

SHRIMP IN ÍSAFJARÐARDJÚP – *Pandalus borealis*

THE FISHERY

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 between 300 and 1100 tonnes (Figure 1). CPUE increased slowly between 1978 and 2003. However, since 2011 CPUE has been higher compared with the years before the closure, mainly due to increased density of shrimp within the innermost part of the fjord.

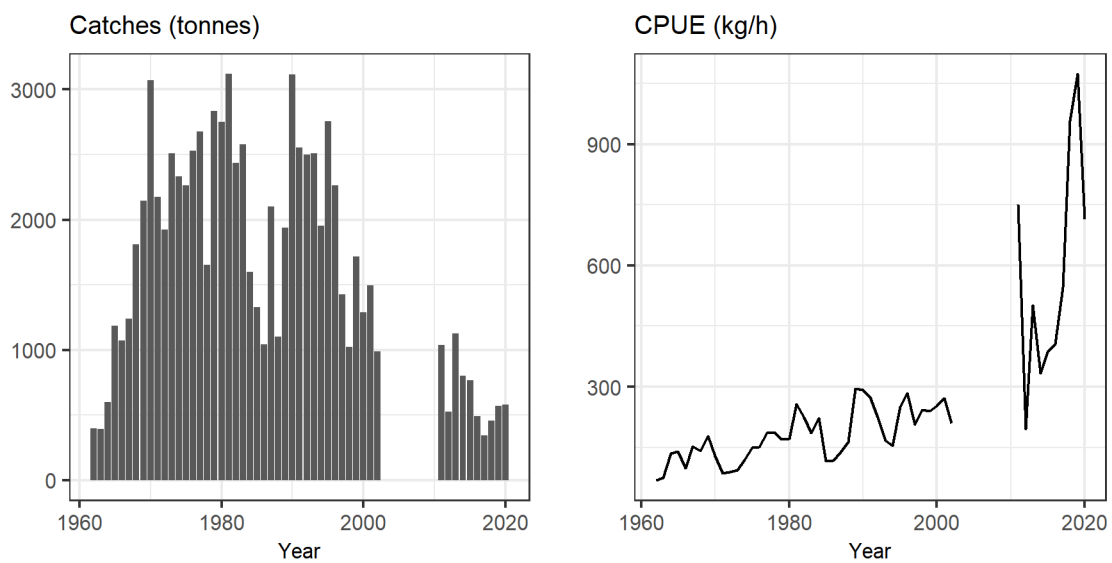


Figure 1. Shrimp in Ísafjarðardjúp. Total catch and catch per unit effort.

The distribution of the fishery has varied over time (Figure 2). From 2012-2017, there have been two main fishing areas; at the innermost part of the fjord and the outermost part. Since 2016, most of the catch has been caught at the innermost part of the fjord.

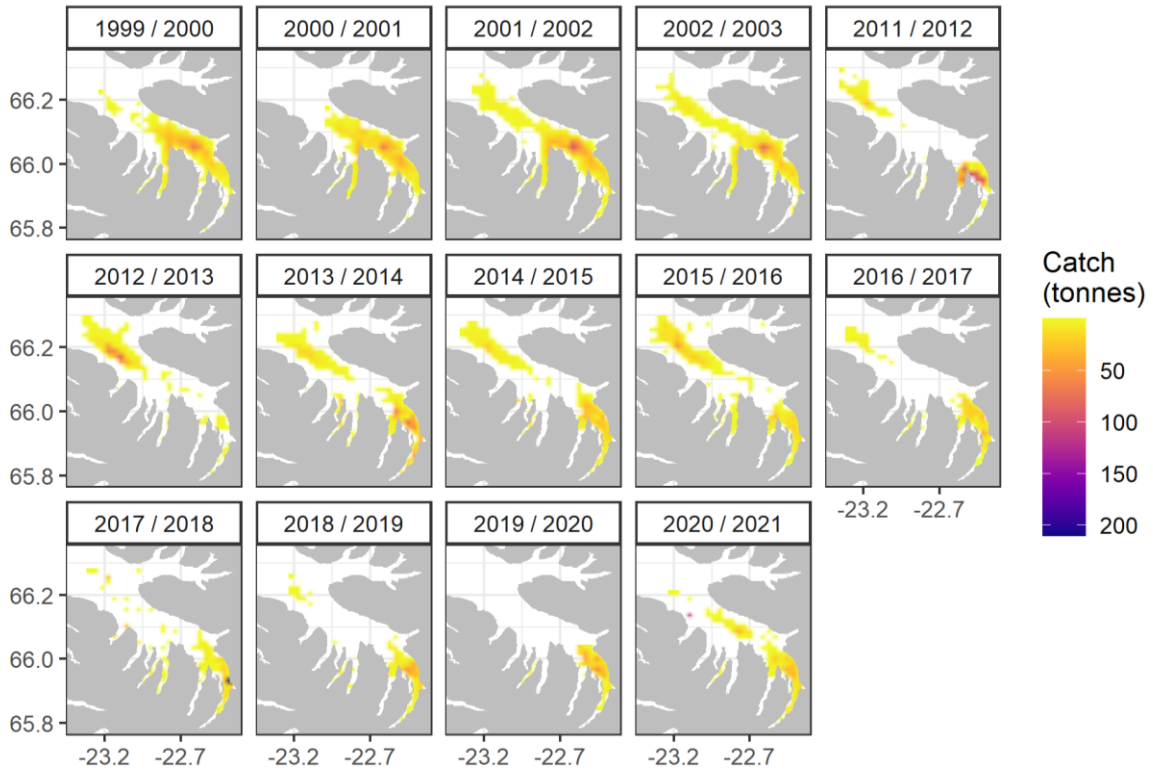


Figure 2. Shrimp in Ísafjarðardjúp. Distribution of shrimp catch. No fishing was conducted from 2003/2004 – 2010/2011.

The shrimp fishery started in October 2020 after the annual shrimp survey. The fishery was limited in the autumn but increased in February and lasted until August (Figure 3).

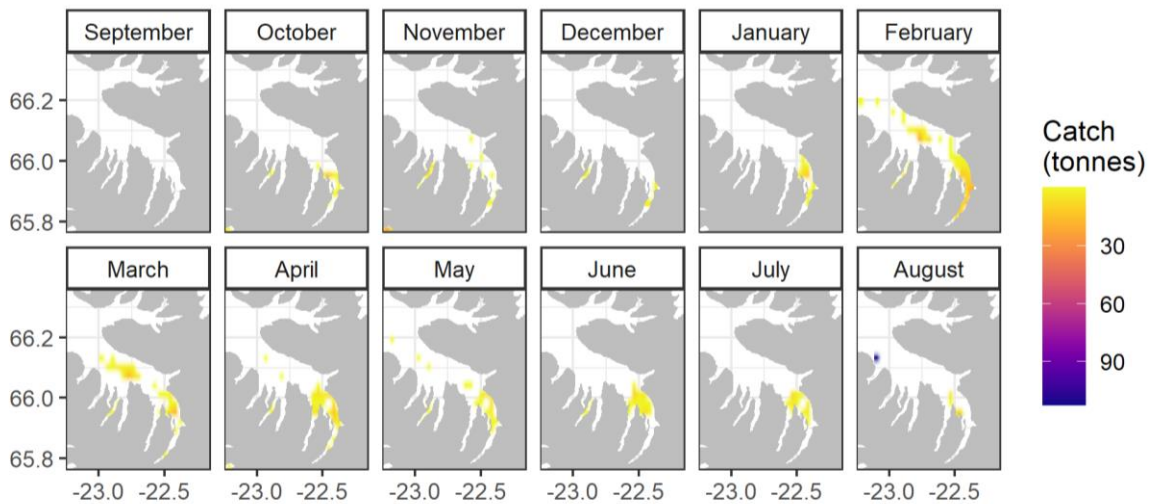


Figure 3. Shrimp in Ísafjarðardjúp. Distribution of shrimp catch by month in 2020/21.

SURVEY DATA

The annual Icelandic shrimp survey has been conducted in the autumn since 1988 in Ísafjarðardjúp. The 2022 survey was conducted on 24 - 30 September 2022 and included 28 fixed and 12 random stations at depths of 35-129 m. Information on sampling procedure can be found in the manual 'Handbók um stofnmælingu rækju 2022' (Jónsdóttir 2022).

From 1988, shrimp was found within the inner part of the fjord as well as in Jökulfirðir. Following the decrease in the biomass index, the distributional area of shrimp decreased (Figure 4). 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. In 2022, shrimp density was highest in the inner part of Ísafjarðardjúp.

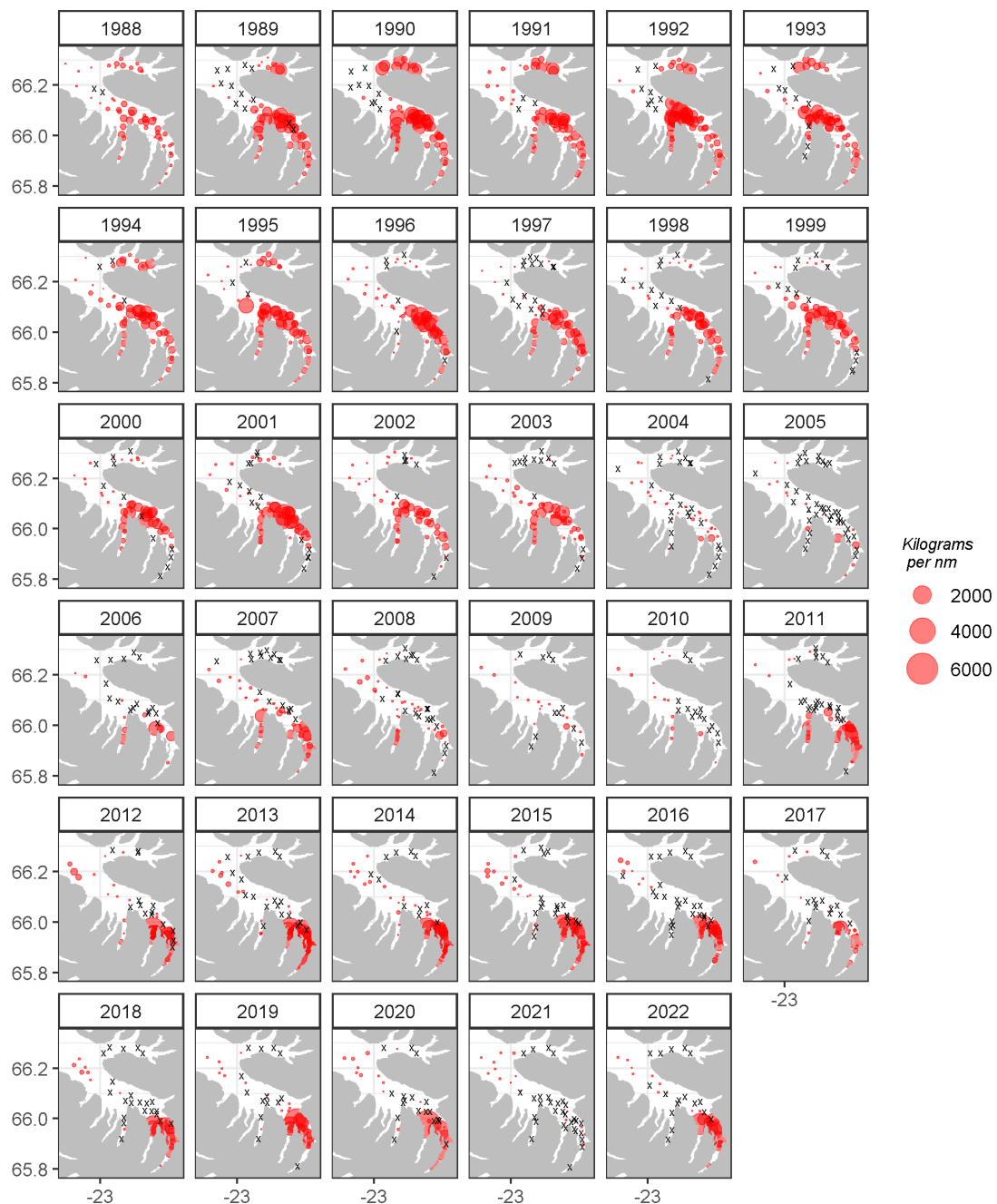


Figure 4. Shrimp in Ísafjarðardjúp. Distribution and abundance of shrimp in the annual shrimp survey. X denotes stations where no northern shrimp was found.

INDICES

Four indices are used to assess the state of the 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 index includes 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.

All the indices, except the juvenile index, gradually decreased from 1990 to 2004 when they were at historically low levels (Figure 5). In 2011, the indices increased and fluctuated for three years. Since 2013 the indices have decreased but have been relatively stable from 2018 to 2022, with the exception of 2021, and 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 three highest indices (I_{lim}) is used as a proxy for B_{lim} .

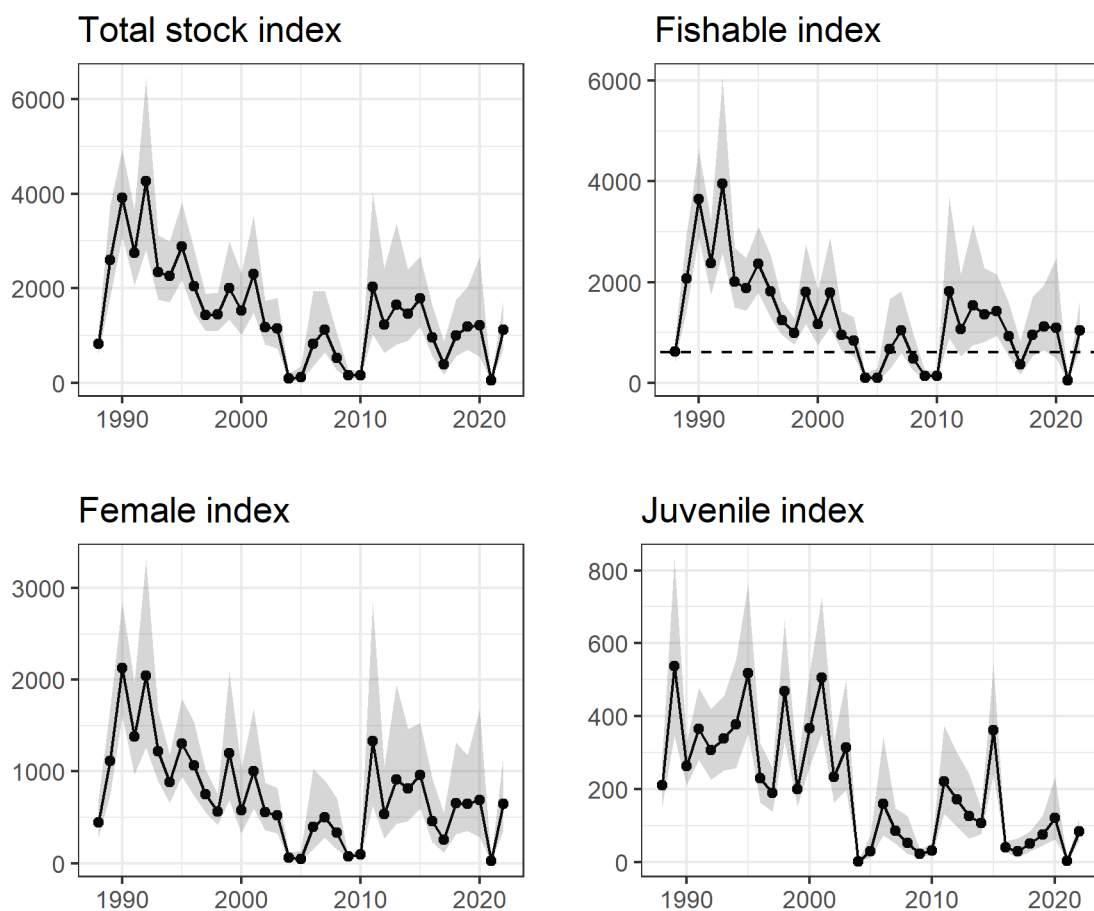


Figure 5. Shrimp in Ísafjarðardjúp. Stock biomass index, fishable biomass index, female biomass index and juvenile biomass index of shrimp. The horizontal line indicates a value where the state of the stock is considered to be critical (20% of the mean of the three highest indices).

LENGTH DISTRIBUTION

In 2022, the male length distribution was below average but younger females were around average (Figure 6). However, few older females were observed.

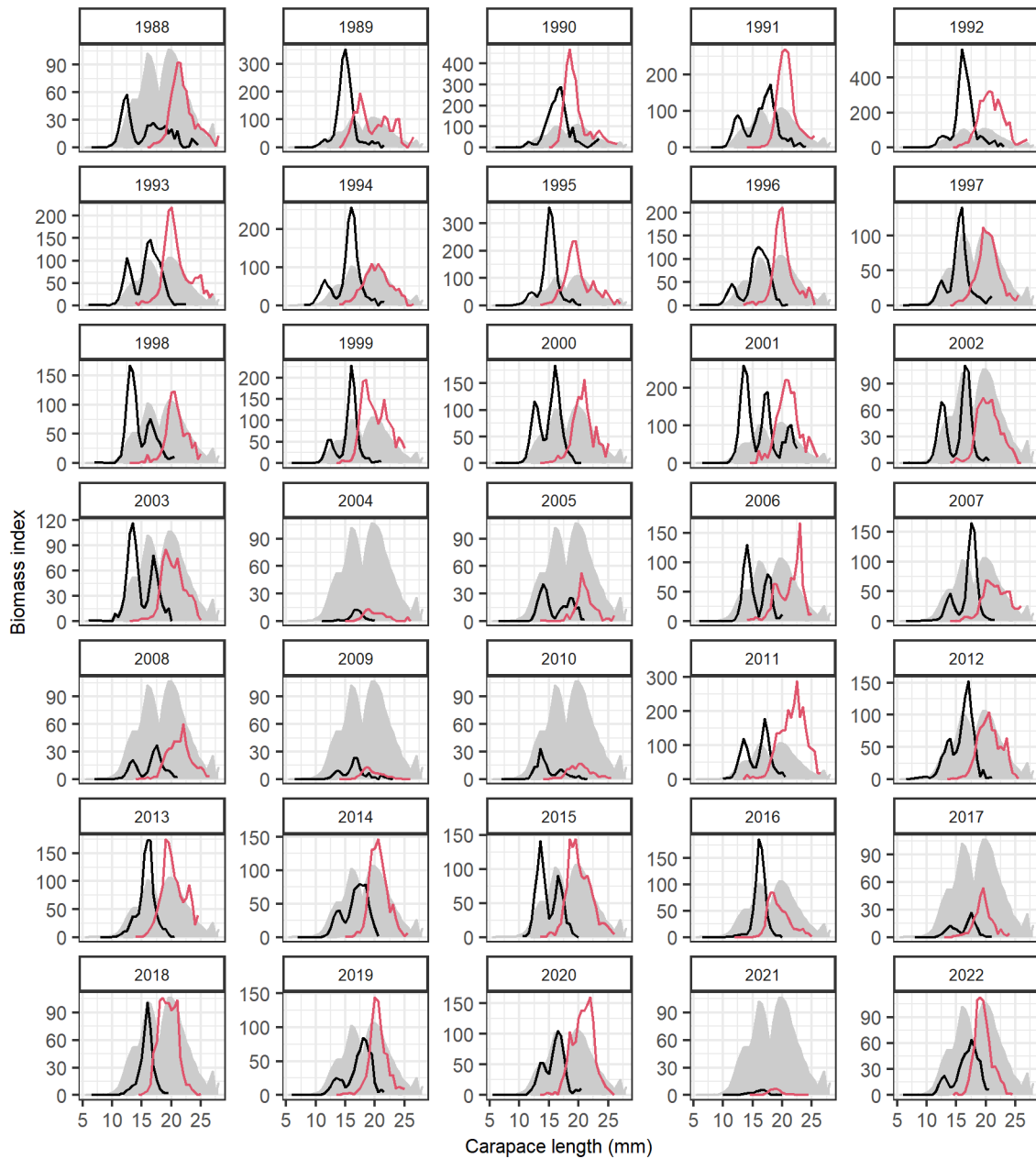


Figure 6. Shrimp in Ísafjarðardjúp. Length distribution. The black line indicates males and the red line females. The grey area is the mean length distribution of both sexes for the whole study period. Note different scales on y-axes.

ABUNDANCE OF COD AND HADDOCK

0-group cod and haddock indices have fluctuated throughout the study period. The number of 0-group cod and haddock was below average in 2022 (Figure 7). Cod abundance fluctuated between 1994 and 2010. In 2011 it increased and was in general at higher levels compared with before 2011. Cod abundance was low in 2022. Haddock abundance index increased steadily in 1995-2005 and has since then fluctuated at higher levels (Figure 7). In 2020-2021, haddock abundance was the highest observed in the study period but decreased in 2022.

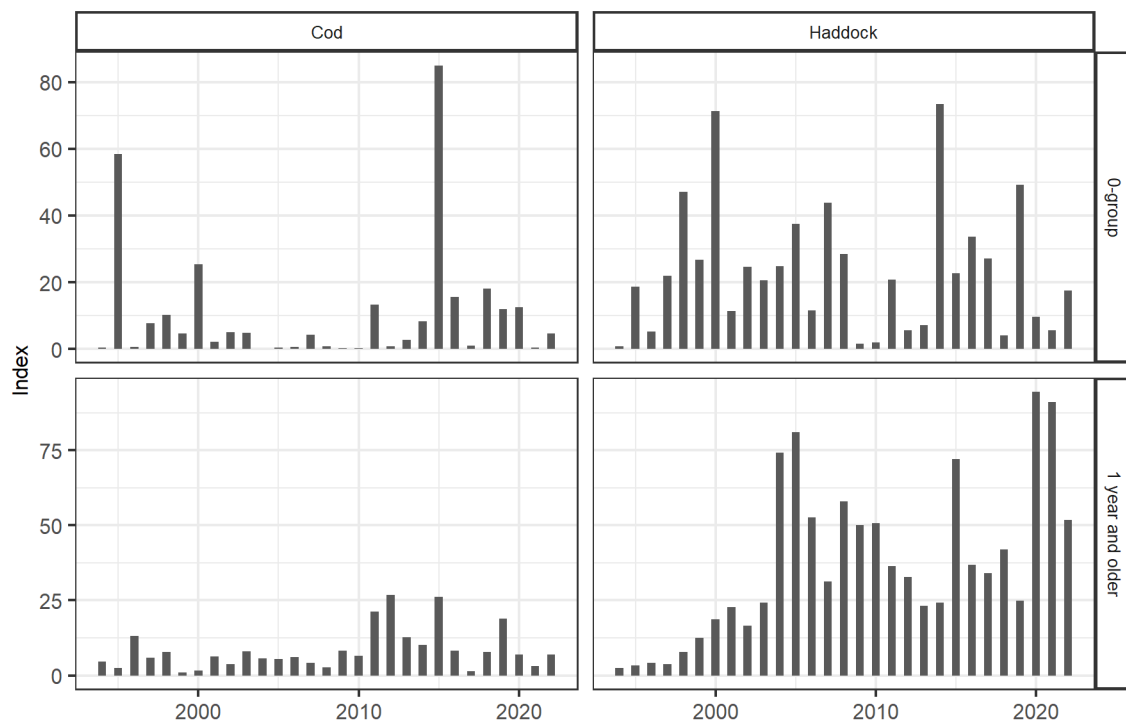


Figure 7. Cod and haddock in Ísafjarðardjúp. Abundance indices of cod and haddock in the annual shrimp survey.

Distribution of haddock has increased following higher haddock biomass in Ísafjarðardjúp (Figure 8). In 1988-2000 haddock was mainly found at the outer part of the fjord, but since 2003 the distributional area has increased, and it has been found in the whole fjord.

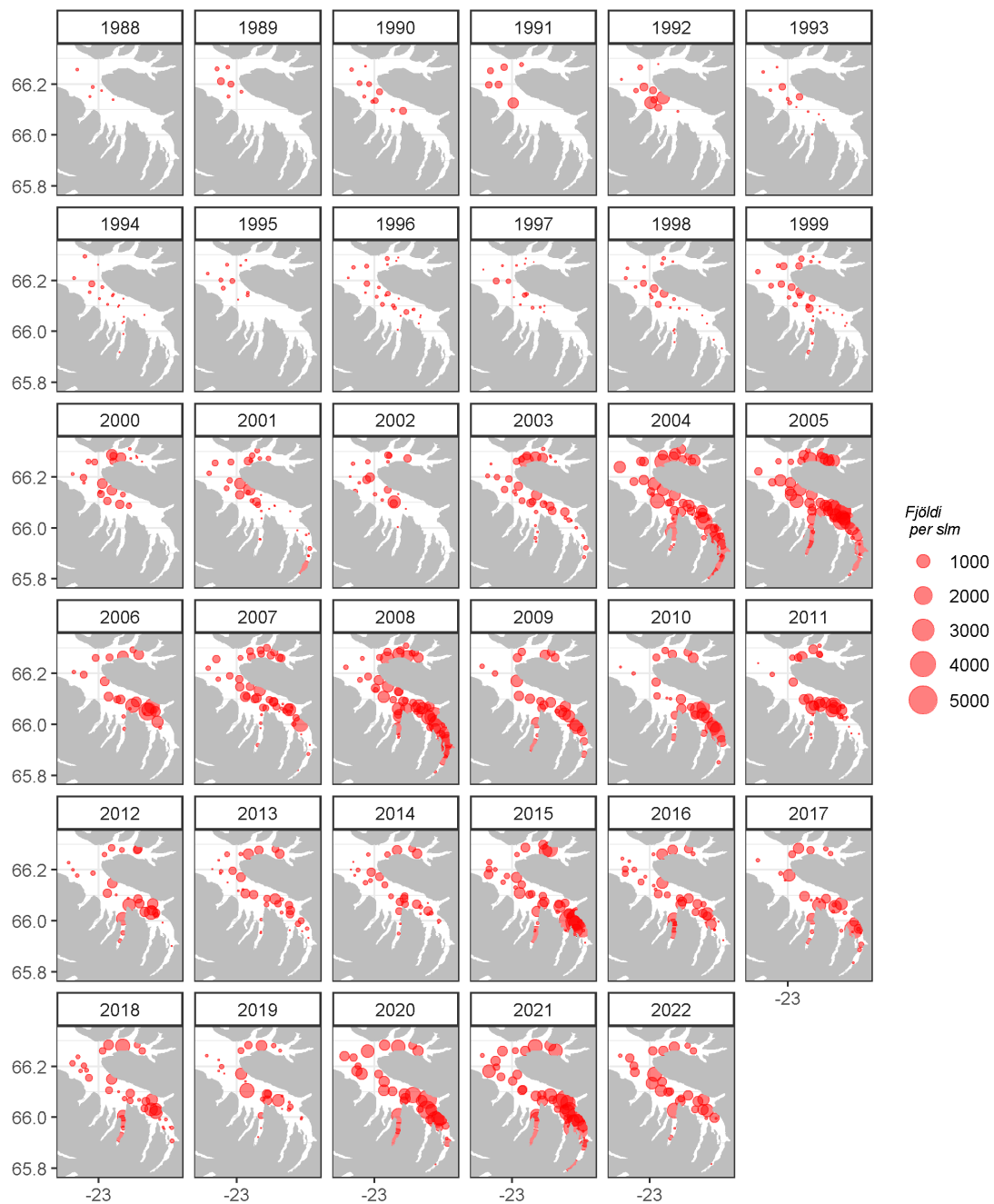


Figure 8. Haddock in Ísafjarðardjúp. Distribution of haddock in the annual shrimp survey.

MANAGEMENT

The Ministry of Food, Aquaculture and Fisheries is responsible for management of all marine fisheries in Iceland and implementation of legislation. The quota year has been from early winter (following the survey in October) until 30 April but was in 2017 changed to 31 August.

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

Year	Biomass index	Relative state	Rec. TAC	National TAC	Catch	F_{proxy}
<i>1988/89</i>	621	0.19			1100	1.77
<i>1989/90</i>	2065	0.62			1938	0.94
<i>1990/91</i>	3651	1.10	3000	3000	3114	0.85
<i>1991/92</i>	2377	0.71	2500	2500	2555	1.07
<i>1992/93</i>	3952	1.19	2500	2500	2501	0.63
<i>1993/94</i>	2007	0.60	2500	2500	2511	1.25
<i>1994/95</i>	1882	0.57	2100	2100	1955	1.04
<i>1995/96</i>	2361	0.71	2700	2700	2756	1.17
<i>1996/97</i>	1812	0.54	2300	2300	2265	1.25
<i>1997/98</i>	1245	0.37	1450	1450	1426	1.14
<i>1998/99</i>	985	0.30	1000	1000	1025	1.04
<i>1999/00</i>	1799	0.54	1800	1800	1715	0.95
<i>2000/01</i>	1165	0.35	1200	1200	1287	1.10
<i>2001/02</i>	1789	0.54	1500	1500	1499	0.84
<i>2002/03</i>	951	0.29	1000	1000	989	1.04
<i>2003/04</i>	833	0.25	0	0	0	-
<i>2004/05</i>	94	0.03	0	0	0	-
<i>2005/06</i>	99	0.03	0	0	3	-
<i>2006/07</i>	670	0.20	0	0	3	-
<i>2007/08</i>	1036	0.31	0	0	9	-
<i>2008/09</i>	478	0.14	0	0	2	-
<i>2009/10</i>	143	0.04	0	0	1	-
<i>2010/11</i>	138	0.04	0	0	0	-
<i>2011/12</i>	1813	0.55	1000	1000	1040	0.57
<i>2012/13</i>	1065	0.32	500*	500	527	0.49
<i>2013/14</i>	1532	0.46	1100*	1100	1128	0.74
<i>2014/15</i>	1359	0.41	750	750	801	0.59
<i>2015/16</i>	1429	0.43	700	700	767	0.54
<i>2016/17</i>	921	0.28	484	484	491	0.53
<i>2017/18</i>	367	0.11	322*	322	343	0.93
<i>2018/19</i>	947	0.28	456	456	459	0.48
<i>2019/20</i>	1120	0.34	568	565	570	0.51
<i>2020/21</i>	1096	0.33	586	586	582	0.53
<i>2021/22</i>	48	0.01	0	0	12	-
<i>2022/23</i>	1045	0.31				

* Recommended TAC re-evaluated after a survey in February.