

Lobster Quality

Preseason Sampling Program

Southwest Nova Scotia LFA33 & LFA34

Preseason Summary Report

November 2022

Submitted by:

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2022 LFA 33 & 34 LOBSTER QUALITY

HIGHLIGHTS FOR 2022

Preseason sampling took place from late August to mid-November during periods of good weather, calm seas. 4 sampling areas with inside-outside sampling locations (8 in total) in LFAs 33 & 34 (see map below). 50 sampling dates and 7,283 lobster samples taken.

Protocol calls for 150 lobster samples per date collected for lobster sex, size, blood protein (BRIX), hardness, moult stage, and egg-bearing status. The focus of this report is on BRIX trend over time and by location.

In 2022, there is evidence that warm water conditions have led to uncertain lobster moult activity that may confound expected quality from elevated BRIX levels. Increased sampling landings and higher percent weaks and soft-medium lobster suggest quality may be lower than anticipated.



2022 LMQ Sampling Area- 4 areas ; 8 sampling locations 4- INSIDE and 4- OUTSIDE August-November 2022. See also map detail on p.3.

This report summarizes results of preseason at-sea sampling in 8 locations within LFA33 and LFA34 from August 29 to November 16, 2022. This sampling represents a continuation of the longstanding Atlantic Lobster Moulting and Quality Project (ALMQ) 17-year longitudinal database that has continued uninterrupted since 2006.

Preseason sampling was conducted by Coldwater Lobster Association in 8 different locations – the designated ‘inside’ and ‘outside’ areas of Lobster Bay, St. Mary’s Bay, Yarmouth in LFA34, and Port La Tour in LFA33. Data analyses were carried out with the cooperation of the Centre de recherche marine/Marine Research Centre of the Université Sainte-Anne, Petit de Grat Campus. The 2022 preseason survey analysis on the status and prediction of lobster quality for the upcoming 2022-2023 commercial season was developed by the Centre de recherche marine/Marine Research Centre in collaboration with Coldwater Lobster Association and member partners of the southwest Nova Scotia lobster industry. We acknowledge this opportunity to maintain the ALMQ longitudinal database and to develop it for the future use by the industry.

The Université Sainte-Anne Lobster Quality Research and Innovation Centre (LQRIC) acknowledges – with gratitude – the financing for this project as a Scientific Partnership Grant from the Atlantic Fisheries Fund (AFF) award for 2020-2023 as well as the continuing support of Fisheries and Oceans, Canada, the Nova Scotia Department of Fisheries and Aquaculture and our industry partners.

As in previous years, individual lobster data on blood protein level (measured via a refractometer as the BRIX Index – Figure 4 below), manual shell hardness (soft, medium or hard), moult stage (from selected lobster pleopod examination under a microscope), carapace length, and sex data were collected manually for 7,283 individual lobster samples over each of 50



Figure 1. Lobster preseason sampling equipment.

location-dates. These data represent determinants of lobster quality that designate suitability for live lobster storage and shipping, and lobster meat content for a superior dining experience. These data are provided as indicators to the Nova Scotia lobster industry about the early season status of the post-moult lobster harvest in the designated sampling subareas of LFAs 33 & 34.

The results presented here focus on the distribution of the recorded BRIX levels for 2022 compared to past years' samples from the same preseason time and sampling locations over the full ALMQ database period 2006-2022. This information enables the industry to compare the 2022 sample results to known past years of observed preseason and subsequent in-season lobster quality and status.

In 2022, as has been the protocol in the past, BRIX index values below 6.0 units/ml in the samples provide a probable indication of "Poor" quality lobster that are less than fully-meated, that are also less suitable for the live market for storage and shipping and for presentation at the dining table. BRIX index values between 6.0–7.99 are deemed as "Moderate" quality and indicate that lobsters may still be recovering from a prior moult and may still be of concern with respect to quality. BRIX levels at 8 or above are indicative of "Good" quality and are relatively more fully-meated lobsters that are more suitable for live product storage and shipping and presentation for consumption. Table I below summarizes the BRIX indicator categories used in this report.

Table I. BRIX Index Categories

Quality:	"Poor"	"Medium"	"Good"
Meat Content:	Most likely low	Not likely fully-meated	Likely fully-meated
Storage/Shipping:	Not ideal	Concerns	Likely suitable
Observed Lobster Quality Indicators:			
Blood Protein Level, BRIX index (units/ml)	Less than 6.0	6.0 to 7.99	8.0 or greater
Shell Hardness	Potentially "Soft" (2)	Potentially "Medium" (4), recovering from previous moult	Likely "Hard" (5)
Appearance	Pale colour, evidence of carapace abnormalities, and/or shell disease	Acceptable colour, little evidence of carapace abnormalities or shell disease	Spring black-bodied, few carapace abnormalities
Shape/size	Culls, misshapen claws, damage to carapace	Small size, misshapen claws, limited damage to carapace	Commercial size, good body shape

The manual assessment of shell hardness is a subjective indicator of lobster quality. Guidelines are in place for manual estimates of shell hardness on a subjective scale of 2 ("soft"), 4 ("medium"), and 5 ("hard"). While "soft" lobsters are 100% of poor quality, and "medium" lobsters are generally of mediocre quality, most sampled lobsters are subjectively judged to be "hard". In 2022, as in previous years, shell hardness measures remain poorly correlated with continuous measures of lobster BRIX levels. Shell hardness measures are effective when used together with other information, e.g., lobster appearance, shape/size, weak status, and including information on when and where lobsters are harvested. Individual indicators of quality are generally not considered as a sole determining factor in lobster quality prediction.

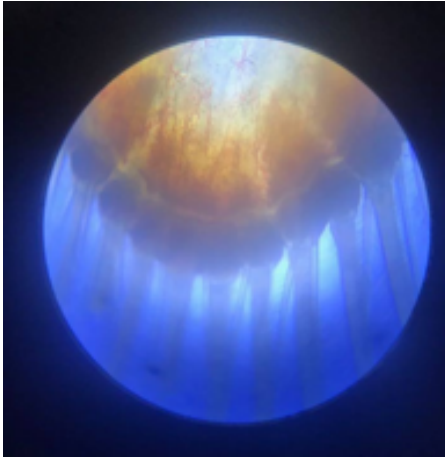


Figure 2. Lobster pleopod under microscope.

Lobster moult stage analyses are carried out on selected lobsters in each sample. As per the ALMQ sampling protocol, 30 (male and female) lobsters are selected from the sample of 150 lobsters per sampling location-date and have a pleopod removed. Each lobster's moult status is determined by microscopic analysis of the lobster pleopod (swimmeret). Moult stage levels of zero (0) indicate no moult activity is pending; advanced moult stages (3+) indicate the moult is approaching and imminent. Pleopod analysis in female lobsters may also indicate the onset of the egg bearing cycle and the presence of cement glands. Figure 2 presents a view of the lobster pleopod for interpretation of moult stage by the reader.

Overview of the 2022 Preseason Survey Results

In 2022, a total of 7,283 preseason lobster samples were taken over the 12-week period from August 29 to November 16, 2022 over 50 sample location-dates. Table 3 below presents a summary of the survey results for each of the 50 location-date samples in the survey program.

2022 Survey Sites. Figure 3 below illustrates the Google map for southwest Nova Scotia survey sites in 2022. The inserted map table on Figure 3 illustrates a survey location in Port La Tour (Inside) that took place on November 9, 2022. The interactive map enables users¹ to examine in detail each of the survey points including identification of the starting string longitude and latitude, depth, bait used, weather conditions at haul, lobsters landed, average BRIX value of the sampled lobsters, and numbers of designated weak lobsters as % of the sample.

2022 Program Participation. Sampling on the survey sites was executed with the assistance of southwest Nova lobster harvesters. These members (Table 2 below) used their fishing vessels to carry out the protocols of the ALMQ program with the assistance of the Coldwater technician. We acknowledge—with gratitude—their expertise and invaluable contribution to the ongoing work of the preseason lobster survey program in LFAs 33&34.

Table 2. Vessels Participating in the 2022 Lobster Quality Preseason Sampling Program

LOCATION	CAPTAIN	VESSEL NAME
St. Mary's Bay	M. Fry	<i>Anne Isabella</i>
Yarmouth	K. Penney	<i>Betty Ann & Brats</i>
Lobster Bay	T. d'Entremont	<i>Jane Rose</i>
Port La Tour	W. Smith	<i>Relentless Pursuit 08</i>

¹ Readers may access the [Google Map of the Lobster Preseason Survey](#) by clicking the underlined designated hyperlink. The map also displays the sites of the 2020 and the 2021 preseason surveys. For further information on accessing this map, please contact: Daniel.Lane@uSainteAnne.ca.

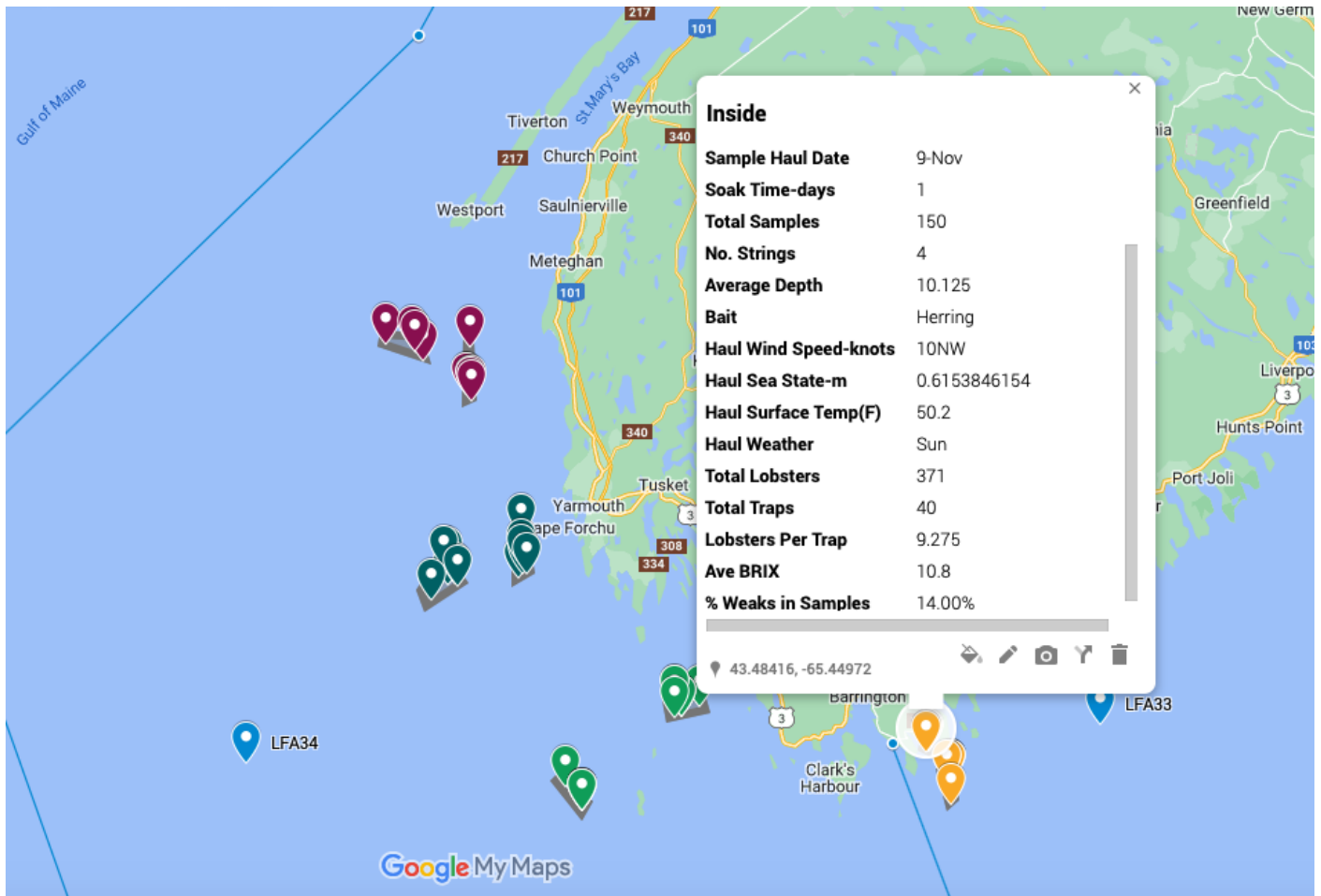


Figure 3. Map of 2022 Preseason Lobster Sampling Locations

2022 Weather Conditions. From the start of the 2022 preseason survey at the end of August, the weather was very good enabling sampling days to take place with ease and no interruptions. Late October and early November saw a change in the favorable weather conditions. Air and sea temperatures decreased and the wind blew more consistently during this period near the end of the survey. Soak times between setting and hauling



on some of these later survey location-days were of fewer hours before being hauled. This was due, once again, to taking advantage of a short weather window to complete sampling on chosen days thus lowering the overall quantity of lobsters per trawl although still maintaining the 150 legal-sized lobsters sampled as per the protocol.

With respect to lobster moulting activity and the evidence that temperature triggers moulting, it may be the case that lobsters in southwest Nova Scotia have moulted more frequently in 2022. It is at least acknowledged that the duration from the start of the period, when lobsters are expected to moult to its end has been elongated in 2022 as water temperatures warmed earlier in the Spring, and cooled off later in the Fall.

Figure 4. Blood sample used in refractometer to determine lobster blood protein BRIX level.

Consequently, some lobsters could have moulted earlier than others and, in return, could be expected to have higher BRIX levels towards the end of the preseason survey. Incidences across most locations of very high BRIX values were observed during late 2022 preseason samples toward mid-November.

Over the survey, minimal by-catch appeared in the traps (Jonah crab and cod), especially as the lobster counts increased toward the latter part of the survey. Average BRIX levels observed at the beginning of the survey, were stable for Inside areas but dropped off somewhat in the outside as more berried females, soft shell and “weak” lobsters started appearing more often in the traps. A shift from higher to lower lobster landings counts for inside areas occurred, while lower to higher counts of lobster began appearing in corresponding outside locations. This is generally consistent with the movement of lobsters in LFAs 33&34. These data are summarized in the Table 3 results below.

2022 Summary Results. In 2022, total landings (legal and sublegal lobsters) were 29,446 lobsters. This represents an increase of 24% versus last year’s landings of 23,715 lobsters and an increase of 23% over the 2020 preseason survey landings of 23,870 lobsters.

The percentage number of “soft” and “weak” lobsters observed in 2022 preseason sampling were 3.27% soft and 16.25% weak over all samples. These observations increased appreciably compared to the 2020 and 2021 percentages of 1%, 2% (soft) and 7%, 12% (weak) in the 2020 and 2021 preseason samples respectively.

Berried (egg-bearing) females were examined in considerable detail again this year. Of the 50-sample location-date combinations, 39 captured at least 1 berried female (“seed”) lobster. The average observed was approximately 5 berried females per sample date or 2% (245) of all female lobsters captured (12,434) during the survey. In 2020 and 2021, those figures were 2.5% (10,851 female lobsters captured), and 1.6% (10,435) respectively.

Berried female analyses recorded carapace size, clutch fullness, egg stage and condition. Analyses of these and other berried female data will be provided in further detail in the full report of the 2022-2023 Preseason and In-season Lobster Quality Sampling Program to be released early in 2023.

Table 3. 2022 Preseason Sampling Survey Program

Sampling Location	Area	2022 Sampling Date	Total Harvested Lobster Count (#)	Lobsters Sampled (#)	Sample %Soft/ %Weak	Sample Ave BRIX level (units/mL)
Yarmouth	Inside	September 6	474	150	0.67%/5.33%	10.34
		September 21	720	150	1.33%/6.67%	10.23
		October 4	650	150	0.67%/14.00%	10.54
		October 20	420	150	2.00%/20.67%	9.94
		November 2	423	150	0.00%/7.33%	9.99
		November 16	402	150	0.67%/12.00%	10.53
	Outside	September 5	424	150	6.00%/10.67%	9.63
		September 20	703	150	3.33%/14.67%	9.69
		October 3	794	150	6.67%/16.67%	9.65
		October 19	1018	150	4.67%/26.00%	8.32
		November 1	717	150	4.67%/12.00%	8.39
		November 15	1191	150	2.67%/16.67%	8.78
Lobster Bay	Inside	August 30	747	150	0.67%/14.67%	10.25
		September 13	638	150	4.67%/13.33%	10.81
		September 28	897	150	3.33%/16.67%	10.76
		October 13	592	150	4.00%/18.00%	9.98
		October 25	778	150	4.67%/26.67%	9.36
		November 8	653	150	7.33%/31.33%	9.47
		November 9	717	150	2.67%/27.33%	9.73
	Outside	August 29	399	150	3.33%/2.67%	10.49
		September 12	685	150	3.33%/10.00%	10.21
		September 27	815	150	3.33%/14.00%	9.63
		October 12	635	150	8.00%/18.00%	8.65
		October 24	769	150	8.00%/23.33%	9.07
November 7	654	150	3.33%/11.33%	10.22		
Port La Tour	Inside	August 31	302	150	7.33%/11.33%	9.02
		September 14	629	150	4.67%/18.67%	8.95
		September 28	288	150	2.00%/6.67%	9.35
		October 13	474	150	1.33%/14.00%	8.13
		October 25	476	150	0.67%/14.67%	9.08
		November 8	288	150	1.33%/15.33%	9.60
		November 9	371	150	0.67%/14.00%	10.80
	Outside	August 30	11	8	25.00%/0.00%	8.99
		September 13	98	75	5.33%/14.67%	8.30
		September 27	222	150	10.67%/39.33%	8.22
		October 12	230	150	6.00%/21.33%	7.47
		October 24	573	150	3.33%/24.67%	7.22
November 7	709	150	2.67%/40.67%	7.34		
St. Mary's Bay	Inside	September 7	363	150	2.67%/5.33%	10.39
		September 20	620	150	3.33%/10.33%	9.93
		October 5	561	150	4.00%/20.00%	8.92
		October 21	742	150	0.67%/16.67%	9.51
		November 1	438	150	0.67%/10.00%	10.41
		November 16	380	150	0.00%/6.67%	10.49
	Outside	September 6	342	150	0.67%/4.00%	10.11
		September 19	825	150	1.33%/9.33%	9.60
		October 4	1143	150	6.67%/27.33%	8.13
		October 20	859	150	2.00%/23.33%	8.89
		November 2	762	150	1.33%/16.67%	9.46
		November 15	825	150	0.67%/23.33%	9.07
TOTALS	8 location-areas	50 sample location-dates	29,446 lobsters landed	7,283 lobsters sampled	Overall % Soft/Weak 3.27%/16.25%	9.46 units/ml

Review of the 2021 Preseason Survey Results

In 2021, a total of 7,039 preseason lobster samples were taken over the 4-month period from August 25 to November 18 (13 weeks) in the selected subareas of LFAs 33 and 34. The results indicated that lobsters landed at the start of the 2021-2022 season in southwest Nova Scotia, were of overall moderate-low quality with 2021 preseason samples average overall BRIX at the moderate-low level of 8.3 units/ml. These results indicated that 2021 lobster quality continued to be consistent with the lower quality regime experienced in southwest Nova Scotia after 2013. It was also reported that St. Mary's Bay (Inside and Outside) collectively outperformed the overall mean with highest mean BRIX value for Inside, and high (BRIX>9) for post-September samples. The Lobster Bay and Yarmouth sites both underperformed in 2021 relative to their BRIX history over the 2006-2020 period. Port La Tour performed better in 2021, especially Port La Tour Inside. Finally, in 2021, the incidence of weak lobsters nearly doubled compared to 2020 values. Weaks in the Inside locations averaged over 10% per sample. Weaks in the Outside locations averaged over 15% per sample. In Outside areas, all locations increased in counts of weak lobster over the sampling period, rising from lows of 0% (Port La Tour) to highs of over 25% (Yarmouth, Lobster Bay, and Port La Tour) by the end of the 2021 preseason sampling.

2022 Preseason Survey Results

In the information on the 2022 survey which follows, sample results by BRIX category are shown for each of the 8 sampling locations. Results present: (i) BRIX category time trend for the 2022 samples; (ii) comparable BRIX category preseason sampling 3-4 weeks before the start of the commercial season for years 2012 to 2022; (iii) lobster quality classifications by location comparing all years 2006 to present; and (iv) BRIX distributions for selected late sample dates for each location. The trends are described and predictions and recommendations for the 2022 start-of-season are presented. A summary of results and highlights conclude this report.

(i) and (ii) Blood Protein (BRIX) Categories. The following pages present the survey breakdown of the 2022 BRIX results for each of the 8 lobster sampling locations. Results are provided for the BRIX indicator values ("Good", "Moderate", "Poor") for each location's 2022 sampling dates (see also Table 1 above). Annual graphics also compare recent years (2012 to 2021) to the current year (2022) sample mean BRIX, and BRIX distribution by category at the end of the annual survey 3 to 4 weeks prior to the start of the commercial season.

(iii) Lobster Quality Category Classification. Consolidated data from all sample dates by location are classified into lobster quality categories derived from the full ALMQ database (2006-2021). Lobster quality categories for each consolidated location sample are based on collective lobster sample characteristics (of 150 sampled lobsters by the protocol) including: BRIX values and carapace length means, medians, ranges, and moments, as well as sample month and days prior to the season opening. Using linear discriminant analysis, the historical consolidated sample data were categorized into 5 'lobster quality' categories as defined in Table 4 below for each location. The results of the analysis enabled the numerical description of each category, and the assignment of each of the 8 sampling locations into its most probable Lobster Quality category. Preseason Lobster Quality categories are particular to the history of each of the 8 locations. These categories are described in Table 4 below.

The comparison of the 2022 preseason sample results by location to past preseason sampling years suggests that the corresponding commercial seasons are likewise comparable. For example, if the current year 2022 preseason sample results for Lobster Bay Inside compare favorably to past preseason survey years of Low (L) Lobster Quality for Lobster Bay Inside (historically estimated from the data to be: 2016 and 2018—see also Table 4 below), then the 2022 preseason can be considered to predict that the 2022-2023 commercial season will be comparable to the commercial seasons of 2016-2017 and/or 2018-2019. Lobster Quality Category assignment for the 2022 locations are accompanied by likelihood values that the sample data indeed belong to the selected Lobster Quality Category.

Table 4. Lobster Quality Category Descriptions

Level	Lobster Quality Category	Description of Sample Location-Date Distribution
1	High (H)	This category is indicative of a consolidated sample date of 150 lobsters with elevated average BRIX value specific to the location over the database period, e.g., exceeding 10 for most locations, and other positive distribution characteristics, e.g., high relative BRIX median and range
2	Moderate-High (MH)	This category is indicative of a consolidated sample date of 150 lobsters with slightly above-average BRIX values specific to the location over the database period, e.g., approximately between 9.5 and 10 in most locations
3	Moderate (M)	This category is indicative of a consolidated sample date of 150 lobsters with near average BRIX values specific to the location over the database period, e.g., approximately between 8.5 and 9.5 for most locations
4	Moderate-Low (ML)	This category is indicative of a consolidated sample date of 150 lobsters with slightly below-average BRIX values specific to the location over the database period, e.g., approximately between 7.5 and 8.5 for most locations
5	Low (L)	This category is indicative of a consolidated sample date of 150 lobsters with below average BRIX values specific to the location over the database period, e.g., less than 7.5 for most locations

The 2022 Lobster Quality Category assignments are determined by the categories with the highest likelihood (expected probability) of occurrence. Assigned categories by location and year are based on preseason sampling data and are provided in the following table of assigned Lobster Quality categories for each location over the full database (2006-2021) containing over 800 location-date samples of 150 lobsters (typically) per sample.

Table 4. 2006-2021 Lobster Quality Category Assignments

Locations:	Yarmouth Inside	Yarmouth Outside	Lobster Bay Inside	Lobster Bay Outside	Port La Tour Inside	Port La Tour Outside	St.Mary's Bay Inside	St.Mary's Bay Outside	Total Annual Sample Dates
2006	MH	H	H	MH	MH	H	H	MH	68
2007	H	H	H	MH	M	-	H	H	61
2008	H	MH	MH	MH	MH	-	MH	MH	60
2009	MH	H	H	MH	MH	MH	M	M	67
2010	H	MH	H	H	H	MH	MH	H	73
2011	MH	M	H	MH	MH	H	MH	-	65
2012	MH	MH	MH	H	M	M	MH	-	63
2013	M	M	MH	H	M	M	M	-	52
2014	ML	ML	M	M	L	ML	-	-	34
2015	ML	ML	ML	M	L	L	-	-	32
2016	L	L	L	L	L	M	ML	ML	52
2017	ML	ML	ML	L	L	L	ML	ML	52
2018	L	ML	L	ML	MH	L	L	L	46
2019	ML	L	M	ML	ML	ML	-	L	12
2020	ML	L	M	ML	ML	ML	ML	M	56
2021	ML	M	M	M	M	M	M	M	51
Total Sample Dates	139	136	164	121	146	47	53	39	845

*2006-2013 – Historical period of high relative quality; 2014-2021 – Current period of low relative quality.

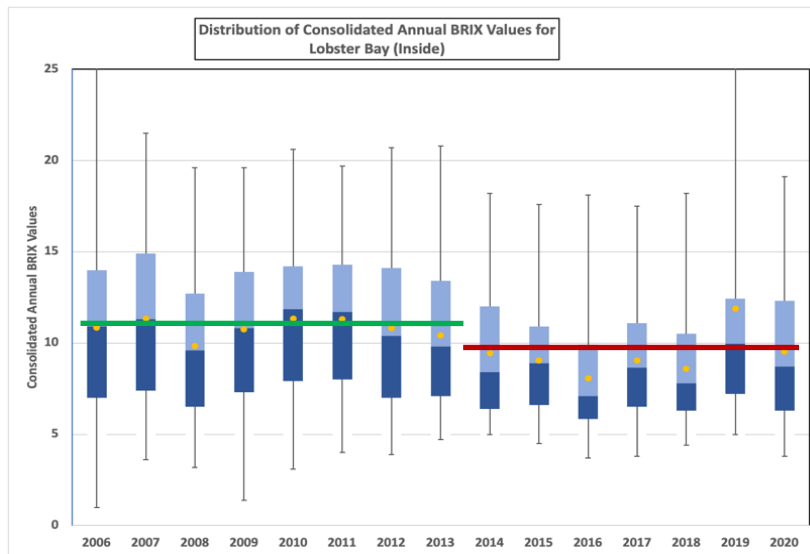


Figure 5. Lobster Bay (Inside) Annual Consolidated BRIX Distributions.

Table 4 values indicate the annual time series of assigned Lobster Quality Category for each location from 2006 to 2021. The relative decline over time of lobster quality across all locations in LFAs 33&34 over the full period 2006 to 2021 is evident from Table 4 and the example of Figure 5 of the annual plots for Lobster Bay Inside. Lobster quality categories from 2006 to 2013 exhibit higher categories (moderate (M) or higher (MH, H)) throughout the period from 2006 to 2013 (green line).

Since 2014, however, assigned Lobster Quality Categories across the locations are nearly all designated as moderate (M) levels or below (ML, and L) (Figure 5, red line). Although it is difficult to identify trends in the consolidated data (i.e., combined annual survey samples by location), it generally appears that since 2018, there may be the beginning of a recovery of lobster quality indicators from L to ML going forward to 2021. These data provide the backdrop for the predictions of lobster quality categories for the 50 preseason sample dates by location in the 2022 preseason period.

In this analysis for the 2022 preseason surveys, one of the designated Lobster Quality Categories (H, MH, M, ML, or L) is assigned to each of the 8 sample locations for the 2022 survey. Summarized results are presented for all sample dates for each location in the pages which follow.

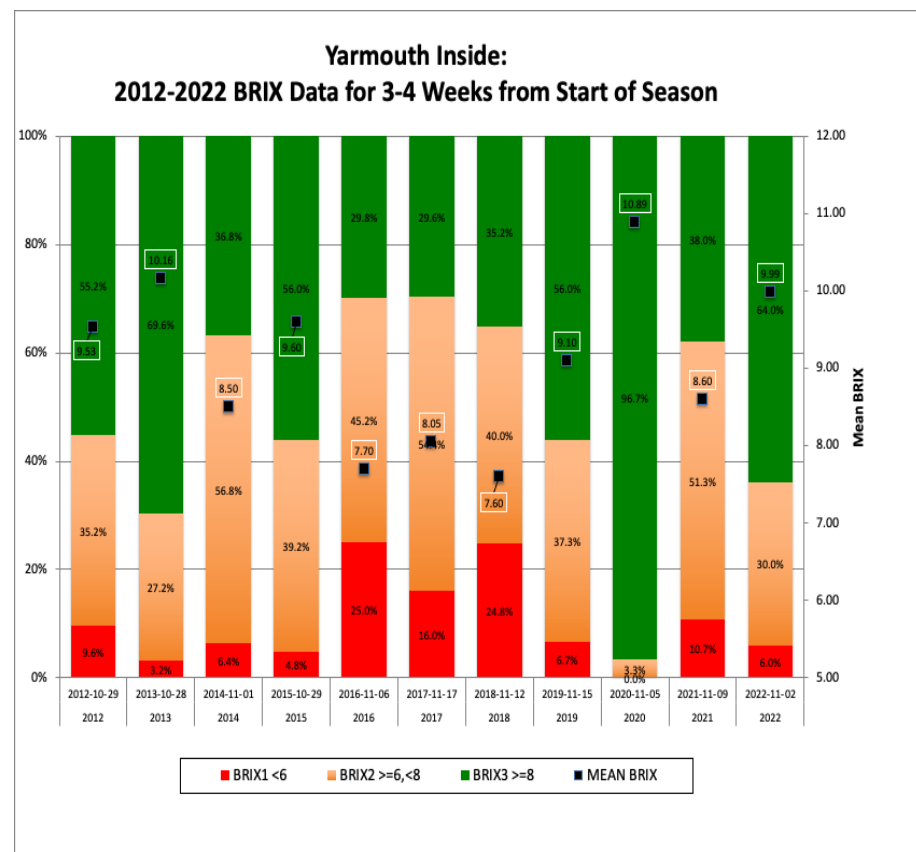
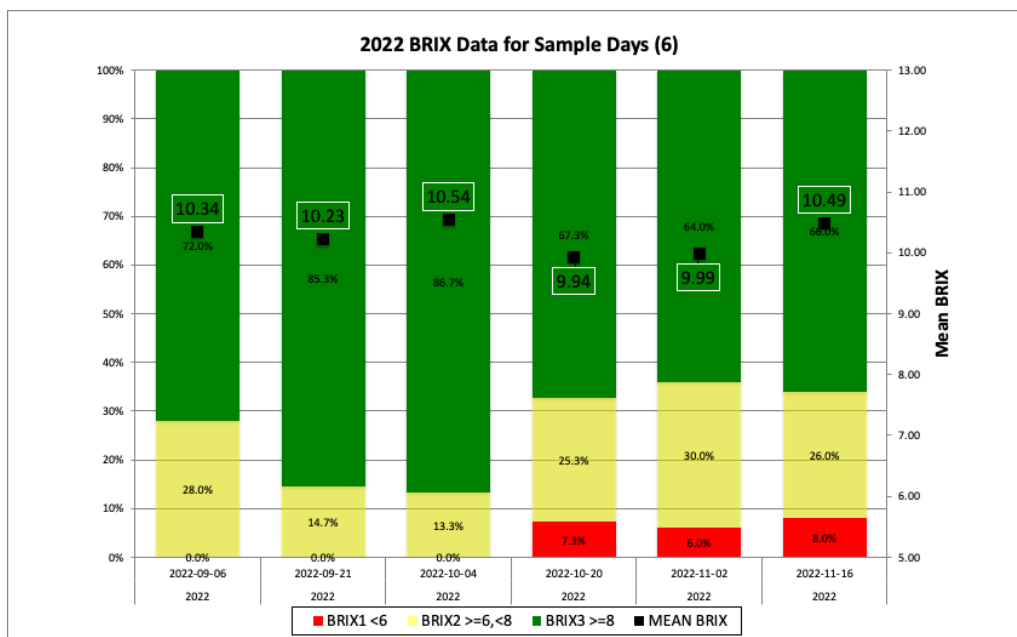
(iv) BRIX distribution of late survey dates are presented and reviewed for each location and the 150-lobster samples. In 2022, the observation of increased landed lobster counts and counts of lobster per trap, and the increases of counts of weak and soft and medium hard lobsters provides indications of lower lobster quality across southwest Nova Scotia. However, these lower quality indicators are tempered by higher overall BRIX values that indicate better quality among the lobster population. A review of the BRIX distributions by location below provides some explanation for this apparent confounding set of observations.

YARMOUTH INSIDE

2022 SUMMARY OF RESULTS

Blood Protein (BRIX) Categories

The 2022 preseason survey results for 6 sample sites in Yarmouth Inside show a small dip in average BRIX in mid-October but relatively constant level of high BRIX (10) with the percentage of “Good” category lobsters (BRIX≥8) at or exceeding two-thirds in each sample. The proportion of “Poor” lobsters sampled moves from zero levels in the early surveys to less than 10% in the later surveys after the mid-October dip.



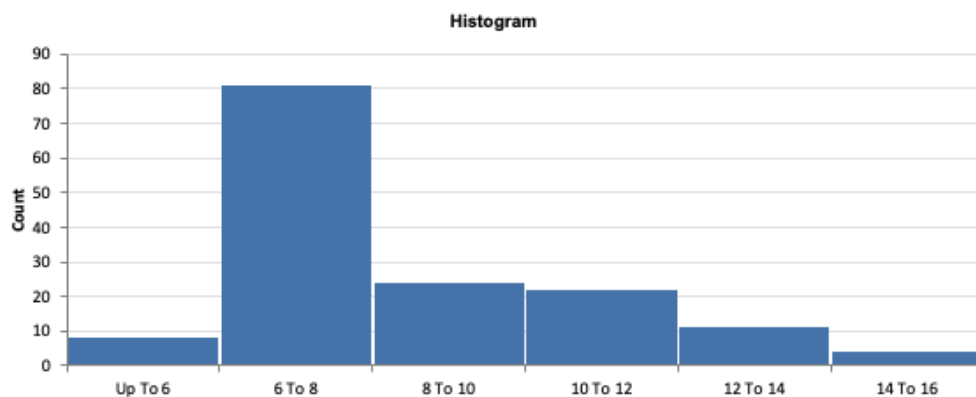
Annual samples 3-4 weeks from the start of each commercial harvest season opening are variable across the series from 2012 to 2022. The 2022 sample (November 2) has the third highest BRIX average (9.99) in the series. The November 9, 2022 sample is comparable to the October 28, 2013 sample categories with a closely matching BRIX average of 10.2.

Other comparable years to 2022 may include 2019 and 2015 however, both of these years had somewhat lower BRIX averages (9.1 and 9.6 respectively) which indicate that the 2022 samples included “Good” BRIX values that were higher in this category.

Lobster Quality Category Classification The assignment of the Lobster Quality categories for Yarmouth Inside are developed from Table 4 above. Based on the historical sampling 2006-2021 in this location, the 6 sample dates in 2022 are all classified as “ML” – Moderate-Low quality. The likelihood of the Yarmouth Inside samples being in the ML category is largest at 70%.

Historically, Lobster Quality classifications for Yarmouth Inside of Moderate-Low (ML) have occurred in 2014, 2015, 2017, 2019, 2020 and 2021 seasons (as per Table 4 above). These years are all part of the post-2013 lobster quality decline period, and indicate that Yarmouth Inside remains just below the higher quality regime in the reduced quality range relative to the full 2006-2021 database.

BRIX Distribution The distribution histogram (below) of 150 samples from the November 16, 2022 (final) sample period with mean BRIX of 10.49 illustrates a pattern of BRIX values that are “expected”. The majority of “Medium” BRIX lobsters (BRIX ≥ 6 , < 8) (50+%) are deemed to be recovering from a recent moult and are expected to fill their shells moving into December and January during the commercial season. The 40+% lobsters already in the “Good” category (BRIX ≥ 8) with high BRIX are expected to be available for harvest at season opening.



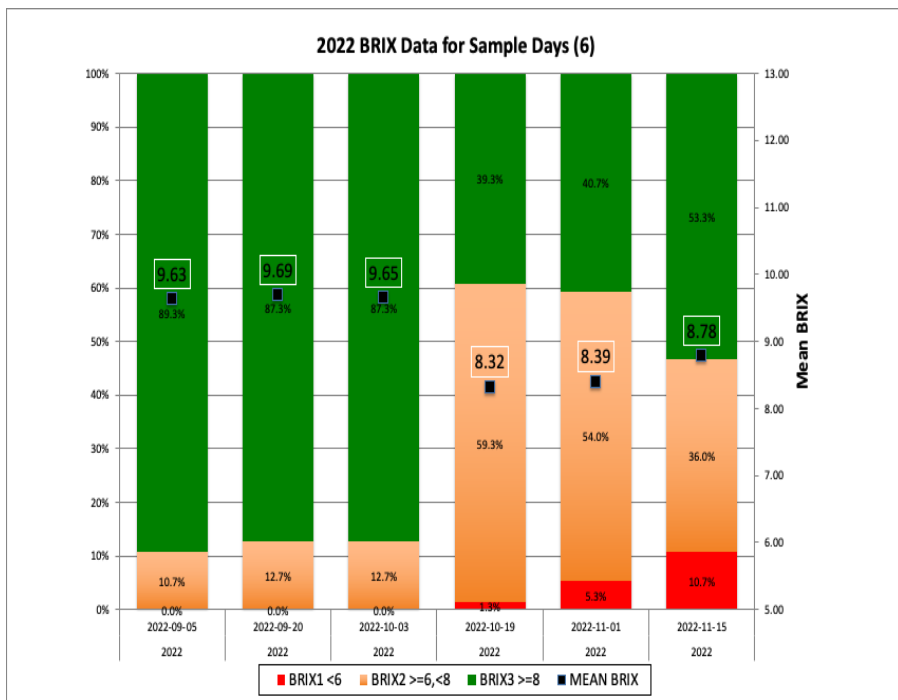
Summary : YARMOUTH INSIDE –

- 1) After a small decline in mid-October, 2022 samples exhibit relatively constant BRIX behaviour over the preseason sampling period at “Good” quality levels (BRIX of 10); the November 9, 2022 sample is most comparable to October 28, 2013 preseason sample 3-4 weeks before the start of the commercial season**
 - 2) Lobster quality category for 2022 samples is classified as “Moderate-Low” (ML) with estimated 70% likelihood of occurrence**
 - 3) Past years with ML classification include 2014, 2015, 2017, 2019, 2020 and 2021 – all years at the post-2013 lower quality regime**
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YARMOUTH OUTSIDE

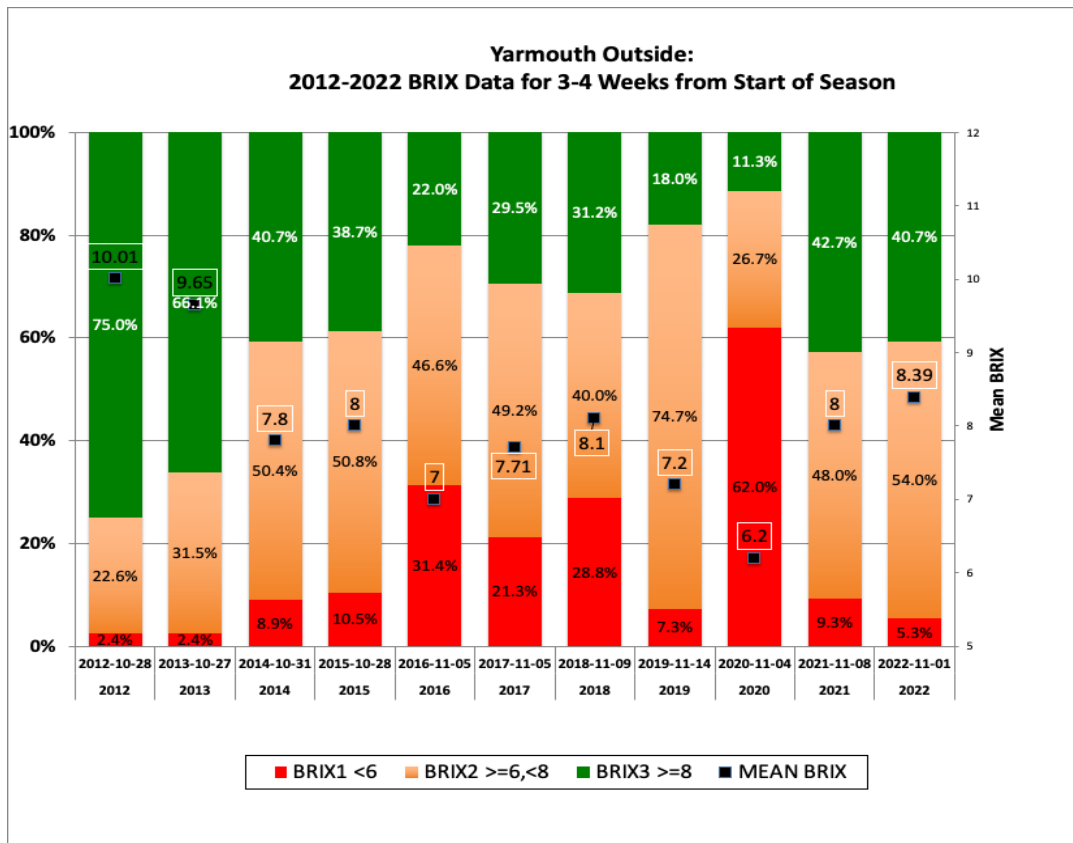
2022 SUMMARY OF RESULTS

Blood Protein (BRIX) Categories



The 6 preseason samples in 2022 for Yarmouth Outside, like Yarmouth Inside, show a dip in average BRIX in mid-October with relatively constant level of high BRIX (8-9+) with the percentage of “Good” category lobsters (BRIX≥8) at 40+% in most samples. Early samples (September through early October) show no “Poor” BRIX, marginal “Medium BRIX (≤15%), and dominant samples of “Good” BRIX (87+% per sample). In the last three samples of 2022, “Poor” BRIX increase from 1% to just over 10%, and “Medium” BRIX are over one-third in these samples.

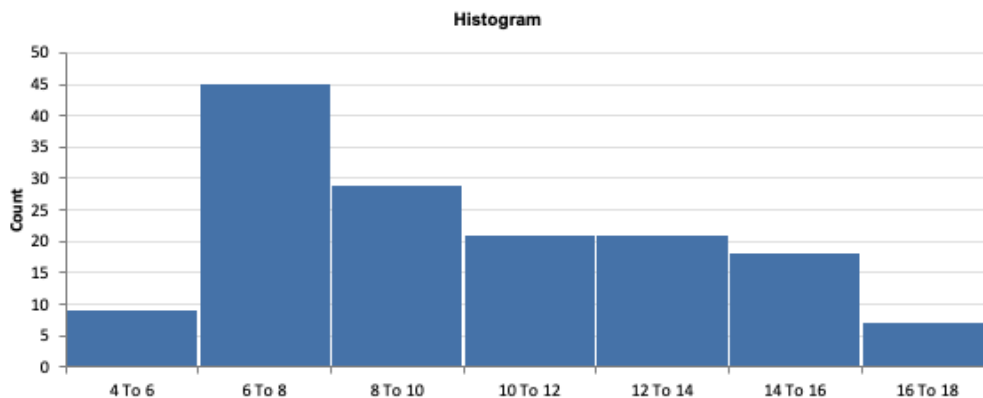
Yarmouth Outside sample BRIX distribution annual results for 3-4 weeks from the start of the commercial harvest season are compared to the series from 2012-2022. The 2022 sample (November 1) has the third highest BRIX average (8.39) in the series exceeded only by the good quality years of 2012 and 2013. The 2022 BRIX category distribution is most comparable to 2014 and 2015 but with higher average BRIX.



Lobster Quality Category Classification Based on the historical sampling in this location since 2006, the 6 sample dates in 2021 are collectively classified as “ML” – Moderate Low quality in comparison to the other years’ samples (Table 4). The likelihood of the Yarmouth Outside samples being in the ML category is largest at 66%.

Historically, Lobster Quality classifications for Yarmouth Outside of Moderate-Low (ML) have occurred in 2014, 2015, 2017, and 2018 seasons (as per Table 4 above). These years are all part of the post-2013 lobster quality decline period, and indicate that Yarmouth Outside remains below the higher quality regime in the reduced quality range relative to the full 2006-2021 database.

BRIX Distribution The distribution histogram (below) of 150 samples from the final November 15, 2022 Yarmouth Outside sample period with mean BRIX of 8.8, also illustrates a pattern of BRIX values, as for Yarmouth Inside, that may be “expected”. “Medium” BRIX lobsters (BRIX ≥ 6 , < 8) represent the maximum counts cell of 30% of all November 15 samples. Lobsters from this group may be recovering from a recent moult and are expected to fill their shells moving into December and January during the commercial season. Consequently, nearly two-thirds of Yarmouth Outside lobsters are already in the “Good” category (BRIX ≥ 8). However, many of these (20%) are experiencing very high BRIX (> 14) levels not typically seen in this location. The availability of these lobsters at the start of the commercial season is uncertain.



Summary : YARMOUTH OUTSIDE –

1) 2022 samples exhibit relatively constant BRIX (9) over the preseason sampling period, after a slight decline in mid-October (to 8.32), at relatively good quality levels, most comparable to the good quality years of 2012 and 2013 preseason samples 3-4 weeks before the start of the commercial season

2) Lobster quality category for samples classified as ML has highest estimated likelihood of 66%

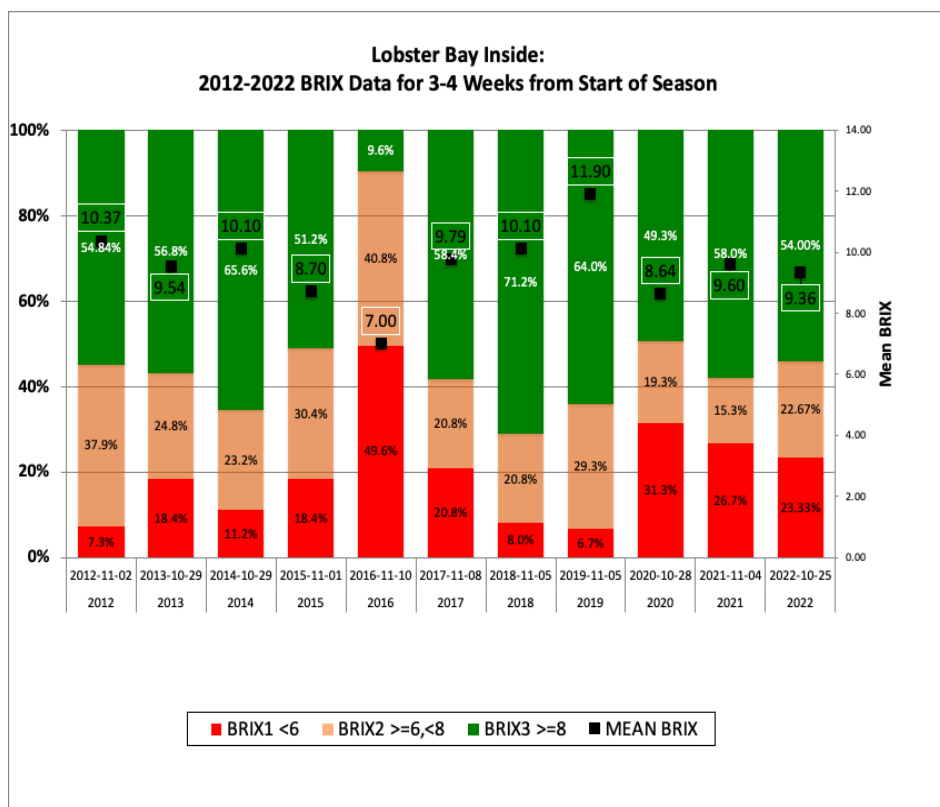
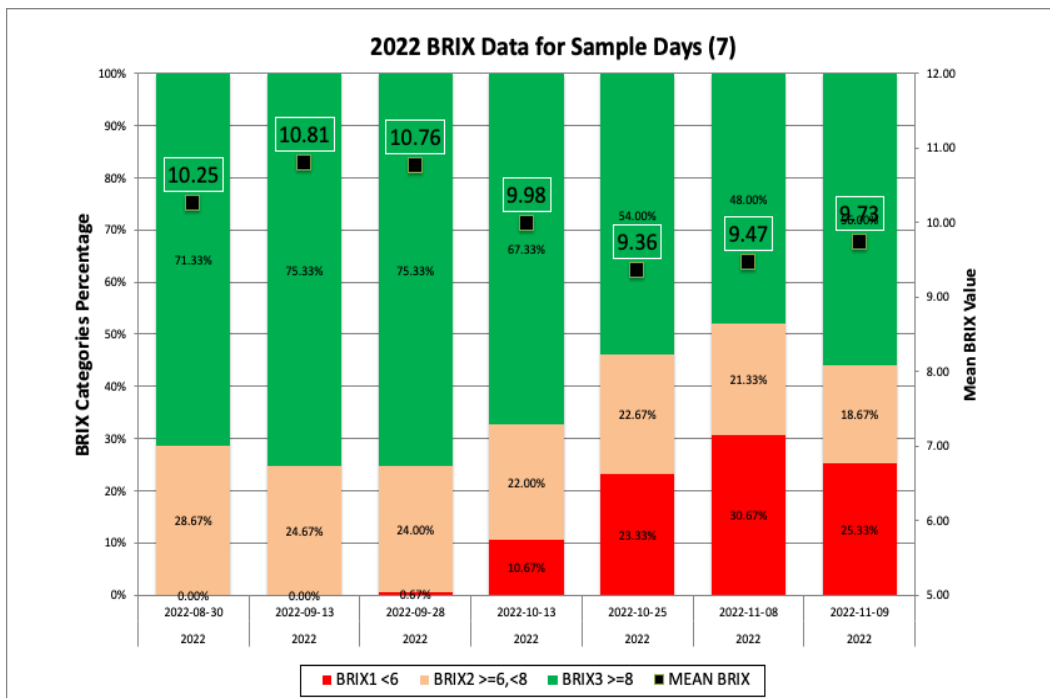
3) Past representative years with ML classification include 2014, 2015, 2017, and 2018– years of the post-2013 lower quality regime

LOBSTER BAY INSIDE

2022 SUMMARY OF RESULTS

Blood Protein (BRIX) Categories

The 2022 preseason survey results for 7 sample sites in Lobster Bay Inside show a relatively constant level of high BRIX (9-10) with the percentage of “Good” category lobsters (BRIX≥8) at nearly 50% or over in each sample. The proportion of “Poor” lobsters sampled moves from zero levels in the early surveys (through September) to 25-30% in the later 3 surveys after mid-October.



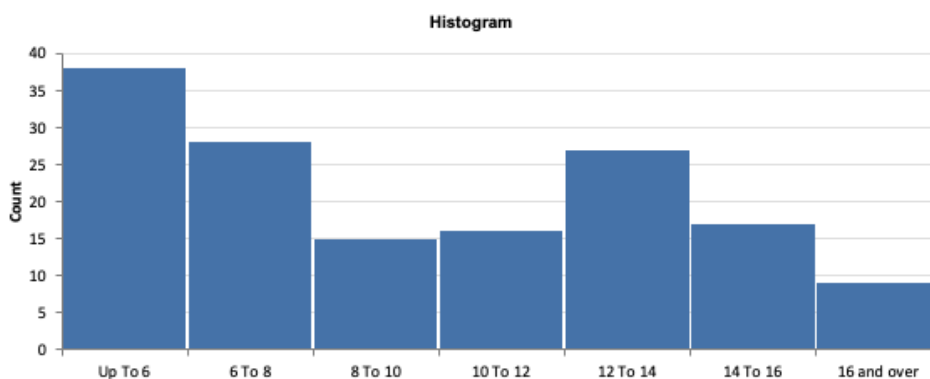
The 2022 Lobster Bay Inside sample results for 3-4 weeks from the start of the commercial harvest season are variable over the time series from 2012 to 2022. The October 25, 2022 sample average BRIX value of 9.4 is the 4th lowest in the series ahead of low quality years 2014-15 and 2020. The 2022 average BRIX value (9.4) trails high average BRIX of 11.9 (2019), 10.4 (2012), 10.1 (2014, 2018), and approximates the average BRIX of 2013 (9.5) and 2021 (9.6).

The October 25, 2022 samples compare well with 2013 and 2021 with respect to the BRIX categories and average BRIX values.

Lobster Quality Category Classification Based on the historical sampling in this location, the 7 sample dates in 2022 are collectively classified as “Moderate” (M) quality in comparison to the other years’ samples (Table 4). The likelihood of the Lobster Bay Inside samples being in either the M or ML categories is nearly 60%.

Historically, Lobster Quality classifications for Lobster Bay Inside of Moderate (M) have also occurred in 2014, and since 2019-2021 seasons (as per Table 4 above). These years are all part of the post-2013 lobster quality decline period, and indicate that Lobster Inside remains below the higher quality regime in the reduced quality range relative to the full 2006-2021 database.

BRIX Distribution The distribution histogram (below) of 150 samples from the final November 9, 2022 Lobster Bay Inside sample period with mean BRIX 9.7 illustrates a particular pattern of BRIX values that may not be as expected. “Poor” BRIX lobsters (BRIX <6) represent the maximum counts cell of 25% of all November 9 samples. “Medium” BRIX lobsters (BRIX ≥6, < 8) represent the second largest cell or almost 20% of all samples. Collectively, lobsters from these groups comprise only 44% of potentially recovering lobsters from a recent moult. More significantly, a second mode of the BRIX histogram occurs at the high BRIX cell of 12-14. Consequently, nearly 60% of Lobster Bay Inside lobsters are already in the “Good” category (BRIX ≥ 8). However, many of these (nearly 20%) are experiencing very high BRIX (>14) – BRIX levels not typically seen in this location. The availability of these significant lobsters at the start of the commercial season is uncertain.



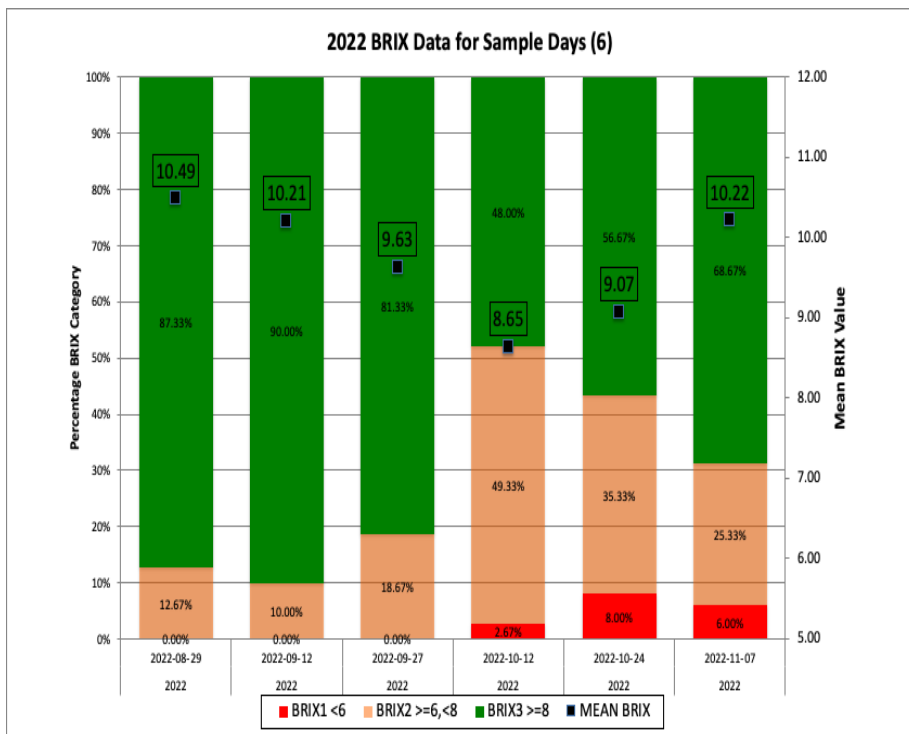
Summary : LOBSTER BAY INSIDE–

- 1) 2022 samples exhibit stable BRIX behaviour from the early sample periods to the end of the preseason sample period when poor BRIX lobsters also appear**
- 2) 2022 samples are most comparable to the 2013 or 2021 preseason samples 3-4 weeks before the start of the commercial season**
- 3) Lobster quality category for 2022 samples is classified as “Moderate” (M) with estimated likelihood of only 34% and comparable to 2014 and 2019 to 2021; likelihood that data comes from a “Moderate-Low” (ML) quality population is 23%**

LOBSTER BAY OUTSIDE

2022 SUMMARY OF RESULTS

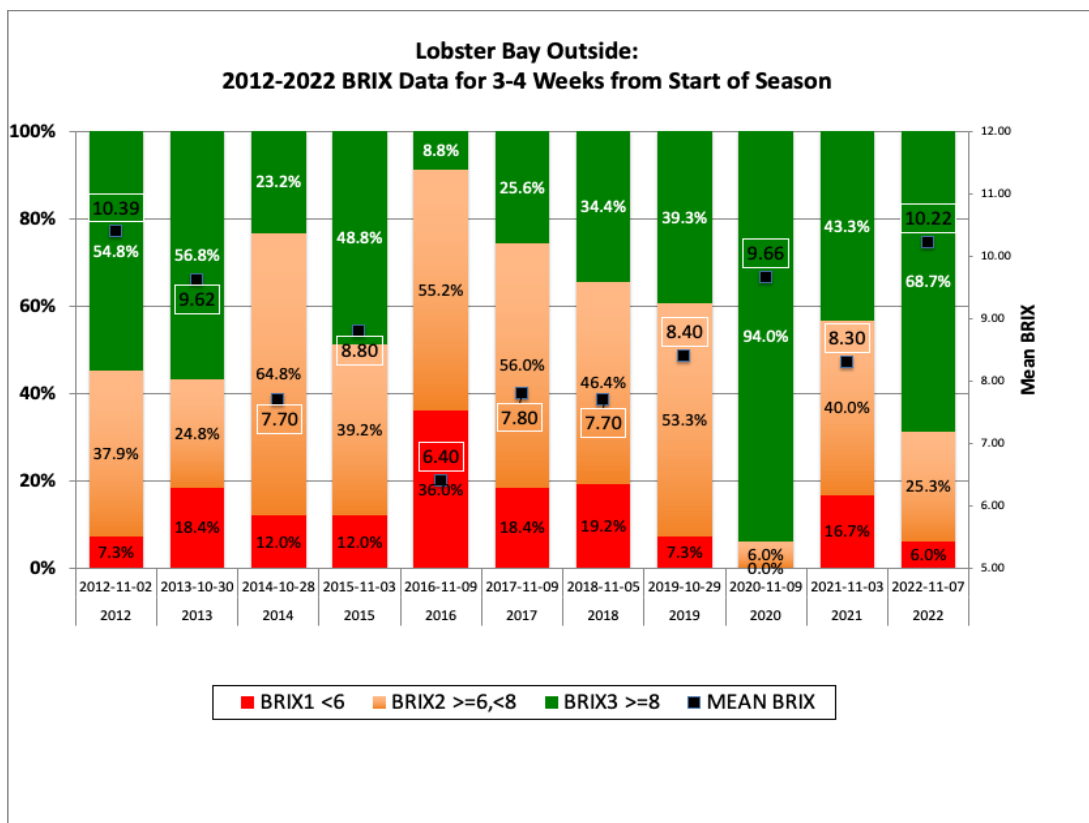
Blood Protein (BRIX) Categories



The 2022 preseason survey results for 6 sample sites in Lobster Bay Outside show a stronger pattern of declining average BRIX to mid-October followed by increasing average BRIX to the end of sampling on November 7.

Average BRIX levels are high (8.6-10.5) with the percentage of “Good” category lobsters (BRIX≥8) at or over 50% in each sample. As for Lobster Bay Inside, Lobster Bay Outside samples of “Poor” lobsters moves from zero levels in the early surveys (through September) to less than 10% in the later 3 surveys after September.

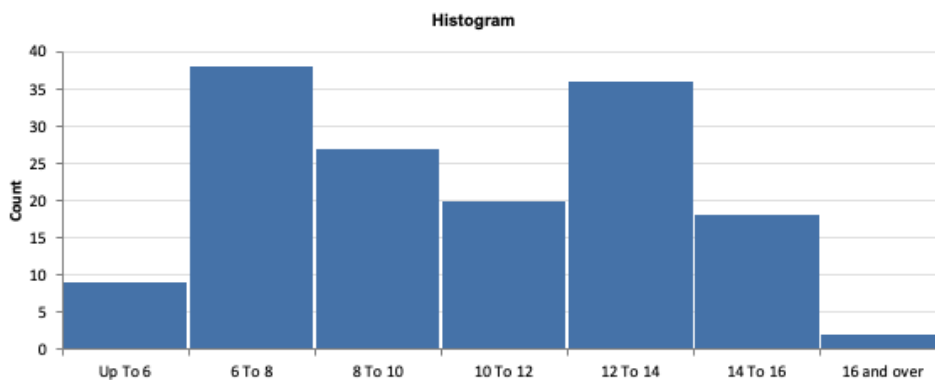
The 2022 Lobster Bay Outside sample results for 3-4 weeks from the start of the commercial harvest season are variable over the time series from 2012 to 2022. The November 7, 2022 sample average BRIX value of 10.2 is the 2nd highest in the series behind good quality year 2012 (10.4). As such, the November 7, 2022 samples compare well with the sample of November 2, 2012 with respect to the 3 BRIX categories and average BRIX value.



Lobster Quality Category Classification Based on the historical sampling in this location, the 6 sample dates in 2022 are collectively classified as “Moderate-Low” (ML) quality in comparison to the other years’ samples (Table 4). The likelihood of the Lobster Bay Outside samples being in the ML category is largest at 56% and likelihood of being from categories ML or L is estimated at 70%.

Historically, Lobster Quality classifications for Lobster Bay Outside of Moderate-Low (ML) have also occurred during the 2018 to 2020 seasons (as per Table 4 above). These years are all part of the post-2013 lobster quality decline period, and indicate that Lobster Outside remains below the higher quality regime in the reduced quality range relative to the full 2006-2021 database.

BRIX Distribution The distribution histogram (below) of 150 samples from the November 7, 2022 (final) Lobster Bay Outside sample period with mean BRIX of 10.2 illustrates a particular pattern of BRIX values that, like Lobster Bay Inside, may not be as expected. “Medium” BRIX lobsters ($BRIX \geq 6, < 8$) represent the largest cell of only 25% of all samples. Collectively, lobsters from the Medium and Poor ($BRIX < 6$) groups comprise approximately one-third of potentially recovering lobsters from a recent moult. More importantly, a second significant mode of the BRIX histogram occurs at the high BRIX cell of 12-14 (24%). Consequently, over two-thirds of Lobster Bay Outside lobsters are already in the “Good” category ($BRIX \geq 8$). However, many of these (nearly 40%) are experiencing high BRIX (> 12). The availability of these lobsters at the start of the commercial season is uncertain.



Summary : LOBSTER BAY OUTSIDE–

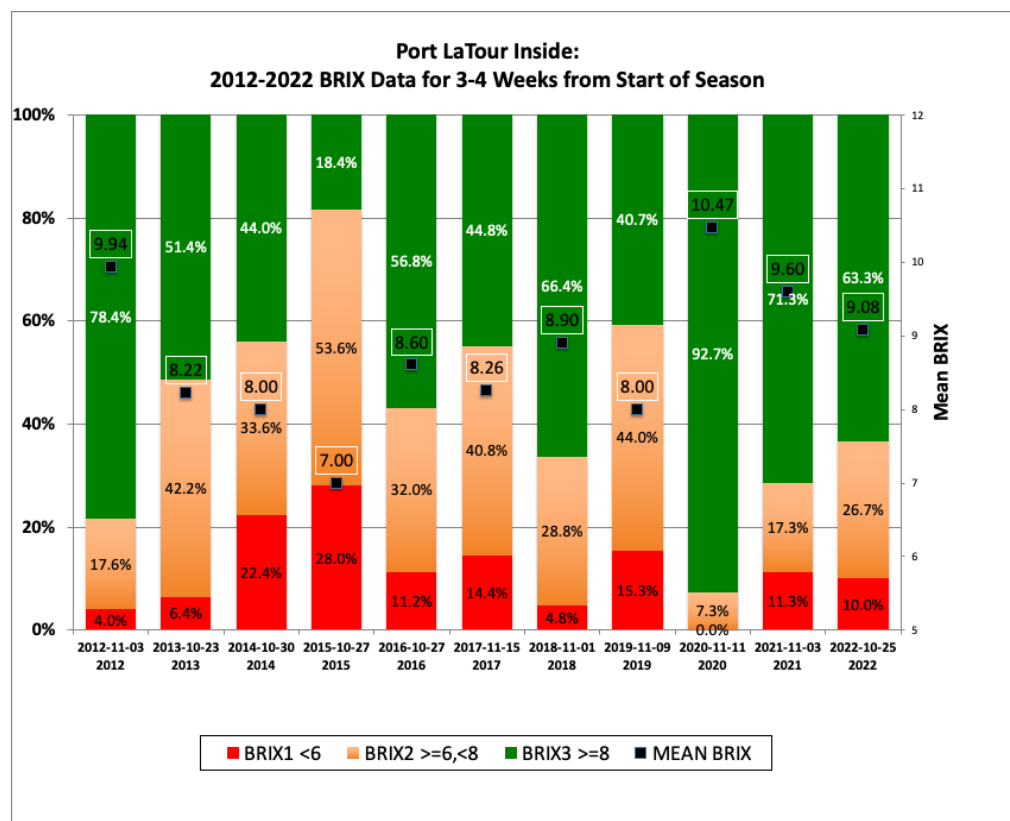
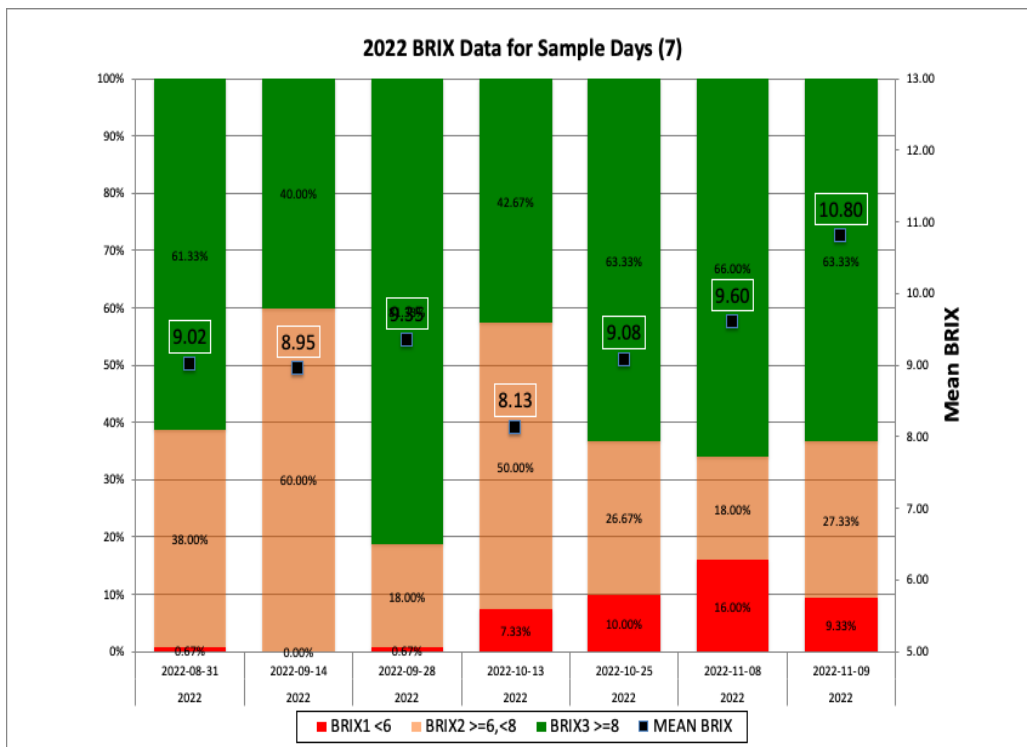
- 1) 2022 samples demonstrate average “Good” BRIX values (≥ 8) that decrease until mid-October and then increase to the end of the sampling period**
 - 2) 2022 preseason samples 3-4 weeks before the start of the commercial season continue the improving trend from low BRIX results to higher BRIX since the lower results of the 2016 preseason sample**
 - 3) Overall Lobster Quality classification for the 2022 samples average to ML with likelihood of ML estimated as 56%**
-

PORT LA TOUR INSIDE

2022 SUMMARY OF RESULTS

Blood Protein (BRIX) Categories

The 2022 preseason survey results for 7 sample sites in Port La Tour Inside show a relatively increasing level of high BRIX (8 to 10) – after a dip in mid-October – over the survey period with the percentage of “Good” category lobsters (BRIX≥8) at over 40% in each sample. The proportion of “Poor” lobsters sampled moves from zero levels in the early surveys (through September) to up to 16% in the later 3 surveys since mid-October.



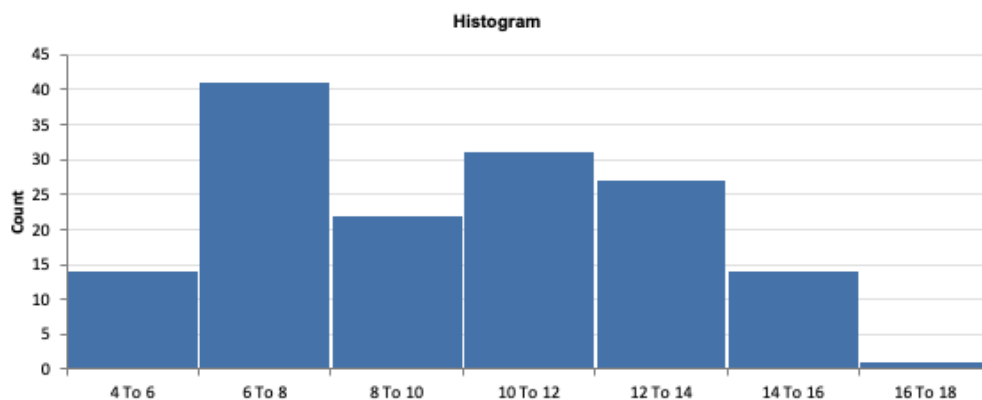
2022 Port La Tour Inside results for the October 25 sample, 3-4 weeks from the start of the commercial harvest season, are part of the variable trend over the period from 2012 to 2022. The October 25, 2022 sample has average BRIX (9.1) among the highest in the series. These results have shown some improvement since 2016 with higher “Good” category samples and lower “Poor” quality samples.

The 2022 sample is most comparable to the November 1, 2018 sample.

Lobster Quality Category Classification Based on the historical sampling in this location, the 7 sample dates in 2022 are collectively classified as “Moderate-Low” (ML) quality in comparison to the other years’ samples (Table 4).

Historically, Lobster Quality classifications for Port La Tour Inside of Moderate-Low (ML) have also occurred during the 2019 and 2020 seasons (as per Table 4 above). These recent years, as years of the post-2013 lobster quality decline period, indicate that Lobster Inside remains below the higher quality regime in the reduced quality range relative to the full 2006-2021 database.

BRIX Distribution The distribution histogram (below) of 150 samples from the final November 9, 2022 Port La Tour Inside sample period with average BRIX of 10.8 illustrates a particular pattern of BRIX values that, like Lobster Bay Inside and Outside, may not be as expected. “Medium” BRIX lobsters (BRIX ≥ 6 , < 8) represent the largest cell of just over 25% of all samples. Collectively, lobsters from the Medium and Poor (BRIX < 6) groups comprise approximately 37% of potentially recovering lobsters from a recent moult. More importantly, a second significant mode of the BRIX histogram occurs at the high BRIX cell of 10-12 (20%). Consequently, nearly two-thirds of Port La Tour Inside lobsters are already in the “Good” category (BRIX ≥ 8). However, many of these (45%) are experiencing high BRIX (> 10). The availability of these lobsters at the start of the commercial season is uncertain.



Summary : PORT LA TOUR INSIDE–

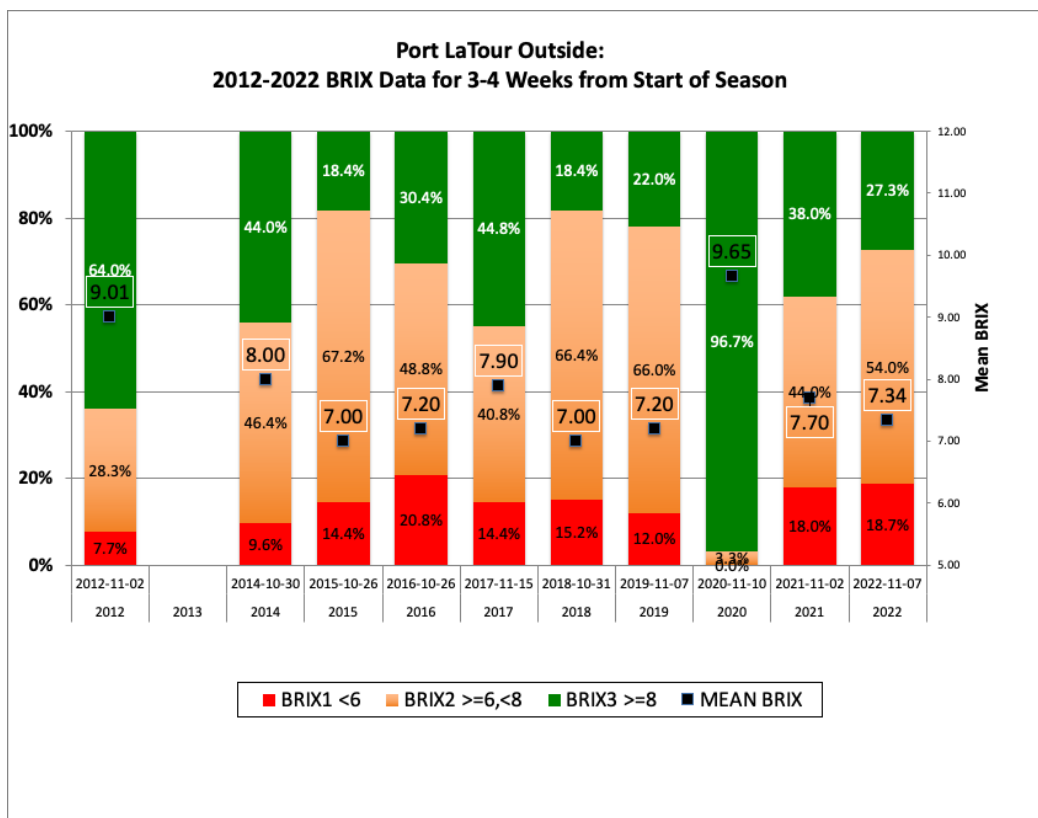
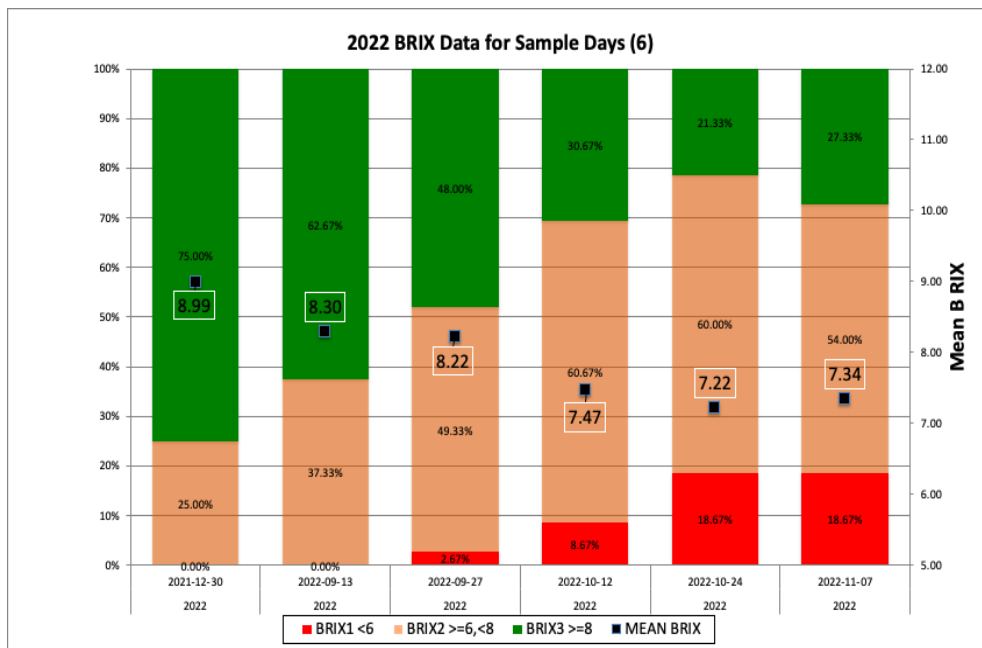
- 1) 2022 samples exhibit a dip in average BRIX in mid-October and variable but improving BRIX behaviour over the 7 preseason sampling dates from low and moderate-low quality to moderate-high BRIX levels by the end of the survey period**
 - 2) 2022 preseason sample 3-4 weeks before the start of the commercial season on October 25 has mean BRIX value (9.6) among the highest in the time series**
 - 3) Overall Lobster Quality classification for the 2022 samples average to ML; however, maximum likelihood is estimated at 56% for ML or lower (L) despite high average BRIX values at 10**
-

PORT LA TOUR OUTSIDE

2022 SUMMARY OF RESULTS

Blood Protein (BRIX) Categories

The 2022 preseason survey results for 6 sample sites in Port La Tour Outside show a declining level of average BRIX (from 9 to 7.3) over the survey period including a decline in mid-October to 7.5. The percentage of “Good” category lobsters (BRIX≥8) fall over the period from 75% to under 30%. The proportion of “Poor” lobsters sampled moves from zero levels in the early surveys (through September) to up to 19% in the later 2 surveys since mid-October.



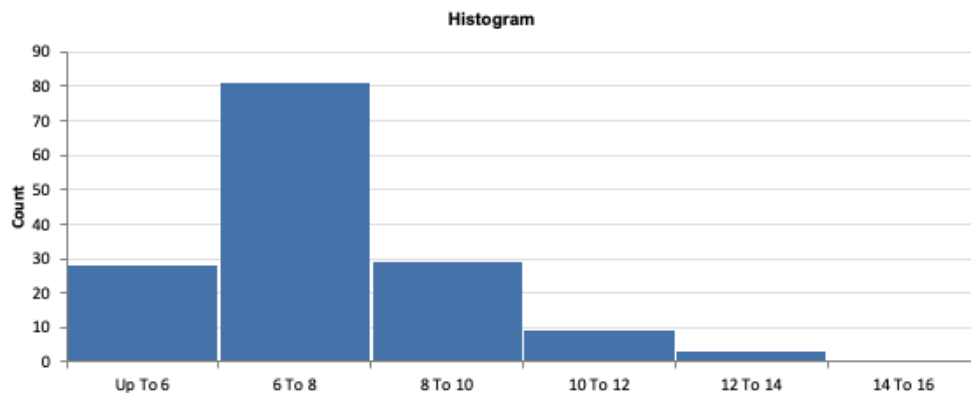
The annual results for Port La Tour Outside and the case of 3-4 weeks before the start of the season for 2012 to 2022 are relatively stable between 2014 and 2022 (2020 excepted) with average BRIX between 7 and 8 (“Medium”) and “Poor” category BRIX between 15% and 20%. The November 7, 2022 sample has average BRIX (7.3) which is consistent with the historical average BRIX levels.

The November 7, 2022 sample is most comparable to the October 26, 2016 sample.

Lobster Quality Category Classification Based on the historical sampling in this location, the 6 sample dates in 2022 are collectively classified as “Moderate-Low” (ML) quality in comparison to the other years’ samples (Table 4).

Historically, Lobster Quality classifications for Port La Tour Outside of Moderate-Low (ML) have also occurred during the 2014, 2019 and 2020 seasons (as per Table 4 above). These years are recent years as part of the post-2013 lobster quality decline period, and indicate that Lobster Inside remains below the higher quality regime in the reduced quality range relative to the full 2006-2021 database.

BRIX Distribution The distribution histogram (below) of 150 samples from the November 7, 2022 (final) sample period with mean BRIX of 7.3 illustrates a pattern of BRIX values that are “expected”. The majority of “Medium” BRIX lobsters (BRIX ≥ 6 , < 8) (50+%) are deemed to be recovering from a recent moult and are expected to fill their shells moving into December and January during the commercial season. The 25+% lobsters already in the “Good” category (BRIX ≥ 8) with high BRIX are expected to be available for harvest at season opening.



Summary : PORT LA TOUR OUTSIDE–

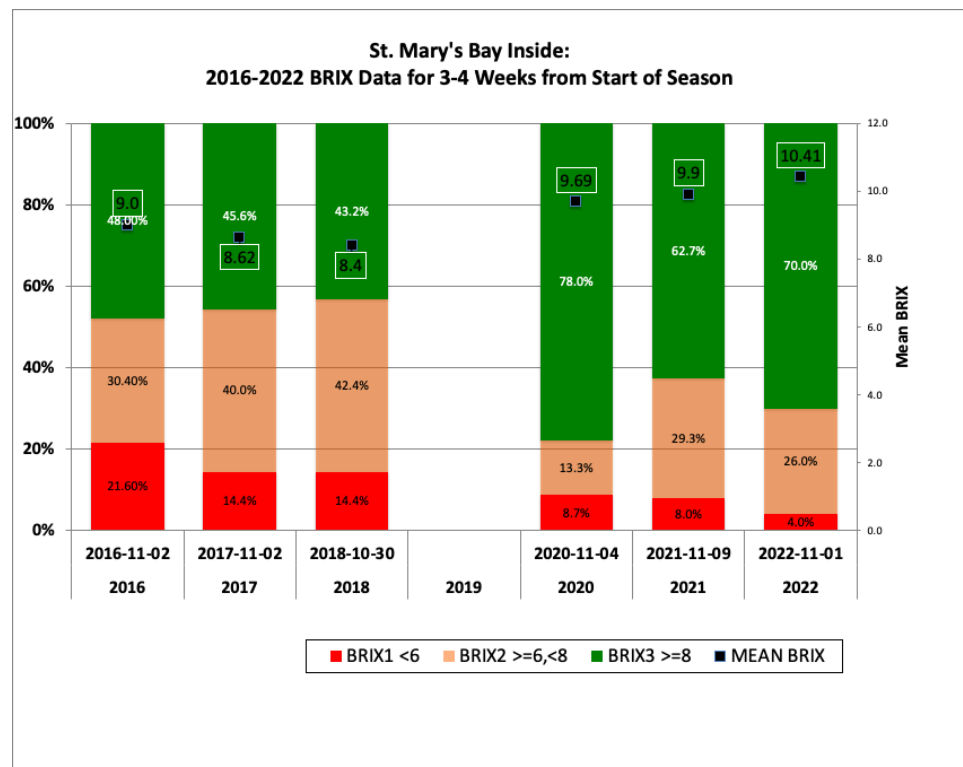
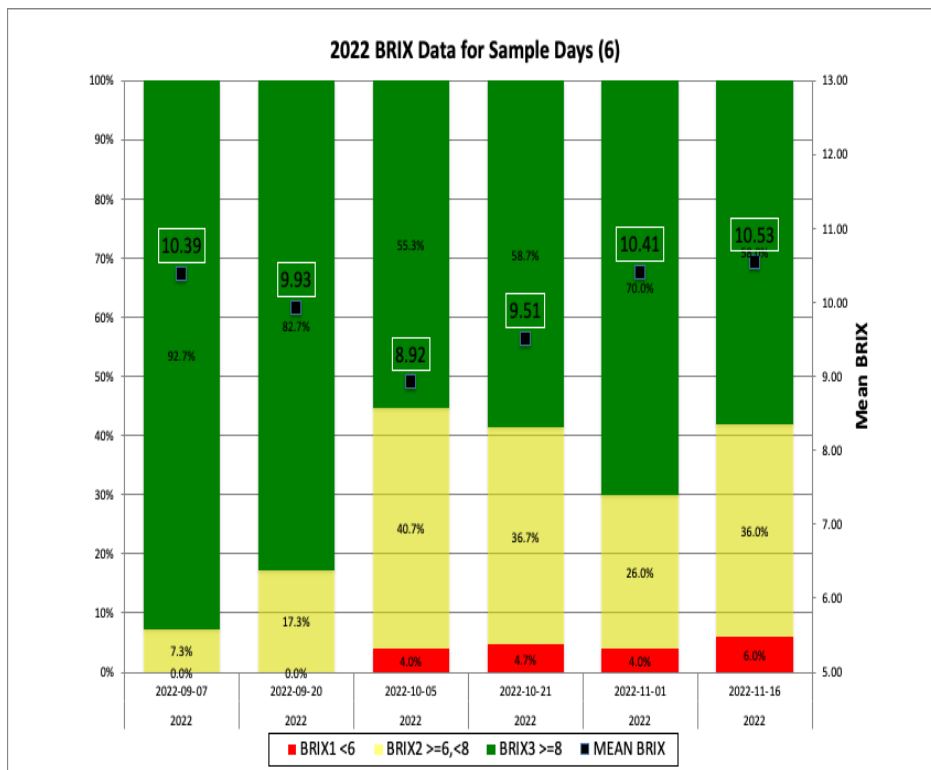
- 1) 2022 samples exhibit declining average BRIX behaviour over the 6 preseason sampling dates from average BRIX levels of 9 to 7.3 by the end of the sampling period including a notable dip in the mid-October survey***
 - 2) November 7, 2022 preseason sample 3-4 weeks before the start of the commercial season is comparable to the BRIX distribution in 2016***
 - 3) Overall Lobster Quality classification for the 2022 samples average ML; estimated likelihood that Port La Tour Outside Lobster Quality category is ML or L is estimated as 77%***
-

ST. MARY’S BAY INSIDE

2022 SUMMARY OF RESULTS

Blood Protein (BRIX) Categories

2022 preseason samples for St. Mary’s Bay Inside over 6 sample dates exhibit an initial decline in average BRIX of over 10 in early September to below 9 by early October. Thereafter, average BRIX shows gradual improvement from mean BRIX (8.5) to maximum high mean BRIX over 10 at the final 2022 November 16 sample. As in other locations, early samples show zero “Poor” BRIX samples. St. Mary’s Bay is characterized by “Poor” BRIX below 10% for all samples in 2022.



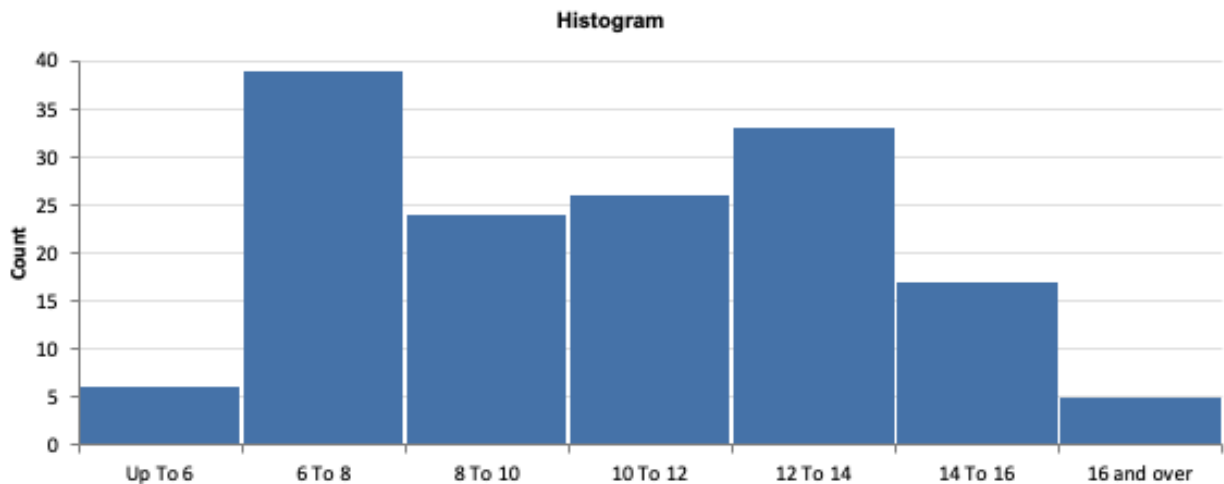
2022 St. Mary’s Bay Inside results for the November 1 sample, 3-4 weeks from the start of the commercial harvest season, show a relatively constant trend over the period from 2016 to 2022. The November 1, 2022 sample has the highest average BRIX (10.4) in the series. This sample also has the lowest “Poor” BRIX results over the series.

The 2022 sample is most comparable to the recent November samples in 2020 and 2021 with similar average BRIX values.

Lobster Quality Category Classification Based on the historical sampling in this location, the 6 sample dates in 2022 are collectively classified as “Moderate-High” (MH) quality in comparison to the other years’ samples (Table 4). This is the highest quality classification of the BRIX distributions since prior to 2013 and the location of higher quality lobster throughout LFAs 33 and 34.

Historically, Lobster Quality classifications for St. Mary’s Bay Inside of Moderate-High (MH) have also occurred during the 2008, and 2010 to 2012 seasons (as per Table 4 above). These results indicate that in 2022 St. Mary’s Bay Inside exhibits higher overall quality comparable to the period from 2006 to 2013 in the full preseason survey database.

BRIX Distribution The BRIX distribution histogram (below) of 150 samples from the final November 16, 2022 St. Mary’s Bay Inside sampling period with mean BRIX of 10.5 illustrates a particular pattern of BRIX values that may not be as expected. “Poor” and “Medium” BRIX lobsters (BRIX < 8) represent only 30% of all samples of potentially recovering lobsters from a recent moult. A second mode of the BRIX histogram occurs at the high BRIX cell of 12-14 (over 20%). Consequently, 70% of St. Mary’s Bay Inside lobsters are in the “Good” category (BRIX ≥ 8) with many of these (37%) with very high BRIX (>12). The availability of these lobsters at the start of the commercial season is uncertain.



Summary : ST. MARY’S BAY INSIDE–

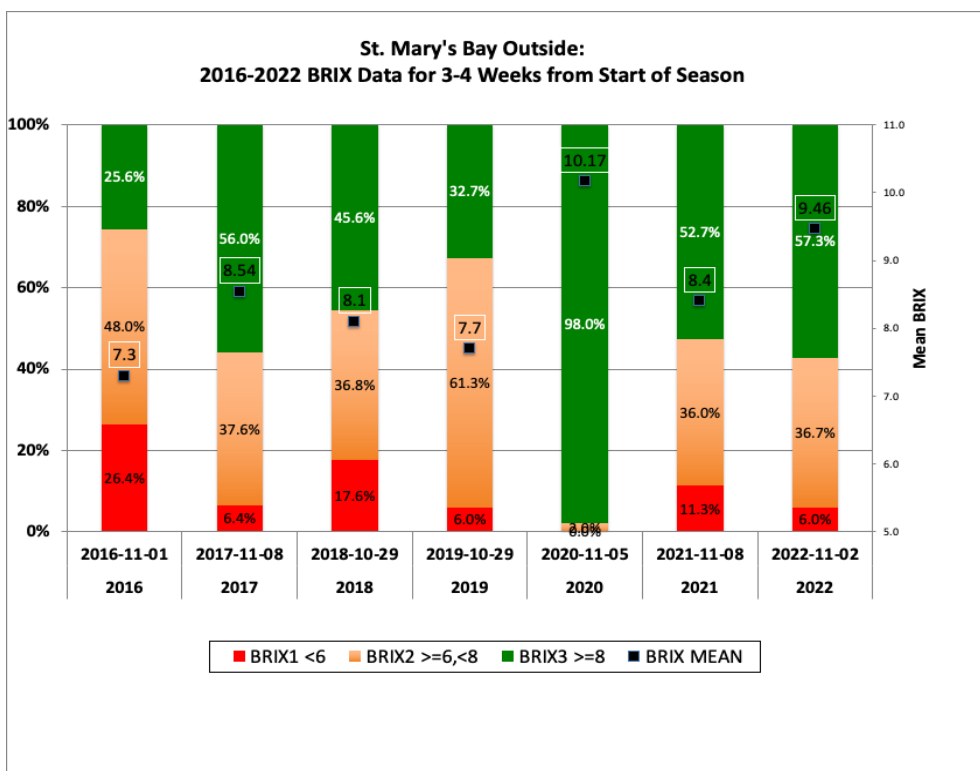
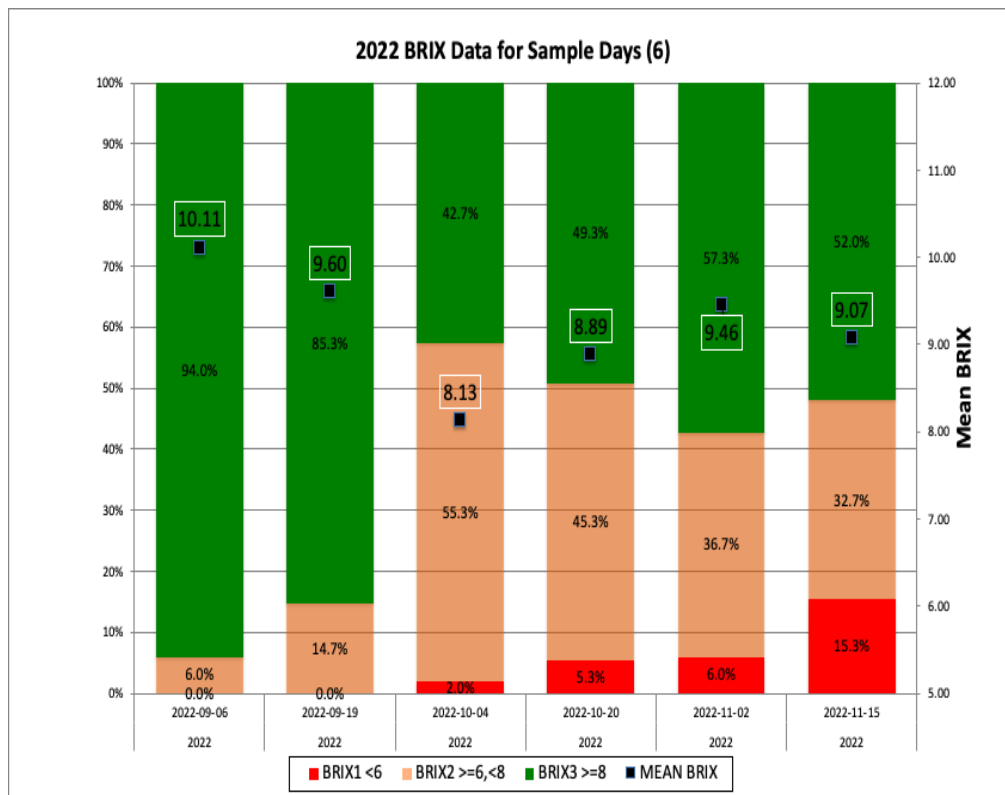
- 1) 2022 samples exhibit an initial decline to early-October and thereafter a gradual improvement in moderately high BRIX levels from 8.9 moving to a high average BRIX of 10.5 by the end of the sample period**
- 2) November 1, 2022 preseason sample 3-4 weeks before the start of the commercial season continue the trend of higher mean BRIX levels since 2018**
- 3) Overall Lobster Quality classification for the 2022 samples approaches MH levels with likelihood of over 75% for classifications MH, M, or ML combined**

ST. MARY'S BAY OUTSIDE

2022 SUMMARY OF RESULTS

Blood Protein (BRIX) Categories

2022 preseason samples in St. Mary's Bay Outside exhibit a pattern similar to St. Mary's Bay Inside with initially declining average BRIX levelling off by early October, and stabilizing to high levels (near 9) by the end of the survey period in mid-November. "Poor" BRIX are initially zero in the early samples (as in other locations) rising to a high of 15% by the mid-November sample. The high average BRIX for this sample indicates that some BRIX may be very high.



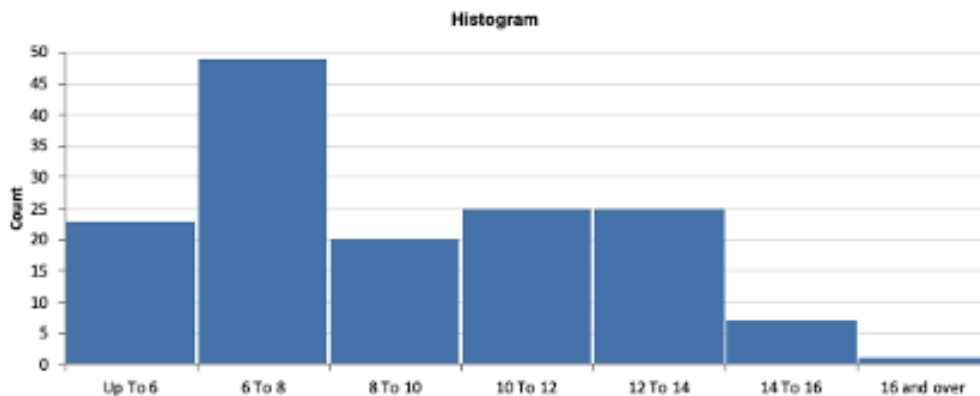
The annual trend of the BRIX distribution categories 3-4 weeks prior to the start of the season also shows a moderately stable time series from 2016 to 2022 (2020 excepted). In the November 2, 2022 sample the average BRIX (9.5) is elevated and highest in the series (2020 excepted). "Poor" BRIX are marginal (6%) with well over 50% in the "Good" category.

The 2022 sample is comparable to that of the November 8 samples in 2017 and 2021 but with higher average BRIX value well over 9.

Lobster Quality Category Classification Based on the historical sampling in this location, the 6 sample dates in 2022 for St. Mary’s Bay Outside are collectively classified as “Moderate” (M) quality in comparison to the other years’ samples (Table 4). The likelihood of the St. Mary’s Bay Outside samples being in either the M or ML classification is over 90%.

Historically, Lobster Quality classifications for St. Mary’s Bay Outside of Moderate (M) have also occurred during the 2009, and the past 2 seasons 2020-2021 (as per Table 4 above). The recent years 2020-2021 are part of the post-2013 lobster quality decline period, and indicate that St. Mary’s Bay Outside remains below the higher quality regime in the reduced quality range relative to the full 2006-2021 database.

BRIX Distribution The BRIX distribution histogram (below) of 150 samples from the final November 15, 2022 St. Mary’s Bay Outside sample period with mean BRIX of 9.1 illustrates a BRIX pattern that may not be as expected. “Poor” and “Medium” BRIX lobsters (BRIX < 8) represent nearly 50% of all samples of potentially recovering lobsters from a recent moult. A second mode of the BRIX histogram may occur at the high BRIX cells of 10-12 and 12-14 (33%). Consequently, 50% of St. Mary’s Bay Inside lobsters are in the “Good” category (BRIX ≥ 8) with most of these (39%) with high BRIX (>10). The availability of these lobsters to be caught at the start of the commercial season is uncertain.



Summary : ST. MARY’S BAY OUTSIDE–

- 1) 2022 samples exhibit an initial decline in average BRIX to mid-October (from 10.11 to 8.13) followed by a small increase to 9.1 by the end of the sampling period**
 - 2) 2022 preseason sample of November 2, 3-4 weeks before the start of the commercial season, is comparable in BRIX categories to 2017 and 2021 samples but with higher average BRIX value (9.5)**
 - 3) Overall Lobster Quality classification for the 2021 samples is at the “Moderate” (M) quality level directly comparable to the 2020 and 2021 categories**
-

2022 Preseason Summary

2022 preseason sampling results in LFAs 33 and 34 indicate that lobsters landed at the start of the 2022-2023 season in southwest Nova Scotia, are of overall moderate-low (ML) quality by comparison with the entire 2006 to 2021 preseason database. 2022 preseason samples average overall BRIX is at the moderately high level of 9.5 units/ml.

Table 5 below summarizes the average BRIX results over all sample dates for each location in 2022. Summary statistics for landed lobster counts per trap by location as well as the percentage of weaks and soft and medium lobster are also recorded. The summary table also shows each location's overall Lobster Quality Classification and comparable years from the historical database. Finally, the table indicates the observed bimodal behaviour of the BRIX distributions as discussed above.

While there is evidence that commercial catches at the start of the season may continue to be strong, it is not clear whether lobster quality will be improved in comparison with 2020 or 2021. Observations from catches early in the commercial season – or potentially from newly open LFA fisheries (e.g., LFAs35-38) – will provide a clearer indication of overall quality for the commercial seasons in LFA33 and 34.

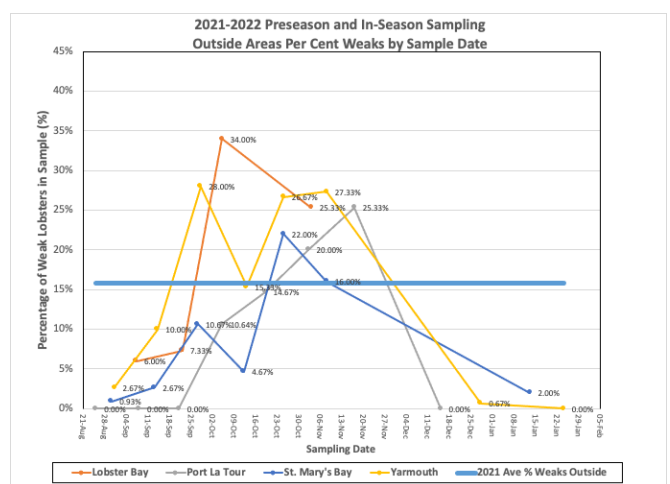
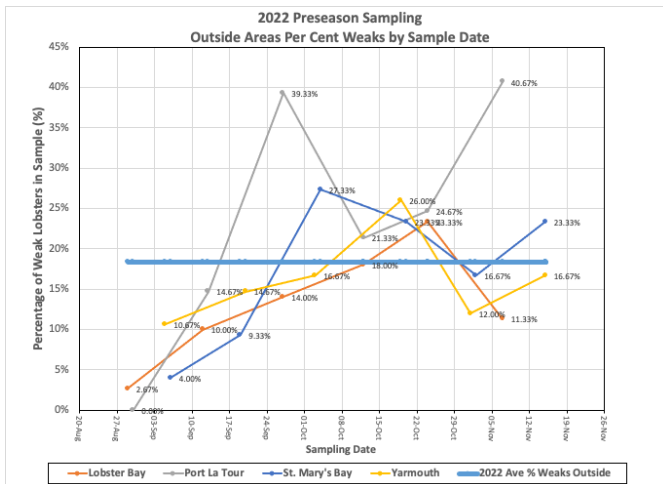
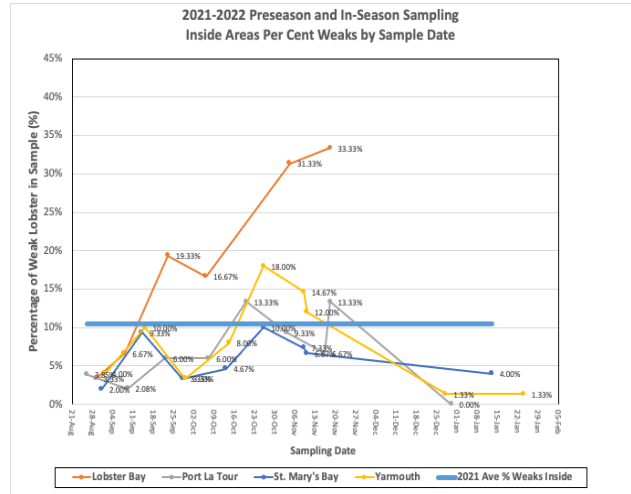
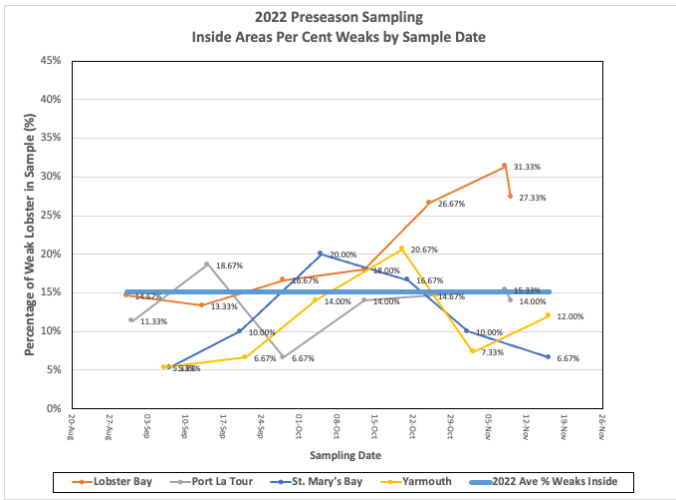
Table 5. 2022 Preseason Sampling Summary Results

Locations:	Yarmouth	Yarmouth	Lobster Bay	Lobster Bay	Port La Tour	Port La Tour	St.Mary's Bay	St.Mary's Bay	Overall
2022 Samples	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside	Locations
Average BRIX	10.25	9.08	10.50	9.71	9.27	7.92	9.95	9.21	9.48
Counts Per Trap	12.87	20.2	17.9	16.48	10.1	10.03	12.93	19.82	15.19
%Soft+Medium	18.78%	28.78%	20.57%	21.44%	26.76%	43.61%	23.11%	21.33%	25.34%
%Weaks	11.00%	16.11%	21.14%	13.22%	13.52%	23.44%	11.44%	17.33%	16.28%
Bimodal BRIX Dist? Yes/No	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Overall Lobster Quality Category	ML	ML	ML	ML	ML	ML	MH	M	ML
No. of Location-dates	6	6	7	6	7	6	6	6	50
Comparable Years	2015, 2019	2014, 2015	2013, 2021	2012, 2019	2018, 2019	2016, 2021	2020, 2021	2017, 2021	2020

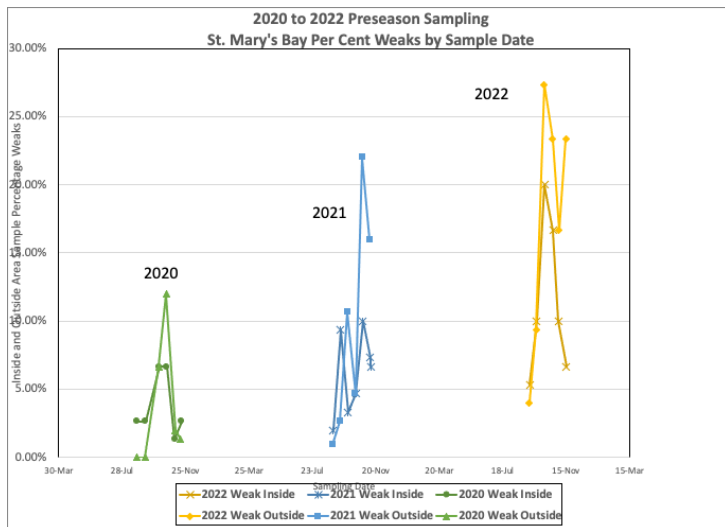
2020 Preseason highlights:

- All early survey results in all 8 locations show elevated BRIX with no “Poor” observations (below 6) in any sample during the early sampling periods. BRIX values tend to decline/dip in late September/early October and then increase moderately or level off in the mid-October samples and toward the end of the sampling period in mid-November.

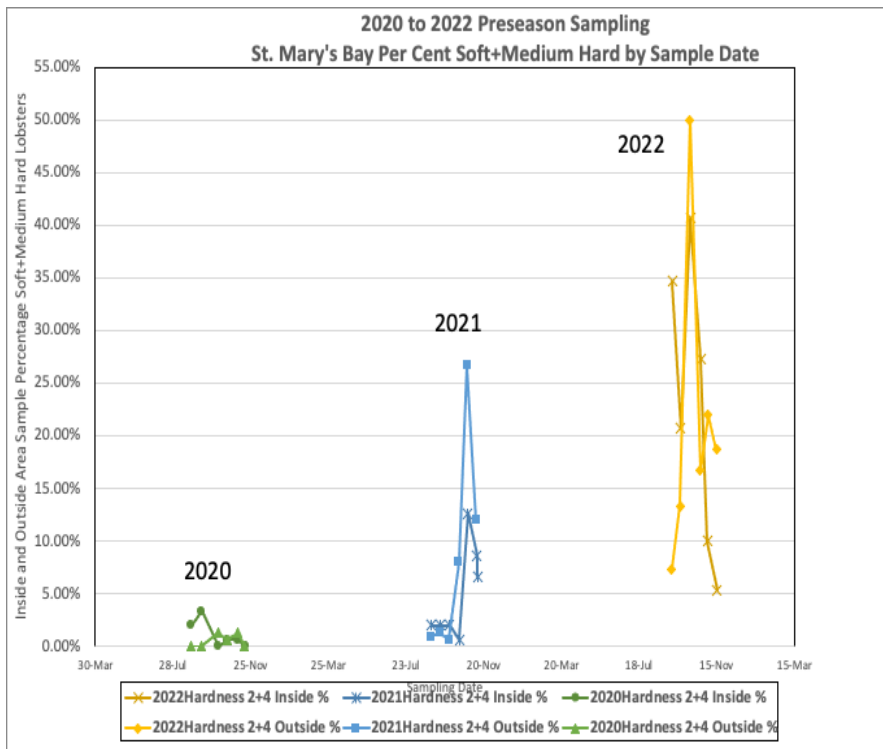
- In 2022, weaks in the Inside locations averaged 14.5% per sample. Weaks in the Outside locations averaged over 18% per sample. Lobster Bay dominated the incidence of weaks in the Inside (average 21%) and Port La Tour dominated the Outside areas (average 23%), compared to the overall average of weaks in all areas of over 16% in 2022 (see also Table 5 above).



- In comparison to the 2021 Preseason and 2022 In-season data, weaks in the 2022 Preseason sampling 2022 generally exceeded weaks in 2021-2022 (see also graphs above). The overall average inside weaks moved from 10% to 15% in 2022 (a 50% increase). Similarly, the overall average outside weaks moved from 16% in 2021-2022 to over 18% in 2022 (a 12% increase). The graph below records these statistics for St. Mary's Bay (Inside and Outside). Similar increases in weaks are noted for Port La Tour (Inside and Outside).



- Lobster hardness measurements also shifted in the 2022 preseason in comparison to the 2021 and 2020



preseason survey results. The graphs below for St. Mary’s Bay (Inside and Outside) compare the counts (in percentage of the 150 samples protocol) of “Soft” (Hardness scale=2) and “Medium” (Hardness scale=4) for the preseason survey dates over the 3-year reporting period. Counts of soft and medium increased from negligible amounts (less than 5%) in 2020 to over 50% in selected sampling dates in 2022. These shifts are also evident in Lobster Bay and Yarmouth Inside and Outside areas but less so for Port La Tour.

Acknowledgements

Coldwater Lobster Association and Université Sainte-Anne wish to thank all participants in, and contributors to the 2022 Preseason Lobster Moul & Quality Survey. Your commitment to this scientific task is commendable. We appreciate and thank all of you for your continued support and improvement of this important scientific study for the benefit of the lobster sector in southwest Nova Scotia. To those about to embark on another lobster season in LFAs 33 and 34, here's to calm waters, a prosperous season, and stable international and domestic markets. Stay safe and watch out for one another.



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