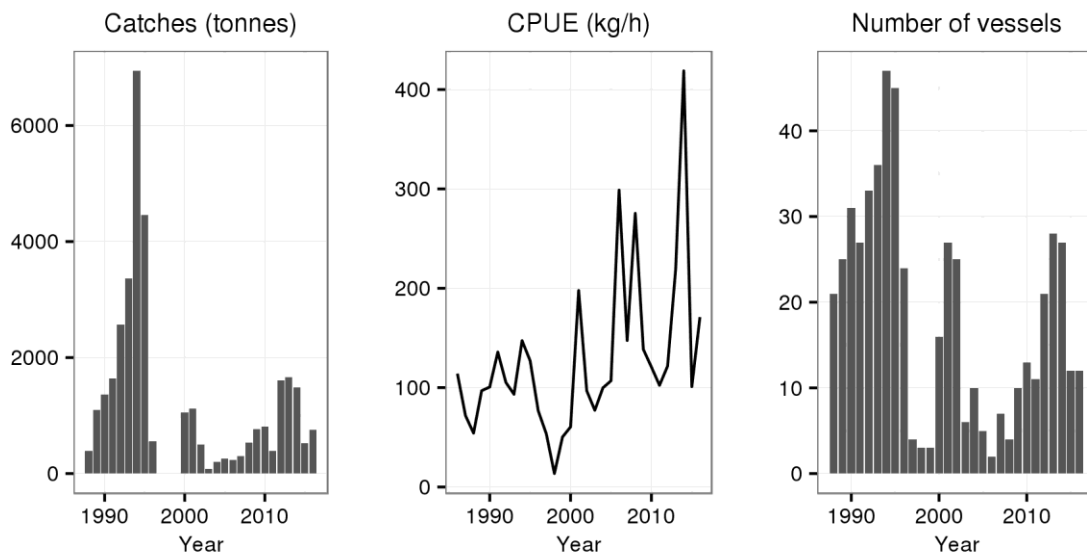


STOCK ASSESSMENT OF SHRIMP IN THE SNÆFELLSNES AREA 2017

COMMERCIAL FISHING

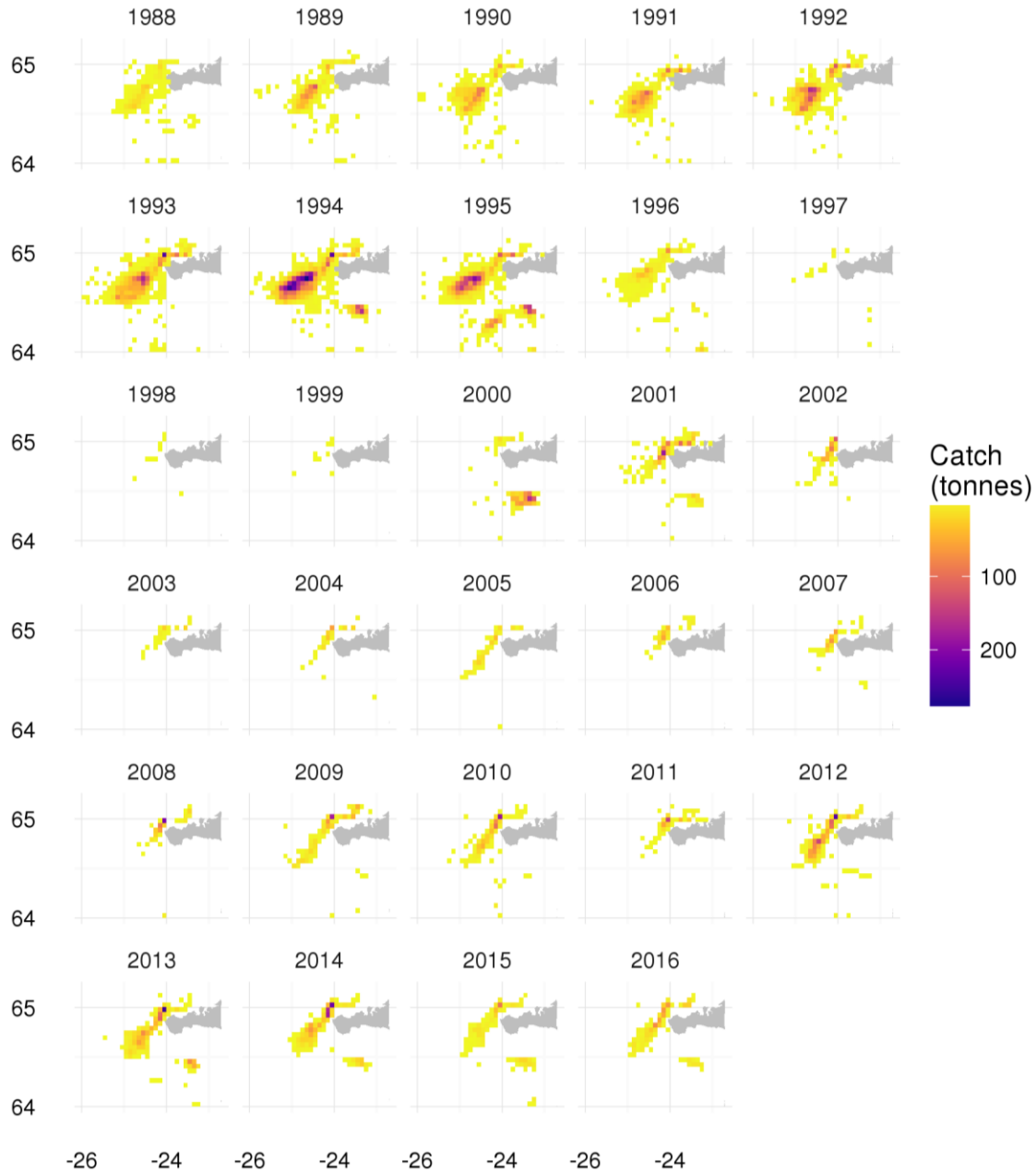
Shrimp catch in the Snæfellsnes area was high from 1992 to 1995, when the annual catch reached almost 7 000 tonnes. It is likely that the fishing pressure was too high during that time, which led to a collapse of the shrimp stock. The shrimp catch was low from 1997 to 1999 but increased after 2007 until it reached a maximum in 2012 to 2014. Catch per unit effort increased from 1998 to 2014 but fluctuated greatly during that period. The number of commercial shrimp vessels increased sharply until 1994 when 47 vessels landed shrimp in the Snæfellsnes area. In 2006, few vessels landed shrimp but the number increased again in the following years until 2015 when it decreased again.



Total catch, catch per unit effort and number of commercial vessels in the Snæfellsnes area.

Heildarafli, afli á sóknareiningu og fjöldi skipa á rækjuveiðum við Snæfellsnes.

The fishing ground of shrimp in the Snæfellsnes area is defined by Kolluáall, southern part of Breiðafjörður and Jökuldjúp. The distribution of the fishery has varied over time. Between 1988 and 1996, the main fishing grounds were in the western part of the Snæfellsnes area (Kolluáall). Since 2006 the main fishing grounds have been closer to land, or northwest of the Snæfellsnes peninsula.



Distribution of shrimp catch in the Snæfellsnes area from 1988 to 2016.

Dreifing rækjuafila við Snæfellsnes 1988-2016.

ICELANDIC SHRIMP SURVEY

The annual Icelandic shrimp survey has been conducted since 1990 in the Snæfellsnes area. The survey was conducted from the 18th to 23rd of April 2017 and includes 31 fixed stations at 110-330 m depth. 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).

In the past years, the density of shrimp was usually greatest in Breiðafjörður (north of the Snæfellsnes peninsula) but less at the western part of the area (Kolluáli). However, in 2017 the shrimp density was low in Breiðafjörður compared to the previous years.



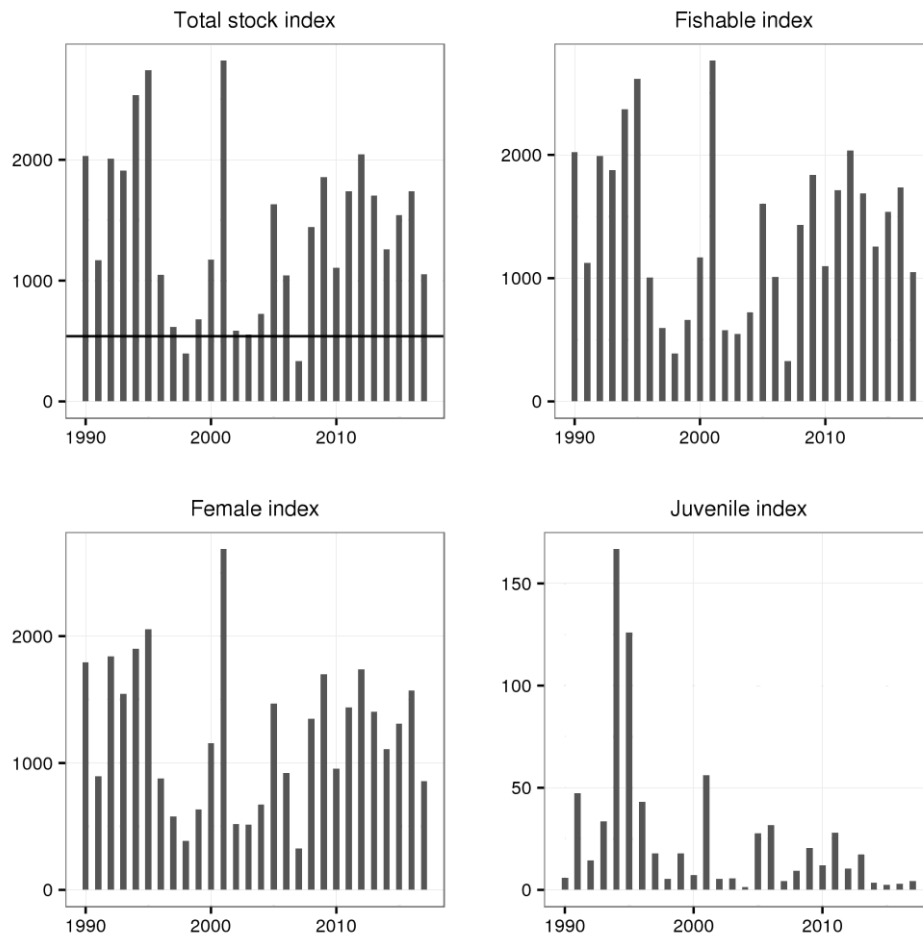
Distribution and abundance of shrimp in the annual shrimp survey from 1990 to 2017.

Útbreiðsla og magn rækju í stofnmælingu 1990-2017.

INDICES

Four indices are used to assess the state of the shrimp stock; the total biomass, the fishable biomass, the female biomass and the 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 have fluctuated greatly without a long-term trend during the study period. The indices decreased sharply from 1995 to 1998 during the time of high fishing pressure. Since 2008 the indices have fluctuated around the long-term mean. In 2017, the indices were substantially lower compared to 2016 and were the lowest observed since 2007. The total biomass index was above the reference level where the state of the stock is considered critical. The juvenile index has been very low since 2014.

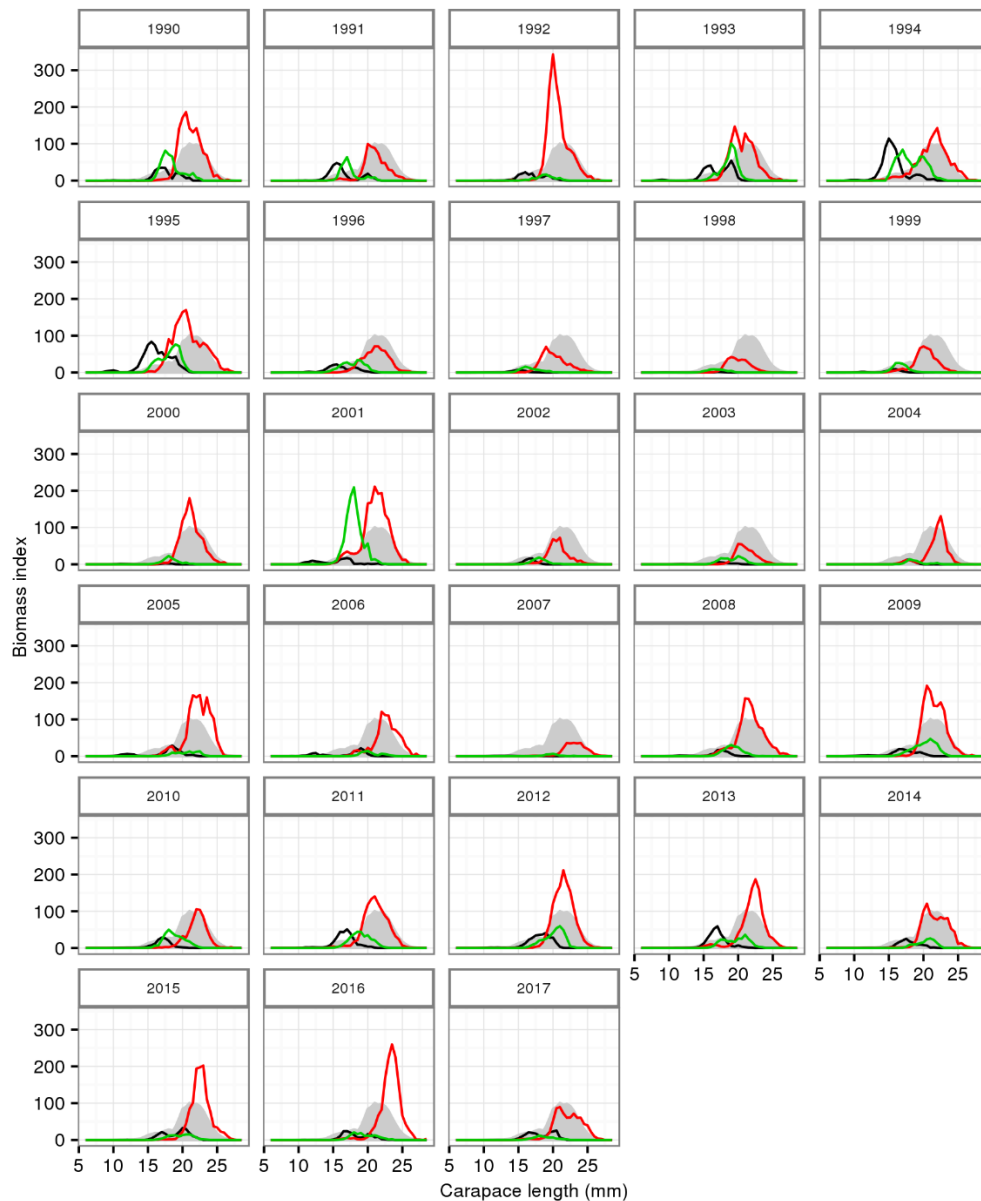


Stock biomass index, fishable biomass index, female biomass index and juvenile biomass index of shrimp. The horizontal line indicates a value where the state of the stock is considered to be critical (20% of the mean of the three highest indices).

Heildarstofnsvísitala, veiðistofnsvísitala, kvendýravísitala og vísitala ungrækju við Snæfellsnes 1990-2017. Lárétt lína sýnir viðmiðunargildi fyrir ástand stofnsins (20% af meðaltali þriggja hæstu vísitalna).

LENGTH DISTRIBUTION OF SHRIMP

A high proportion of the stock is mature females, whereas males compose a considerably lower proportion of the fishable biomass. The absence of juveniles indicates that the recruitment patterns and drift of larvae between adjacent areas are unknown. In 2017, the length distribution of shrimp was similar to the mean length distribution of the whole study period. In the past two years, the majority of the mature females belonged to a single cohort. In contrast, in 2017 several cohorts of females were observed, similar to what was observed in 2014.

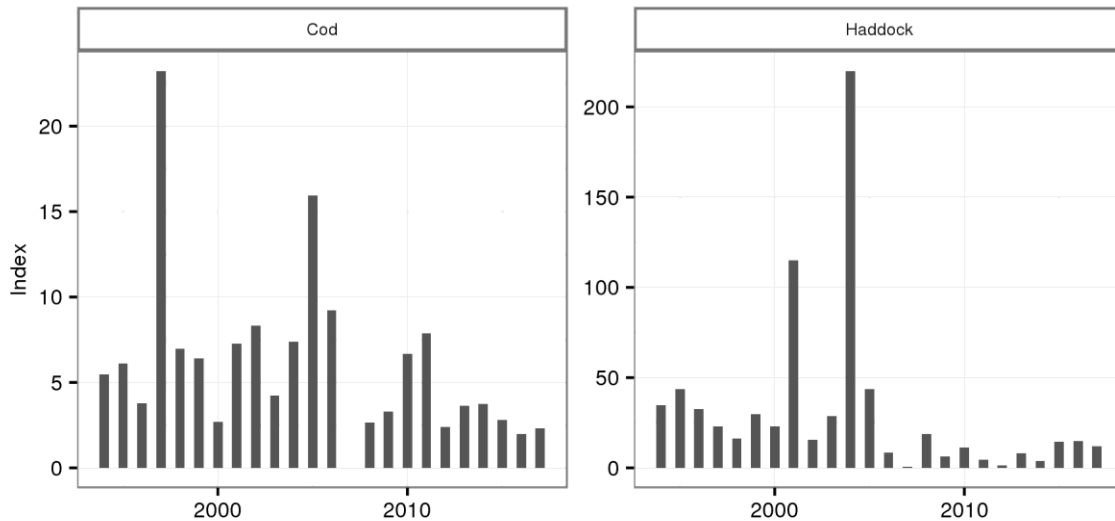


Length distribution of shrimp. The black line indicates males, the green immature females, and the red line mature females. The grey area is the mean length distribution of both sexes for the whole study period.

Lengdardreifing rækju í stofnmælingu við Snæfellsnes 1990-2017. Svört lína sýnir karldýr, græn lína ókynþroska kvendýr og sú rauða kynþroska kvendýr. Gráa svæðið sýnir meðallengdardreifingu beggja kynja allt rannsóknatímabilið.

ABUNDANCE OF COD AND HADDOCK

In general, the cod abundance index was relatively high between 1994 and 2006, but has been lower since 2008. The haddock abundance index has fluctuated and was highest in 2004. Since 2008 the haddock index has been relatively low.



Abundance indices of cod and haddock from 1994 to 2017.

Vísitala þorsks og ýsu í stofnmælingu rækju við Snæfellsnes 1994 til 2017.

ADVICE

The Icelandic shrimp survey was used as a biomass indicator. The target F_{proxy} (catch/survey biomass) of 0.5 is considered precautionary based on the historical relationship between catch and survey index. The advice is based on multiplying the target F_{proxy} with the mean of the two most recent index values.

The state of the stock is estimated as the total stock biomass index divided with the mean of the three highest indices. If the state of the stock is below 0.2, zero catch is advised. If the state of the stock is above 0.2, the advice is based on multiplying the mean of the two most recent index values with the target $F_{\text{proxy}} = 0.5$.

In April 2017, the state of the stock was 0.37 and hence the MFRI advises that catch in the Snæfellsnes area should be no more than 698 tonnes.

Biomass index, state of the stock (relative to the mean of the three highest indices), advice, catch (tonnes in fishing year) and F_{proxy}

Heildarstofnsvísitala, ástand stofns (vísitala miðað við meðaltal þriggja hæstu vísitölu gilda), ráðgjöf, afli og vísitala veiðihlutfalls (F_{proxy})

Year	Biomass index	Relative state	Rec. TAC	Catch	F_{proxy}
1990	2 736	0.97		1 597	0.58
1991	1 169	0.42		2 111	1.81
1992	2 158	0.77		5 035	2.33
1993	1 923	0.68		4 809	2.50
1994	2 535	0.90		6 765	2.67
1995	2 928	1.04		2 432	0.83
1996	967	0.34		283	0.29
1997	693	0.25		11	0.02
1998	492	0.18		8	0.02
1999	662	0.24		65	0.10
2000	1 164	0.41		2 257	1.94
2001	2 770	0.99		506	0.18
2002	554	0.20		89	0.16
2003	551	0.20	200	209	0.38
2004	409	0.15	200	265	0.65
2005	785	0.28	200	238	0.30
2006	1 042	0.37	200	316	0.30
2007	3 32	0.12	400	530	1.60
2008	1 445	0.51	400	779	0.54
2009	1 858	0.66	900	830	0.45
2010	1 106	0.39	450	414	0.37
2011	1 735	0.62	850	1 632	0.94
2012	2 057	0.73	1 000	1 755	0.85
2013	1 704	0.61	950	1 698	1.00
2014	1 258	0.45	600	133	0.11
2015	1 540	0.55	700	589	0.38
2016	1 739	0.62	820	826	0.47
2017	1 054	0.37	698		

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.