



# 2021 RECRUITMENT INDEX PROGRAM RESULTS

Gulf Nova Scotia Fleet Planning Board

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## 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 2021 (Table 1):

*Table 1. 2021 legal minimum carapace length (mm) by sub-zone*

Management Zone	Length (mm)
26A1	74
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”:

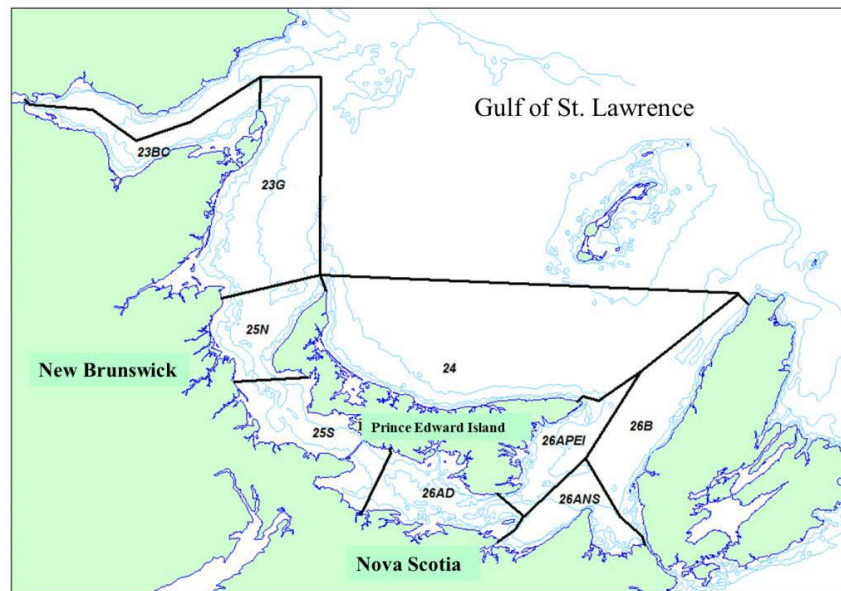


Figure 1: DFO scientific analyses sub-regions

This analysis will examine the sub-zones that DFO uses 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 2021 we had new harvester participants from Pictou Island, Arisaig, Mabou, Margaree and Pleasant Bay.

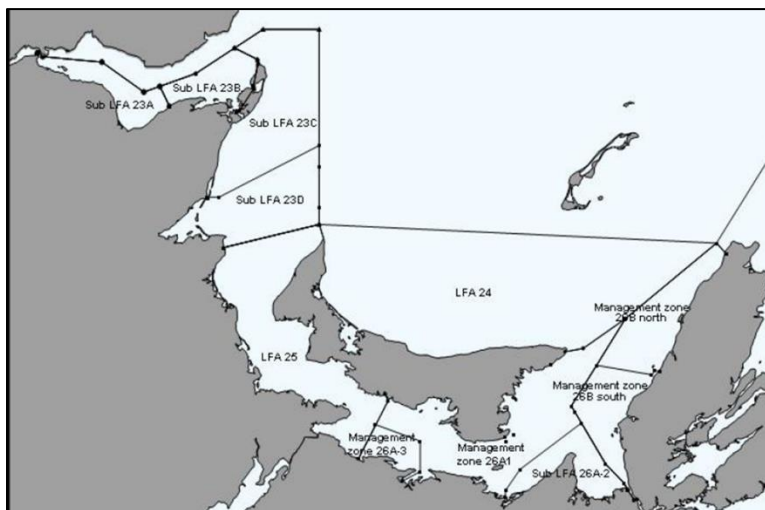


Figure 2: Map of sub-zones used in GNSFPB analysis. 26A1, 26A2, 26A3, 26B South and 26B North

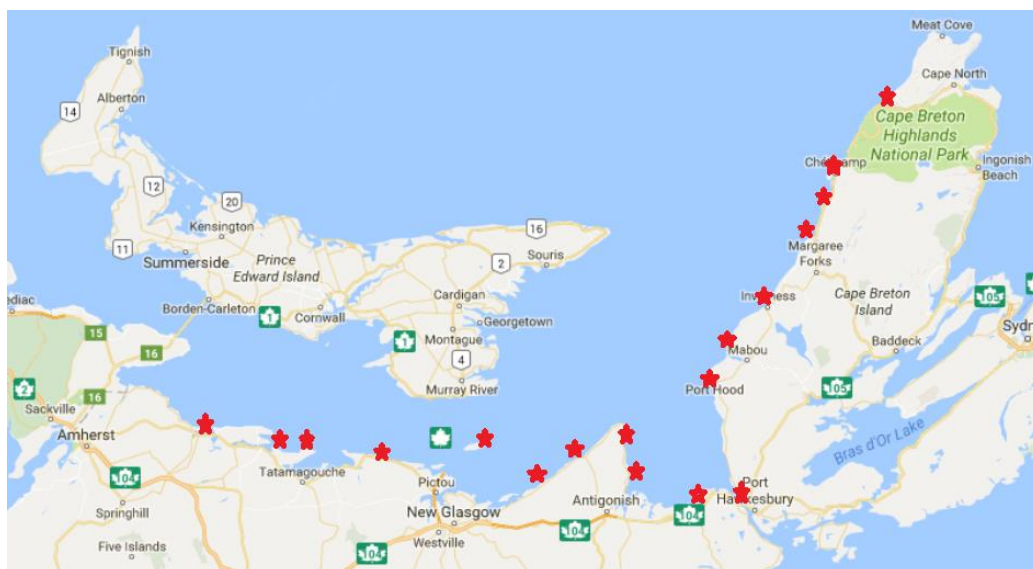


Figure 3: Map of harvester participants for 2021. From West to East: Pugwash, Wallace, Wallace, River John, Pictou Island, Lismore, Cribbons, Arisaig, Ballantyne's Cove, Havre Boucher, Aulds Cove, Port Hood, Mabou, Inverness, Margaree, Grand Etang, Cheticamp, Pleasant Bay.

## 2021 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 2021 & Historical Data (page 9). The project was not conducted in 2020 due to the covid-19 pandemic.

In this section, we will present a summary of the 2021 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. 2021 Summary Statistics for 26A (10 participants) and 26B (8 participants). Recruits include male, female, and berried female of recruit size.*

<b>26A</b>	<b>Modified</b>	<b>Regular</b>	<b>Total</b>
Lobsters	8297	5017	13314
Recruit Sized	5262	1942	7204
Berried	1293	906	2199
Traps Sampled	1341	1341	2682
Empty Traps	79	128	207
<b>26B</b>	<b>Modified</b>	<b>Regular</b>	<b>Total</b>
Lobsters	9182	4801	13983
Recruit Sized	7444	2879	10323
Berried	1174	583	1757
Traps Sampled	930	930	1860
Empty Traps	21	57	78
<b>Total</b>	<b>Modified</b>	<b>Regular</b>	<b>Total</b>
Lobsters	17479	9818	27297
Recruit Sized	12706	4821	17527
Traps Sampled	2271	2271	4542

*\*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. Recruits include male, female, and berried female of recruit size.*

26A1	Modified Traps	Regular Traps	Total
Lobsters	2544	1051	3595
Recruit Sized	1862	447	2309
Berried	501	269	770
Traps Sampled	270	270	540

Table 4. 26A2 descriptive statistics of traps and lobsters. 5 participants. Recruits include male, female, and berried female of recruit size.

26A2	Modified Traps	Regular Traps	Total
Lobsters	4935	3287	8222
Recruit Sized	3207	1402	4609
Berried	655	516	1171
Traps Sampled	681	681	1362

Table 5. 26A3 descriptive statistics of traps and lobsters. 3 participants. Recruits include male, female, and berried female of recruit size.

26A3	Modified Traps	Regular Traps	Total
Lobsters	818	679	1497
Recruit Sized	193	93	286
Berried	137	121	258
Traps Sampled	390	390	780

Table 6. 26B South descriptive statistics of traps and lobsters. 4 participants. Recruits include male, female, and berried female of recruit size.

26B South	Modified Traps	Regular Traps	Total
Lobsters	5329	2695	8024
Recruit Sized	4469	1755	6224
Berried	617	332	949
Traps Sampled	447	447	894

Table 7. 26B North descriptive statistics of traps and lobsters. 4 participants. Recruits include male, female, and berried female of recruit size.

26B North	Modified Traps	Regular Traps	Total
Lobsters	3853	2106	5959
Recruit Sized	2975	1124	4099
Berried	557	251	808
Traps Sampled	483	483	966

## 2021 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, 2682 traps sampled. Recruit size lobsters excluding berried females.

	<b>Modified</b>	<b>Regular</b>
<b>26A1</b>		
Lobsters/Trap	9.4	3.9
Recruits/Trap	5.8	1.3
Berried/Trap	1.9	0.99
<b>26A2</b>		
Lobsters/Trap	7.2	4.8
Recruits/Trap	4.3	1.8
Berried/Trap	0.96	0.76
<b>26A3</b>		
Lobsters/Trap	2.1	1.7
Recruits/Trap	0.47	0.21
Berried/Trap	0.35	0.31
<b>26A TOTAL</b>		
Lobsters/Trap	6.2	3.7
Recruits/Trap	3.5	1.2
Berried/Trap	0.96	0.68

Table 9. Key status indicators for 26B, represented as per trap sampled. 8 participants, 1860 traps sampled. Recruit size lobsters excluding berried females.

	<b>Modified</b>	<b>Regular</b>
<b>26B South</b>		
Lobsters/Trap	11.9	6.0
Recruits/Trap	8.8	3.4
Berried/Trap	1.4	0.74
<b>26B North</b>		
Lobsters/Trap	7.9	4.4
Recruits/Trap	5.2	2
Berried/Trap	1.2	0.52
<b>26B TOTAL</b>		
Lobsters/Trap	9.9	5.2
Recruits/Trap	6.9	2.7
Berried/Trap	1.3	0.63

### 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 of recruit size lobsters are bin-sizes 3 and 4. Very few size 1 lobsters were observed; 8.1% in 26A1 and below 3% in the other subzones sampled.

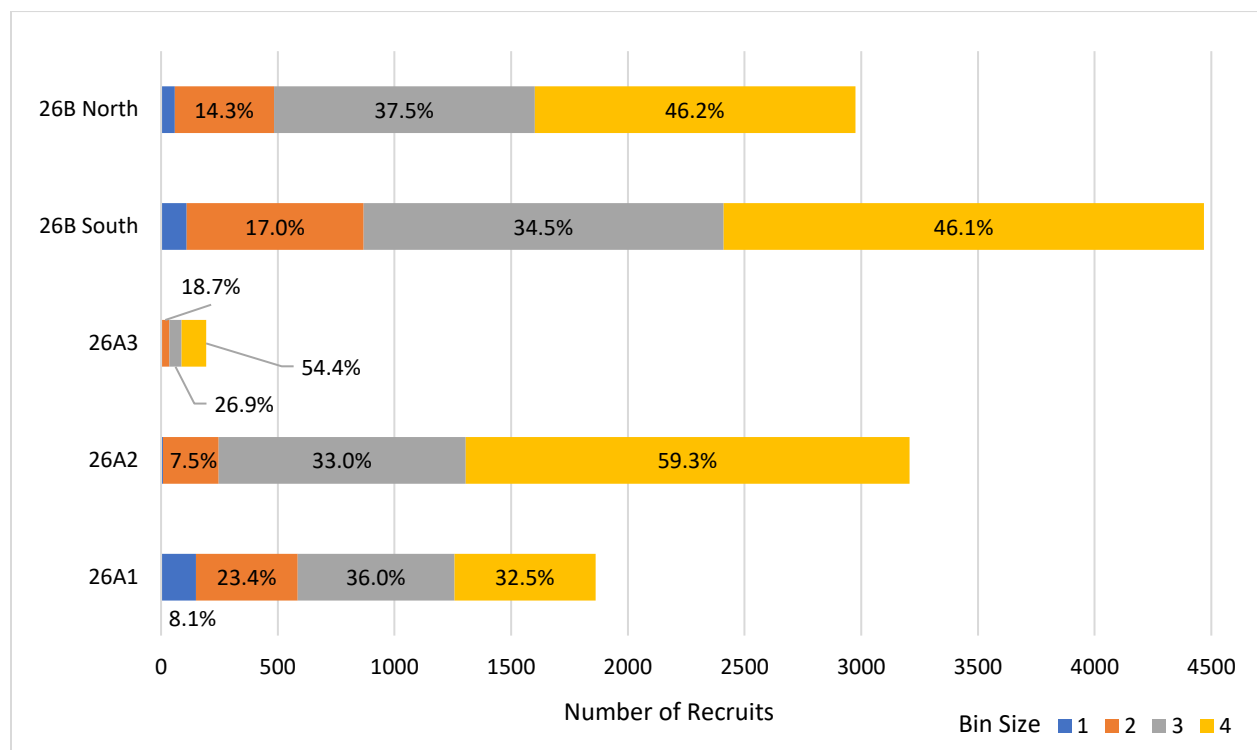


Figure 4. Recruit size lobsters (including berried) by bin size, for all **modified traps** in each subzone. Percentages are only shown if proportion is greater than ~3%.

The majority of the recruit-sized lobsters (including berried) in the modified traps were in the bin sizes 3 and 4 showing healthy number of lobsters coming to size in the upcoming years (Figure 4).



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 1-13 (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 sizes 8-13 were observed in all areas.

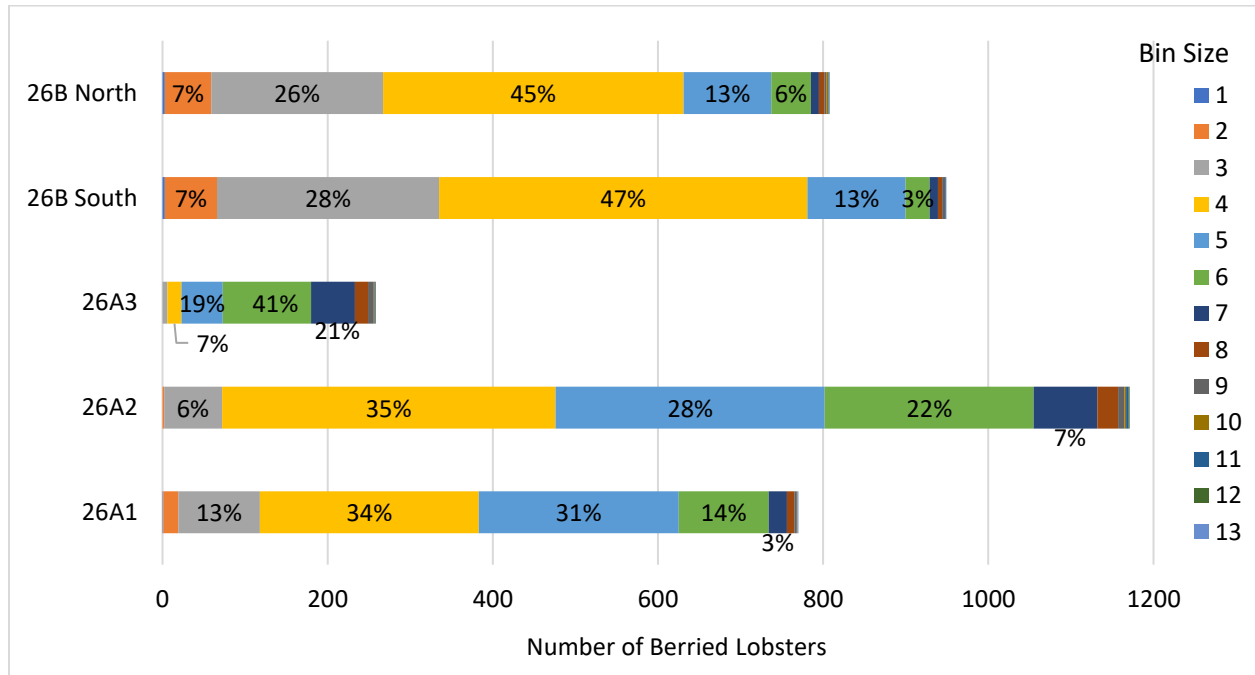


Figure 5. All berried females, represented by bin sizes 1-13, in all sub-zones. Percentages are only shown if proportion is greater than ~3%.

Our berried female analysis shows that in 26A, the majority of the berried females (66%) caught in 2021 were above recruit size (Figure 5). The majority of the berried females (80%) caught in 26B in 2021 were recruit size (Figure 5). This might be due to the differences of carapace sizes between the areas.

## 2021 & Historical Data

The 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. With multiple 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. The project was not conducted in 2020 due to the covid-19 pandemic.

Table 10. All historical recruitment index data. *Project was not completed in the year 2020.*

LFA	Year	Participants	Lobsters Measured Modified	Modified Traps Sampled	Lobsters Measured Regular	Regular Traps Sampled	Total Lobsters Measured
<b>26A2</b>	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
	2021	5	4935	681	3287	681	8222
	<b>26A1 and 26A3</b>	2016	4	1939	410	1162	366
2017		4	1950	651	1289	651	3239
2018		5	2881	681	2165	681	5047
2019		5	3784	672	2811	672	6595
2021		5	3362	660	1730	660	5092
<b>26B</b>	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
2021	8	9182	930	4801	930	13,983	

The following two tables summarize the recruits per trap in all sub-zones from 2016 to 2021. Project was not conducted in 2020. 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 2016-2021 for all sub-zones in GNS. Project was not completed in the year 2020.*

<b>Modified Traps</b>	<b>2016 Recruits/Trap</b>	<b>2017 Recruits/Trap</b>	<b>2018 Recruits/Trap</b>	<b>2019 Recruits/Trap</b>	<b>2021 Recruits/Trap</b>
<b>26A1</b>	3.88	3.0	3.7	5.9	5.8
<b>26A2</b>	2.08	2.7	3.0	2.8	4.3
<b>26A3</b>	0.32	0.5	0.7	0.5	0.47
<b>26B North</b>	5.10	6.6	8.1	8.6	5.2
<b>26B South</b>	4.53	4.4	5.6	8.4	8.8

*Table 12. Recruit sized lobsters (male and non-berried female) per regular trap, from 2016-2021 for all sub-zones in GNS. Project was not completed in the year 2020.*

<b>Regular traps</b>	<b>2016 Recruits/Trap</b>	<b>2017 Recruits/Trap</b>	<b>2018 Recruits/Trap</b>	<b>2019 Recruits/Trap</b>	<b>2021 Recruits/Trap</b>
<b>26A1</b>	1.24	1.0	2.2	2.8	1.3
<b>26A2</b>	0.81	1.2	1.6	1.3	1.8
<b>26A3</b>	0.13	0.1	0.3	0.2	0.21
<b>26B North</b>	2.73	3.7	4.4	3.0	2.0
<b>26B South</b>	2.65	2.5	3.7	4.6	3.4

Tables 11 and 12 summarize recruits (excluding berried) per trap in all areas from 2016 to 2021 (2020 not sampled). In the modified traps, 26A1 and 26B South stayed stable in 2021 compared to 2019 still increased from 2016-2018 levels (Table 11). 26A2 showed in increase in 2021 recruits per modified trap above the previous years sampled (Table 11). 26A3 stayed relatively stable with 2019 (Table 11). There was slight decrease in 26B North from 2018-2019 to 2021 (Table 11). We expect slight differences from year to year, especially considering that we have several new participants fishing in slightly different locations. In the regular traps, we see a slight increase of recruits per trap in 26A2 in 2021 compared to the previous years sampled (Table 12). In 2021 there were decreases in 26A1, 26B North and 26B South compared to 2018-2019 values (Table 12). 26A3 remained consistent with 2019 (Table 12).

Next in Tables 13 and 14, 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. 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 (including berried) caught per site in each area, broken down by bin size 1 to 4, from 2016 to 2021 for regular traps. Project was not completed in the year 2020.

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
	2021	6.0	25.0	47.0	145.5
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
	2021	0.8	13.0	64.6	202.2
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
	2021	1.0	3.0	8.0	18.7
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
	2021	7.5	21.0	65.25	187.25
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
	2021	3.25	28.5	107.5	300.0

26A1 seen an increase in the average number of size 1 recruits per site and a decrease from 2019 to 2021 in sizes 2-4 (Table 13). Please note there was a change in minimum legal carapace size in 26A1 between 2019 and 2021. An increase in the average number of recruit size lobster per site was seen in 26A2 for sizes 1-4 from 2019 to 2021 and the number of size 4 was higher than previous years sampled (Table 13). 26A3 seen an increase in the average number of size 1-3 lobsters per site to above previous years sampled (Table 13). 26B North seen a decrease in the average number of sizes 1-4 in regular traps compared to 2019 (Table 13). 26B South seen a decrease in the average number of sizes 1-3 in regular traps to below previous years sampled but seen more size 4 than previously sampled years (Table 13).

Table 14. Average number of recruit sized lobsters (including berried) caught per site in each area, broken down by bin size 1 to 4, from 2016 to 2021 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
	2021	75.0	218.0	355.5	302.5
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
	2021	1.6	47.8	211.8	380.2
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
	2021	0.0	12.0	17.3	35.0
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
	2021	14.75	106.25	279.25	343.5
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
	2021	27.5	189.5	385.5	514.75

The average number of recruit sized lobsters (including berried) caught per site in each area, broken down by bin size 1 to 4, from 2016 to 2021 for modified traps was seen in Table 14. There were increases in the average number of size 1,3, 4 seen per site in 26A1 for modified traps to higher than previous years sampled (Table 14). Please note there was a change in minimum carapace size between 2019 and 2021 in 26A1. 26A2 seen a decrease in the average number of size 1 in modified trap but seen an increase from 2019 for sizes 2-4 (Table 14). 26A3 seen an increase in the average number of size 2 in modified traps while the other sizes remained relatively stable with previous years sampled (Table 14). 26B North seen a decrease in the average number of recruits in modified traps for all four recruit sizes 1-4 to amounts lower than the previous 3 years sampled of 2017-2019 (Table 14). 26B South seen a decrease in the average number of sized 1 and 2 from 2019 but seen an increase in sizes 3 and 4 to above previous years sampled (Table 14).

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 (Table 15) compares the average number of recruit-sized berried females caught in the regular and modified traps for the years 2017 to 2021 (project not conducted in 2020).

*Table 15. Average number of recruit-sized berried females, in regular and modified traps, from 2017-2021. Project was not completed in the year 2020.*

<b>LFA</b>	<b>Year</b>	<b>Regular traps</b>	<b>Modified traps</b>
<b>26A1</b>	2017	13.0	23.0
	2018	50.0	44.0
	2019	81.0	155.0
	2021	46.5	145.0
<b>26A2</b>	2017	37.4	56.4
	2018	33.8	54.8
	2019	30.8	53.3
	2021	34.2	61.0
<b>26A3</b>	2017	3.0	0.7
	2018	5.0	6.0
	2019	6.0	8.6
	2021	4.0	3.7
<b>26B South</b>	2017	61.3	97.8
	2018	90.3	115.0
	2019	101.25	133.0
	2021	60.0	135.25
<b>26B North</b>	2017	91.5	160.7
	2018	89.9	135.0
	2019	68.75	177.25
	2021	42.25	115.5

In 2021, 26A1 seen a decrease in the average number of recruit-sized berried females in regular traps compared to 2019 and the amount stayed relatively stable for modified traps (Table 15). Please note there was a change in minimum carapace size between 2019 and 2021 in 26A1. 26A2 seen an increase in the average number of recruit-sized berried females in both modified and regular traps above 2018 and 2019 amounts, whereas 26A3 seen a decrease for regular and modified to below 2018 and 2019 amounts (Table 15). 26B South seen a decrease of average number of recruit-sized berried females in 2021 to below previous years in the regular traps and seen an increase to above previous years in the modified traps (Table 15). 26B North seen a decrease in 2021 of the average number of recruit-sized berried females in regular and modified traps to below previous years sampled (Table 15).

## Interpretation

The key recruitment indicators considered in this report are lobsters per trap, recruit size lobsters per trap and several berried female measurements. Overall, the number of recruit sized lobsters per trap have remained stable when compared to the previous year sampled of 2019. Tables 11 and 12 (pages 9, 10) summarize recruits per trap (excluding berried females) in all areas from 2016 to 2021 except for 2020 as the project was not completed that year. Recruits per modified trap have remained relatively stable since 2019 with areas 26A1, 26A3, and 26B South showing values comparable to 2019 whereas 26A2 showed an increase and 26B North showed a decrease (Table 11). The number of recruits per regular trap have decreased from 2019 values in 26A1, 26B North, and 26B South and the number has remained relatively stable with 2019 for 26A2 and 26A3 (Table 12). The average number of overall recruits (including berried) per site per area in 2021 displayed a decrease in the regular traps for areas 26A1, 26B North, and 26B South and showed an increase in the average number in 26A2 and 26A3 (Table 13). In the modified traps, the average number of recruits (including berried) seen a decrease in 2021 in 26B North and increases in 26A1, 26A2, 26A3, and remained stable in 26B South when compared with 2019 (Table 14).

Our berried female analysis shows 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 26A2 and 26B South in 2021 compared to 2019 whereas 26A1, 26A3, and 26B North showed a decrease (Table 15). In regular traps, the average number of recruit-sized berried females decreased in 26A1, 26A3, 26B South, and 26B North in 2021 compared to 2019 and 26A2 showed an increase (Table 15).

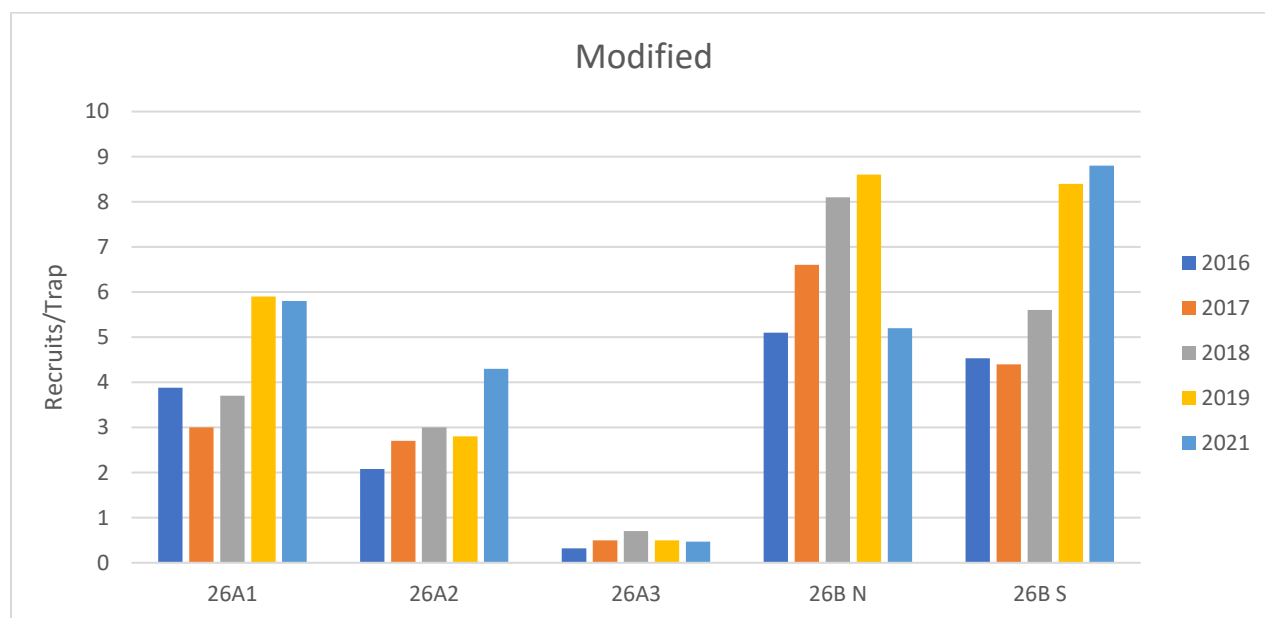


Figure 6. Recruit sized lobsters (male and non-berried female) per modified trap, from 2016-2021. Project was not completed in the year 2020. Data also presented in Table 11.

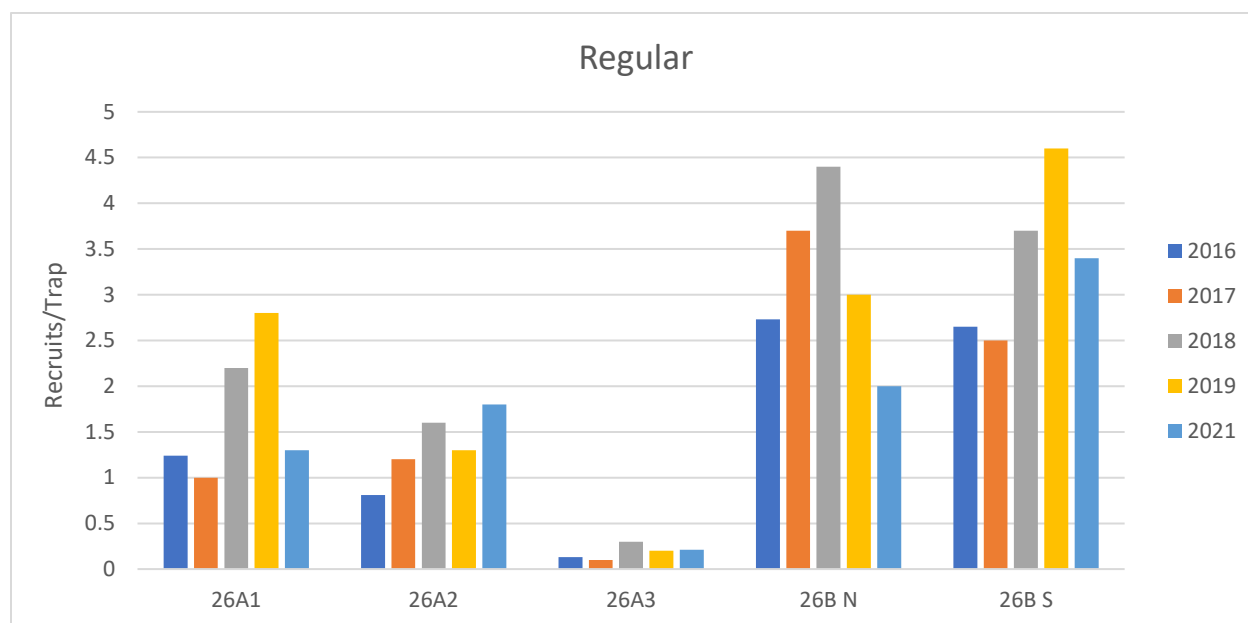


Figure 7. Recruit sized lobsters (male and non-berried female) per regular trap, from 2016-2021. Project was not completed in the year 2020. Data also presented in Table 12.

## Acknowledgements

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