2019 RECRUITMENT INDEX PROGRAM RESULTS

Gulf Nova Scotia Fleet Planning Board

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Contents

Program Description

The lobster recruitment index program is an annual sampling project designed by DFO and carried out by harvesters. Harvesters sample all lobsters caught in six consecutive traps throughout the regular fishing season. Three of the traps are standard traps used by the harvester, and the other three are modified with blocked escapes to capture small (sub-market, recruit) lobsters. Harvesters use gauges to measure the lobster, with bin sizes 1 to 13. All lobsters in bin size four and under are not of commercial size (recruits).

It is important to acknowledge that the minimum carapace length for market sized lobsters varies across sub-zone management areas. Harvesters use gauges with bin sizes adjusted to account for differences in the minimum legal carapace size. Population dynamics including the distribution of 'age classes' or sizes may be impacted by differences in minimum legal carapace size. The following table shows the minimum legal size for each sub-zone in 2019 (Table 1):

Table 1.2019 legal minimum carapace length (mm) by sub-zone

Management Zone	Length (mm)
26A1	73
26A2	76
26A3	76
26 B South	82.5
26 B North	82.5

The Gulf Nova Scotia is divided into regions for analyses. DFO analyses scientific data based on the following "sub-regions":

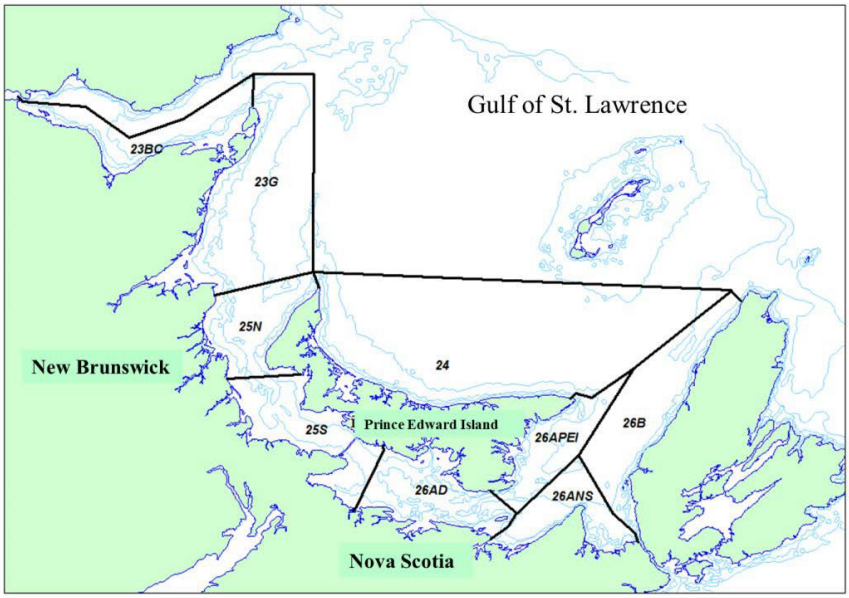

Figure 1: DFO scientific analyses sub-regions

This analysis will examine the sub-zones that DFO uses is in the management of the fishery (Figure 2). The 18 sites have been selected to cover the entire Gulf NS region, with evenly distributed sampling in each sub-zone (Figure 3). Efforts are made to retain the same harvester participants from year to year to ensure consistency in the data, however; it is not uncommon to have 1-2 new participants each year. New harvesters are chosen from the same wharf (or sub-zone if necessary), however they will not fish their experimental traps in the exact same location as the previous harvester, which may lead to some variation in the data. It is important to consider these differences when comparing annual average values across sites. In 2019 we had new harvester participants from Pictou Island, Margaree and Inverness.

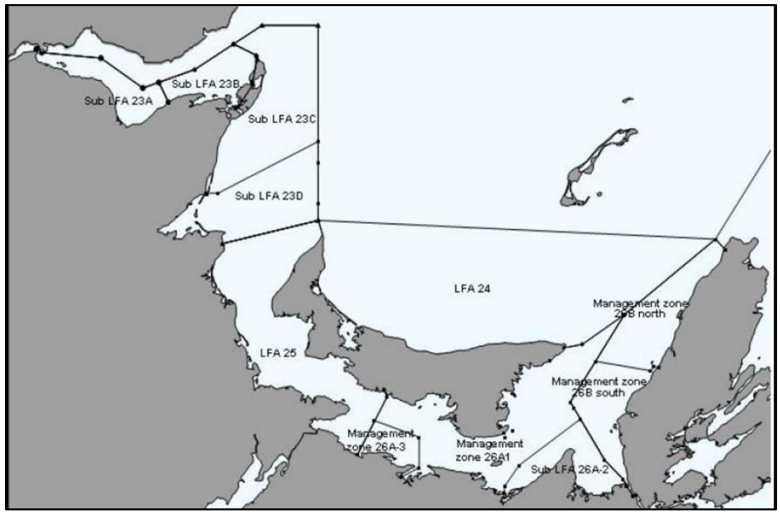

Figure 2: Map of sub-zones used in GNSFPB analysis. 26A1, 26A2, 26A3, 26B South and 26B North

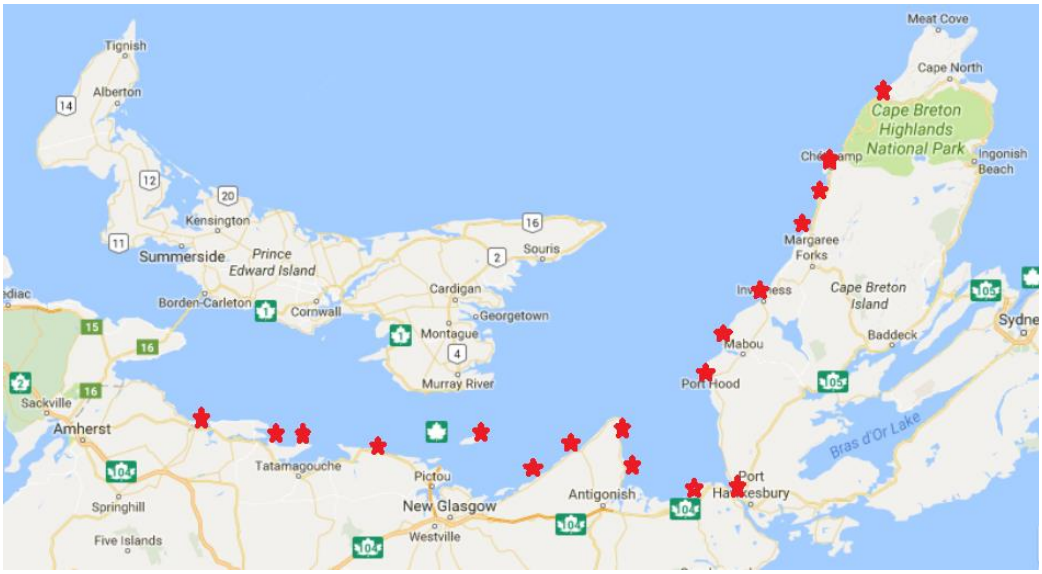

Figure 3: Map of harvester participants for 2019. From West to East: Pugwash, Wallace, Wallace, River John, Pictou Island, Lismore, Cribbons, Arisaig, Ballantyne's Cove, Havre Boucher, Aulds Cove, Port Hood, Mabou, Inverness, Margaree, Grand Etang, Cheticamp, Pleasant Bay.

2019 Summary Statistics

In previous years, data collected from the Index Recruitment program was submitted to DFO for analysis. DFO uses the data to inform stock assessments and other management processes, using the number of recruits per trap as a key indicator. In 2017, the GNSFPB began to conduct an in-house analysis of data. The intention is to develop indicators to monitor pulses and trends in recruitment data. The historical and contextual data collected throughout this project is presented in the section 2019 & Historical Data (page 9).

In this section, we will present a summary of the 2019 data and key indicators. The total number of traps sampled varies throughout each region; based on the number of sampling sites in each region and days fished at each site. Please note that the number of lobsters does not represent overall landings; each region has a different number of harvesters and traps sampled.

Table 2. 2019 Summary Statistics for 26A (10 participants) and 26B (8 participants).

26A	**Modified**	**Regular**	**Total**
Lobsters	7665	5606	13,271
Recruit Sized	3996	1828	5824
Berried	1326	1072	2398
Traps Sampled	1430	1430	2860
Empty Traps	70	108	178
26B	**Modified**	**Regular**	**Total**
Lobsters	10889	5634	16,523
Recruit Sized	7714	3442	11,156
Berried	1322	841	2163
Traps Sampled	909	909	1818
Empty Traps	12	38	50
Total	**Modified**	**Regular**	**Total**
Lobsters	18,554	11,240	29,794
Recruit Sized	11,710	5270	16,980
Traps Sampled	2339	2330	4669

**Note: Unmodified trap landings reflects differences in minimum carapace length by LFA*

The following tables further break down the summary statistics by DFO sub-zone. Notice that each sub-zone has a different number of participants. The project protocol aims to cover the entire Gulf NS with relevant, evenly distributed sampling sites.

Table 3. 26A1 descriptive statistics of traps and lobsters. 2 participants.

26A1	Modified Traps	Regular Traps	Total
Lobsters	2847	2077	4924
Recruit Sized	1659	776	2435
Berried	549	453	1002
Traps Sampled	279	279	558

Table 4. 26A2 descriptive statistics of traps and lobsters. 5 participants.

26A2	Modified Traps	Regular Traps	Total
Lobsters	3881	2795	6676
Recruit Sized	2123	975	3098
Berried	581	465	1046
Traps Sampled	758	758	1516

Table 5. 26A3 descriptive statistics of traps and lobsters. 3 participants.

26A3	Modified Traps	Regular Traps	Total
Lobsters	937	734	1671
Recruit Sized	214	77	291
Berried	196	154	350
Traps Sampled	393	393	786

Table 6. 26B South descriptive statistics of traps and lobsters. 4 participants.

26B South	Modified Traps	Regular Traps	Total
Lobsters	5054	3327	8381
Recruit Sized	3805	2063	5868
Berried	622	498	1120
Traps Sampled	453	453	906

Table 7. 26B North descriptive statistics of traps and lobsters. 4 participants.

26B North	Modified Traps	Regular Traps	Total
Lobsters	5835	2307	8142
Recruit Sized	3909	1379	5288
Berried	700	343	1043
Traps Sampled	456	456	912

2019 Status Indicators Results

The above statistics provide insight on a sub-zone and site level. In order to compare recruitment levels across sites, we will present all of the key indicators as number of lobsters per trap sampled. The key indicators of interest are total number of lobsters per trap, total number of recruit size lobsters (excluding berried females) per trap and the number of berried females per trap.

The number of lobsters per trap is an estimate of Catch Per Unit Effort and provides insight in to changes in catch rate. The number of recruit sized lobsters per trap shows the pre-fishery recruitment levels, demonstrating a healthy juvenile stock and providing insight in to pulses in catches in the coming years. Berried females per trap is an assessment of the reproductive potential of the stock. The key indicators are shown in Table 8 (for 26A) and Table 9 (for 26B) below.

As identified earlier, there are differences in legal minimum carapace size across sub-zones. In areas with a greater minimum legal size, regular traps will have greater escape mechanisms. The data under “regular” reflects these subtle differences.

Table 8. Key status indicators for 26A, represented as per trap sampled. 10 participants, 2860 traps sampled.

	Modified	**Regular**
26A1		
Lobsters/Trap	10.2	7.4
Recruits/Trap	5.9	2.8
Berried/Trap	2.0	1.6
26A2		
Lobsters/Trap	5.1	3.7
Recruits/Trap	2.8	1.3
Berried/Trap	0.8	0.6
26A3		
Lobsters/Trap	2.4	1.9
Recruits/Trap	0.5	0.2
Berried/Trap	0.5	0.4
26A TOTAL		
Lobsters/Trap	5.4	3.9
Recruits/Trap	2.8	1.3
Berried/Trap	0.9	0.7

Table 9. Key status indicators for 26B, represented as per trap sampled. 8 participants, 1818 traps sampled.

	Modified	**Regular**
26B South		
Lobsters/Trap	11.2	7.3
Recruits/Trap	8.4	4.6
Berried/Trap	1.4	1.1
26B North		
Lobsters/Trap	12.8	5.1
Recruits/Trap	8.6	3.0
Berried/Trap	1.5	0.8
26B TOTAL		
Lobsters/Trap	12.0	6.2
Recruits/Trap	8.5	3.8
Berried/Trap	1.5	0.9

Bin size of recruit and berried lobsters

It is useful to further break down the recruitment index to identify the proportion of recruit size lobsters in each bin size (1-4). Note that the bin sizes are designed to account for differences in minimum legal carapace size across sub-zones. Figure 4 has total number of recruit sized lobsters across the horizontal axis. The majority (60-90%) of recruit size lobsters are bin-sizes 3 and 4. Very few size 1 lobsters were observed; 7% and 4% in 26B North and South respectively.

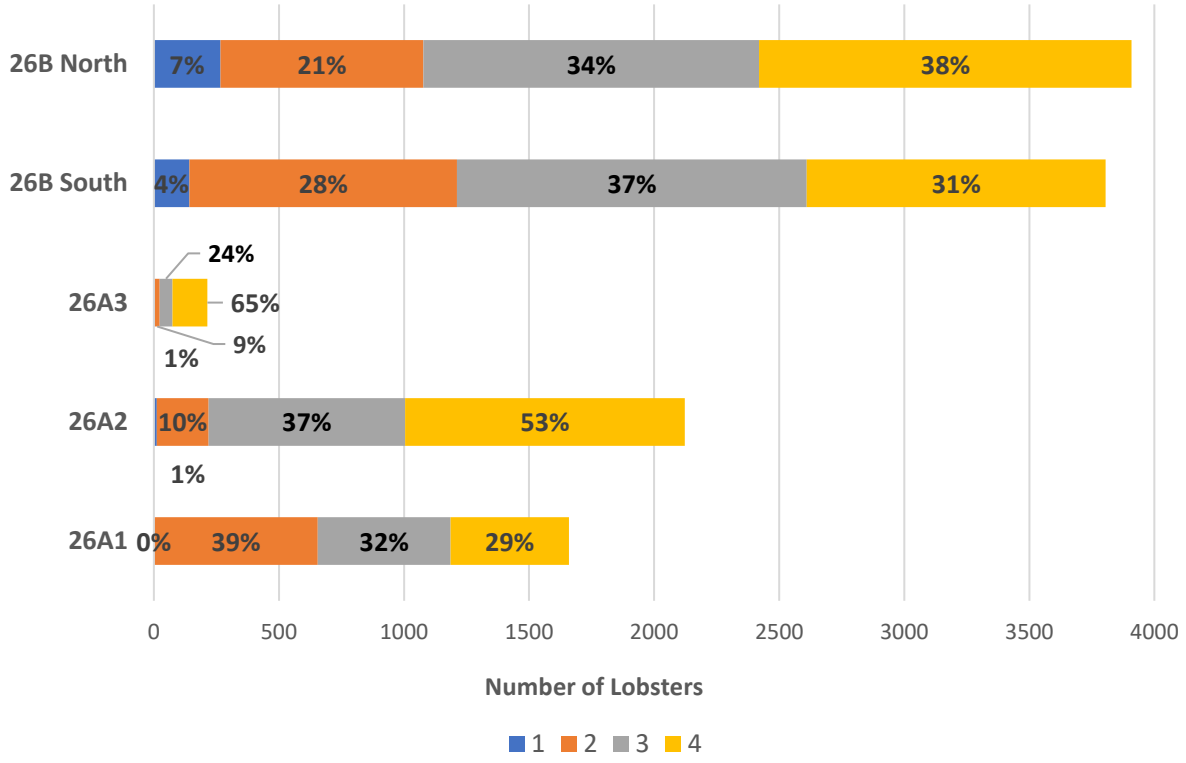

*Figure 4. Recruit size lobsters by bin size, for all **modified traps** in each subzone. Bin sizes are adjusted to reflect differences in minimum legal carapace size.*

Berried females are an indicator of stock level reproductive health. The size and age of maturity varies in female lobsters. Below, berried females from all sub-zones are broken down by bin-sizes 1-12 (Figure 5). 26B North and 26B South have very similar size proportions of berried females; with the majority of berried females being bin-size 3 and 4. 26A2 and 26A3 have majority of berried females being bin sizes 4 and 5. Very few berried lobsters of bin size 7-12 were observed in all areas.

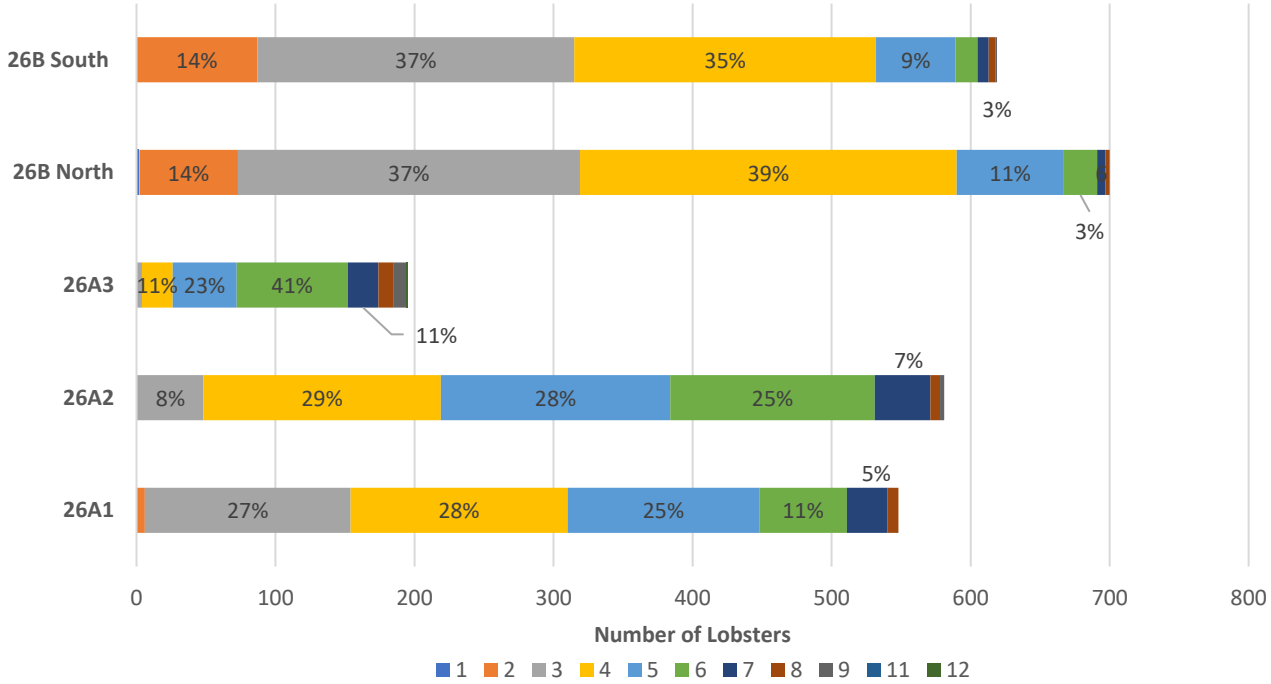

Figure 5. All berried females, represented by bin sizes 1-13, in all sub-zones. Percentages are only shown if proportion is greater than ~3%.

2019 & Historical Data

This purpose of this annual sampling is to identify the incoming recruitment and monitor the reproductive health of the lobster stocks. This valuable harvester commitment and contribution has allowed us to catalogue annual indicators throughout the entire gulf of Nova Scotia, and now with 4 years of data we can begin to follow pulses in the data over time.

Table 10 displays all historical data associated with the index recruitment project. In some areas, such as 26A2 and 26B, there has been intermittent sampling since the early 2000's.

Table 10. All historical recruitment index data.

LFA	Year	Participants	Lobsters Measured Modified	Modified Traps Sampled	Lobsters Measured Regular	Regular Traps Sampled	Total Lobsters Measured
26A2	2000	9	2545	1114	1916	1113	4461
	2012	8	3053	1122	2498	1122	5551
	2013	6	3144	793	2647	792	5791
	2014	10	5547	1443	4545	1443	10,092
	2016	6	3499	771	2456	742	5955
	2017	5	3488	708	2443	708	5931
	2018	5	4295	630	2858	630	7153
	2019	5	3881	758	2795	758	6676
26A1 and 26A3	2016	4	1939	410	1162	366	3101
	2017	4	1950	651	1289	651	3239
	2018	5	2881	681	2165	681	5047
	2019	5	3784	672	2811	672	6595
26B	2004	9	2616	1029	2138	1028	4754
	2012	5	2915	645	1893	641	4808
	2013	4	2853	432	2116	434	4969
	2014	10	6869	1177	4889	1165	11,758
	2015	4	4238	512	2606	493	6844
	2016	7	5973	878	4145	860	10,118
	2017	8	7876	945	5675	945	13,551
	2018	8	9208	927	6350	927	15,558
	2019	8	10,889	909	5634	909	16, 523

The following two tables summarize the recruits per trap in all sub-zones from 2016 to 2019. This indicator represents all male and non-berried recruit sized lobsters (bin sizes 1-4). The modified trap data (Table 11) presents a full picture of the future market lobsters. The regular trap data is a more accurate picture of the typical catch distribution (Table 12); where recruit/trap is an estimate of the average number of sub-legal lobsters being returned to the water per trap.

Table 11. Recruit sized lobsters (male and non-berried female) per modified trap, from 2016-2019 for all sub-zones in GNS.

Modified Traps	2016 Recruits/Trap	2017 Recruits/Trap	2018 Recruits/Trap	2019 Recruits/Trap
26A1	3.88	3.0	3.7	5.9
26A2	2.08	2.7	3.0	2.8
26A3	0.32	0.5	0.7	0.5
26B North	5.10	6.6	8.1	8.6
26B South	4.53	4.4	5.6	8.4

Table 12. Recruit sized lobsters (male and non-berried female) per regular trap, from 2016-2019 for all sub-zones in GNS.

Regular traps	2016 Recruits/Trap	2017 Recruits/Trap	2018 Recruits/Trap	2019 Recruits/Trap
26A1	1.24	1.0	2.2	2.8
26A2	0.81	1.2	1.6	1.3
26A3	0.13	0.1	0.3	0.2
26B North	2.73	3.7	4.4	3.0
26B South	2.65	2.5	3.7	4.6

In modified traps, the number of recruit sized lobsters per trap has increased on average (for all sites) by 2.05 lobsters from 2016 to 2019 levels. In 26A, recruits per trap increased on average by .97 (~1) lobsters. In 26B, the increase has been much greater at 3.68 lobsters from 2016 to 2019. Overall, from 2018 to 2019, several sub-zones had increases: 26A1, 26B North and 26B South. There were slight decreases in 26A2 and 26A3. We expect slight differences from year to year, especially considering that we have several new participants fishing in slightly different locations.

Below, the average total number of recruit size lobsters caught per site in each area was broken down into bin sizes one through four. Regular traps are displayed in table 13, and modified traps are shown in table 14. Note that these numbers represent the number of lobsters in each bin size at a representative site within each sub-zone; for example, an average of 154 recruit size lobsters were observed at each site in 26A1 in 2019. These tables provide insight for recruitment in the coming years. Lobsters in bin sizes 1-2 may still be 5-7 years away from commercial size.

Table 13. Average number of recruit sized lobsters caught per site in each area, broken down by bin size 1 to 4, from 2016 to 2019 for regular traps.

Regular Traps		**Bin Size**			
LFA	**Year**	**1**	**2**	**3**	**4**
26A1	2016	1.5	27.5	47.5	116.5
	2017	1.0	15.5	35.0	96.0
	2018	1.0	27.5	85.5	189.5
	2019	0.5	107.5	126.0	154.0
26A2	2016	2.2	12.6	33.6	83.0
	2017	1.8	20.2	67.2	117.2
	2018	1.5	16.4	57.6	157.4
	2019	0.4	9.4	47.8	137.2
26A3	2016	0.0	0.0	3.5	12.0
	2017	0.7	1.3	5.0	9.3
	2018	1.5	2.0	7.3	4.3
	2019	0.5	1.6	4.6	19.3
26B North	2016	15.8	50.3	106.0	259.5
	2017	12.0	45.8	132.3	346.0
	2018	0.0	4.4	28.4	57
	2019	10.5	35.0	77.5	221.75
26B South	2016	7.3	37.0	118.0	191.0
	2017	6.3	49.3	124.0	185.8
	2018	9.0	61.0	200.3	252.3
	2019	8.75	91.75	179.75	235.5

Table 14. Average number of recruit sized lobsters caught per site in each area, broken down by bin size 1 to 4, from 2016 to 2019 for modified traps.

Modified Traps		**Bin Size**			
LFA	**Year**	**1**	**2**	**3**	**4**
26A1	2016	3.5	159.5	198.0	231.5
	2017	0.5	86.5	123.5	229.0
	2018	4.0	105.0	189.5	254.0
	2019	0.5	327.0	265.5	236.5
26A2	2016	8.6	64.8	122.2	125.8
	2017	10.8	73.8	164.4	185.2
	2018	6.8	82.75	214.25	280.75
	2019	2.2	41.6	157.0	224.0
26A3	2016	1.0	4.0	11.0	20.5
	2017	1.7	14.0	13.0	28.0
	2018	0.0	0.0	2.0	4.0
	2019	1	6.6	17	47.0
26B North	2016	70.8	191.5	231.0	268.8
	2017	55.5	196.3	285.5	411.8
	2018	59.8	243.0	354.4	410.0
	2019	66.5	203.0	335.5	372.25
26B South	2016	16.7	139.0	217.0	208.0
	2017	17.3	145.8	225.0	220.3
	2018	18.3	172.7	305.3	278.0
	2019	35.5	267.5	349.5	298.75

The total number of recruit sized berried females is an indicator of future stock growth and productivity potential in the coming years. The following table compares the average number of recruit sized berried females caught in all experimental traps in 2019. These values are the average number of recruit sized lobsters in all traps, **not** per trap as above.

Table 15. Total number of recruit sized berried females, in regular and modified traps, from 2017-2019.

LFA	Year	Regular traps	Modified traps
26A1	2017	13.0	23.0
	2018	50.0	44.0
	2019	81.0	155.0
26A2	2017	37.4	56.4
	2018	33.8	54.8
	2019	30.8	53.3
26A3	2017	3.0	0.7
	2018	5.0	6.0
	2019	6.0	8.6
26B South	2017	61.3	97.8
	2018	90.3	115.0
	2019	101.25	133.0
26B North	2017	91.5	160.7
	2018	89.9	135.0
	2019	68.75	177.25

The number of recruit sized berried females has been generally increasing since 2017. Notably, 26A1 had a drastic increase from 2017/2018 levels in 2019. The number of recruit sized berried females more than tripled in 26A1 modified traps. This drastic change is likely due to the new participant in Pictou Island; the experimental traps were fished in an area referred to as a 'nursery', with generally high recruitment. Although this is inconsistent with previous years data, it is valuable to have data from multiple locations throughout each sub-zone to highlight that population dynamics vary within sub-zones. Recruit sized berried females are increasing in 26B South and North. Generally, this indicator shows healthy reproductive potential.

Interpretation

The key recruitment indicators considered in this report are lobsters per trap, recruit size lobsters per trap and several berried female measurements. Generally, recruitment levels are stable or moving in a positive direction for all sub-zones. Tables 11 and 12 (pages 9, 10) summarize recruits per trap in all areas since 2019. Recruits per trap have increased by 2.05 lobsters from 2016 levels across all sites. Recruits per trap have increased by 0.97 (~1) lobsters in 26A and 3.68 lobsters in 26B; from 2016 levels.

The figures (6 and 7) below show the recruits per trap in both modified and regular traps from 2016 to 2019. In 26A there has been an upward trend from 2017-2019, however the drastic jump in 2019 is likely due to the participation of a new harvester in Pictou Island. 26A2 and 26A3 both saw slight declines in recruits per trap but are still within the stable range as observed since 2016.

This recruit per trap data is further broken down in tables 12 and 13, where we see the distribution of lobsters in each bin size. A lobster in bin size 1-2 may still be 5-7 years from commercial size, so following the pulses in this data in future years will be essential to predicting stock growth or depression.

Our berried female analysis indicates that there is very positive growth and stability in the number of berried females, and therefore reproductive potential of the entire population. In modified traps, the average number of recruit sized berried females increased in 26B North, 26B South, 26A3 and 26A1. There was a very slight decrease in 26A2, however the average has remained stable ranging from 53-56 recruit sized berried lobsters per trap since 2017.

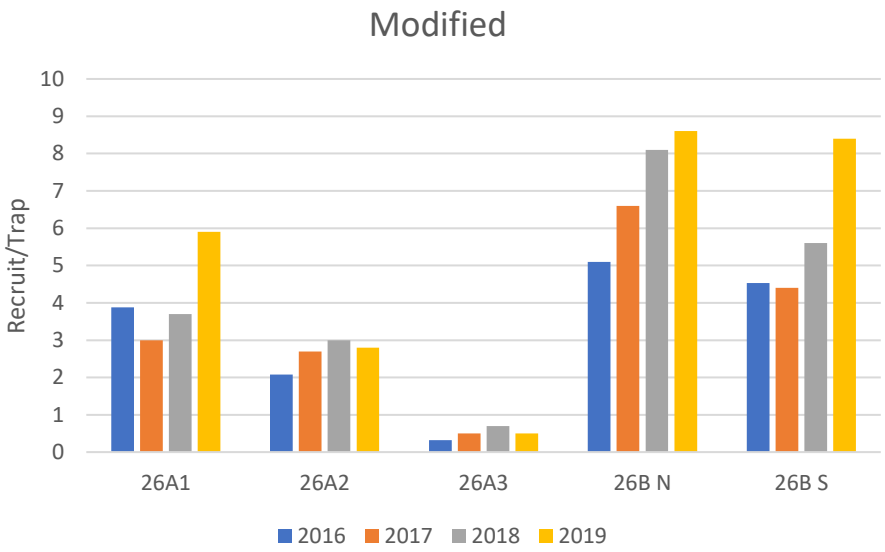

Figure 6. Comparison of recruits/trap in modified traps from 2016 to 2019.

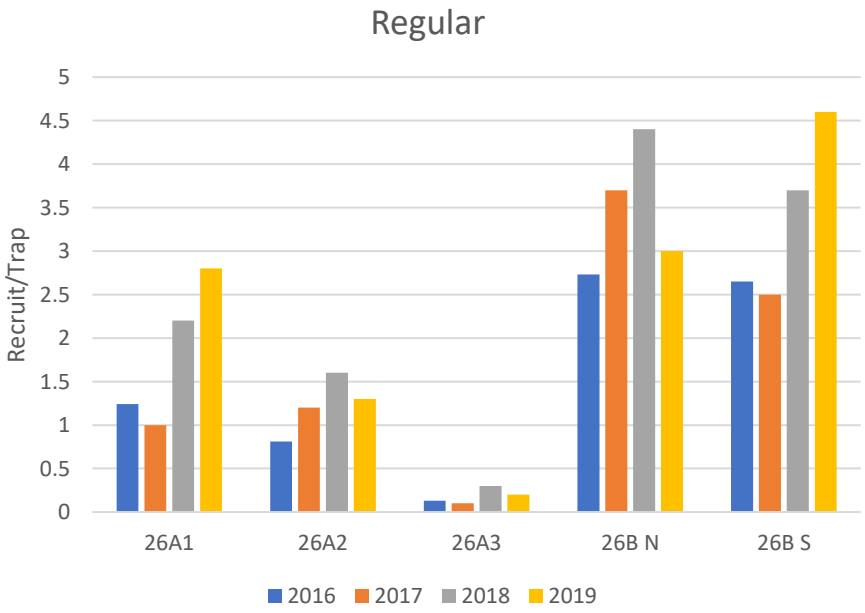

Figure 7. Comparison of recruits/trap in regular traps from 2016 to 2019

Acknowledgements

The Gulf Nova Scotia Fleet Planning Board would like to sincerely thank all of the harvester participants for 2019 (and previous years) for their valuable efforts in collecting this data; John Collins, Marc Lefort, Alexander Norman Beaton, Wallace Allen, Wallace Murray, Richard Mealong, Robert MacDougall, Dave Crawford, Jamie Craig, Jessica Hinkley, Eben Elliot, Paul Smith, Gordon Beaton, Donald MacAskill, Donald MacDonald, Dylan MacKay, Andrew Bourgeois and Mark Timmons. We would also like to thank the GNSFPB Secretary Treasure, Leonard LeBlanc, for contributing a lot of time, resources and expertise to this project every year. The results of this project are used to improve understanding of the lobster stock and the future of the fishery in the Gulf of Nova Scotia.