2016	14.62 (±2.1)	75.5	7.3%	3349	260	7.8%
2017	9.31 (±1.6)	76.7	2.6%	2216	272	12.3%
2018	6.64 (±0.6)	76.4	5.0%	1453	204	14.0%
2019	5.31 (±0.5)	78.1	2.1%	1134	103	9.1%

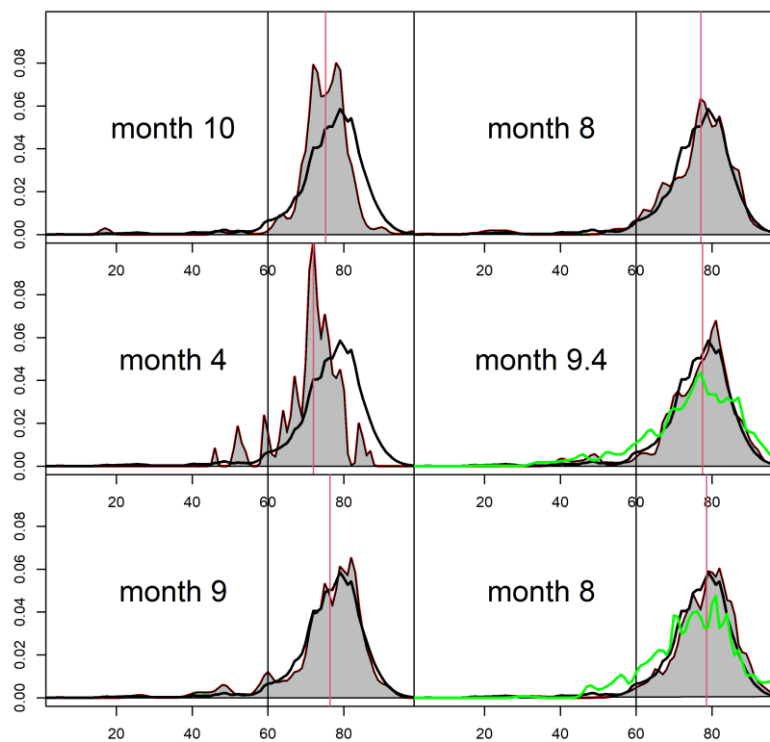


Figure 6. Iceland scallop. Relative size frequency distribution (%) of scallops from experimental fishing area in Flatey area during 2013–2019 (month sampled indicated). Grey filled area is the distribution of individual year and the black line is the mean of the period. Black vertical line is set at 60 mm which is the minimal landing size and red vertical line is the mean length of each year. Green lines for years 2018 and 2019 are length frequency distributions derived from images within fished grounds in Breiðasund.

In Bjarneyjar region in northern Breiðafjörður, fishing activity was mainly recorded on one large area, that stretched to couple of smaller area to the northeast (Figure 3). The estimated size of fishing grounds, based on VMS data, was 3.26 km² (Table 4). There was a continuous decline in scallop abundance on fishing ground from 15.02 scallops m² in 2016 to 5.84 scallops m² in 2019 (Table 4). There were little changes in mean shell height from 2016-2019, with average shell height around 78 mm (Figure 7). That is also reflected in low ratio (1-2%) of small scallops in the area (Table 4). Shell height estimated from images revealed slightly higher abundance of scallops between 50-70 mm for both 2018 and 2019 (Figure 7).

Table 4. Iceland scallop. Bjarneyjar. Number of scallops per m² with standard error, mean shell height (mm) in dredges, ratio of scallops above 60 mm, catch in the area and harvest ratio. The size of fishable area in Bjarneyjar was estimated 3,26 km².

Year	Mean N	Mean SH	Ratio < 60mm	Biomass	Catch	HR
2016	15.02 (±2.8)	77.4	1.4%	3090	-	-
2017	-	-	-	-	198	6,4%
2018	8.64 (±1.19)	78.6	2.4%	1875	208	11,1%
2019	5.84 (±0.54)	78.1	1.7%	1242	121	9,7%

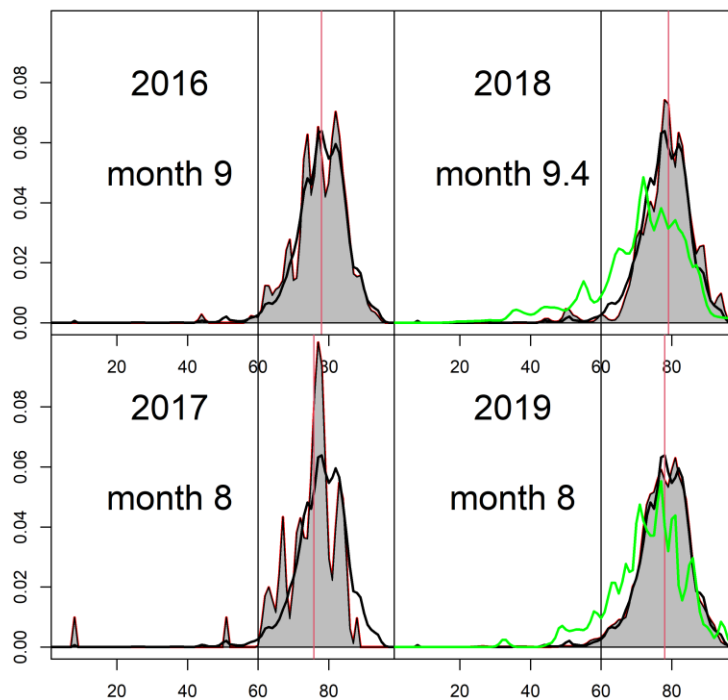


Figure 7. Iceland scallop. Relative size frequency distribution (%) of scallops from experimental fishing area in Bjarneyjar during 2016–2019 (month sampled indicated). Grey filled area is the distribution of individual year and the black line is the mean of the period. Black vertical line is set at 60 mm which is the minimal landing size and red vertical line is the mean length of each year. Green lines for years 2018 and 2019 are length frequency distributions derived from images within fished grounds.

In Rúfeyjar region in northern Breiðafjörður, fishing activity was recorded on one relatively thin strip (Figure 3). The estimated size of fishing grounds, based on VMS data, was 1.05 km² (Table 5). There was a continuous decline in scallop abundance from 18.24 scallops m² in 2017 to 5.75 scallops m² in 2019 (Table 5). There were little changes in mean shell height from 2017 – 2019, with average shell height around 77 mm (Table 5). The ratio of small scallop was low in Rúfeyjar region (~1%, Table 5).

Table 5. Iceland scallop. Rúfeyjar. Number of scallops per m² with standard error, mean shell height (mm) in dredges, ratio of scallops above 60 mm, catch in the area and harvest ratio. The size of fishable area in Rúfeyjar was estimated 1,05 km².

Year	Mean N	Mean SH	Ratio < 60mm	Biomass	Catch	HR
2017	18.24 (±4.4)	75.4	1.0%	1114	-	-
2018	12.94 (±2.3)	77.1	0.4%	850	78	9,2%
2019	5.75 (±0.95)	77.2	1.0%	378	78	20,6%

MANAGEMENT

Throughout the period 1993–2000, the total allowable catch (TAC) in Breiðafjörður was relatively stable at about 8000–8500 tonnes (Table 6). At that time, the recommended annual TAC was 10% of the total estimated biomass from dredge surveys; since 1994, the national TAC and the landings have been in accord with the recommendations. Between 2003 and 2013 the MRI advised that no fishery should be conducted on scallop grounds in Breiðafjörður. In 2014 the advice was no fishery on conventional grounds, but small-scale fishing experiments were allowed in areas outside the limits of the dredge survey. The same advice has been given in 2015–2019 and fishing trials continued, mainly on new grounds, but later also on traditional grounds where scallops are found in fishable quantities.

In the experimental fishery, harvest rates in areas in the southern part of Breiðafjörður (Breiðasund and Hvammsfjörður) was rather stable at 6–9%. Recruitment of those substocks has been around average during the experimental period. In the region in northern part of Breiðafjörður, recruitment has been much less pronounced. Abundance and biomass estimates have fallen rather sharply at harvest rate between 6–11% in Bjarneyjar, 8–14% in Flatey and 9–20% in Rúfeyjar. The stocks in northern areas can be considered recruitment impaired and withstand little or no fishing. Therefore, it was only proposed to allow fishing in the southern areas, Breiðasund and Hvammsfjörður in 2020 and again in 2021.

The stock of Iceland scallop in Breiðafjörður are considered to be a data limited stocks and it is proposed to follow the ICES framework for such stocks (category 3.2) i.e. where survey-based assessments indicate trends the advice is based on the ratio of the mean of the last two biomass indices (Index A) and the mean of the three preceding values (Index B), multiplied by the latest advice (ICES, 2012). That method was applied for Breiðasund and Hvammsfjörður where catch history and survey time series stretch more than 5 years. If the index ratio is estimated to be above 1.2 or below 0.8 an uncertainty cap is applied. The advice for each area is given in the advice sheet but summary table for previous years is found below.

Table 6. Iceland scallop. Recommended TAC of scallop within Breiðafjörður, recommended TAC in Iceland, TAC in Breiðafjörður, catch in Breiðafjörður and catch in Iceland. Since 1992 the TAC was for following quota year. *Experimental fishery.

Year	Rec. Breiðafj. TAC	Rec. N. TAC	TAC Breiðafj.	Catch Breiðafj.	Catch Total
1980	-			7100	9100
1981	-			8300	10200
1982	-			10000	12100
1983	-			11200	15200
1984	11000	14100	11000	11900	15600
1985	11000	15400	12000	12100	17100
1986	10000	14200	12000	12700	16400
1987	11000	14500	11000	11000	13300
1988	10000	13500	10000	9800	10100
1989	9000	12500	10000	10100	10800
1990	10000	13500	10000	10100	12400
1991	9000	12500	9000	8900	10300
1992	8500	11200	8500	10600	12400
1992/93	8500	11500	8500	10300	11600
1993/94	8000	10100	9800	8000	9400
1994/95	8500	10200	8200	8800	9400
1995/96	8000	9500	8000	7400	8000
1996/97	8000	9300	8000	8400	9200
1997/98	8000	9300	8000	8900	10600
1998/99	8500	9800	8500	8100	9100
1999/00	8500	9800	8500	8700	9200
2000/01	8000	9300	8000	7900	8200
2001/02	6500	6750	6500	6400	6600
2002/03	4000	4150	4000	4435	4505
2003/04	0	0	0	0	0
2004/05	0	0	0	0	0
2005/06	0	0	0	0	0
2006/07	0	0	0	0	0
2007/08	0	0	0	0	0
2008/09	0	0	0	0	0
2009/10	0	0	0	0	0
2010/11	0	0	0	0	0
2011/12	0	0	0	0	0
2012/13	0	0	0	0	0
2013/14	0	0	0	15	15
2014/15	*	-	-	266	266
2015/16	*	-	-	635	635
2016/17	*	-	-	590	590
2017/18	*	-	-	942	944
2018/19	*	-	-	694	697
2019/20	*	-	-	451	454
2020/21	93				

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Jonasson, J.P., Thorarinsdottir, G., Eiriksson, H., Solmundsson, J., Marteinsdottir, G., 2007. Collapse of the fishery for Iceland scallop (*Chlamys islandica*) in Breidafjordur, West Iceland. ICES J. Mar. Sci. 64, 298-308.