

Influence of increased cod abundance and temperature on recruitment of northern shrimp (*Pandalus borealis*)

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Abstract Despite an increase in northern shrimp (*Pandalus borealis*) female biomass in the past years, the recruitment of the offshore population north and northeast of Iceland has remained very low. In this study, the influence of abiotic and biotic factors was studied in relation to shrimp recruitment. Two factors, cod (*Gadus morhua*) abundance and summer sea surface temperature (SST), were found to have a negative effect on offshore shrimp recruitment, explaining 71 % of the observed variation. Both cod abundance and temperature on the offshore shrimp grounds have increased in the past years, while recruitment has decreased and been at historically low levels since 2005. No significant relationship was found between recruitment and spawning biomass, indicating that recruitment variability is mainly driven by other factors. Cod abundance and summer SST are likely to affect different life stages of shrimp, as SST influences shrimp during its planktonic phase while cod abundance influences the demersal stage.

Introduction

Recruitment is often defined as the number of young-of-the-year surviving and joining a population. Recruitment is a complex process driven by the biological and physical variability of the environment (Cushing 1996; Chambers and Trippel 1997). The factors determining the recruitment, however, vary both spatially and temporally, resulting in

inconsistent recruitment. The year class strength of many marine species is probably largely determined during the early life stages. Reliable information on recruitment is important for effective management of the exploited stock. However, the population dynamics during the first years are often poorly known, and the processes causing the interannual variations in recruitment remain largely unexplained.

Northern shrimp (*Pandalus borealis*) has a circumpolar distribution and is widely distributed in the northern hemisphere (Bergstrom 2000). In Icelandic waters, offshore shrimp is found in the waters north and northeast of Iceland. Offshore shrimp fishing started in the early 1970s and shrimp was one of the most important commercial species in Icelandic waters in the 1980s and 1990s. Shrimp fishing peaked in 1994–1997 when the annual catch reached 65,000 t (Anonymous 2012a). In the following years, shrimp biomass and catch decreased and the biomass reached historically low values in 2004 (Anonymous 2012a). Since 2004, the shrimp biomass has increased slightly but despite very limited fishing in the past 7 years, the shrimp biomass has remained lower than the biomass in the years 1990–1997. In contrast, the female biomass index has increased since 2004, perhaps due to limited fishing, and was above average between 2007 and 2009. The recruitment, which is estimated as 2-year-old shrimp, has been highly variable in the period between 1988 and 2011 but has been well below average since 2004 (Anonymous 2012a). Despite increasing female biomass from 2004 to 2009, recruitment has remained low (Anonymous 2012a). One of the reasons for slow recovery of the shrimp stock may be low recruitment, since no strong year classes have appeared since the 2000 year class.

Shrimp recruitment variability is influenced by various factors, both abiotic and biotic. The most studied abiotic factor is temperature (Wieland 2005; Aschan and

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Ingvaldsen 2009). The studies have demonstrated different results and have recorded positive (Wieland 2005), negative (Ouellet et al. 2007) or no (Worm and Myers 2003) effect on shrimp recruitment. Biotic factors, like larval food availability (Pedersen and Storm 2002) and condition (Carbonell et al. 2008), were, however, found to have positive effect on shrimp recruitment. In contrast, mismatch between the timing of the spring phytoplankton bloom and larvae release (Koeller et al. 2009) and increasing abundance of fish species have negative effect on shrimp recruitment (Wieland et al. 2007; Aschan and Ingvaldsen 2009). One of the most evident factor, the spawning biomass, does not always appear to be related to recruitment (Ramirez-Rodriguez and Arreguin-Sanchez 2003; Aschan and Ingvaldsen 2009). In such cases, environmental factors are often assumed to be more influential. The environmental variability and degree of influence is likely to vary between stocks in different geographic areas, so it is important to study the effects of different factors with respect to a specific population, for prediction of recruitment and effective resource management.

In this study, the objective was to investigate the recruitment of shrimp in offshore waters north and northeast of Iceland. The primary goal was to evaluate which factors influenced the recruitment. A dataset of 22 years from the annual offshore shrimp survey (SMR) was included in the analysis, where the influence of both abiotic and biotic factors on recruitment was studied.

Materials and methods

Shrimp research survey

The annual offshore shrimp survey SMR has been conducted since 1988 in July–August north and northeast of Iceland, between the 200 and 700 m depth contours (Fig. 1). The main purpose of the survey is to provide indices of shrimp biomass and recruitment, forming the basis of advice for managing the offshore shrimp fishery. Approximately 190 stations were sampled each year from 1988 to 2005, but since 2006, the number of stations has been 92. This reduction in the number of stations did not affect the overall area covered in the survey, and therefore, survey indices are based on all sampled data. The survey trawl is a standard shrimp bottom trawl of 1,400 meshes. The codend has a diamond mesh of 37 mm open size and 40 mm total size. The distance between the wing ends is 17 m and the mean (\pm) vertical opening is 6.0 ± 0.4 m. The tow length was 4 nautical miles in the first 3 years of the survey, reduced to 2–3 nautical miles in 1991, and further reduced to 1.5–2 nautical miles since 2004. The towing speed was 2.1–2.3 knots in all years. Sea surface

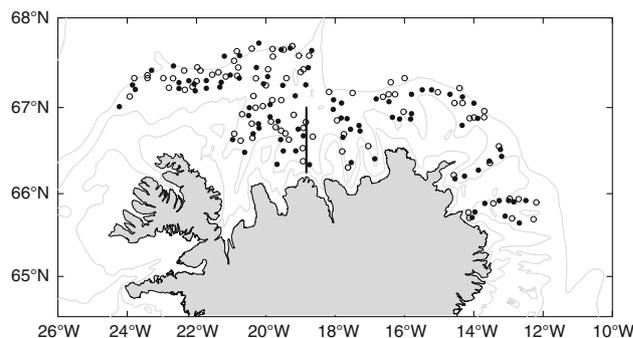


Fig. 1 Sampling locations in the annual shrimp survey. *Filled symbols* show the 92 stations sampled throughout the study period, while *open symbols* show stations sampled only from 1988 to 2005. *Contour lines* are shown at 100, 200 and 500 m depth. The *vertical line* indicates the Siglunes section where zooplankton density, salinity and temperature are measured

and bottom temperatures were recorded for each station. Sea bottom temperature is determined at each station using a pre-calibrated trawl sensor (Scanmar) attached to the trawl headline, while the sea surface temperature (SST) was measured with platinum resistance thermometer (PT100). The mean temperature for the survey area was calculated for each year.

At each station, the shrimp catch was weighed, a subsample of approximately 250 individuals measured, and the subsample weight recorded. The carapace length was measured using sliding callipers and the individuals grouped in 0.5 mm carapace length intervals. Sex and maturity of all individuals was determined as described in Rasmussen (1953) and McCrary (1971). The nine sexual stages determined were later grouped into three categories: males, immature females (transitionals and females with sternal spines), and mature females (females without sternal spines and females carrying eggs).

Length frequencies (LFs) were analyzed within three geographic subareas before pooling them. Modal analysis of the LFs for males and immature females was conducted using the Macdonald and Pitcher (1979) method, as implemented in the MIX software (Macdonald and Green 1988). Estimation of the total number caught of the three sex categories involved the following steps. The LF of each sex category was converted to weight using two length–weight relationships, one for males and immature females, $W = \exp(2.82 \log L - 6.77)$, and another for mature females, $W = \exp(2.89 \log L - 7.09)$. The number sampled in the three categories was then scaled to represent the catch per nautical mile in each tow. The scaled LFs were then pooled within statistical squares to estimate the average LF within each square. The number of individuals was then calculated using the swept-area method described by Sparre and Venema (1989). The shrimp female biomass index was calculated by combining the weight of immature

and mature females. For the recruitment analysis in this study, only the LFs of males and immature females were used. The immature female LFs were analyzed with MIX to see whether they were unimodal, bimodal, or occasionally trimodal. Then, the LFs of males and immature females combined were analyzed with MIX using 4–6 components as judged by the LF modes. Often, the deviation method (Skúladóttir 1981) was used as a guidance in deciding the number of modes present.

Zooplankton biomass was measured in an annual spring survey in May, where fixed radial transects were sampled in the waters around Iceland. Five stations of the Siglunes section are in the middle of the shrimp distribution area (Fig. 1), where the average zooplankton biomass (g dry weight m^{-2}) was measured at 0–50 m depth (Anonymous 2012b). The SST in the survey was measured using a CTD. In this present study, the mean temperature and salinity for 0–20 m was used.

The cod abundance index was calculated as number per nautical mile in SMR.

Statistical analysis

Several models were used to analyze the relationship between shrimp recruitment as 2-year-olds and candidate predictors, including the female biomass at the time of spawning. Linear models (LM) were used to test the significance of predictors and examine variable transformations. The relationship between shrimp recruitment and predictors was further investigated using a generalized additive model (GAM), as implemented in the *mgcv* package in R (Wood 2006).

The stock-recruitment (SR) relationship was estimated with two standard models representing a nonlinear relationship between the spawning biomass and recruitment. The asymptotic model by Beverton and Holt (1957) predicts higher recruitment as spawning biomass increases, $R = \alpha S / (\beta + S)$, where R is recruitment, S is spawning biomass, α is the asymptotic maximum recruitment, and β is the spawning biomass that produces 50 % of the expected maximum recruitment. The Ricker (1954) model predicts maximum recruitment at an intermediate spawning biomass, with recruitment declining at higher levels of spawning biomass due to density dependence, $R = \alpha S e^{-\beta S}$, where α is the initial slope of the recruitment curve, β is the inverse of the spawning biomass at which maximum recruitment occurs, and $\alpha / (e\beta)$ is the maximum recruitment. External predictors can be added to both SR models as multiplicative terms of the form $e^{\beta x}$ as demonstrated below. The Ricker model was cast as a linear model and fitted in R, but the Beverton–Holt model was fitted using the AD Model Builder framework (Fournier et al. 2012).

The external predictors were bottom temperature, SST in spring and summer, salinity, zooplankton biomass index, shrimp female biomass index, and cod index. Prior to analysis, the shrimp recruitment index was lagged by 2 years to be compared with the surroundings during the year of larval emergence. Shrimp recruitment was log-transformed under the assumption of lognormal recruitment variability, while the cod index was log-transformed to establish linearity. Furthermore, all predictor variables were converted to deviations from the mean, after log-transformation. Stepwise model selection led to the following seven models used in this study,

$$\log \hat{R}_t = \log \hat{\alpha} \quad (\text{Null})$$

$$\log \hat{R}_t = \log \hat{\alpha} + \hat{\beta}_1 \log C_t + \hat{\beta}_2 T_t \quad (\text{LM})$$

$$\log \hat{R}_t = \log \hat{\alpha} + s(C_t) + s(T_t) \quad (\text{GAM})$$

$$\log \hat{R}_t = \log \hat{\alpha} + \log S_t - \log(\hat{\beta} + S_t) \quad (\text{BH})$$

$$\log \hat{R}_t = \log \hat{\alpha} + \log S_t - \log(\hat{\beta} + S_t) + \hat{\beta}_1 \log C_t + \hat{\beta}_2 T_t \quad (\text{BH-external})$$

$$\log \hat{R}_t = \log \hat{\alpha} + \log S_t - \hat{\beta} S_t \quad (\text{Ricker})$$

$$\log \hat{R}_t = \log \hat{\alpha} + \log S_t - \hat{\beta} S_t + \hat{\beta}_1 \log C_t + \hat{\beta}_2 T_t \quad (\text{Ricker-external})$$

where C is cod biomass index, T is summer SST, β_1 and β_2 are coefficients expressing the magnitude of their effects, s are GAM smooth functions, and t is the year.

The models were fitted by minimizing the negative log-likelihood,

$$-\log L = 0.5n \log 2\pi + n \log \hat{\sigma} + \frac{\sum (\log R_t - \log \hat{R}_t)^2}{2\hat{\sigma}}$$

where n is the number of data points and σ is the maximum-likelihood standard deviation of the error term:

$$\hat{\sigma}_{\text{MLE}} = \sqrt{\frac{\sum ((\log R_t - \log \hat{R}_t)^2)}{n}}$$

Model comparison was based on a second-order Akaike's information criterion for small samples (Burnham and Anderson 1998),

$$\text{AIC}_c = -2 \log L + 2K \left(\frac{n}{n - K - 1} \right)$$

where K is the number of model parameters, including σ . Residuals of all models were tested for autocorrelation using the Durbin–Watson test (Durbin and Watson 1950, 1951), as implemented in the *car* package in R (Fox and Weisberg 2011).

Results

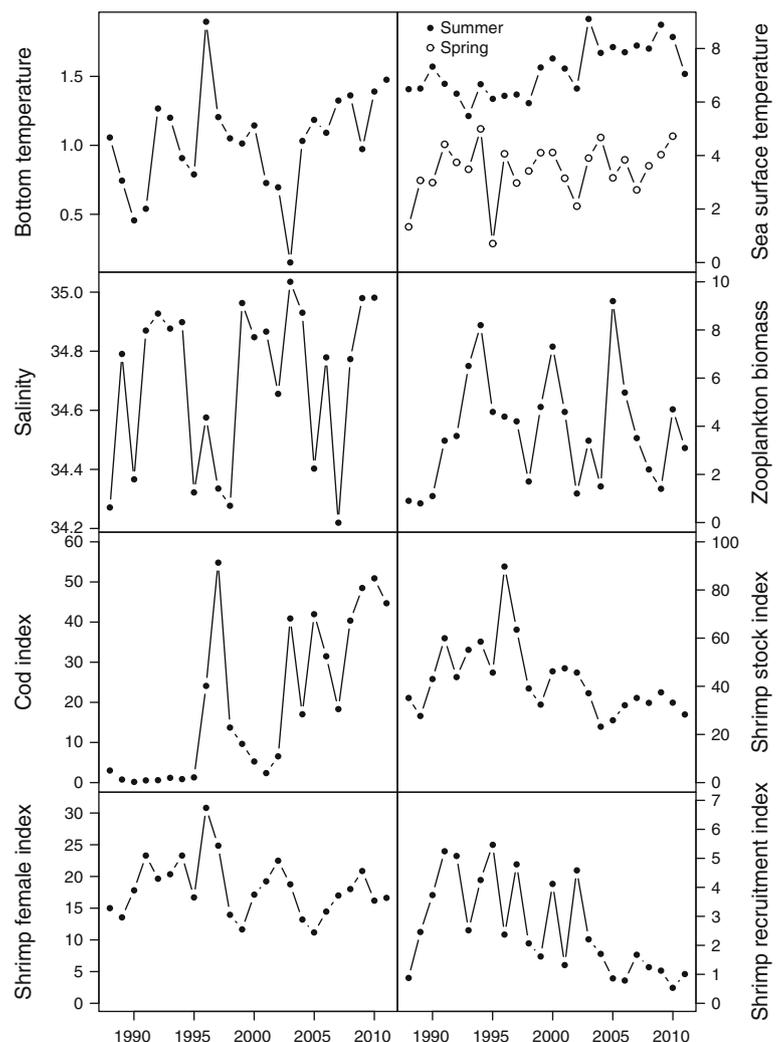
Abiotic factors

The mean bottom temperature in the entire offshore SMR area fluctuated around 1.0 °C since 1988 with a maximum of 1.9 °C in 1995 but shows a steady increase since a minimum of 0.2 °C recorded in 2003 (Fig. 2). The mean SST in the SMR area ranged between 5.5 and 7.6 °C in the period between 1988 and 2002, peaked at 9.1 °C in 2003, and has since then been higher than in the years 1988–2002, with mean values between 7.8 and 8.9 °C (Fig. 2).

Biotic factors

The zooplankton biomass peaked three times in the study period, in 1994, 2000, and 2005 (Fig. 2). The cod index was low in the period between 1988 and 1995 (Fig. 2). Since 1996, the cod index has been variable, but higher than before 1996, and it has been increasing since 2007.

Fig. 2 Overview of all time series analyzed in this study: mean bottom temperature from SMR, mean sea surface temperature (°C) in the annual shrimp survey (SMR) in summer and from the Siglunes section in the annual spring survey in May, salinity from the Siglunes section in the annual spring survey, zooplankton biomass (g dry weight m⁻²) from the Siglunes section in the annual spring survey, cod index, shrimp stock index, shrimp female index, and 2-year-old recruits from SMR



Trends in shrimp stock

The shrimp biomass index ranged between 43 and 60 t between 1990 and 1995. After a peak in 1996 and 1997, the index was between 32 and 48 t until 2004, when it reached the historical minimum (Fig. 2). Since 2004, the index has increased slowly (Fig. 2). The female biomass has followed the same trends as the total stock biomass. After a peak in 1996 and 1997, it declined to a historical minimum in 2005, but has been increasing since then and is currently around the long-term average (Fig. 2). Shrimp recruitment has fluctuated throughout the study period, but the general trend has been a long-term decline, with very low recruitment since 2005 (Fig. 2).

Recruitment models

The traditional Beverton–Holt and Ricker models did not explain recruitment variability better than a flat horizontal line, as reflected by poorer AIC_c scores than the null model

(Fig. 3; Table 1). The null model describes the geometric mean recruitment of 2.1 billion individuals.

Stepwise LM selection from the null model indicated that two regression terms, summer SST and cod biomass index, had significant and negative influence on the recruitment (Table 1). The effect of cod biomass was slightly more significant ($P = 0.002$) than that of summer SST ($P = 0.008$), with coefficients -0.212 (95 % CI = $-0.332, -0.092$) and -0.309 (95 % CI = $-0.529, -0.090$) respectively. The estimated regression coefficients measure the effect of cod abundance and summer SST on the offshore shrimp recruitment. For example, $\beta_1 = -0.212$ implies that when cod abundance increases tenfold, as it has in the past, shrimp recruitment can be expected to decrease by around 39 %. Likewise, $\beta_2 = -0.309$ implies that when summer SST increases by 1 °C, recruitment can be expected to decrease by around 27 %. Together, these two factors explained 71 % of the observed recruitment variability. The two regression terms T and $\log C$ have a significant ($P = 0.013$) positive correlation of 0.520 (95 % CI = 0.127, 0.773). This does not affect the usefulness of the fitted model for estimating mean responses or making predictions, as long as future observations of T and $\log C$ have the same correlation (Kutner et al. 2005, p. 431). No significant autocorrelation was found in the residuals (one-sided Durbin–Watson test, $P = 0.910$). This simple LM had the best AIC_c score of all the models evaluated (Table 1).

Stepwise GAM selection indicated a significant effect of the same regression terms, cod biomass and summer SST. After log-transforming recruitment, the effect of cod

Table 1 Summary of the fitted recruitment models: geometric mean recruitment (null model), multiple linear regression (LM), generalized additive model (GAM), Beverton–Holt (BH), Beverton–Holt with external factors (BH-external), Ricker, and Ricker with external factors (Ricker-external)

Model	α	β	β_1	β_2	K	AIC_c
Null	2.135				2	50.6
LM	2.135		-0.212	-0.309	4	29.1
GAM	2.135				4.82	32.9
BH	2.425	2.346			3	53.2
BH-external	2.135	0.000	-0.212	-0.309	5	32.5
Ricker	0.312	0.052			3	53.0
Ricker-external	0.487	0.076	-0.191	-0.366	5	31.0

The significant external factors were cod biomass and sea surface temperature. α is the regression intercept in the null model, LM, and GAM, but α and β are stock-recruitment shape parameters in the BH and Ricker models. β_1 and β_2 are regression coefficients for cod biomass and sea surface temperature, K is the number of estimated parameters, and AIC_c is Akaike’s information criterion for small samples

biomass was a smooth curve with 1.82 effective degrees of freedom, but the effect of summer SST was linear (Fig. 4). This model got a poorer AIC_c score than the LM (Table 1). The estimated effect of cod biomass was a relatively flat curve for the highest observed cod biomass values, and when cod biomass was log-transformed, the estimated effect of both cod biomass and summer SST became linear, resulting in the same model as the LM.

In the Beverton–Holt model with external factors, cod biomass and summer SST, the shape parameter β converged toward zero, indicating no relationship between female biomass and recruitment, thus making the model effectively the same as the LM but with one more estimated parameter (Table 1). In the Ricker model with external factors, the effects of cod biomass and summer SST were equally significant ($P = 0.004$), with coefficients -0.191 (95 % CI = $-0.311, -0.071$) and -0.366 (95 % CI = $-0.596, -0.136$) respectively, and no significant autocorrelation in the residuals (one-sided Durbin–Watson test, $P = 0.928$). Adding the external effects improved the performance of the Beverton–Holt and Ricker models considerably, but based on AIC_c scores (Table 1), the simple LM is a better model for explaining recruitment variability.

The regression data used to fit the recruit models are included in the “Appendix”.

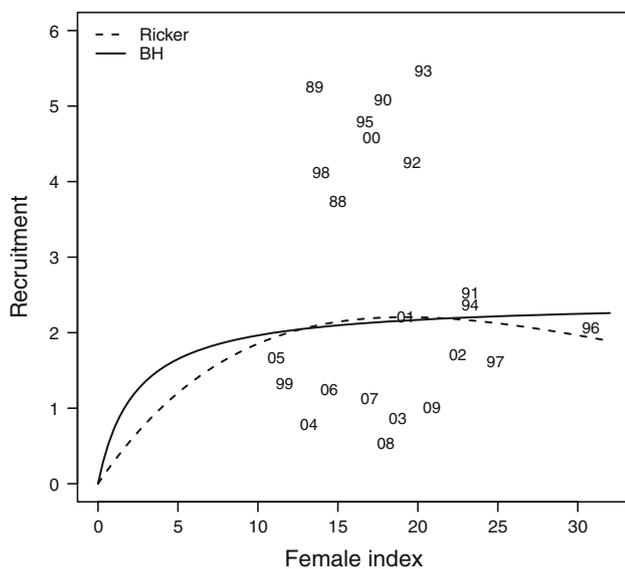


Fig. 3 Stock-recruitment data and model fits. Numbers indicate the year classes 1988 to 2009 and fitted values from the Beverton–Holt and Ricker models are shown

Discussion

The aim of this study was to determine what factors influenced the recruitment of offshore shrimp north and

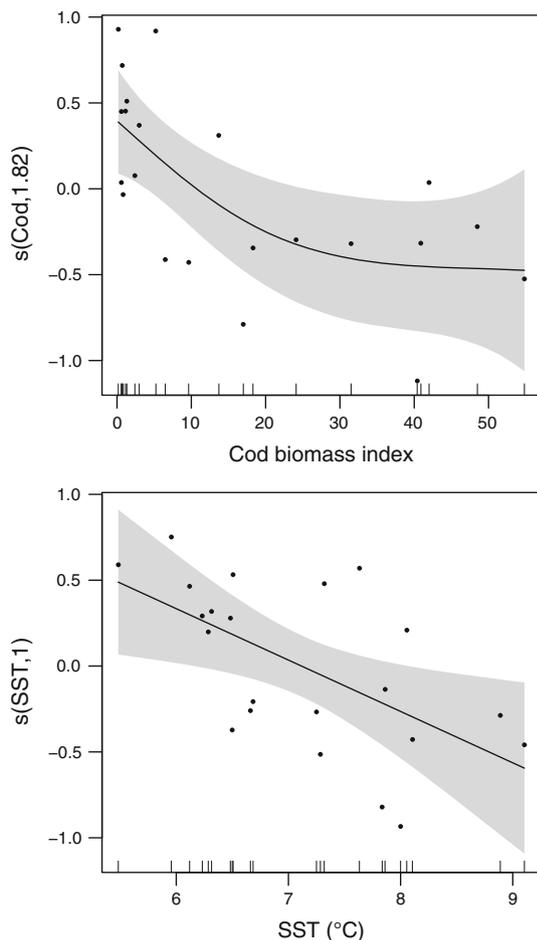


Fig. 4 GAM plots showing of the effects of summer sea surface temperature (SST) and cod biomass on shrimp recruitment. Shades indicate 95 % confidence limits for the fitted relationship

northeast of Iceland. The results demonstrated that two factors, cod abundance and summer SST, explained the greatest variation in offshore shrimp recruitment. Both cod abundance and summer SST have increased in the past years, while shrimp recruitment has declined. Since 2005, shrimp recruitment has been at historically low levels, despite increasing female biomass. Cod biomass and summer SST are likely to influence different life-history stages, as summer SST influences shrimp viability during the planktonic phase while cod is more likely to influence the demersal stages. Other species have also been influenced in some way by the observed temperature changes around Iceland, but in recent years, increasing sea temperature and salinity due to a stronger inflow of Atlantic water (Jónsson and Valdimarsson 2005) have caused changes in the abundance, structure, and diversity of both fish (Stefansdottir et al. 2010) and invertebrate (Jonasson et al. 2007) species.

Cod abundance was one of the two main factors influencing shrimp recruitment and had a negative effect on

recruitment. The shrimp population in the offshore area suffered a major depletion after 1996, following a sudden increase of cod in the area. Before 1996, cod had been almost absent on the shrimp grounds despite large cod year classes. The abundance of cod has been shown to have an impact on shrimp abundance (Stefánsson et al. 1998), and close linkages between populations of Atlantic cod and northern shrimp have been described for various parts of the North Atlantic (Berenboim et al. 2000; Worm and Myers 2003). Northern shrimp is one of the main preys for cod (Albers and Anderson, 1985; Jónsdóttir et al. 2012; Pálsson and Björnsson 2011). The importance of shrimp as prey for cod decreases with increasing cod length (Berenboim et al. 2000; Jónsdóttir et al. 2012). Furthermore, predation pressure is in relation to predator length, as larger cod feed on larger shrimp (Magnússon and Pálsson 1991). On average, 55–60 % of shrimp preyed by cod in the length groups 50–69 cm (the mean length of cod in SMR ranged from 53.5 to 66.3 cm) was below 16 mm (Magnússon and Pálsson 1991), which corresponds approximately to 1- and 2-year-old shrimp. Shrimp is demersal after a 3-month pelagic larval phase, hence 1- and 2-year-old shrimp are demersal. As shrimp is one of the four main prey items of cod in the offshore shrimp grounds (Jónsdóttir et al. 2012), variable levels of predation can be expected to have a considerable effect on mortalities of young shrimp and the eventual cohort size at the age of recruitment.

The other factor influencing shrimp recruitment was summer SST. Like cod abundance, increasing summer SST had negative effect on the recruitment, but variations in bottom temperature and spring SST were not found to have a significant effect. As shrimp spend most of its time in the upper water column during its larval phase, but less thereafter, it must be assumed that summer SST affects the early life-history stages during the planktonic phase. Shrimp hatch their eggs in May and June in the offshore area (Skúladóttir 1991), and it has been estimated that the pelagic phase lasts up to 3 months (Ouellet and Allard 2006). The influence of temperature on recruitment is the most studied factor, but the studies have demonstrated positive (Wieland 2005; Aschan and Ingvaldsen 2009), negative (Ouellet et al. 2007) or no (Worm and Myers 2003) effect on shrimp recruitment. The metabolism (Chabot and Ouellet 2005) and feeding rate (Shumway et al. 1985) of shrimp larvae increase with higher temperature, escalating their need for food. High SST is often an indication of strong stratification and reduced vertical mixing can limit biological production. High summer SST negative impact on abundance of 2-year-old shrimps could reflect poorer feeding condition for the late larval stages or early juveniles still feeding in the water column. The temperature changes

may, however, influence shrimp recruitment in various indirect ways, including changes in predator abundance, food availability, and distribution. It is hard to conclude how summer SST may be affecting shrimp recruitment, due to complex interaction of temperature with other factors, such as growth and predation.

Recruitment in fish populations can be highly variable from 1 year to another. Although recruitment is undoubtedly related to the spawner biomass, SR data often indicate a weak relationship. In the present study, the traditional Beverton–Holt and Ricker models did not fit the observed recruitment better than a flat horizontal line. This lack of SR relationship suggests that shrimp recruitment is mainly influenced by other external factors. In fact, a better fit was obtained by a linear model that included cod abundance and summer SST as regression terms. Variation in invertebrate recruitment is generally not considered closely related to the parent stock size (Koslow 1992), and environmental factors are often of greater importance. The results of this study indicate that the forms of density dependence that are intrinsic to the Beverton–Holt and Ricker models do not apply to the offshore shrimp stock in Icelandic waters, possibly due to the relatively low density of shrimp across the large distribution area.

Even though cod biomass and summer SST explained 71 % of the recruitment variability, it still leaves 29 % unexplained. Various other factors may influence recruitment, including the timing of the phytoplankton bloom, other predators, and shrimp female fecundity. Even though spring SST was not significant in the models, oceanographic conditions in the spring may have influenced the survival at the earliest stages. The increasing bottom temperature may have been responsible for changes in hatching time (Richards 2012) and caused a mismatch between the larvae and the biological production cycle (Koeller et al. 2009). In regions where cod biomass is still very low or do not totally overlap with shrimp distribution, the influence of ocean temperature on northern shrimp recruitment was shown to be significant (Wieland et al. 2007; Ouellet et al. 2011; Wieland and Siegstad 2012). There are other predators in the area that may have an effect on shrimp recruitment, as various fish species prey on shrimp (Parsons 2005). One of them is Greenland halibut (*Reinhardtius hippoglossoides*), which is the most important bycatch in the offshore shrimp fishery in Icelandic waters. West of Greenland, a negative relationship was found between shrimp recruitment and biomass of Greenland halibut (Wieland et al. 2007). In the waters north of Iceland, shrimp is around 9 % of the diet of Greenland halibut (Solmundsson 2007). There may be variability in the spawning stock's ability to

produce eggs, where the size distribution of females is relevant, as fewer eggs are produced by smaller females (Allen 1959).

It is tempting to predict that the next 2 year classes are unlikely to be strong, due to high summer SST and high cod abundance recorded in SMR in 2010 and 2011. However, predicting recruitment from environmental factors is notoriously uncertain (Hilborn and Walters 1992). In order to make predictions about recruitment, it is necessary to consider all steps of the life cycle, including the distribution of parents, stock structure, spawning areas and time, drift of larvae, and female fecundity.

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Appendix

See Table 2.

Table 2 The data used to fit the recruit models

	Recruitment	Spawning biomass	Cod index	SST
1988	3,736	15.00	2.99	6.482
1989	5,249	13.55	0.72	6.507
1990	5,087	17.82	0.17	7.319
1991	2,518	23.29	0.58	6.685
1992	4,256	19.64	0.60	6.315
1993	5,470	20.35	1.15	5.483
1994	2,365	23.28	0.84	6.661
1995	4,793	16.70	1.32	6.119
1996	2,068	30.82	24.11	6.232
1997	1,620	24.86	54.83	6.285
1998	4,122	13.96	13.71	5.956
1999	1,323	11.67	9.64	7.285
2000	4,586	17.11	5.23	7.633
2001	2,213	19.25	2.40	7.250
2002	1,702	22.50	6.50	6.499
2003	859	18.74	40.90	9.104
2004	782	13.19	17.00	7.836
2005	1,671	11.15	42.00	8.055
2006	1,242	14.46	31.50	7.861
2007	1,125	16.98	18.30	8.105
2008	535	18.00	40.40	8.000
2009	1,008	20.88	48.50	8.889

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