Methods:

A series of two-sample Kolmogorov–Smirnov (KS) tests was used to detected differences in total length and year one ring length between locations. More specifically, ten individual KS tests were used for each pairwise comparison of five locations, yielding ten pairwise comparisons. A Bonferroni correction was applied for multiplicity (0.05 / 10 comparisons), yielding an alpha of 0.005. This approach was conducted on total lengths and again year one ring lengths. This approach was then repeated to test for differences in size distributions between years. Six years were used, yielding an alpha of 0.003 (0.05 / 15 comparisons). In other words, to test for spatial differences, data from different years were grouped together. And to test for temporal differences, data from locations were grouped together. Density ridge plots were used to visualize size distributions by location and year.

To test the hypothesis that the number of days past the start of fall leads to increases in fecundity, a beta regression model was used to predict proportion of ripe scallops as a function of the number of days (on the date of sampling) past September 30.

To test the hypothesis that fecundity in the fall affects the relative abundance of scallops with small annual growth rings the following year, a beta regression model was used to predict the proportion of scallops with small annual growth the rings the following year as a function of proportion of ripe the scallops the previous year. When more than one location was sampled during an individual year, the mean of all locations was used for that given year.

Results:

The total length size distribution was significantly different at Hogneck than all other sites, with no other significant differences between sites (Table 1, Fig 1). More specifically, median total length at Hogneck was higher than that of all locations (Fig. 1). All locations yielded unimodal total lengths distributions with a mode between 60 and 70 mm (Fig. 1). The year one ring length distribution was significantly different between all pairs of sites, other than Hallock-Alewife (Table 2). Although it should be noted that while the KS test yielded no significant differences between these two sites (due to their well aligned median year one ring lengths), Alewife displayed a uniquely bimodal distribution (Fig. 1). Alewife yielded a year one right length distribution with two distinct modes, one at ~5 mm and another at ~40 mm (Fig. 1). Barcelona yielded a major mode at ~45 mm and a smaller mode at ~15 mm (Fig. 1). The three remaining locations yielded clear unimodal distributions for year one ring length, with Hogneck having the highest mode and median year one ring length and the lowest amount of scallops with small (> 20 mm) year one ring lengths (Fig. 1).

Median and mode total length generally increased with time from 1991 to 2008 (Fig. 2). The size distribution between pairwise combinations of years was significantly different between most pairs of years, other than four pairs that was close together through time including 1998-1999, 1998-2001, 1999-2001 and 2006-2008 (Table 3). Year one ring length patterns through time were relatively complicated, but significant differences in distributions were detected among all pair of years other than 1998-2001 and 2006-2008 (Fig. 2, Table 4). The two most recent years (2008 and 2006) yielded the highest median and mode year one rings lengths of ~45 and ~50 mm, respectively (Fig. 2). 2006 was clearly unimodal but 2008 yield a small second mode near year one right lengths of ~15 mm (Fig. 2). More distinct bimodal distributions were present for 1998, 1999 and 2001(Fig. 2). The highest mode occurred between ~35-40 mm for 1999 and 2001, but the highest mode occurred near ~18 mm for 1998 (Fig. 2). Similar to 2006 and 2008, 1991 yielded a clear mode year one ring length of ~48, but also yielded a small second mode near 25 mm (Fig. 2).

The number of days past the start of fall significantly affected (p = 2.2e-4, R^2 = 0.25, n = 28) the percent of ripe scallops (i.e., fecundity), with a higher number of days past September 30 leading to a higher percent of ripe scallops (Fig. 3).

The percent of ripe scallops the previous year significantly affected (p = 0.0009, R^2 = 0.53, n = 14) the percent of scallops with small (> 20 mm) growth rings the following year, with a higher percent of ripe scallops leading to a higher percent of scallops with small growth rings (Fig. 4).

Tables:

Table 1: Pairwise Krusktal-Wallis test output for pairwise comparisons of total shell length by site.

	Hallock	Hogneck	Barcelona	Alewife
Hogneck	<2.2e-16			
Barcelona	0.030	<2.2e-16		
Alewife	0.261	<2.2e-16	0.083	
Orient	0.601	<2.2e-16	0.016	0.358

Table 2: Pairwise Krusktal-Wallis test output for pairwise comparisons of year one size by site.

	Hallock	Hogneck	Barcelona	Alewife
Hogneck	<2.2e-16			
Barcelona	<2.2e-16	<2.2e-16		
Alewife	0.640	<2.2e-16	<2.2e-16	
Orient	<2.2e-16	<2.2e-16	<2.2e-16	1.4e-11

Table 3: Pairwise Krusktal-Wallis test output for pairwise comparisons of total shell length by year.

	1991	1998	1999	2001	2006
1998	<2.2e-16				
1999	3.04e-15	0.118			
2001	3.06e-11	0.045	0.581		
2006	<2.2e-16	<2.2e-16	<2.2e-16	<2.2e-16	
2008	<2.2e-16	<2.2e-16	<2.2e-16	<2.2e-16	0.095

Table 4: Pairwise Krusktal-Wallis test output for pairwise comparisons of year one ring size by year.

	1991	1998	1999	2001	2006
1998	<2.2e-16				
1999	3.86e-6	<2.2e-16			
2001	<2.2e-16	0.196	1.5e-14		
2006	2.1e-15	<2.2e-16	<2.2e-16	<2.2e-16	
2008	9.5e-7	<2.2e-16	<2.2e-16	<2.2e-16	0.056

Figures:

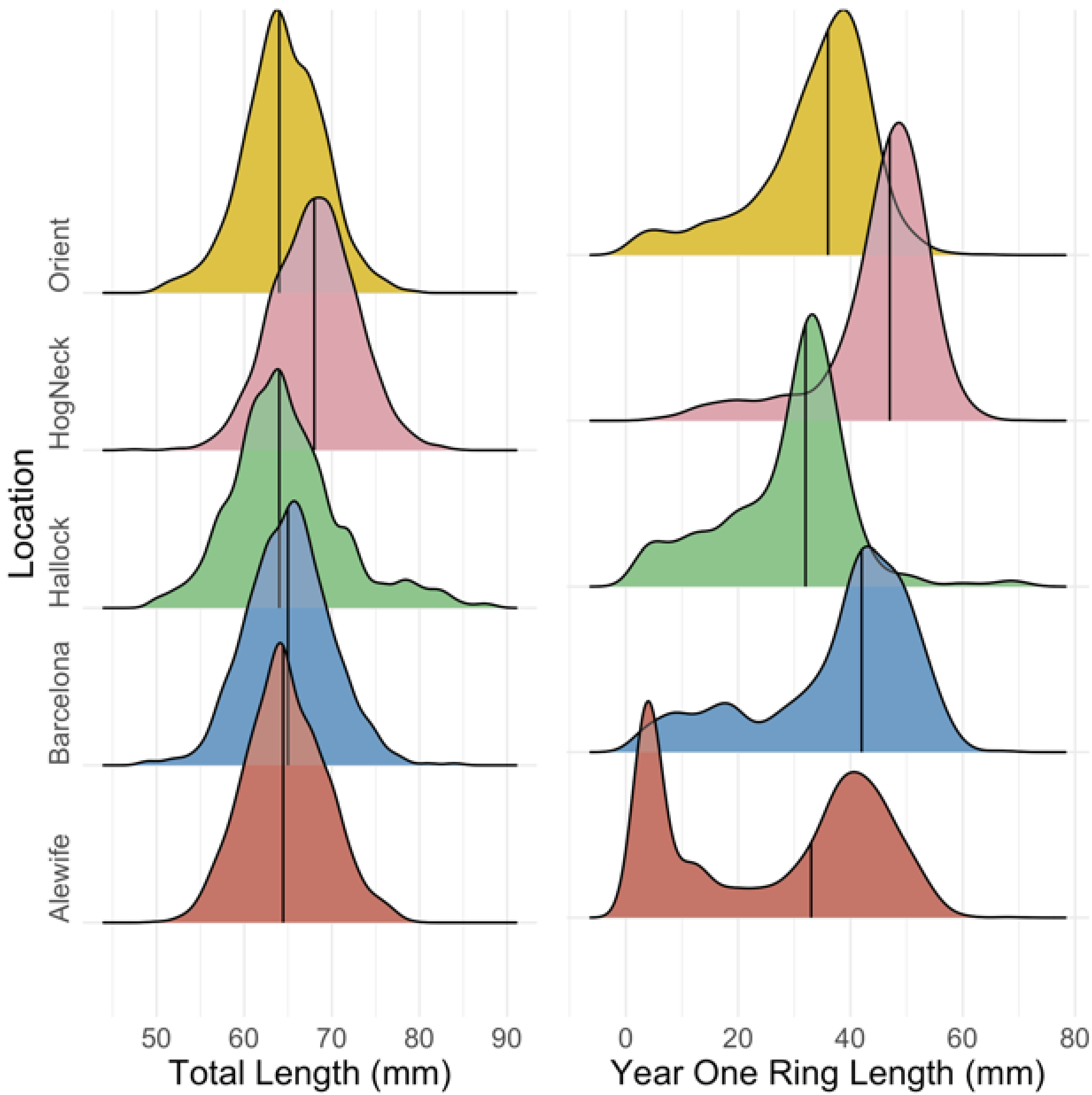

Figure 1: Density ridge plots for size distribution for scallop total length (mm, left) and scallop year one right length (mm, right) for six different years. Solid vertical lines denote median lengths.

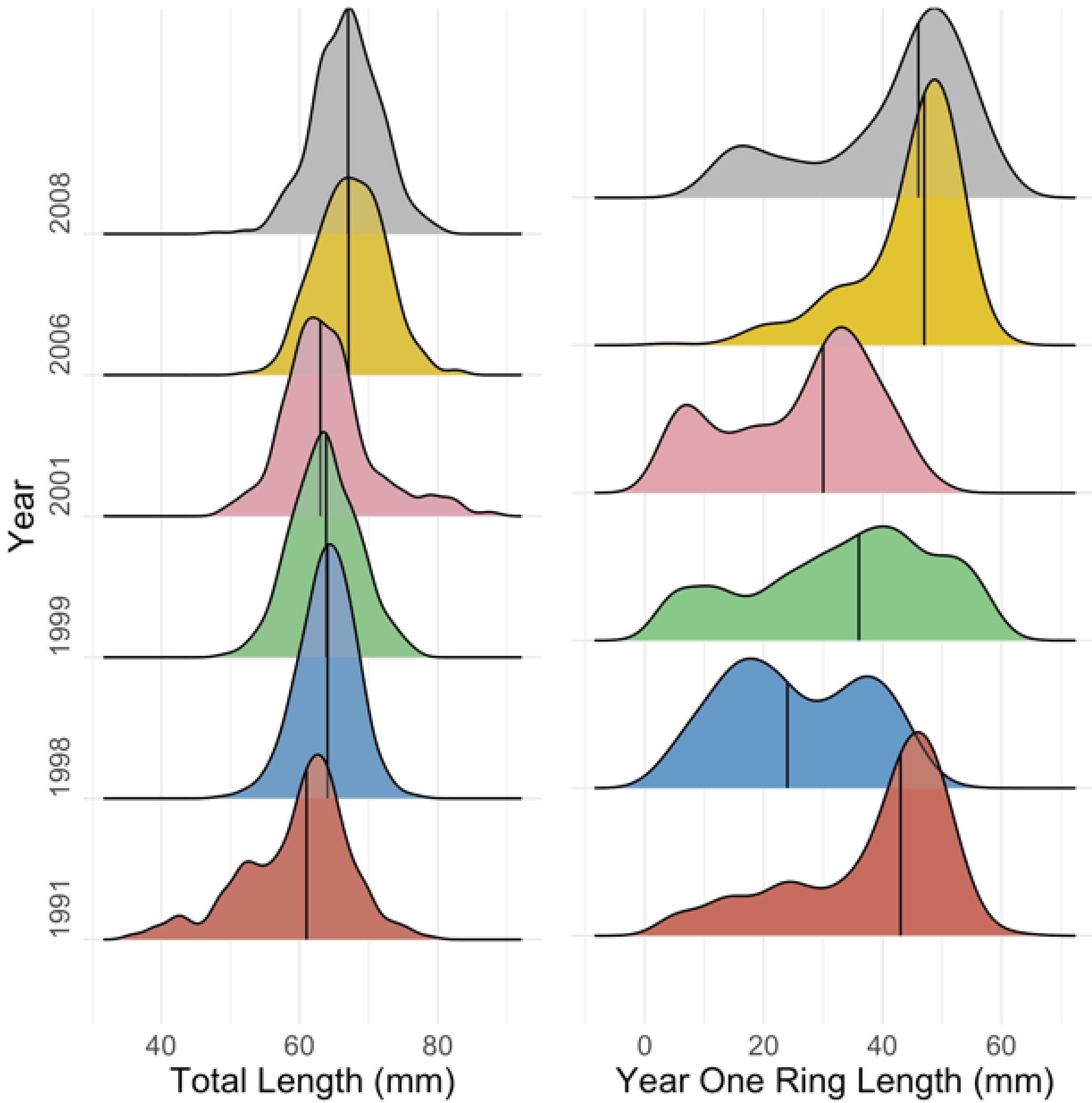

Figure 2: Density ridge plots for size distribution for scallop total length (mm, left) and scallop year one right length (mm, right) for six different years. Solid vertical lines denote median lengths.

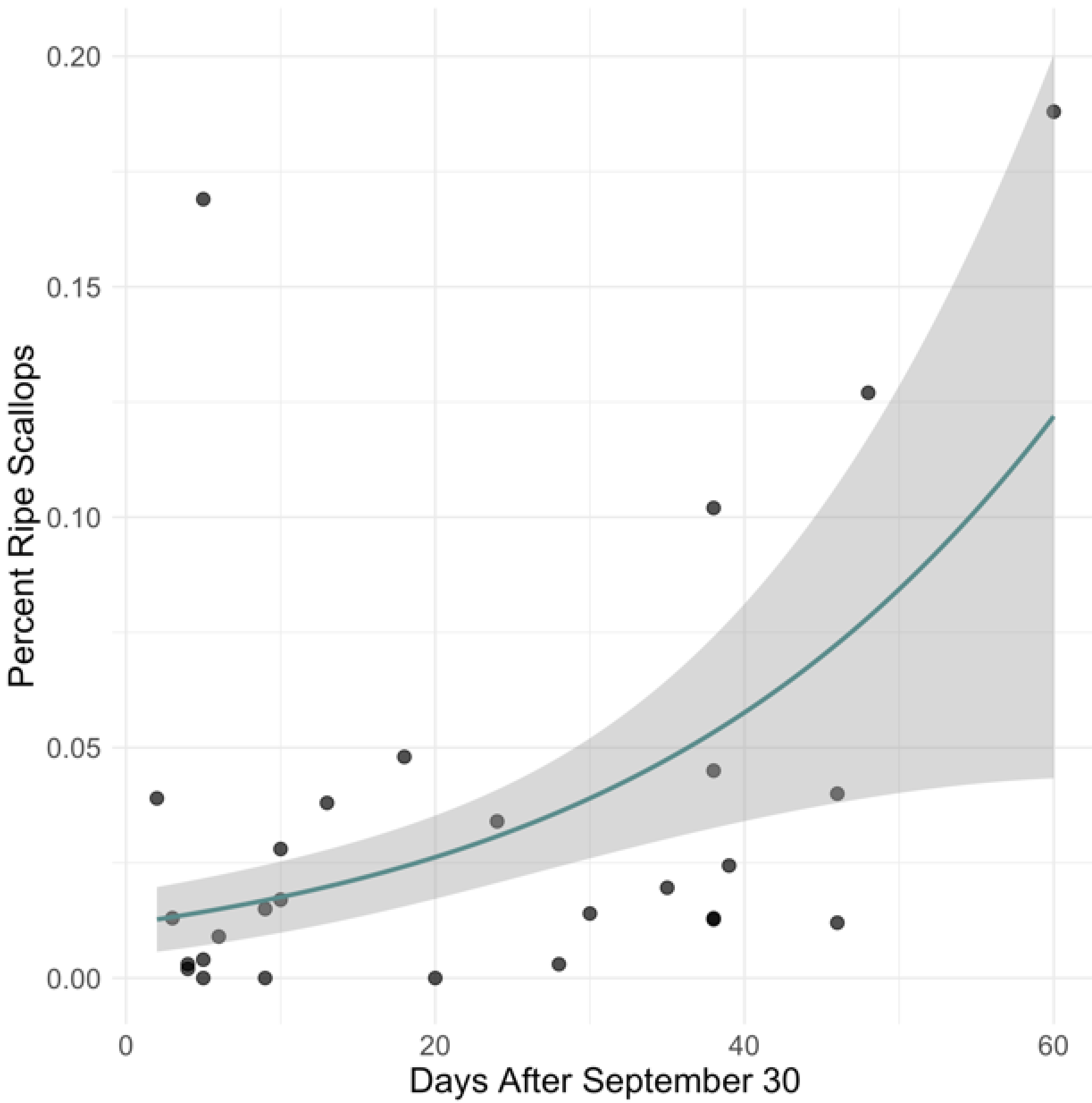

Figure 3: The percent of ripe scallops in the fall as a function of number of days into the fall (i.e., after September 30), modeled by a beta regression. Shaded regions represent 95% confidence intervals.

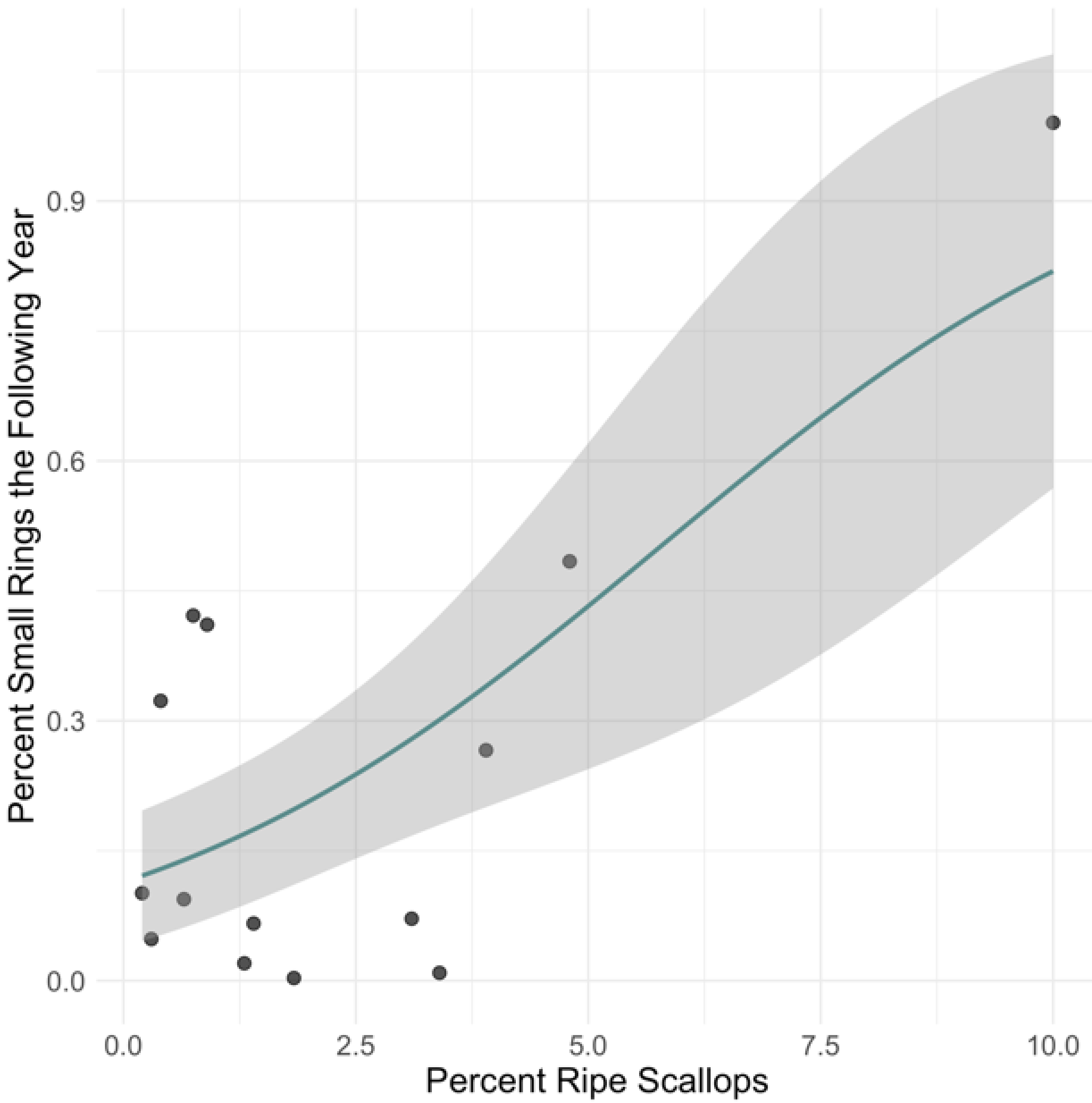

Figure 4: The percent of scallops with small rings the following year as a function of the percent of ripe scallops in the fall of the previous year, modeled by a beta regression. Shaded regions represent 95% confidence intervals.