An analysis of Georges Bank windowpane monthly catch per tow in Closed Area 2 from the scallop dredge bycatch survey

Prepared for the Groundfish PDT

By

Steven Correia

Massachusetts Division of Marine Fisheries

September 27, 2012

The research set aside project: Optimizing the Georges Bank Scallop Fishery by Maximizing Meat Yield and Minimizing Bycatch conducted standardized survey of bycatch in scallop trawls in closed areas I and II in 2010-2012 provides estimates of windowpane catches. I used a dataset provided by Deirdre Boelke (NEFMC) to estimate differences in monthly catches of windowpane in the study area. The dataset consists of only "standardized selected" stations (Figure 2, Table 1) as described in (Smolowitz et al, 2012). Focusing on windowpane catch per tow rather than the windowpane: scallop discard ratio, eliminates the confounding effects of changes in scallop yields on the seasonal availability of windowpane in the closed areas.

Closed Area II

month	2010	2011	year 2012
Jan	0	0	28
Feb	0	0	28
Mar	0	28	28
Apr	0	28	28
May	0	28	0
June	0	28	0
July	0	28	0
Aug	0	28	0
Sept	0	28	0
Oct	28	28	0
Nov	0	0	0
Dec	0	28	0

Table 1. Count of sampling "standardized selected" stations by area, month and year. These totals do not include station 218, which was sampled in all months in 2011 but not 2012.

Methods

The number of stations sampled varied by month and year, with incomplete sampling in all years. Sampling occurred in all months but January, February and November in 2011 (Table 1). I used an analysis of variance to compare windowpane catch per tow by month for 2011 for "standardized selected" stations only. This eliminates the confounding year effects with month effects for incomplete sampling years of 2010 and 2012.

The windowpane data are significantly different from normal and monthly variances are heterogeneous and do not meet assumptions of either the ANOVA or the Tukey range test. Therefore, I used the Kruskal-Wallace non-parametric test to test for homogeneity of location of windowpane catch rates by month. I used pairwise Wilcoxon tests to test for shifts in location of catch rates by month and controlled the family-wise error rate at 5% using Bonferroni adjustment procedure to account for the 36 A-posteriori monthly comparisons.

Results

Boxplots of the windowpane catch per tow by month for closed Area II in 2011 are shown in Figure 1. The distributions of catch rates are shifted higher in March, April and May relative to summer months of June, July and August. Catches distribution are shifted higher for October and December compared with the summer months. The inter-quartile range of the distributions appears relatively heterogeneous for all months. No sampling occurred in January, February or November in 2011.

An ANOVA of windowpane catch per tow rates for closed area II indicated significant month effect (Table 2). Diagnostics indicated that distribution of residuals was significantly different from normal and variances were heteroscedastic. Differences between monthly mean catch rates are shown in Table 3. Confidence limits and p-values are not provided as inference from the Tukey-Range test is not likely valid giving inability for these data to meet assumptions of the test.

Results from the Kruskal-Wallace test (p<0.001) indicated that location was heterogeneous among months. Pairwise Wilcoxon tests (Table 4 and Table 5) resulted in significantly median differences in location for 22 out of 36 monthly comparisons. Note that many ties occur in the ranking of monthly catch per tow, mostly because of many zero catch values. Probability values from the Wilcoxon test are not exact because of ties. However, the confidence intervals are constructed using a different algorithm than p-values derived from the distribution of Wilcoxon test statistics. Months with significant differences in location can be determined by having confidence intervals that do not overlap zero. The paired month comparisons with significant median differences in location are the same whether P-values are used or confidence intervals that do not overlap zero criteria are used to make inferences in shifts in location.

Windowpane catch rates in March were higher than all other months. April was also significantly higher than all months but December. Median difference in location was significantly higher in May than June, August and September. However, the shifts in location were small (1 lb). Median differences in location were higher in December compared to June, July, August, September and October. For closed area II, monthly catch per tow for windowpane is higher during spring months (March-May) compared with catch per tow during summer months (June-October).
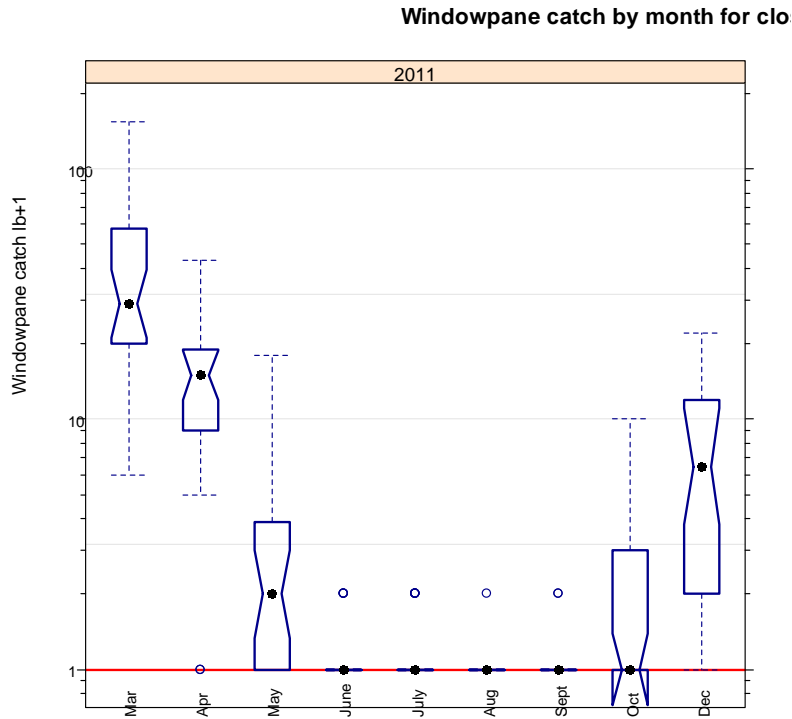
Figure 1. Boxplots of windowpane catch (lb+1) for standardized selected stations in closed area II by month for 2011. Y-axis scale is logarithmic. Black dots are medians and non-overlapping notches indicate approximately 95% confidence interval for differences in median. Folded notch for October indicates that notch for that month may not be reliable as indicator of differences in median. Red line is median yellowtail catch rate for all months pooled. No sampling occurred in January, February or November in 2011.

	DF	Sum sq	Mean square	F-value	P(>F)
Month	8	39694	4962	31.96	<0.001
Residuals	243	37722	155		

Table 2. Summary results of ANOVA of windowpane catch per tow by month for closed area II for 2011.

	monthly mean	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
		no data	no data	40.5	14.4	2.9	0.1	0.2	0.0	0.1	1.3	no data	7.3
Jan	no data	0	na	na	na	na	na	na	na	na	na	na	na
Feb	no data	na	0	na	na	na	na	na	na	na	na	na	na
Mar	40.5	na	na	0.0	-26.1	-37.7	-40.4	-40.3	-40.5	-40.5	-39.3	na	na
Apr	14.4	na	na	26.1	0.0	-11.6	-14.3	-14.2	-14.4	-14.4	-13.1	na	na
May	2.9	na	na	37.7	11.6	0.0	-2.7	-2.6	-2.8	-2.8	-1.6	na	na
Jun	0.1	na	na	40.4	14.3	2.7	0.0	0.1	-0.1	-0.1	1.1	na	na
July	0.2	na	na	40.3	14.2	2.6	-0.1	0.0	-0.2	-0.1	1.1	na	na
Aug	0.0	na	na	40.5	14.4	2.8	0.1	0.2	0.0	0.0	1.3	na	na
Sep	0.1	na	na	40.5	14.4	2.8	0.1	0.1	0.0	0.0	1.2	na	na
Oct	1.3	na	na	39.3	13.1	1.6	-1.1	-1.1	-1.3	-1.2	0.0	na	na
Nov	no data	na	na	na	na	na	na	na	na	na	na	0	na
Dec	7.3	na	na	33.3	7.1	-4.4	-7.1	-7.1	-7.3	-7.2	-6.0	na	0

Table 3. Difference between monthly column mean and monthly row means for in closed area II in 2011. Monthly mean catch per tow are in lb. na indicates that sampling did not occur during that month in 2011.

Month pair	Median difference	Lower limit	Upper limit	P-value
March-Aug	28.00	20.00	54.00	<0.001
March-Sept	28.00	20.00	54.00	<0.001
March-June	28.00	20.00	54.00	<0.001
March-July	28.00	19.00	54.00	<0.001
April-Aug	13.51	8.00	18.00	<0.001
March-Oct	27.00	18.00	54.00	<0.001
April-Sept	13.49	8.00	18.00	<0.001
April-June	13.45	8.00	18.00	<0.001
April-July	13.40	8.00	18.00	<0.001
March-May	27.00	15.00	53.00	<0.001
Aug-Dec	-5.00	-11.00	-1.00	<0.001
Sept-Dec	-5.00	-11.00	-1.00	<0.001
April-Oct	13.00	6.00	17.00	<0.001
June-Dec	-5.00	-11.00	-1.00	<0.001
March-Dec	22.00	9.00	48.00	<0.001
July-Dec	-5.00	-11.00	-1.00	<0.001
April-May	11.00	4.00	16.00	<0.001
May-Aug	1.00	0.00	2.00	<0.001
Oct-Dec	-5.00	-11.00	0.00	<0.001
May-Sept	1.00	0.00	2.00	<0.001
March-April	16.00	3.00	42.00	<0.001
May-June	1.00	0.00	2.00	<0.001
Aug-Oct	0.00	-2.00	0.00	0.001
Sept-Oct	0.00	-2.00	0.00	0.003
May-Dec	-4.00	-10.00	0.00	0.004
May-July	0.00	0.00	2.00	0.004
April-Dec	7.00	-1.00	14.00	0.004
June-Oct	0.00	-1.00	0.00	0.017
July-Aug	0.00	0.00	0.00	0.047
July-Oct	0.00	-1.00	0.00	0.059
July-Sept	0.00	0.00	0.00	0.134
June-Aug	0.00	0.00	0.00	0.169
May-Oct	0.00	-1.00	2.00	0.253
June-Sept	0.00	0.00	0.00	0.400
June-July	0.00	0.00	0.00	0.497
Aug-Sept	0.00	0.00	0.00	0.571

Table 4. Summary of results from pairwise Wilcoxon test for paired monthly windowpane catch per tow in closed area II in 2011. Cells with yellow highlighting have median difference (first month – second month) in location that is significantly different from 0 using a Bonferroni adjusted critical value (1.004) to obtain a family-wise error rate of 5%. Cells with pink highlighting have significantly different location, but the magnitude of difference is small. Confidence limits are also adjusted for family-wise error rate using Bonferroni adjustment to the 95% confidence limits (adjusted to a 0.9986 CI).

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Jan	**0**											
Feb	**na**	**0**										
Mar	**na**	**na**	**0**									
Apr	**na**	**na**	16	**0**								
May	**na**	**na**	27	11	**0**							
Jun	**na**	**na**	28	13	1	**0**						
July	**na**	**na**	28	13	0	0	**0**					
Aug	**na**	**na**	28	14	1	0	0	**0**				
Sep	**na**	**na**	28	13	1	0	0	0	**0**			
Oct	**na**	**na**	27	13	1	0	0	0	0	**0**		
Nov	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**0**	
Dec	**na**	**na**	22	7.0	-4	-5	-5	-5	-5	-5	**na**	**0**

Table 5. Median difference of catch per tow distribution (lb) from Wilcoxon test (column month-row month). Cells with yellow highlights have a statistically significant shift in location using Bonferroni adjusted critical value. Cells with pink highlights are also statistically significant shift in location, but median differences in locations are small. No sampling in January, February and November in 2011 in Closed Area II.
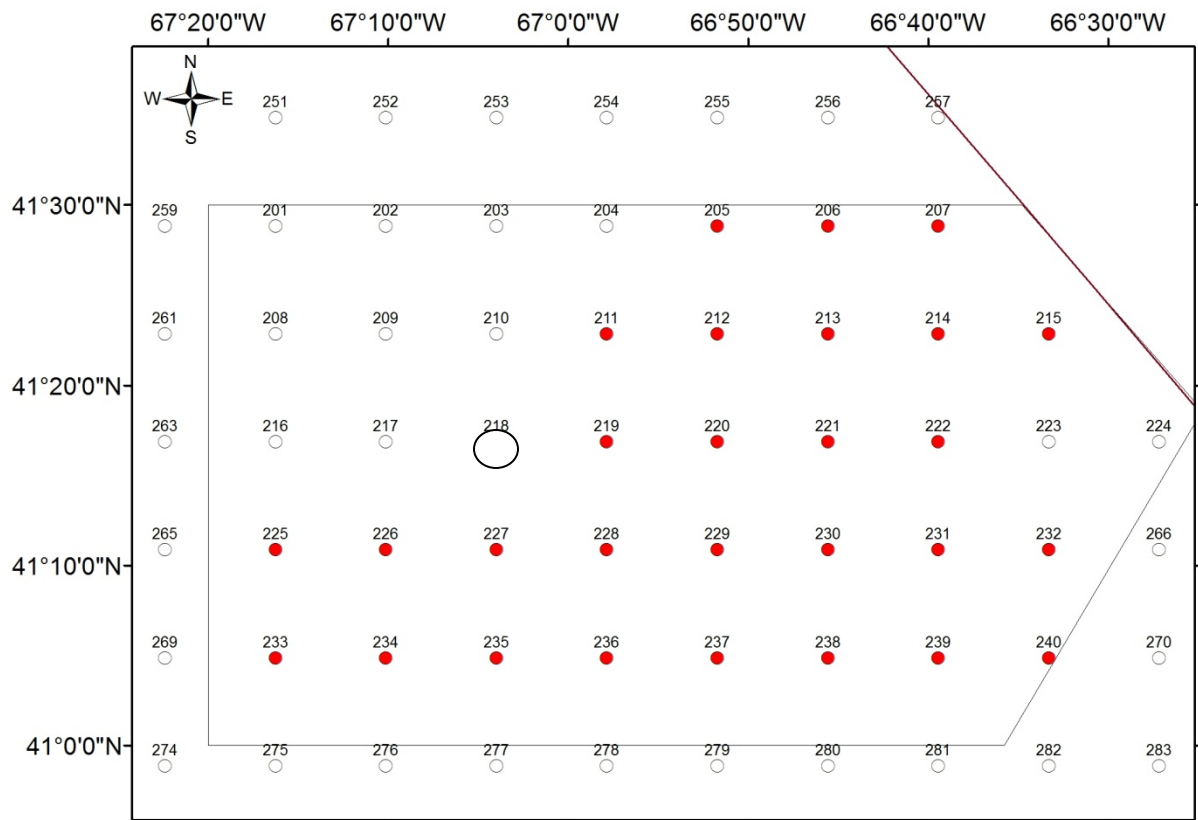
Figure 2. Station locations within Closed Area II. Red dots indicate consistently sampled stations that were used in the analysis. Open dots represents stations that were dropped during the study. Note that station 218 was not included in the analysis of windowpane because it was not included in the standard

Literature cited

Smolowitz, R.; Goetting, K.; Davis, F.; and Ward D. (May 2012).   Optimizing the Georges Bank Scallop Fishery by Maximizing Meat Yield and Minimizing Bycatch. Final Report.