Haddock S-R models

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# 1 Fogarty Analysis

Fogarty re-analysis Figure 1

This analysis will compare recruitment between the primary harvested sympatric Atlantic Cod and Haddock stocks in the Atlantic Ocean, comparing the period before 1993 (*Pre-1993 Period*) with the period from 1993 onwards (*Recent Period*), data shown in Figure 1.1. This is Figure 1 from Fogarty

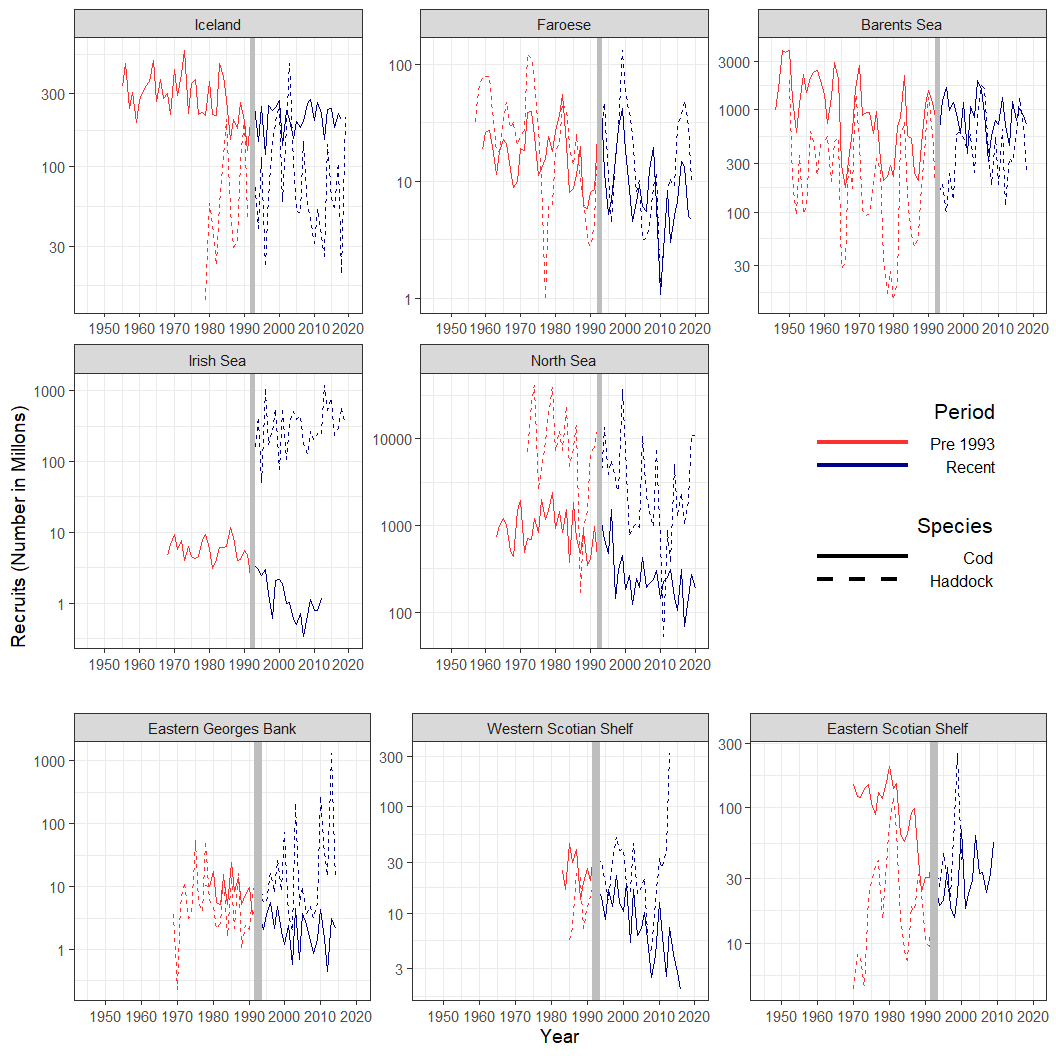


Figure 1.1: Recruitment (in millons) time series for 8 Atlantic Cod (solid line) and Haddock (dashed line) stocks in the Atlantic Ocean. The red line indicates data from the Pre-1993 Period, while the blue line is for the Recent Period. The vertical grey line indicates the division between the two periods

Next up was a simple stock-recruitment model using the linearization of the Ricker SR model.

**Here is Figure 2 from Fogarty, the Residual plot from the S-R models**

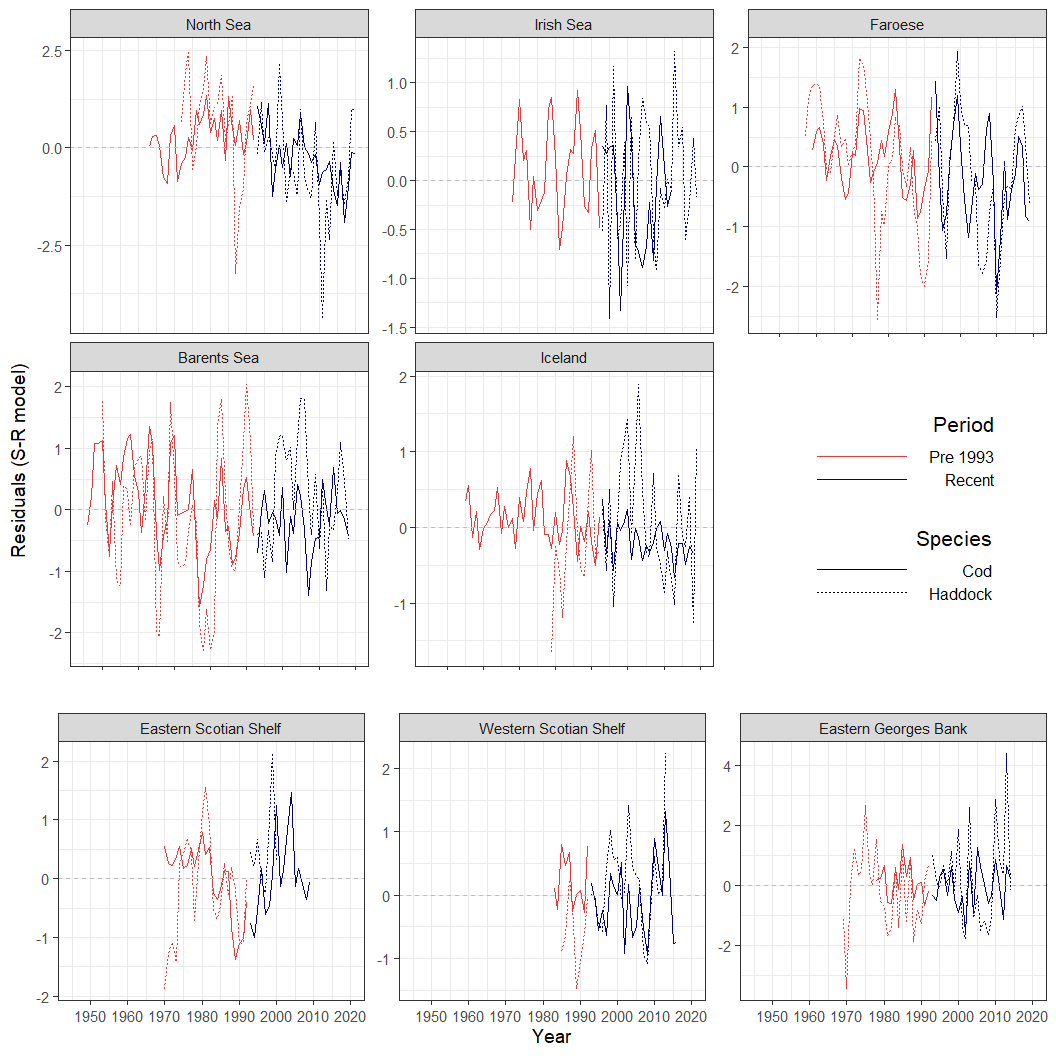


Figure 1.2: Residuals from the Ricker Stock recruitment model.

**Here is the GAM residual plot, kind of Figure 2, but for the smoothed time series**

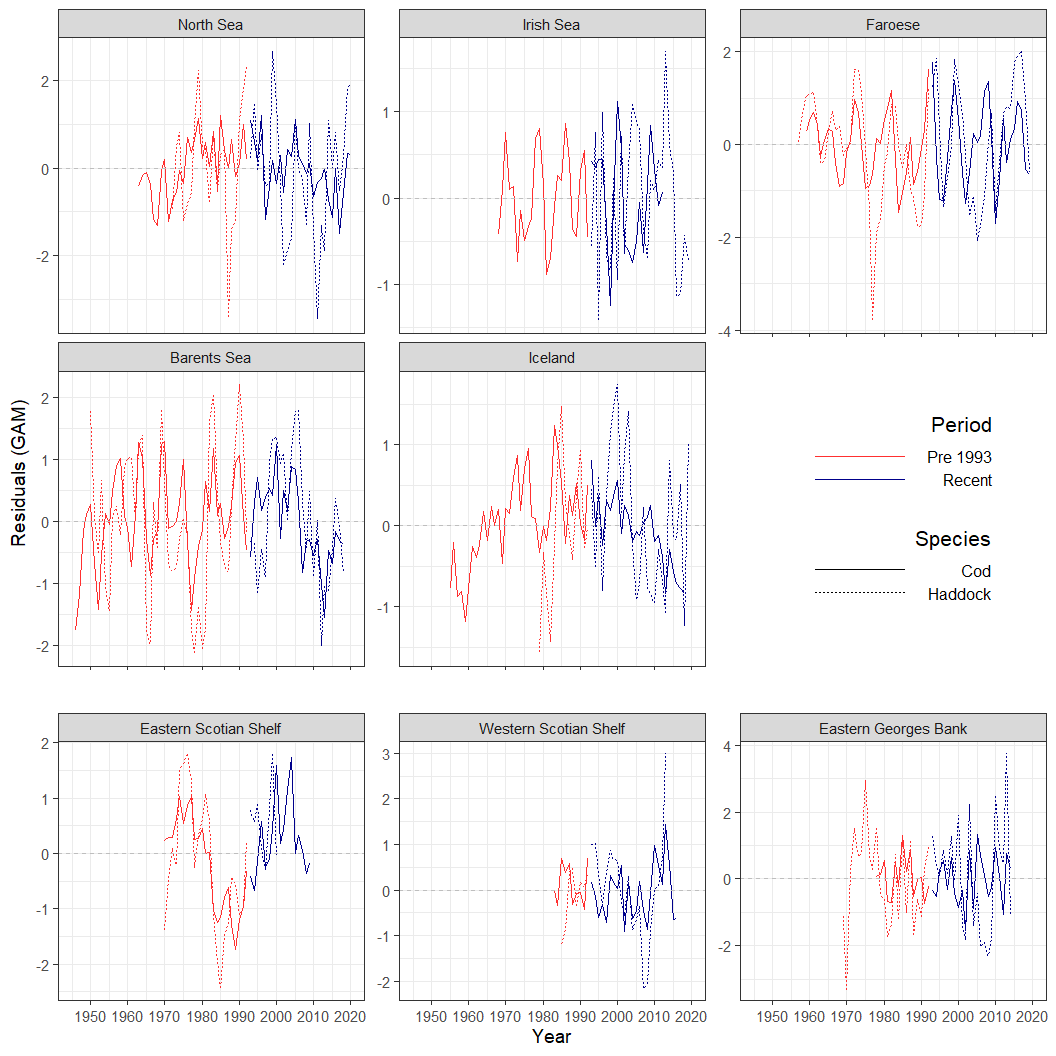


Figure 1.3: Recruit residuals from the GAM model.

**Next up is Figure 3, which will be the SD of the residuals from both the GAM and the S-R models, I will split this into 2 figures, the first being the S-R model SDs. The only way I can see getting a 95% CI around these would be to bootstrap them, but I don’t see any real utility in doing that as it doesn’t change our story at all. I can do it, but not sure what it adds other than making the figure look more ‘cool’.**

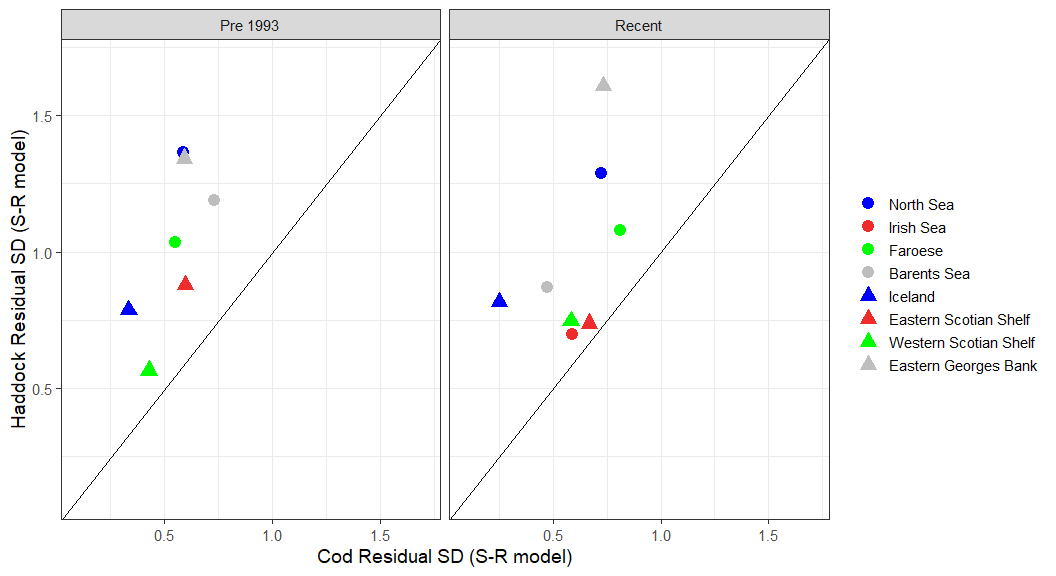


Figure 1.4: Standard deviation of the log residuals from the Ricker S-R Model

**Same figure as above, but only using data in which we have overlapping years of data between the stocks in a given location**

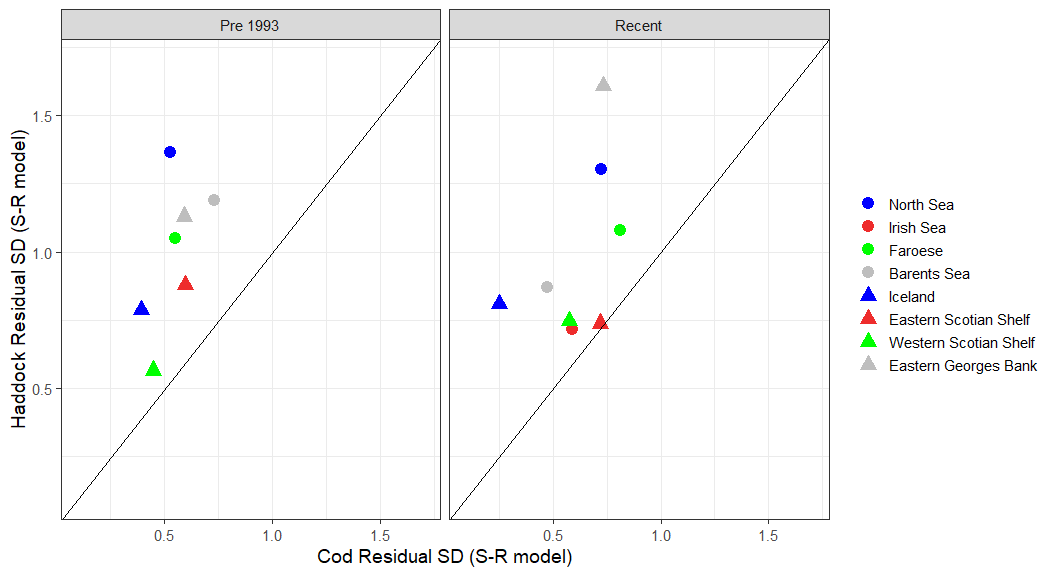


Figure 1.5: Standard deviation of the log residuals from the Ricker S-R Model but using residuals only from years in which data is found in both time series.

**Here are the SDs of the residuals from the GAMs. The only way I can see getting a 95% CI around these would be to bootstrap them, but I don’t see any real utility in doing that as it doesn’t change our story at all. I can do it, but not sure what it adds other than making the figure look more ‘cool’.**

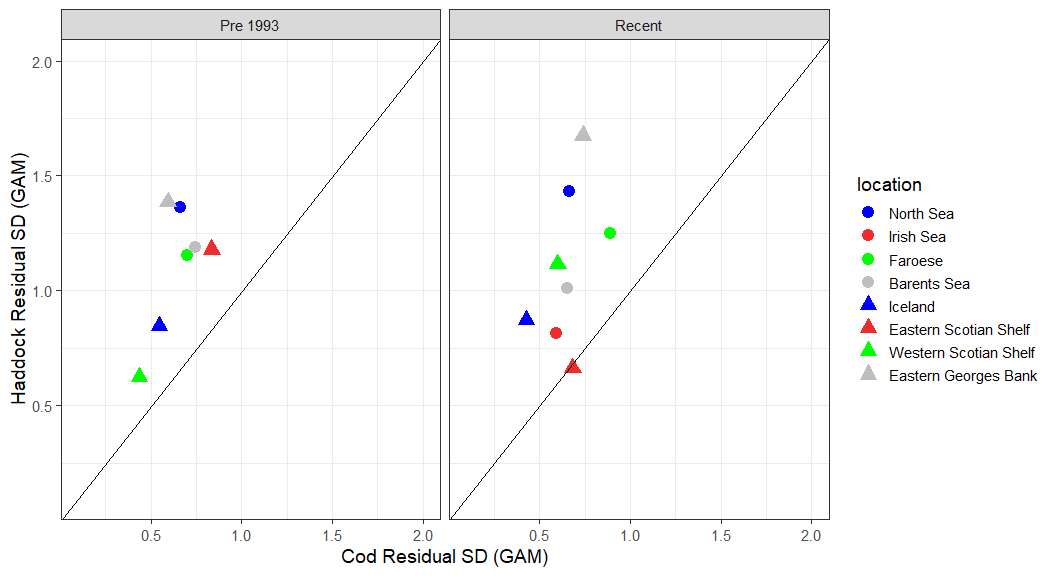


Figure 1.6: Standard deviation of the log residuals from the GAMs

**Same figure as above, but only using data in which we have overlapping years of data between the stocks in a given location**

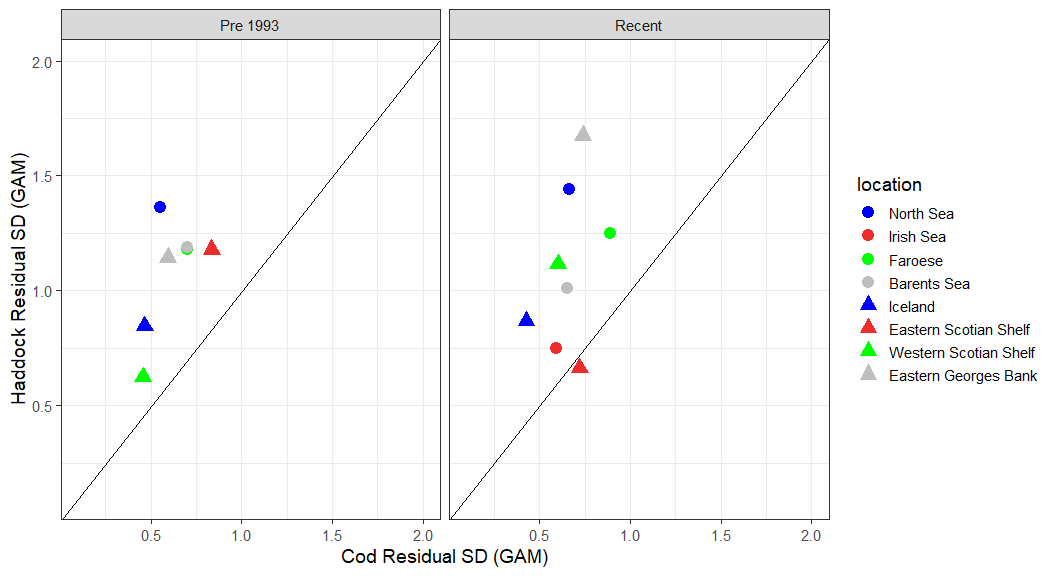


Figure 1.7: Standard deviation of the log residuals from the GAMs but using residuals only from years in which data is found in both time series.

**Table with the ACF values in it, both from SR and from GAM residuals**

## Location Species acf.sr acf.gam  
## 9 North Sea Haddock 0.390 0.360  
## 10 North Sea Cod 0.370 0.270  
## 7 Irish Sea Haddock -0.320 0.047  
## 8 Irish Sea Cod 0.370 0.330  
## 3 Faroese Haddock 0.660 0.680  
## 4 Faroese Cod 0.510 0.510  
## 5 Barents Sea Haddock 0.460 0.480  
## 6 Barents Sea Cod 0.510 0.490  
## 1 Iceland Haddock 0.180 0.290  
## 2 Iceland Cod 0.250 0.600  
## 11 Eastern Scotian Shelf Haddock 0.520 0.680  
## 12 Eastern Scotian Shelf Cod 0.590 0.720  
## 13 Western Scotian Shelf Haddock 0.370 0.470  
## 14 Western Scotian Shelf Cod 0.150 0.160  
## 15 Eastern Georges Bank Haddock 0.053 0.100  
## 16 Eastern Georges Bank Cod -0.150 -0.160

**Now lets get the Correlation between the time series, Figure 4**

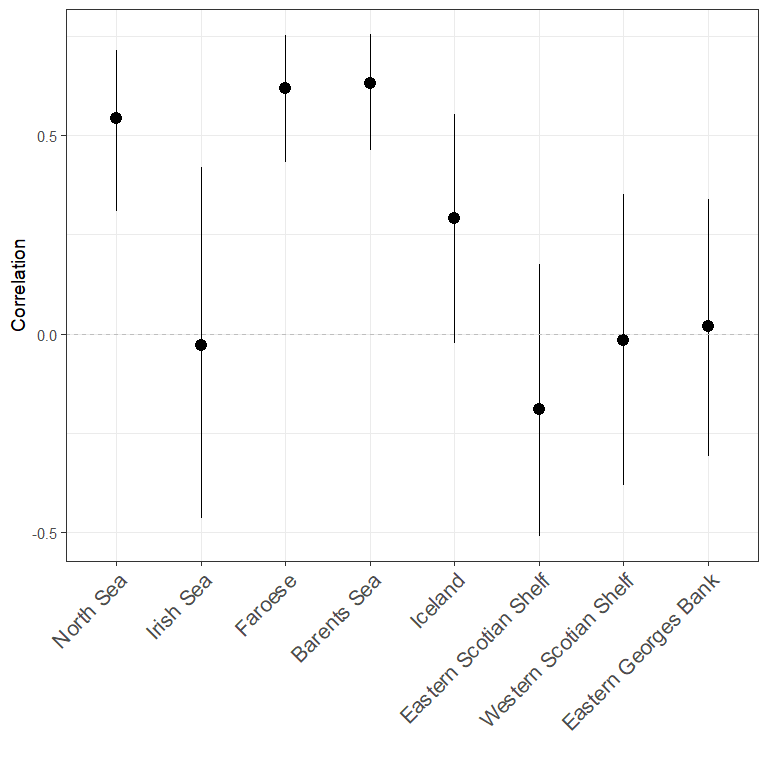


Figure 1.8: Cross correlation of the recruiment (log scale) time series

**Figure 5 is the Alpha from the Stock Recruitment models, now will be 2 panels.**

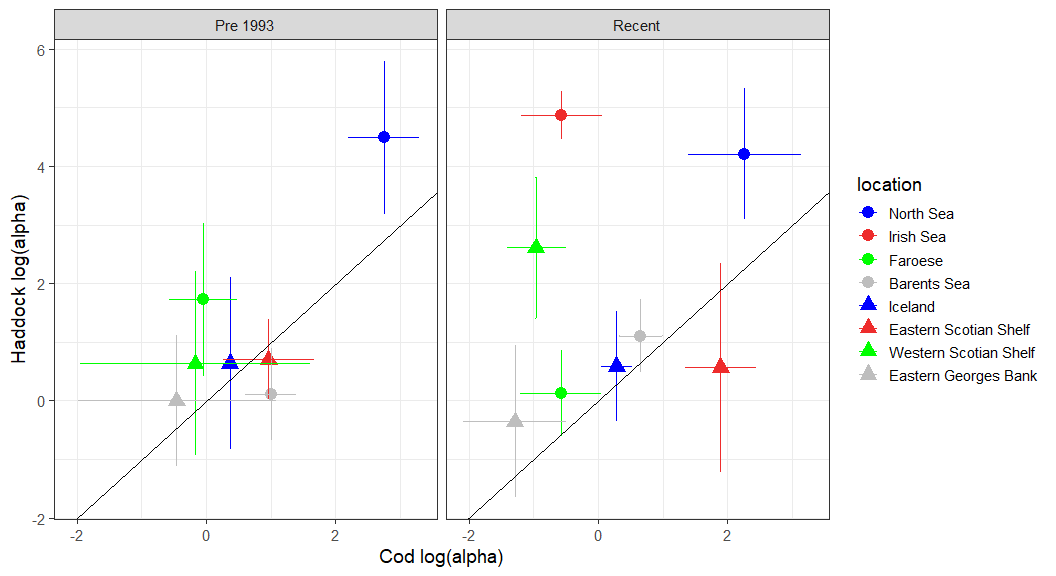


Figure 1.9: Estimated log(alpha) from Ricker Stock Recruitment models for each stock in the Pre 1993 and Recent period.

**This figure is the frequency of the SSB data by stock and era showing where data lands in terms of SSB, I show figure with 20% and 40% cut offs., data is binned into 10 bins (so about every 0.1 is a bin)**

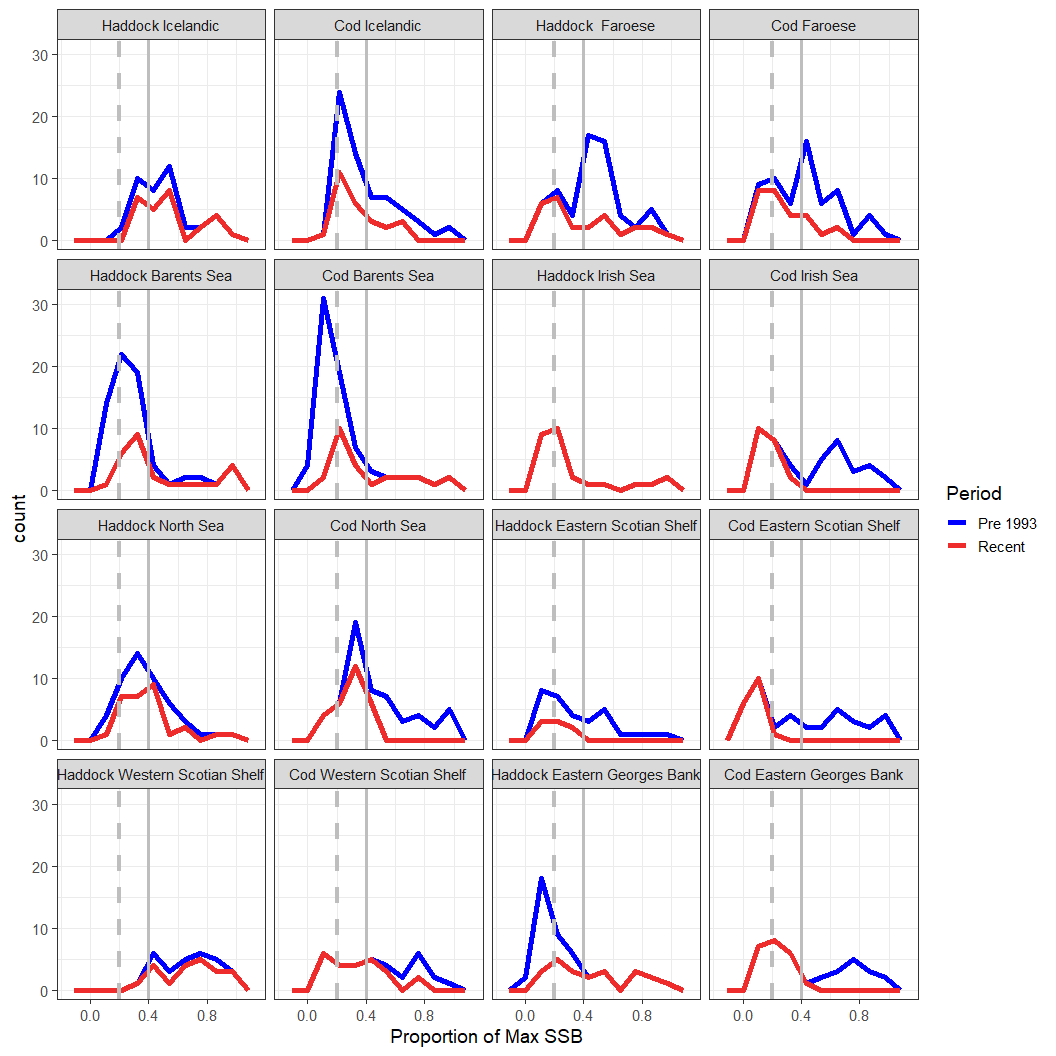


Figure 1.10: Here is a density plot of the SSB values by each period. Vertical grey dashed line is the SSB of 0.2 while the grey solid vertical line is 0.4.

**“Alpha” using the mean of the log(Rec/SSB) for SSB of <= 0.2 of maximum SSB**

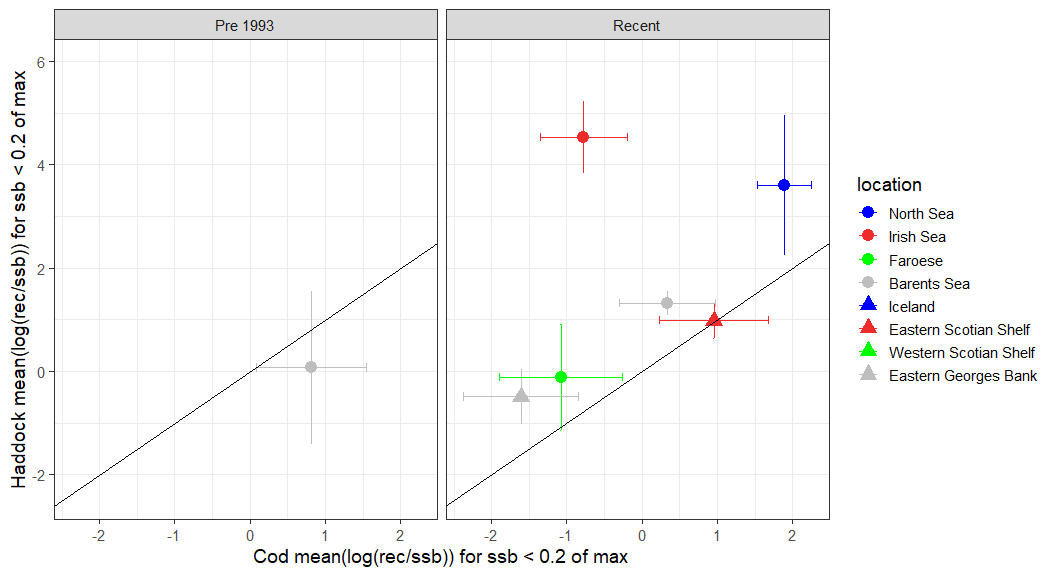


Figure 1.11: The mean log(Rec/SSB) when SSB is <= 0.2 of maximum ssb

**“Alpha” using the mean of the log(Rec/SSB) for SSB of <= 0.4 of maximum SSB**

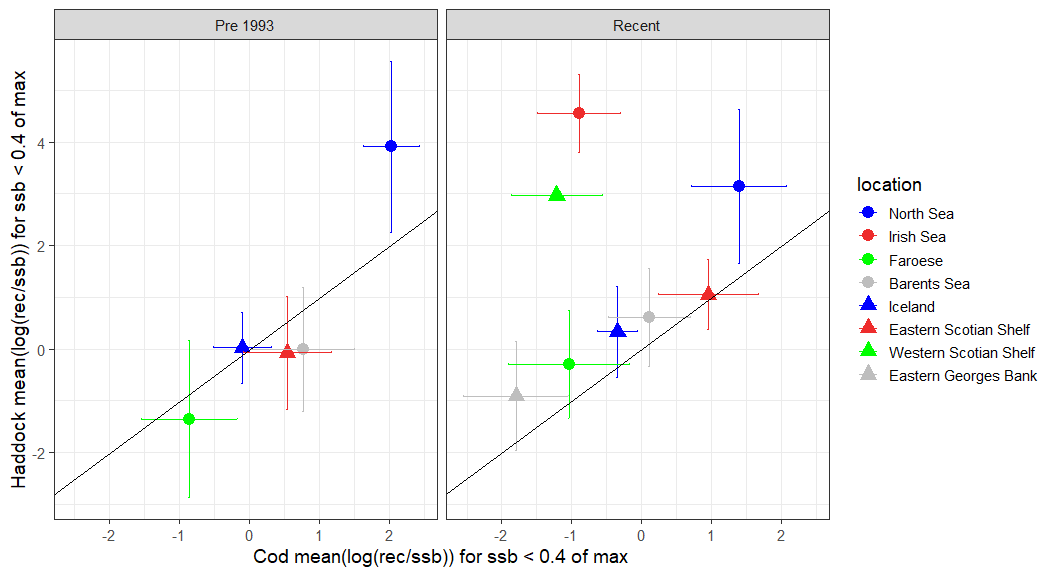


Figure 1.12: The mean log(Rec/SSB) when SSB is <= 0.2 of maximum ssb

# 2 Appendix

**The fits of the Ricker S-R model, first is the one with two periods**

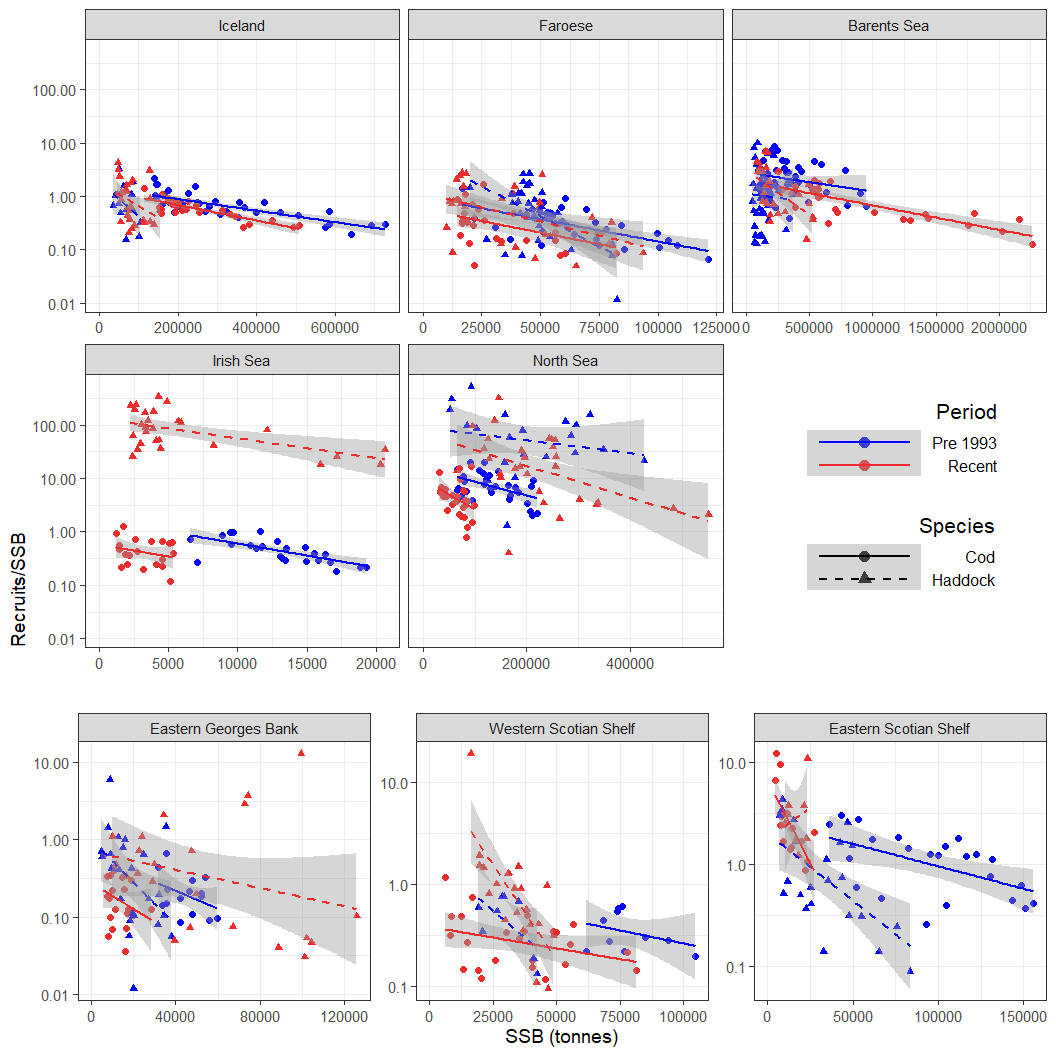


Figure 2.1: Recruits/SSB (log scale) vs SSB, Linear model fit on log(10) scale with Alpha calculated for pre 1993 and recent periods

**Now the S-R model with just the one period**

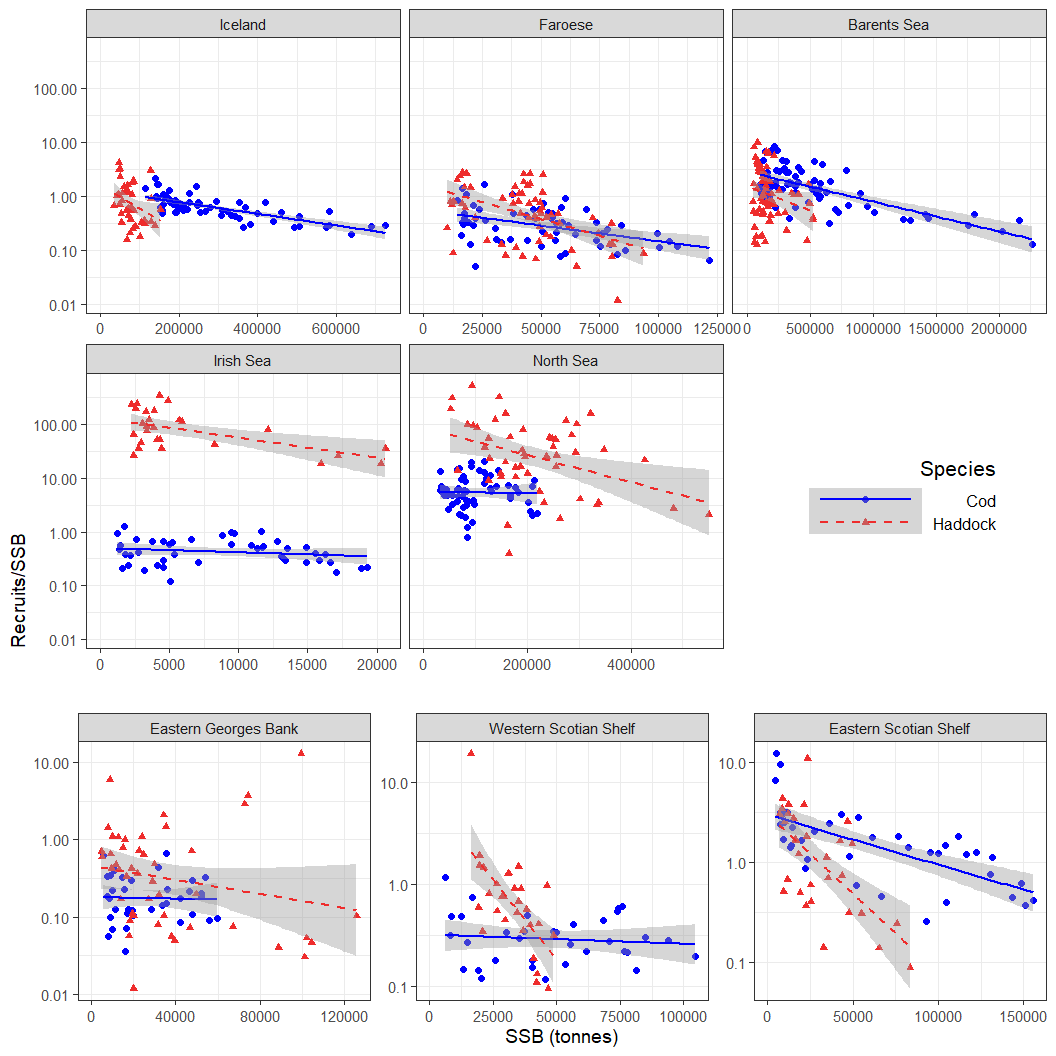


Figure 2.2: Recruits/SSB (log scale) vs SSB, Linear model fit on log(10) scale with no differentiation between Periods. Used for Residual analyses.

**Here are the GAM fits from the Recruit time series, GAMs were fit on the log scale**

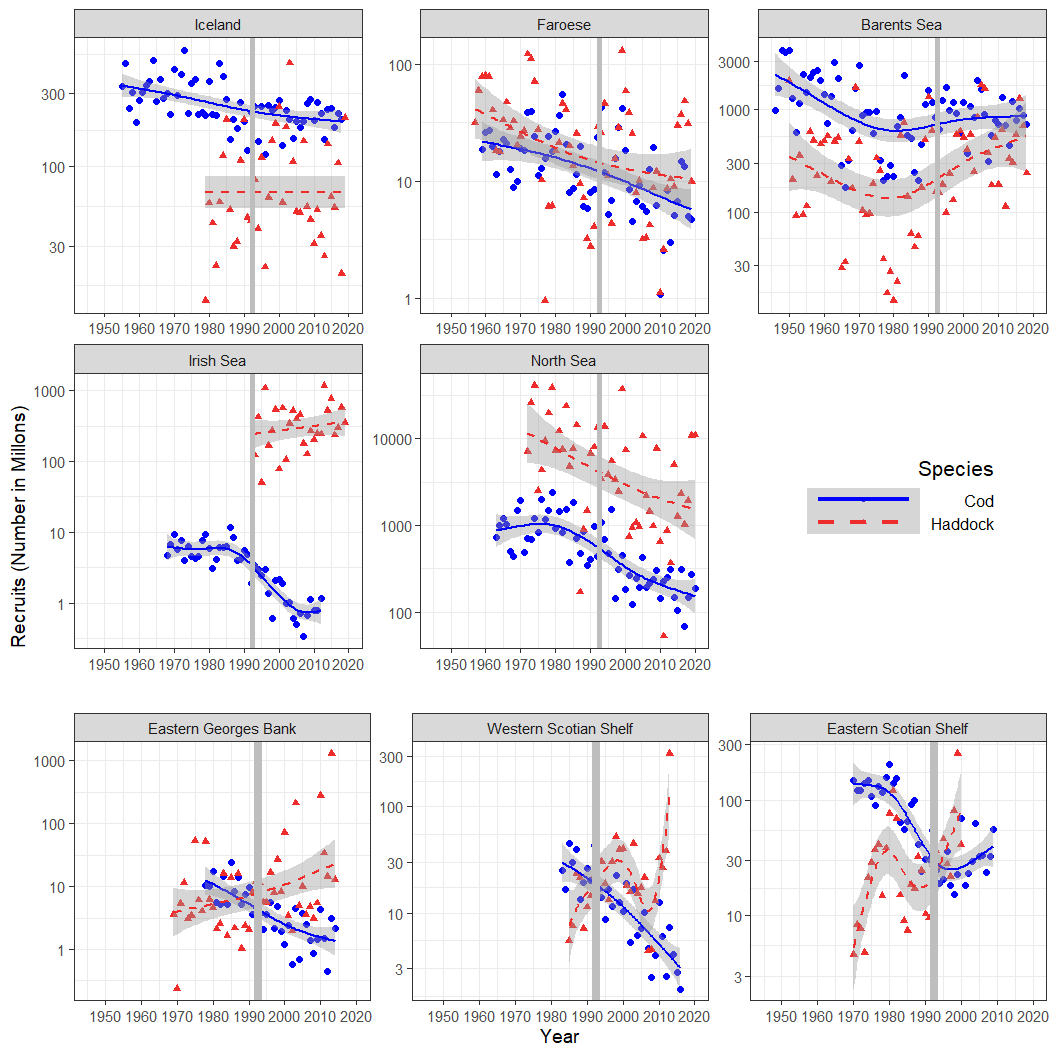


Figure 2.3: Recruitment (in millons) time series for 8 Atlantic Cod and Haddock stocks in the Atlantic Ocean. The vertical grey line indicates the division between the two periods. The lines are the GAM fits with 95% CI in the shaded region

**We can make a cross-correlation figure by region to if we want**

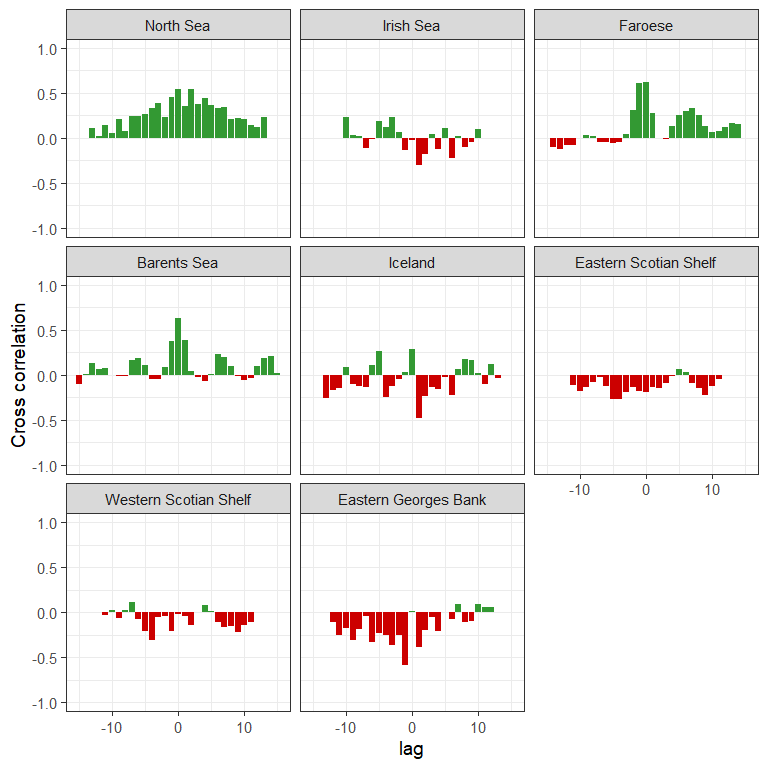


Figure 2.4: Cross correlation of recruitment time series for all location.

**ACF figure for the full SR model residuals**

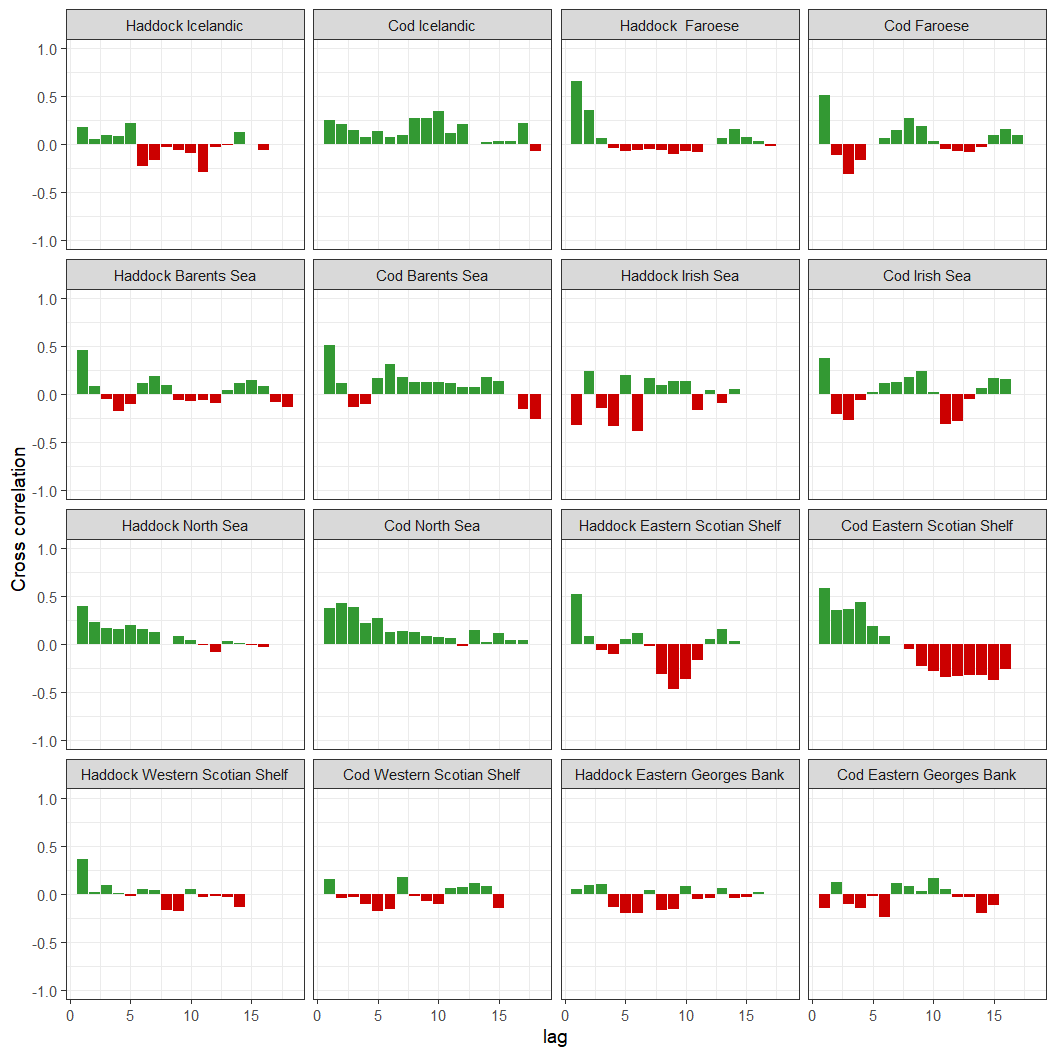


Figure 2.5: Autocorrelation of recruitment residuals from the full stock recruitment model for each stock.

\*\* ACF figure for the GAM model residuals\*\*

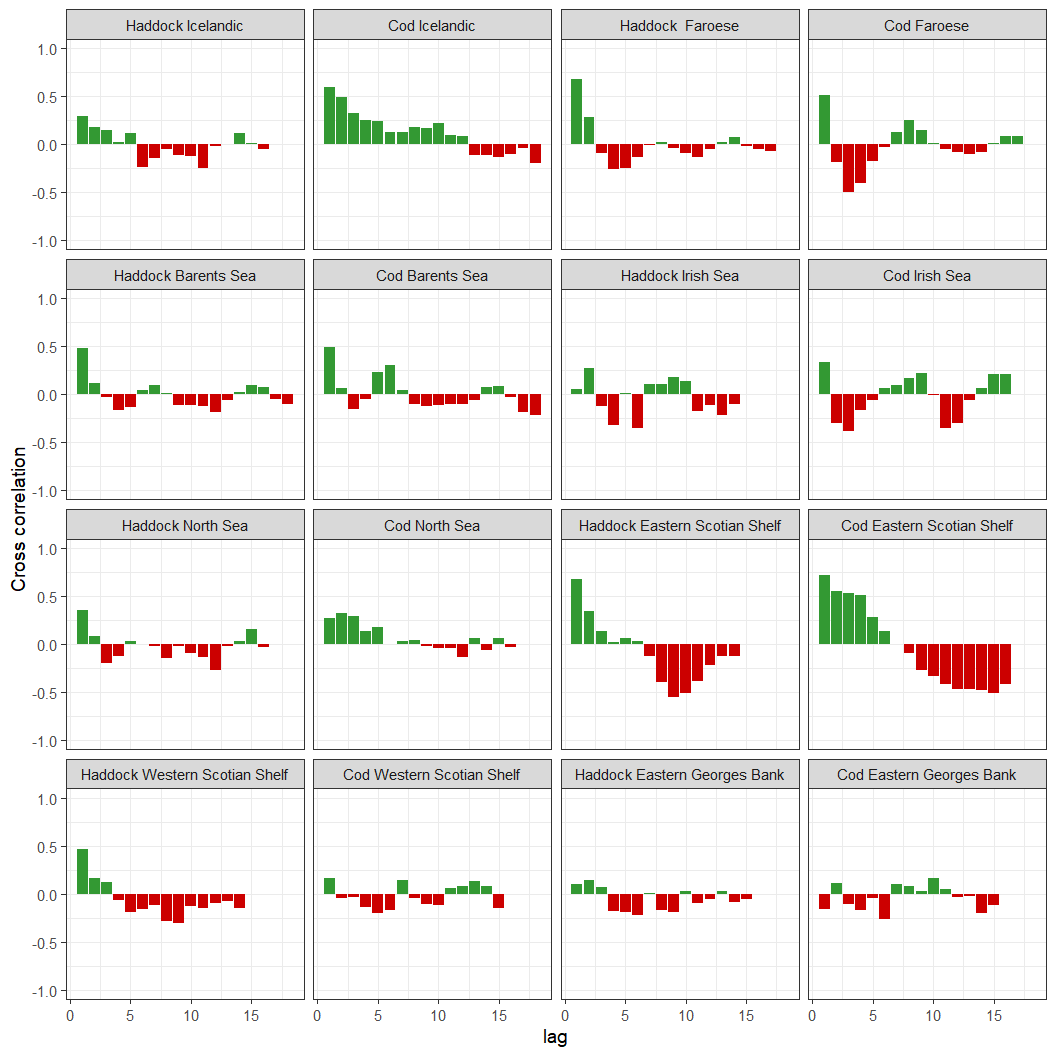


Figure 2.6: Autocorrelation of recruitment residuals from the GAMs for each stock.