Atlantic States Marine Fisheries Commission

DRAFT ADDENDUM XXV TO AMENDMENT 3 TO THE AMERICAN LOBSTER FISHERY MANAGEMENT PLAN

RESPONSE TO SOUTHERN NEW ENGLAND STOCK DECLINE

This draft document was developed for Management Board review and discussion during the October 2016 Lobster Board meeting. This document is not intended to solicit public comment as part of the Commission/State formal public input process. However, comments on this draft document may be given at the appropriate time on the agenda during the scheduled meeting. Also, if approved, a public comment period will be established to solicit input on the issues contained in the document.

ASMFC Vision Statement: Sustainable Managing Atlantic Coastal Fisheries

October 2016

Public Comment Process and Proposed Timeline

In May 2016, the American Lobster Management Board initiated Draft Addendum XXV to address continued stock declines in Southern New England. In August 2016, the Board identified a management goal for the Southern New England stock as well as management targets for development in this addendum. This draft addendum presents background on the Atlantic States Marine Fisheries Commission's management of lobster, the addendum process and timeline, a statement of the problem, and potential management measures for public consideration and comment.

The public is encouraged to submit comments regarding the proposed management options in this document at any time during the addendum process. The final date comments will be accepted is **Month, Day 201X at 5:00 p.m**. **EST.** Comments may be submitted by mail, email, or fax. If you have any questions or would like to submit comment, please use the contact information below.

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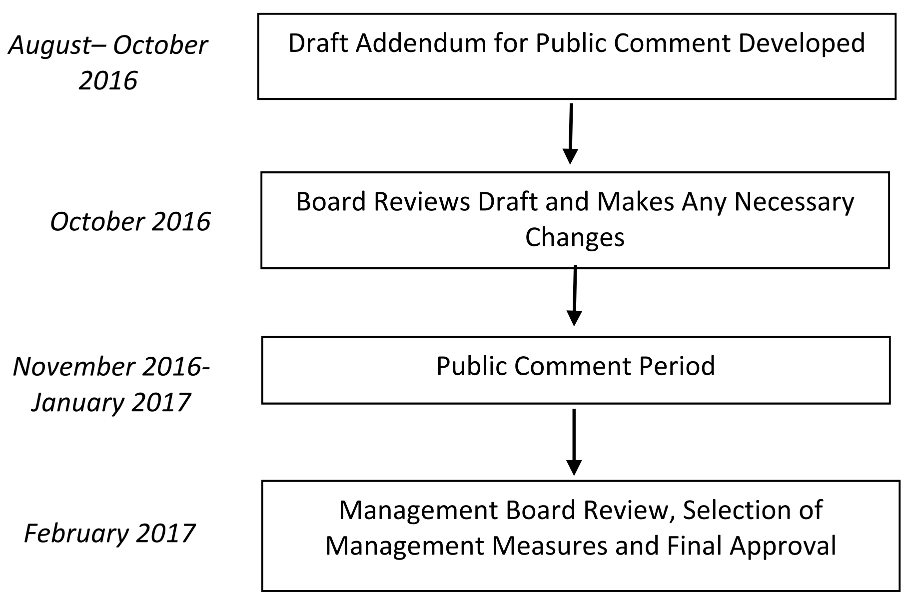

Executive Summary

The Southern New England (SNE) lobster stock is at record low abundance and is experiencing recruitment failure (ASMFC, 2015). This poor stock condition is the result of environmental factors and continued fishing mortality (ASMFC, 2015). As an initial management response, the American Lobster Management Board initiated this draft addendum to consider increasing egg production in SNE by 20% to 60%. This addendum focuses on increases in egg production so that, if environmental conditions become favorable, the SNE stock can benefit from a strong recruitment year. The addendum also considers whether these management measures should be applied to the entire extent of Lobster Conservation Management Area (LCMA) 3, which includes portions of the SNE and Gulf of Maine/Georges Bank stocks, or just the SNE portion of LCMA 3.

To respond to the Board's objective to increase egg production, the Plan Development Team (PDT) evaluated multiple management tools, including: gauge size changes, trap reductions, season closures, trip limits, v-notching, culls, and the potential to standardize regulations. In their evaluation of these various management tools, the PDT analyzed not only the ability to achieve the specified management targets but also the ability to effectively monitor, administer, and enforce selected management tools.

This draft Addendum includes two issues. The first proposes four management options to increase egg production, including a 0% increase in egg production (status quo), a 20% increase in egg production, a 40% increase in egg production, and a 60% increase in egg production. The second issue asks where in LCMA 3 these management measures should apply.

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1.0 Introduction

The Atlantic States Marine Fisheries Commission (ASMFC) has coordinated the interstate management of American lobster (*Homarus americanus)* from 0-3 miles offshore since 1996. American lobster is currently managed under Amendment 3 and Addenda I-XXIV to the Fishery Management Plan (FMP). Management authority in the Exclusive Economic Zone (EEZ) from 3-200 miles from shore lies with NOAA Fisheries. The management unit includes all coastal migratory stocks between Maine and Virginia. Within the management unit there are two lobster stocks and seven management areas. The Southern New England (SNE) stock (subject of this draft addendum) includes all or part of five of the seven Lobster Conservation Management Areas (LCMAs) (Appendix 1). There are eight states (Massachusetts to Virginia) which regulate American lobster in state waters of the SNE stock, as well as regulate the landings of lobster in state ports.

The Board initiated Draft Addendum XXV to respond to continued stock declines in SNE. The 2015 Benchmark Stock Assessment found abundance, spawning stock biomass (SSB), and recruitment are all at historic low levels in SNE. The stock was deemed depleted as the current reference abundance of 10 million lobsters is well below the management threshold of 24 million lobsters. As a result, the Board directed the Plan Development Team (PDT) to draft an addendum to address the poor condition of the SNE stock by increasing egg production and decreasing fishing mortality.

The principle challenge facing the SNE stock is the increase in natural mortality, primarily due to climate change and predation. Specifically, the 2015 stock assessment showed a pronounced warming trend in coastal waters, particularly in New England and Long Island Sound. These warming waters have negatively impacted the stock as they have resulted in reduced spawning and recruitment. Predation from species such as black sea-bass has further depleted the stock. Together, these challenges highlight the vital role the environment plays in the health of the American lobster population. Importantly, fishing pressure, while at an all-time low level, continues to be a significant source of mortality and a measurable factor contributing to the overall decline of the SNE stock.

Given these challenges, the Board identified the following goal for this addendum.

> "*Recognizing the impact of climate change on the stock, the goal of Addendum XXV is to respond to the decline of the SNE stock and its decline in recruitment while preserving a functional portion of the lobster fishery in this area.*"

The Board tasked the TC and the PDT to analyze whether the above goal could be met by increasing SNE stock egg production. The Board identified three alternative egg production targets for analysis: increasing egg production by 20 %; 40%; and 60%. The Board asked the TC to determine what impacts the different targets would have on the stock and asked the PDT to develop potential measures for each alternative. A 0% increase was also analyzed to provide a baseline, no-action context to assist in decision-making. The Board is pursuing increases in egg production so that, if environmental conditions become favorable in SNE, there will be enough eggs in the water to produce a successful and impactful recruitment event.

This addendum is intended to be an initial response to the most recent stock assessment. The 2015 Stock Assessment clearly stated climate change is impacting the SNE fishery in a profoundly negative way. While the Board recognizes serious and impactful management actions are needed to preserve the SNE stock, they also recognize questions regarding the full impacts of climate change still remain, especially in regards to the success of recruitment offshore. As a result, the Board agreed to take quick and decisive action while preserving a portion of the fishery. The Board will continue to monitor the stock and fishery in order to determine the next appropriate course of action. All management tools remain available for future consideration.

2.0. Overview

2.1 Statement of the Problem

The 2015 Benchmark Stock Assessment found the SNE stock to be depleted, with record low abundance and recruitment failure. This poor stock condition can be attributed to many factors including changing environmental conditions and continued fishing mortality. In response, the Board initiated Draft Addendum XXV with the goal of preserving a functional portion of the SNE lobster fishery while addressing the poor stock condition. The measures in this addendum are intended to increase egg production so that, if environmental factors improve, the stock can benefit from a successful recruitment event. This addendum is an initial response to the most recent stock assessment and may be followed by other management measures.

2.2 Resource Issues

Results of the 2015 Benchmark Stock Assessment show continued declines and poor stock conditions in SNE. The assessment highlights that abundance, SSB, and recruitment are all at historic low levels for the model time-series (1982-2013). Model-free indicators corroborate these findings as spawning stock abundance, a measure of the reproductively mature portion of the population, is below the 25^{th} percentile in six of the eight surveys from 2008-2013 (Appendix 2). Furthermore, the distribution of lobsters inshore has contracted as the survey encounter rate is negative in all six inshore indices over the 2008-2013 time period. Overall, the assessment concludes the SNE stock is depleted as the 2011-2013 reference abundance, which is defined as the number of lobsters 78+ mm carapace length on January 1 plus the number that will molt and recruit to the 78+ carapace length group during the year, is significantly below the threshold (Table 1).

Table 1. Current (2011-2013) reference estimates for each stock as well as the target and threshold levels for abundance and effective exploitation. The reference abundance is used to determine a depleted status while effective exploitation is used to determine an overfishing status.

		GOM/GBK	SNE
Abundance (millions)	2011-2013 Reference	248	10
	Threshold	66	24
	Target	107	32
Effective Exploitation	2011-2013 Reference	0.48	0.27
	Threshold	0.50	0.41
	Target	0.46	0.37

One of the largest indicators of poor stock condition in SNE has been the marked decline in recruitment, or the number of lobsters surviving to enter the fishery. Indices suggest the stock is in recruitment failure as, since 2011, all larval indices have been below the 25^{th} percentile. Model-free indicators show similar trends as all four young-of-year indices, which measure the abundance of age 0 lobsters, are below the median (Appendix 2). In 2015, the young-of-year index in Massachusetts hit zero (Appendix 2). This is concerning as it means the number of young lobsters which have yet to recruit into the fishery is low and the stock may experience further declines.

Furthermore, analysis by the TC shows spawning-stock biomass (SSB) and recruitment may be decoupled. Figure 1 shows the relationship between SSB and recruitment from 1979 to 2011. Overall, the plot indicates a positive relationship such that there are more lobsters entering the fishery when the reproductive portion of the population is larger; however, over the last decade, this relationship has decoupled, with recruitment declining and SSB remaining steady. This suggests depensatory mechanisms may be at play in SNE, such that recruitment drops to very low levels well before SSB reaches zero. Low recruitment levels may be the result of reduced mating success, environmentally-mediated changes in survivorship, and/or increased predation. Figure 1 also shows the wide range of recruitment which can be produced from a single level of SSB, even when stock abundance was high in the early 1990's. This is important to note as management action seeking to increase SSB and egg production can result in a wide range of recruitment.

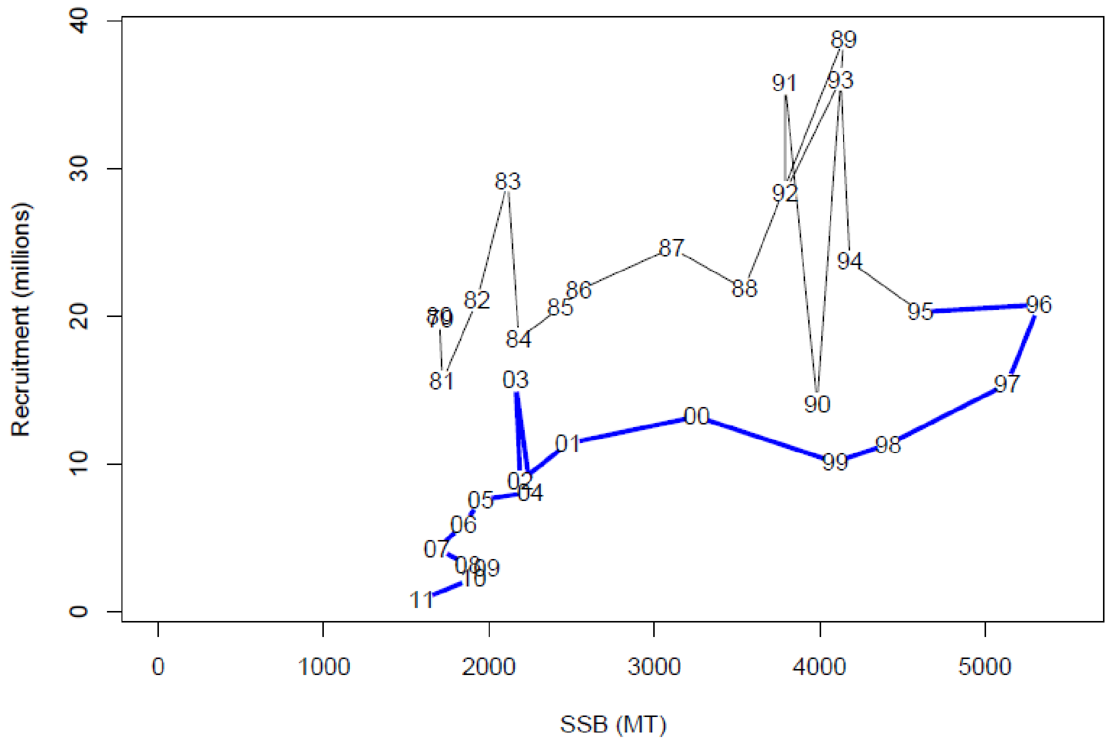

Figure 1: The relationship between model-based spawning stock biomass and recruits from 1979 to 2011. The blue line denotes the trajectory from 1995 – 2011 (recruiting to the model from 1998 to 2014).

There are several contributors to the poor stock condition in SNE, including an increase in natural mortality and continued fishing pressure. Climate change has had a significant impact on the stock as lobster physiology is intricately tied to water temperatures. Not only does water temperature impact when lobster eggs hatch but it also has a direct effect on larval survivorship as waters which are too cold (<10°C) or too warm (>22°C) increase mortality.[1] Adult lobsters also are impacted by warming waters as recent laboratory studies suggest lobsters have a threshold of ~20.5°C, above which lobsters experience significant stress.[2] Unfortunately, ocean temperatures, particularly inshore, have been rising. Data from Buzzards Bay, MA and Long Island Sound show the number of days above 20°C has markedly increased since 1997 (Appendix 3). These warming waters have increased the natural mortality of the stock. Predation also has an significant impact on the species. Lobsters, especially juveniles, are an important source of food for many finfish species including Atlantic cod, spiny dogfish, black seabass and skate. When populations of these species increase, pressure on the lobster stock increases.

In conjunction with the increase in natural mortality, continued fishing pressure has furthered the decline of the SNE stock. As the stock has decreased to record low

[1] MacKenzie, 1988.
[2] Powers et al., 2004.

abundance, effort and landings in the SNE fishery have likewise declined. This is in response to not only the low abundance but also recently implemented regulations and the higher costs of fuel and bait. Importantly, while the 2015 Stock Assessment did not conclude overfishing is occurring, fishing mortality is still the primary contributor to the stock's mortality. Work by the TC shows that, even when accounting for the recent increases in natural mortality, fishing mortality is removing roughly twice as much SSB from the population annually than natural mortality (Figure 2). This suggests that, in the face of climate change and increases in predation, management action can still have real effects on spawning stock abundance and egg production. Importantly, favorable environmental conditions will be needed to translate this increase in egg production into a successful recruitment event. This is highlighted in Figures 1 and 2 as, while the proportion of SSB surviving in SNE has generally increased since 2000, recruitment has markedly declined.

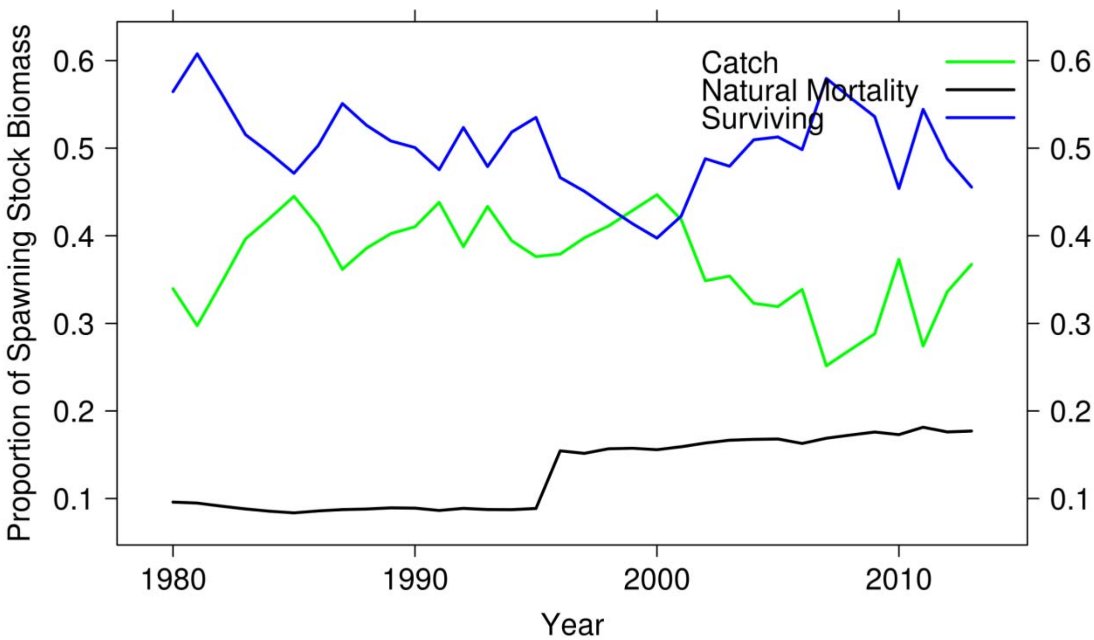

Figure 2: Proportion of SSB surviving or removed by fishing and natural mortality annually.

In an attempt to understand the extent of management action needed to improve stock conditions, the Board directed the TC to model future lobster abundance under various levels of fishing mortality and natural mortality. Results of these stock projections concluded a 75% to 90% reduction in fishing mortality would be needed to stabilize the stock under current natural mortality conditions (Appendix 4); should natural mortality increase, greater reductions in fishing mortality would be needed. The projections also showed that without management action, stock conditions would be expected to deteriorate and reference abundance could decline by 50%. These results highlight the poor condition of the stock and the need for impactful management action.

2.3 Fishery Status

2.3.1 Commercial Fishery

The SNE fishery is carried out by fishermen from the states of Massachusetts, Rhode Island, Connecticut, New York and New Jersey, with smaller contributions from the states of Delaware, Maryland, and Virginia. This fleet is comprised of small vessels (22' to 42') which make day trips in nearshore waters (less than 12 miles) as well as larger boats (55' to 75') which make multi-day trips to the canyons along the continental shelf. The SNE fishery is executed in LCMAs 2, 4, 5, and 6 as well as the western portion of LCMA 3.

The SNE fishery has experienced a noticeable contraction in effort and landings over the last decade (Table 2). Landings in the 1980's steadily rose from 4.06 million pounds in 1981 to over 13 million pounds in 1989. Landings continued to rise in the 1990's, peaking at 21.9 million pounds in 1997. 43% of these landings were from New York, followed by Rhode Island (28%), Connecticut (16%), and Massachusetts (12%). Starting in the early 2000's, landings began to precipitously decline. In 2004, landings (5.48 million pounds) were less than half of what they were four years earlier in 2000 (13.39 million pounds). This trajectory continued such that landings in 2015 were 3.5 million pounds. Rhode Island was the largest contributor of landings (55%) followed by Massachusetts (22%). This large decline in harvest is likely the result of a declining stock size, attrition in the fishery, regulatory changes, and substantial increases in operating costs in the fishery associated with fuel and bait. Interestingly, despite the decrease in overall fishing effort, those who remain in the fishery have experienced increasing catch rates. The TC discussed this trend in their February 2016 presentation to the Board and highlighted that this is due to high attrition in the lobster fleet which has resulted in fewer fishermen concentrating their effort on the remaining aggregations of lobster in SNE.

In conjunction with the decrease in landings, the number of active permit holders has also decreased (Table 3). In 1990, there were 341 active permits in Massachusetts and 994 active permits in New York. Only 24 years later, these numbers decreased by 45% and 60%, respectively, with 190 active permits in Massachusetts and 309 active permits in New York. Similar trends can be seen in the other states as from 2007-2014, the number of active traps in Rhode Island decreased 50% and in Connecticut they decreased 60%. Today there are only 750 active permits in the SNE lobster fishery.

Data on the number of traps fished in Massachusetts, Rhode Island, Connecticut, and New York also matches the trends seen in landings (Table 4). In 1990, the number of active traps fished in Massachusetts, Connecticut and New York was 291,632 and this quickly rose to 443,833 by 1995. The number of traps fished peaked in 1998, just one year after landings peaked, at 588,422 traps. At this time, 59% of traps were from New York. Since then, the number of active traps has dramatically declined. In 2013, only 151,970 traps were fished with New York seeing the largest decline, comprising only

14% of active traps fished. Rhode Island fishermen contributed the largest number of traps fished in 2013 at 42%.

Table 5 shows the current trap allocations in the LCMAs 2, 3, 4, 5, and 6. The greatest number of traps are allocated in LCMA 2, 3 and 6; however; a large portion of traps in LCMA 6 are not actively fished. This is corroborated by data showing the harvest of lobster from each LCMA (Table 6) as LCMA 6 has the second lowest landings in the SNE fishery. Roughly two-thirds of landings in 2012 came from the LCMA 3, followed by LCMA 4 and LCMA 2. The lowest landings are from LCMA 5, which also the fewest traps allocated to its waters.

Table 2. SNE landings, in pounds, by state from 1981 to 2015.

Year	MA	RI	CT	NY	NJ & South	Total
1981	952,396	749,571	806,891	835,551	714,297	4,058,705
1982	1,161,835	1,737,241	879,643	1,119,947	1,007,511	5,906,177
1983	1,340,409	3,236,382	1,653,465	1,208,132	912,713	8,351,101
1984	1,494,732	3,611,168	1,796,765	1,307,340	1,168,449	9,378,453
1985	1,276,475	3,509,755	1,380,092	1,241,201	1,322,772	8,730,295
1986	1,300,726	4,310,032	1,254,429	1,417,571	1,382,297	9,665,054
1987	1,274,270	4,241,689	1,571,894	1,146,402	1,591,736	9,825,991
1988	1,384,501	3,897,768	1,922,429	1,571,894	1,699,762	10,476,354
1989	1,485,914	4,989,055	2,076,752	2,345,716	2,198,006	13,095,443
1990	2,004,000	6,382,375	2,645,544	3,414,956	2,350,125	16,797,000
1991	2,059,115	5,998,771	2,674,204	3,128,356	1,761,491	15,621,937
1992	1,792,356	5,502,732	2,533,108	2,652,158	1,263,247	13,743,601
1993	1,913,610	5,509,345	2,175,960	2,667,590	981,056	13,247,562
1994	2,158,323	6,078,137	2,147,300	3,955,088	597,452	14,936,301
1995	2,160,528	5,628,395	2,541,927	6,653,543	663,591	17,647,983
1996	2,151,709	5,557,847	2,888,052	9,409,318	690,046	20,696,973
1997	2,574,996	6,086,956	3,467,867	8,878,005	895,076	21,902,900
1998	2,420,673	5,897,359	3,712,580	7,896,949	745,162	20,672,722
1999	2,180,369	7,656,645	2,594,838	6,452,923	985,465	19,870,240
2000	1,629,214	6,483,787	1,386,706	2,883,643	1,005,307	13,388,657
2001	1,649,056	4,179,960	1,322,772	2,052,501	641,544	9,845,833
2002	1,653,465	3,600,144	1,062,627	1,439,617	293,214	8,049,068
2003	1,025,148	2,742,547	668,000	945,782	249,122	5,630,599
2004	989,874	2,250,917	639,340	1,170,653	425,492	5,476,276
2005	1,117,742	3,068,831	712,092	1,225,769	436,515	6,560,949
2006	1,199,313	2,769,003	789,254	1,300,726	529,109	6,587,405
2007	850,983	2,321,465	544,541	888,462	760,594	5,366,045
2008	751,775	2,707,273	416,673	705,478	800,277	5,381,477
2009	888,462	2,334,693	410,059	729,729	855,393	5,218,336
2010	762,799	2,231,075	432,106	811,300	806,891	5,044,171
2011	548,950	1,604,963	196,211	343,921	751,775	3,445,821
2012	637,135	1,845,267	240,304	275,578	992,079	3,990,362
2013	696,660	1,618,191	127,868	246,917	791,459	3,481,095
2014	727,525	1,807,788	141,096	216,053	619,542	3,512,004
2015	771,617	1,966,521	156,528	145,505	505,982	3,546,153

Table 3. The number of active permits (MA, RI, CT, NJ, DE, MD) or total permits (NY) in the SNE stock.

	MA	RI	CT	NY	NJ	DE	MD	Total
1990	341			994				1335
1991	320			1067				1387
1992	309			1171				1480
1993	350			1211				1561
1994	405			1265				1670
1995	397		365	995				1757
1996	377		322	932	42		12	1685
1997	392		305	888	42		15	1642
1998	399		311	761	40		12	1523
1999	405		299	746	41		11	1502
2000	365		245	657	53		10	1330
2001	347		234	600	54		10	1245
2002	378		210	554	46		10	1198
2003	324		167	507	34	7	8	1047
2004	290		177	477	35	7	9	995
2005	264		179	458	27	3	7	938
2006	276		220	428	27	5	7	963
2007	285	304	195	412	31	5	8	1240
2008	238	288	162	384	30	5	7	1114
2009	228	267	139	375	33	3	7	1052
2010	218	269	129	360	30	3	7	1016
2011	219	216	98	344	30	2	5	914
2012	209	195	80	334	29	1	6	854
2013	198	163	59	326	29	1	5	781
2014	190	156	57	309	29	3	6	750

Table 4. Number of traps reported fished by state in the SNE stock unit. (Source: 2015 Stock Assessment)

Year	Massachusetts	Rhode Island	Connecticut	New York	Total
1981	41,395	NA		48,295	89,690
1982	44,123	NA		43,977	88,100
1983	46,303	NA		59,808	106,111
1984	49,072	NA	66,709	77,599	193,380
1985	55,954	NA	65,262	88,332	209,548
1986	59,156	NA	65,826	77,429	202,411
1987	63,518	NA	70,646	76,729	210,893
1988	63,610	NA	79,154	101,790	244,554
1989	62,700	NA	83,915	143,320	289,935
1990	53,768	NA	100,360	137,504	291,632
1991	59,922	NA	101,290	155,276	316,488
1992	58,406	NA	107,668	187,661	353,735
1993	62,615	NA	115,224	237,117	414,956
1994	71,472	NA	110,805	269,419	451,696
1995	71,269	NA	119,983	252,581	443,833
1996	71,830	NA	130,360	314,297	516,487
1997	76,717	NA	133,770	335,860	546,347
1998	83,166	NA	158,527	346,729	588,422
1999	83,394	NA	162,149	332,323	577,865
2000	68,162	NA	122,386	212,767	403,314
2001	65,225	173,133	121,501	191,853	551,712
2002	78,965	152,021	117,731	157,747	506,464
2003	63,444	133,687	85,048	101,207	383,386
2004	55,191	128,081	84,071	102,351	369,694
2005	47,779	117,610	83,946	85,817	335,152
2006	52,990	120,242	90,421	89,301	352,954
2007	49,722	130,556	81,792	92,368	354,438
2008	42,934	104,440	56,355	90,909	294,638
2009	40,237	105,414	63,824	51,173	260,648
2010	48,558	111,509	53,516	70,350	283,933
2011	58,783	78,849	39,518	49,779	226,929
2012	54,102	76,826	29,353	29,678	189,959
2013	49,319	63,089	18,435	21,127	151,970

Table 5: Current trap allocations by LCMA in the SNE stock. LCMA 3 includes traps fished in both the SNE stock and the Gulf of Maine/Georges Bank stock.

	LCMA 2	LCMA 3	LCMA 4	LCMA 5	LCMA 6
MA	33,377	49,040	1,100		
RI	59,789	41,288	2,424		
CT	4,163	652	2,725		139,186
NY	1,141	2285	11,075	600	111,108
NJ	940	12,155	6,530	3,154	
DE				4,530	
MD				4,000	
VA				1,200	

Table 6. Estimated lobster landings (in pounds) by LCMA.

Year	LCMA 2	LCMA 3	LCMA 4	LCMA 5	LCMA 6
1982	1,656,479	2,135,954	622,674	99,093	1,359,058
1983	2,958,366	2,258,492	633,254	71,804	2,428,633
1984	2,978,985	2,765,512	795,180	135,652	2,704,070
1985	2,992,330	2,330,628	964,043	170,998	2,273,337
1986	3,081,903	3,009,509	1,084,282	125,969	2,362,128
1987	3,219,900	2,655,725	1,473,841	98,486	2,378,765
1988	3,259,336	2,269,480	1,666,439	85,142	3,195,208
1989	4,175,114	2,845,444	2,232,935	106,126	3,735,250
1990	4,374,062	5,253,653	2,431,198	237,410	4,250,654
1991	4,140,145	4,811,267	2,096,138	115,020	4,393,986
1992	3,795,367	4,023,295	1,448,866	77,854	4,362,551
1993	3,772,494	3,776,113	1,597,447	89,495	3,968,663
1994	5,602,507	3,030,046	554,367	26,013	5,738,398
1995	4,960,453	2,661,176	962,077	45,054	8,564,325
1996	4,880,328	2,610,223	978,376	52,758	11,705,439
1997	5,324,775	3,183,034	1,162,862	36,623	11,650,701
1998	5,273,463	2,724,429	1,534,067	41,963	10,575,143
1999	6,938,658	3,195,423	1,346,509	77,621	8,331,142
2000	5,651,160	2,673,111	1,123,486	53,364	3,802,880
2001	3,862,054	2,053,831	762,408	55,537	3,013,551
2002	3,445,004	1,899,923	442,425	14,838	2,230,869
2003	1,110,534	2,519,713	423,583	17,394	1,448,011
2004	1,184,942	2,014,702	480,203	93,270	1,534,130
2005	1,464,433	1,800,406	457,275	54,181	1,673,396
2006	1,853,505	1,983,721	516,130	59,928	1,840,308
2007	1,430,836	1,494,830	617,978	56,866	1,263,648
2008	1,168,921	1,918,429	440,108	322,916	920,951
2009	1,051,241	2,227,432	488,792	308,212	896,594
2010	1,022,528	2,135,008	522,037	184,409	966,505
2011	730,889	1,954,052	488,977	148,587	306,079
2012	627,051	2,003,412	782,684	154,455	286,215

*To separate landings by LCMA, NMFS statistical areas are placed into a single LCMA.

One of the largest changes over the last decade in the fishery has been the transition from primarily inshore to primarily offshore. In 1982, 64% of landings in SNE were from the inshore portion of the stock. This increased to 87% in 1998 as landings quickly grew in the fishery. However, declines in the stock, particularly inshore, have led the fishery to be primarily executed offshore. Figure 3 shows the landings of lobster inshore and offshore. While the pounds of lobster landed inshore has declined since 1997, offshore landings have experienced less severe declines and have even stabilized over the last decade. In fact, 2011 was the first year in which a greater portion (55%) of lobster were landed offshore than inshore. This shift in the fishery can likely be explained by warming coastal waters which have caused declines in recruitment and prompted migrations of lobsters to cooler waters offshore.

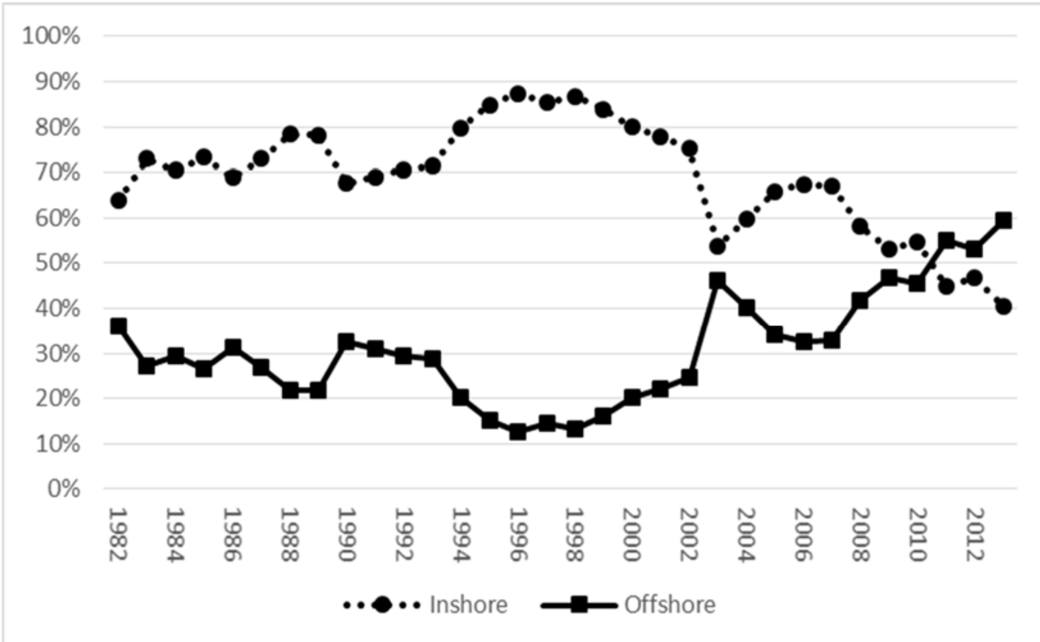

Figure 3: Percentage of landings in SNE occurring in the inshore and offshore fishery. The inshore fishery is defined as landings from statistical areas 538, 539, 611, 612, 613, 614, 621, 625, 631, and 635. The offshore fishery is defined as landings from statistical areas 533, 534, 537, 615, 616, 622, 623, 24, 626, 627, and 632.

The non-trap fishery for lobster is a small percentage of the overall SNE landings. In 2015, a total of 55,191 pounds were landed with non-trap gear. This value is an underestimate as it does not include non-trap landings from Massachusetts. Overall, landings by non-trap gear represent less than 2% of the landings in SNE.

2.3.2. Recreational Fishery

While the lobster fishery is predominately commercial, there is a small recreational fishery which harvests lobsters with pots, and in some states, by hand while diving. The states of New Hampshire, Massachusetts, Connecticut, and New York currently collect recreational information on lobster landings. In general, recreational landings are only a small percentage of the states' total landings. Average recreational harvest in Massachusetts from 2010 to 2015 was 224,932 pounds, or roughly 1.4% of the state's total harvest. New Hampshire's recreational harvest in 2015 was 7,731 pounds, representing less than 1% of total catch. In Connecticut, recreational landings have declined in conjunction with commercial landings, with the number of personal-use licenses sold in Connecticut dropping from 875 in 2009 to 163 in 2015. Recreational harvest in New York in 2015 was 2,130 pounds.

2.4 Status of Management

Lobster are currently managed under Amendment 3, and its twenty-four addenda. One of the hallmarks of Amendment 3 was the creation of seven LCMAs along the coast. These areas are intended to reflect the regional differences in the fishery and, as a result, are permitted to have disparate management measures. The Lobster Board, the Commission's managing body for the species, is comprised of 10 states (Maine through Virginia) and the Federal Government. While ASMFC is not under the purview of the Magnuson-Stevens Act (MSA), the Federal Government, via NOAA Fisheries, supports the Commission's management of interjurisdictional fisheries. When federal support involves the implementation of management measures offshore (3-200 miles), those regulations must both be compatible with the Commission Plan and consistent with the National Standards outlined in MSA.

To date, the American lobster fishery has primarily been managed through input controls, such as trap caps and biological measures, which limit the amount of effort fishermen put into the fishery. Table 7 describes current management measures for all LCMAs which fall within SNE. All areas have had a minimum size of 3 ⅜", with the exception of LCMA 3, which is at 3 $^{17}/_{32}$". All areas also have the same maximum size of 5 ¼", with the exception of LCMA 3, which is at 6 ¾". LCMAs 2, 5, and federal waters of Area 4 require v-notching of egg-bearing females; this is not required in LCMA 6, state waters of LCMA 4, or the SNE portion of LCMA 3. All areas in SNE, however, do have the same v-notch definition which requires the notch be at least an 1/8 inch deep. All areas have history-based effort control programs with LCMA 2 having the lowest trap cap set at 800 traps.

In response to the findings of the 2009 stock assessment, the Board passed several addenda aimed at reducing exploitation and scaling the size of the fishery. Addendum XVII reduced exploitation by 10% with LCMAs 2, 5, and federal waters of 4 instituting mandatory v-notching, LCMA 3 increasing the minimum gauge size by 1/32", and LCMAs 4, 5, and 6 instituting closed seasons. The Board also approved Addendum XVIII, which implemented a series of trap allocation reductions in LCMAs 2 and 3. The goal of this management action was to scale the size of the SNE fishery to the diminished size of the resource. In a subsequent phase of management action, the Board approved Addenda XXI and XXII, which modified the trap transferability rules for LCMAs 2 and 3. The intent of these addenda was to increase the flexibility for fishermen to adjust to management measures aimed at reducing latent effort through fishery consolidation. Management measures in these addenda include modifications to the single or individual ownership caps (otherwise known as trap banking) and aggregate ownership caps. These measures have not yet been implemented in Federal waters.

Table 7. 2016 LCMA specific management measures.

Mgmt Measure	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	OCC
Min Gauge Size	3 1/4”	3 3/8”	3 17/32 ”	3 3/8”	3 3/8”	3 3/8”	3 3/8”
Vent Rect.	1 15/16 x 5 3/4”	2 x 5 3/4”	2 1/16 x 5 3/4”	2 x 5 3/4”	2 x 5 3/4”	2 x 5 3/4”	2 x 5 3/4”
Vent Cir.	2 7/16”	2 5/8”	2 11/16”	2 5/8”	2 5/8”	2 5/8”	2 5/8”
V-notch requirement	Mandatory for all eggers	Mandatory for all legal size eggers	Mandatory for all eggers above 42°30’	Mandatory for all eggers in federal waters. None in state waters.	Mandatory for all eggers	None	None
V-Notch Definition[1] (possession)	Zero Tolerance	1/8” with or w/out setal hairs[1]	1/8” with or w/out setal hairs[1]	1/8” with or w/out setal hairs[1]	1/8” with or w/out setal hairs	1/8” with or w/out setal hairs[1]	State Permitted fisherman in state waters 1/4” without setal hairs Federal Permit holders 1/8” with or w/out setal hairs[1]
Max. Gauge (male & female)	5”	5 ¼”	6 3/4”	5 ¼”	5 ¼”	5 ¼”	State Waters none Federal Waters 6 3/4”
Season Closure				April 30-May 31	February 1-March 31	Sept 8-Nov 28	February 1-April 30

2.5 Economic Status of Fishery

Total ex-vessel value in 2015 from the SNE lobster stock was just under $18.5 million (Table 8). The largest contributor was Rhode Island with 57% of the total value in SNE. This was followed by Massachusetts (20.9%) and New Jersey (12.2%). While there are a number of participants in the SNE lobster fishery, a large portion of landings are harvested by a small portion of fishermen. In 2015, 57% of fishermen landed less than 10,000 pounds of lobster per year; however, these fishermen were responsible for just

9% of total SNE landings, in pounds. In contrast, just 2% of fishermen landed greater than 100,000 pounds each year but they were responsible for 20% of landings in the fishery. This suggests landings in the lobster fishery are concentrated in a few number of participants.

Table 8: 2015 ex-vessel values in the SNE lobster fishery.

	MA	RI	CT	NY	NJ	DE	MD	VA	Total
Ex-Vessel ($)	3,871,993	10,535,726	748,797	820,456	2,248,638	61,400	186,039	24,092	18,497,141
%	20.9%	57.0%	4.0%	4.4%	12.2%	0.3%	1.0%	0.1%	100.0%

*MA and RI values were calculated by multiplying landings from harvester reports by an average price based on dealer information.

2.6 Management Tools Considered

At the August 2016 meeting, the Lobster Board provided the Plan Development Team (PDT) with a list of potential management tools to consider in this addendum. They included: gauge size changes, trap reductions, closed seasons, trip limits, v-notching, and culls. There was also a recommendation to standardize regulations across LCMAs. The PDT evaluated the effectiveness of these various tools, considering the ability to successfully achieve the management targets for egg production as well as the ability to monitor, administer, and enforce the management tools in the fishery. For this evaluation, the PDT made extensive use of the TC's expertise, including their three memos to the Board in January 2016, April 2016 and July 2016.

2.6.1 Gauge Size Changes

Analysis conducted by the TC suggests that, both inshore and offshore, gauge size changes are an effective management tool to increase egg production and decrease fishing mortality. Changes to the minimum and maximum gauge size are enforceable and provide a direct benefit of keeping lobsters in the water longer. Furthermore, gauge size changes are intricately tied to the biology of lobsters, with clear benefits in terms of egg production and fitness. These impacts can be accurately predicted, adding confidence to the results of management decisions. As a result, gauge size changes are recommended for use in this document.

Work presented in the TC's July memo to the Board (see Appendix 5) suggests gauge size changes can be used to achieve up to a 60% increase in egg production. Increases in the minimum size result in larger increases in egg production; however, the PDT does note that decreases to the maximum gauge size provide permanent protection to larger lobsters which have likely already survived stressful conditions. Changes to the gauge size may necessitate changes to the vent size as the harvestable window of lobster sizes narrows. This would allow a greater portion of undersized lobsters to exit the trap and reduce stress from handling.

Economic impacts of gauge size changes depend on how the change is implemented, as gradual changes to the gauge size over several years may dampen the reductions in harvest. Short-term impacts of gauge size changes include an immediate decrease in landings as there is a narrower slot from which to harvest lobsters; however, as the population stabilizes, landings settle into a common trajectory.

When considering changes to the gauge size, potential impacts to interstate commerce should be considered. It is likely that an implementation of gauge size changes, or any of the proposed measures in the addendum, will create increased demand and shipments of lobsters from different LCMAs, including those Areas in the Gulf of Maine and Georges Bank (GOM/GBK). Currently, the minimum and maximum sizes in place are possession limits, meaning harvesters and dealers must abide by their state's regulations. While these strict regulations improve enforcement of gauge sizes, it can complicate interstate commerce as lobsters legally caught in LCMA 1 have a smaller minimum gauge size of 3 ¼". Massachusetts, because it has lobster landed from four LCMAs, is an exception to this and is only able to enforce LCMA-specific gauge sizes at the harvester level with significant penalties for violations. Some states, such as Rhode Island and Connecticut, allow dealers to possess smaller lobsters legally harvested in other LCMAs as long as those lobsters are not sold to consumers in their state. Dealers are required to have thorough documentation regarding the origin of lobsters below the state's minimum size and these smaller lobsters must be kept separate from those lobsters legally landed in the state. States should consider adopting similar language to minimize economic disruptions in the GOM/GBK stock.

2.6.2 Trap Reductions

The relationship between the biology of lobsters and trap reductions is not well understood. One of the major sources of uncertainty is the effect of trap reductions on the exploitation rate. Currently, LCMAs 2 and 3 are going through a series of trap reductions aimed at reducing trap allocations (ASMFC, 2012). Specifically, Addendum XVIII established a 25% reduction in year 1 followed by a series of 5% reductions for 5 years in LCMA 2. In LCMA 3, Addendum XVIII established a series of 5% reductions for 5 years. The intent of these reductions is to scale the size of the SNE fishery to the reduced size of the SNE stock. Importantly, these actions reduce a fishermen's total allocation, which includes both actively fished traps and latent effort. This means that the current trap reductions can remove latent effort and/or active traps and that, through trap transferability, fishermen can maintain their number of actively fished traps. Current trap reductions may impact the number of trap actively fished; however it is impossible to predict the tipping point between reductions in latent effort and reductions in the number actively fished traps.

In an attempt to understand the impact of trap reductions on the SNE stock, the TC attempted to model the relationship between the number of traps actively fished (as opposed to trap allocations) and the exploitation rate. Information on the number of actively fished traps was from the 2015 stock assessment, which includes data from Massachusetts, Connecticut, Rhode Island and New York (Table 4). Data on the number of traps actively fished in states south of New York is not consistently collected and were not available for use by the TC. Furthermore, the analysis does not consider potential reductions in the number of actively fished traps as the result of current trap allocation reductions in LCMAs 2 and 3. This is because it is impossible to predict the number of active traps retired due to this management measure. The analysis suggests a 25% reduction in the number of actively fished traps may result in an 11.6% reduction in exploitation. This equates to a 13.1% increase in egg production.

The TC highlighted several concerns with the ability of trap reductions to achieve the projected increase in egg production. First, the TC noted that the above analysis assumes fishermen maintain a constant soak time when their trap allocation is reduced. Studies show this assumption is not true, as fishermen reduce their soak time to compensate for fewer traps[3]; fishermen haul fewer traps more frequently to maintain current exploitation rates. This results in decreased impacts to catch and much smaller increases in egg production. Secondly, the analysis is based on reductions in the number of traps actively fished; however trap allocation reductions decrease a combination of latent and active traps. As a result, the expected increase in egg production is likely much lower as trap reductions remove latent effort too. Fishermen in LCMAs 2 and 3 can also maintain their number of actively fished traps through the trap transferability program. Given these caveats, the TC's analysis, while based on the best available data, primarily serves as a tool for guidance by providing a baseline of expected increases in egg production from active trap reductions. As a result, trap reductions are only recommended for use in conjunction with gauge size changes; trap reductions are not recommended as the sole management measure used to increase egg production.

Given the tenuous relationship between traps fished and fishing mortality, the economic impacts of trap reductions are not clear. Analysis suggests fishermen may be able to reduce their soak time in order to maintain current harvest levels, thereby minimizing reductions in profit. However, fishermen may also be encouraged to purchase traps up to the trap cap in order to maintain their current business through the reductions.

The PDT also considered the potential impact of accelerating the current trap reductions in LCMAs 2 and 3. Given the TC's concerns that fishermen can 1) reduce soak times to maintain harvest, 2) current trap reductions are primarily intended to remove latent effort, and 3) fishermen have the ability to maintain their number of actively fished traps through trap transferability, the acceleration of trap reductions specified in Addendum XVIII is not recommended as a management tool in this addendum. Furthermore, the PDT notes accelerated trap reductions would place a greater conservation burden on fishermen from LCMAs 2 and 3.

2.6.3 Closed Seasons

Closed seasons are a management tool which can be used to reduce pressure on the lobster stock at vulnerable times. A biological benefit of this tool is it removes stress on

[3] Miller, 1990; Fogarty and Addison, 1997.

lobsters as they are caught in a trap, hauled to the surface, and handled by fishermen. Analysis by the TC shows seasonal closures can achieve up to a 21.6% increase in egg production. The largest increases in egg production result from summer closures (July-September) when fishing mortality is highest. Furthermore, a summer closure protects female lobsters which have mated but have yet to extrude their eggs. Importantly, this analysis is predicated on the assumption that fishermen do not adapt to the implementation of a season closure by intensifying their effort during the rest of the year. As a result, the realized increases in egg production may be lower than is predicted in the analysis.

An important consideration with closed seasons is the potential impact on the Jonah crab fishery. Particularly in SNE, the lobster fishery is evolving into a mixed crustacean fishery in which lobsters and Jonah crab can be caught with the same gear at different times of the year. Season closures would directly impact the Jonah crab fishery if traps must be taken out of the water. Allowing lobster traps to remain in the water during a closed season would reduce the biological benefit of the management tool as lobsters would still be hauled, handled, and thrown overboard. As a result, the timing of season closures, if used, should be considered to minimize impacts on the Jonah crab fishery.

Given the assumptions in the analysis on season closures and the potential impact on the Jonah crab fishery, closed seasons are recommended for use in conjunction with gauge size changes; closed seasons are not recommended as the sole management measure used to increase egg production. Economic impacts of season closures include reduced profits at certain times of the year; however, studies suggest gross revenues over the year may increase as the result of season closures. Analysis of the Maine lobster fishery by Chen and Townsend (1993) suggests closures of at least 3-4 months causes the redistribution of landings across seasons, which evens out prices and strengthens market values. SNE markets are more tenuous than in Maine but may be strengthened by consolidation.

2.6.4 Trip Limits

While trip limits are frequently used as a management tool in other fisheries, to-date they have not been used in the directed lobster fishery. Overall, trip limits are an enforceable management tool which can be used to maintain catch over the harvestable year and potentially reduce exploitation. Trip limits allow for the execution of both the lobster and Jonah crab fishery as lobster traps would still be allowed in the water.

During their discussion of trip limits, the TC noted several concerns with the effectiveness of this management tool. Given the difference in vessel size and capacity between the inshore and offshore fleet, trip limits may disproportionately impact the offshore fleet which frequently takes multiday trips. As a result, impacted fishermen may respond by increasing the number of trips taken each year to maintain current harvest levels. Trip limits may also encourage fishermen who typically harvest below the limit to increase their catch and maximize their potential harvest. This unintended consequence could result in increased landings, a result contradictory to the stated purpose of this Addendum. Furthermore, trip limits often result in increased discards and stress as lobsters are hauled, handled, and returned to the water.

Given these concerns, the TC recommended trip limits be considered in conjunction with a quota for the SNE stock. A quota, if properly enforced, can cap landings in a fishery and allow managers to increase or decrease the total catch for the year depending on the current stock status. Implementing a quota in the lobster fishery presents many challenges and questions. The establishment of quotas requires tough discussions on how the total allowable catch will be set and if this will be allocated among jurisdictions, LCMAs, and/or seasons. An effective quota also requires good monitoring and enforcement, both of which need to be carefully considered prior to implementation. A particular challenge in the lobster fishery is how states with fishermen harvesting from both the SNE stock and GOM/GBK stock should monitor landings.

The PDT recognizes the challenges associated with implementing a trip limit and quota in the SNE lobster fishery; however, they also recognize the potential value these tools bring in being able to control the amount of lobster taken from the water. Given the intent of this Addendum is to take quick and decisive action and the Board has stated this is an initial management response to the 2015 stock assessment, the PDT recommends trip limits and quotas be considered in a subsequent management document. This will allow for the proper consideration and analysis of these management tools.

2.6.5 V-Notching

V-notching is a tool which has been used in the lobster fishery to protect reproductive females in the population. Currently, LCMAs 2, 5, and federal waters of LCMA 4 require mandatory v-notching; LCMA 6, state waters of LCMA 4, and the SNE portion of LCMA 3 do not. All areas use the same 1/8" definition for a v-notch, a less strict definition than the zero tolerance rule in LCMA 1. As a result, there is some concern that reproductive females who are protected in the Gulf of Maine, receive less protection if they migrate south. While v-notching can be a valuable management tool when actively conducted, the PDT notes the value of this tool is predicated on high encounter and harvest rates. Given significant reductions in landings in SNE, v-notching is not expected to produce a large benefit to the stock. Furthermore, the effectiveness of v-notching in SNE has been hindered by issues with non-compliance and incorrect marking, which lessen the value of this management tool. As a result, v-notching is not recommend as a management tool for use in this addendum.

2.6.6 Culls

Lobsters which only have one claw are referred to as culls. Claws can be lost naturally, such as in an interaction with other another lobster, or during handling by fishermen. Currently, culls can be legally landed in the lobster fishery. A prohibition on the harvest of culls may reduce fishing mortality; however, it may also encourage better handling practices, reducing the number of culls and the benefit of this management tool on the stock. Furthermore, should culls be prohibited, tolerances would have to be established in case a lobster loses a claw during the steam to port and a clear definition would be needed to address regeneration. Given these limitations, a prohibition on culls is not recommended as a management tool for use in this document.

2.6.7 Standardize Regulations

In their April 25th memo to the Board, the TC outlined the costs and benefits of standardizing regulations in SNE. Overall, the TC felt standardizing biological measures would improve enforcement and the stock assessment process but may negatively impact industry by creating clear winners and losers in the fishery. This is especially true in regards to changes to the gauge size, as uniform increases in the minimum size will primarily impact inshore fishermen while uniform decreases in the maximum size will primarily impact offshore fishermen.

The LCMAs established in Amendment 3 were created to reflect the different stock conditions in different parts of the fishery; they resulted from the acknowledgement that a one-size-fits-all approach would not work well in the lobster fishery. Industry has supported the creation of these different regulations and has participated in their evolution through Lobster Conservation Management Teams (LCMTs). Given the different dynamics of the fishery, the PDT does not recommend standardized regulations between the inshore and offshore fishery but does support standardized regulations within the inshore fishery (LCMAs 2, 4, 5, and 6). This would be achieved by maintaining uniform gauge sizes and standardizing closed seasons.

2.7 Stock Boundaries

The seven LCMA's established in Amendment 3 were created in recognition that the lobster stock is not uniform across the management unit. Unfortunately, the boundaries of the LCMAs do not align with the biological boundaries of the stocks (SNE vs. GOM/GBK). This is particularly problematic in LCMA 3 which spans both SNE and GOM/GBK. Historically, management measures implemented in LCMA 3 to address the poor condition of the SNE stock also impacted the GOM/GBK stock, which is not depleted. The complexity of the stock boundaries is further complicated by the fact that many vessels fishing out of Rhode Island and Massachusetts who are harvesting lobsters in Georges Bank, must travel through the SNE stock to reach their port of landing. This means SNE-specific rules designed to be enforced only at the port of landing provide compliance challenges.

To date there has been no permit requirements to delineate within which stock an Area 3 fisherman is eligible to fish. Management action taken in response to the 2009 stock assessment was applied throughout LCMA 3, including portions in the GOM/GBK. Given the conservation burden of this addendum applies only to SNE, new conservation rules must either apply to all Area 3 fishermen regardless of location and stock fished (with economic implications on the GOM/GBK fisheries) or new measures will have to be stock specific. This can be achieved by having fishermen declare and be permitted to fish exclusively within the GOM/GBK portion of LCMA 3.

3.0 Management Options

Issue 1: Increases in Egg Production

The following management targets are intended to increase egg production and decrease fishing mortality in SNE. These measures are proposed for all gear types and for both the commercial and recreational sectors. During the public comment period, LCMTs are encouraged to submit proposals on how they would prefer to achieve each of the proposed increases in egg production. The management options are presented with the intent that each LCMT and/or jurisdiction can choose how they would like to achieve the targeted increases in egg production. Standard regulations between the inshore areas (LCMAs 2, 4, 5 and 6) are supported by the PDT but not a requirement in this addendum.

This document considers potential changes to the minimum and maximum carapace length at which lobsters can be harvested. Carapace length is defined as the straight-line measurement from the rear of the eye socket parallel to the centerline of the carapace to the posterior edge of the carapace.

This document also considers trap allocation reductions. These potential reductions are separate and in addition to the trap allocation reductions established in Addendum XVIII. Should trap allocation reductions be chosen in this addendum for LCMA 2 and 3 fishermen, they will occur following the final year of trap reductions specified in Addendum XVIII.

<u>Option 1: Status Quo</u>
Under this option no changes to management would be made through this addendum. All measures would remain the same as listed in Table 7.

<u>Option 2: 20% Increase in Egg Production</u>
Under this option, all SNE LCMAs must increase egg production by 20%. This can be achieved through changes to the gauge size or a combination of gauge size changes, season closures, and trap reductions.

a. <u>Increase Minimum Size:</u> Only one minimum size can be implemented for each LCMA. States and LCMTs would use Table 9 to determine the minimum size limit which would achieve the 20% increase in egg production.
b. <u>Decrease Maximum Size:</u> Only one maximum size can be implemented for each LCMA. States and LCMTs would use Table 9 to determine the maximum size limit which would achieve a 20% increase in egg production.
c. <u>Trap Reductions:</u> A single, one year trap allocation reduction or a series of trap allocation reductions over multiple years can be implemented in each LCMA. Analysis by the TC suggests a 25% active trap reduction results in, at most, a

13.1% increase in egg production. Trap allocation reductions must be used in conjunction with gauge size changes to achieve the 20% increase in egg production. Together, trap allocation reductions and closed seasons cannot account for more than 10% of the expected increase in egg production.

d. Closed Season: A season closure can be implemented in each LCMA. Jurisdictions that land lobster from an LCMA which implements a season closure must be closed at that time. States and LCMTs would use Table 10 to determine the dates of the season closure and the expected increase in egg production. Season closures must be used in conjunction with gauge size changes to achieve the 20% increase in egg production. Together, active trap reductions and closed seasons cannot account for more than 10% of the expected increase in egg production.

Option 3: 40% Increase in Egg Production

Under this option, all SNE LCMAs must increase egg production by 40%. This can be achieved through changes to the gauge size or a combination of gauge size changes, season closures, and trap reductions.

a. Increase Minimum Size: Only one minimum size can be implemented for each LCMA. States and LCMTS would use Table 9 to determine the minimum size limit which would achieve the 40% increase in egg production.
b. Decrease Maximum Size: Only one maximum size can be implemented for each LCMA. States and LCMTs would use Table 9 to determine the maximum size limit which would achieve a 40% increase in egg production.
c. Trap Reductions: A single, one year trap allocation reduction or a series of trap allocation reductions over multiple years can be implemented in each LCMA. Analysis by the TC suggests a 25% active trap reduction results in, at most, a 13.1% increase in egg production. Trap allocation reductions must be used in conjunction with gauge size changes to achieve the 40% increase in egg production. Together, trap allocation reductions and closed seasons cannot account for more than 20% of the expected increase in egg production.
d. Closed Season: A season closure can be implemented in each LCMA. Jurisdictions that land lobster from an LCMA which implements a season closure must be closed at that time. States and LCMTs would use Table 10 to determine the dates of the season closure and the expected increase in egg production. Season closures must be used in conjunction with gauge size changes to achieve the 40% increase in egg production. Together, active trap reductions and closed seasons cannot account for more than 20% of the expected increase in egg production.

Option 4: 60% Increase in Egg Production

Under this option, all SNE LCMAs must increase egg production by 60%. This can be achieved through changes to the gauge size or a combination of gauge size changes, season closures, and trap reductions.

a. Increase Minimum Size: Only one minimum size can be implemented for each LCMA. States and LCMTs would use Table 9 to determine the minimum size limit which would achieve the 60% increase in egg production.

b. Decrease Maximum Size: Only one maximum size can be implemented for each LCMA. States and LCMTs would use Table 9 to determine the maximum size limit which would achieve a 60% increase in egg production.
c. Trap Reductions: A single, one year trap allocation reduction or a series of trap allocation reductions over multiple years can be implemented in each LCMA. Analysis by the TC suggests a 25% active trap reduction results in, at most, a 13.1% increase in egg production. Trap allocation reductions must be used in conjunction with gauge size changes to achieve the 60% increase in egg production. Together, trap allocation reductions and closed seasons cannot account for more than 30% of the expected increase in egg production.
d. Season Closures: A season closure can be implemented in each LCMA. Jurisdictions that land lobster from an LCMA which implements a season closure must be closed at that time. States and LCMTs would use Table 10 to determine the dates of the season closure and the expected increase in egg production. Season closures must be used in conjunction with gauge size changes to achieve the 60% increase in egg production. Together, active trap reductions and closed seasons cannot account for more than 30% of the expected increase in egg production.

Table 9: Changes in the gauge size inshore (LCMAs 2, 4, 5, and 6) and offshore (LCMA 3) and the corresponding effects in egg production, exploitation, SSB, reference abundance, and catch. Each LCMT may use this table to propose how they will achieve the targeted increase in egg production.

		Min	Max	Harvest Window (mm)	Egg Production	Exploitation	Spawning Stock Biomass	Reference Abundance	Catch
20%	Inshore	88mm (3-15/32")	105mm (4-1/8")	17 (0.7")	20%	-18%	20%	9%	-11%
		91mm (3-9/16")	115mm (4 ½")	24 (0.9")	18%	-22%	22%	11%	-14%
		92mm (3-5/8")	165mm (6 ½")	73 (2.9")	20%	-27%	25%	13%	-17%
	Offshore	91mm (3-9/16")	105mm (4-1/8")	14 (0.6")	22%	-21%	22%	9%	-13%
		94mm (3-11/16")	115mm (4 ½")	21 (0.8")	20%	-26%	24%	12%	-17%
		95mm (3 ¾")	165mm (6 ½")	70 (2.8")	21%	-28%	26%	13%	-19%
40%	Inshore	96mm (3-25/32")	115mm (4 ½")	19 (0.7")	40%	-43%	49%	23%	-30%
		96mm (3-25/32")	165mm (6 ½")	69 (2.7")	37%	-42%	46%	22%	-29%
		97mm (3-4/5")	165mm (6 ½")	68 (2.7")	43%	-46%	53%	25%	-33%
	Offshore	98mm (3-27/32")	165mm (6 ½")	67 (2.6")	39%	-45%	46%	22%	-33%
		99mm (3-7/8")	165mm (6 ½")	66 (2.6")	41%	-47%	49%	23%	-35%
60%	Inshore	99 mm (3-7/8")	115mm (4 ½")	16 (0.6")	60%	-56%	71%	32%	-42%
		101mm (3-29/32")	165mm (6 ½")	64 (2.5")	59%	-59%	76%	35%	-45%
	Offshore	102mm (4")	115mm (4 ½")	13 (0.5")	62%	-60%	71%	31%	-47%
		103mm (4-1/16")	165mm (6 ½")	62 (2.4")	63%	-63%	75%	34%	-50%

Table 10: Season closures in SNE and the corresponding effects in egg production, exploitation, SSB, and catch. Each LCMT may use this table to propose how they will achieve the targeted increase in egg production.

Season Closure	Egg Production	Exploitation	Spawning Stock Biomass	Catch
Winter (Jan-March)	3.0%	-2.1%	2.3%	-0.7%
Spring (April-June)	15.0%	-10.8%	16.0%	-1.7%
Summer (July-Sept)	21.6%	-26.0%	15.5%	-12.3%
Fall (Oct-Dec)	8.1%	-13.6%	8.4%	-4.2%

Issue 2: Implementation of Management Measures in LCMA 3

The following management options are intended to determine where in LCMA 3 the management measures selected in this addendum will apply.

Option 1: Maintain LCMA 3 as a Single Area

Under this option, the current boundaries of LCMA 3 would be maintained. Management measures in this document would apply to all LCMA 3 permit holders, including those that fish in the GOM/GBK stock.

Option 2: Split LCMA 3 along the 70^{o}W Longitude Line

Under this option, LCMA 3 would be split along the 70^{o}W longitude line to create an eastern section and a western section in LCMA 3 (see Appendix 1). The eastern portion of LCMA 3 would be comprised of areas east of the 70^{o}W longitude line which are currently a part of the GOM/GBK stock. The western portion of LCMA 3 would be comprised of areas west of the 70^{o}W longitude line which are currently a part of the SNE stock. On an annual basis, current LCMA 3 fishermen could elect to fish exclusively in the eastern portion of LCMA 3. Fishermen who do not choose this option could fish throughout the entire LMCA 3; however, they will be held to the stricter management measures of the two sections, as per the most restrictive rule (ASMFC, 2009). Fishermen can elect to fish exclusively in the eastern portion of LCMA 3 at the start of the fishing year but not during a fishing season. Trap tags would be amended to include "3E" for fishermen exclusively fishing in the eastern portion of the LCMA and traps with "3E" trap tags can only be fished in the eastern portion of LCMA 3. All other LCMA 3 trap tags can be fished in the eastern or western portions of LCMA 3. LCMA 3 permits and trap allocations may still be transferred as specified in Addendum XXI and the transfer recipient will designate at the start of the fishing year in which section he/she would like to fish. Management measures adopted in this addendum would only apply to the western portion of LCMA 3.

4.0 Monitoring

Given Addendum XXV represents an initial response to the results of the 2015 stock assessment, monitoring is necessary to determine the need and extent of future management action. The stated goal of this addendum is to increase egg production and reduce fishing mortality. As a result, the exploitation rate of the SNE stock will be monitored. If a reduction in fishing morality, and a corresponding increase in egg production, is not observed following implementation of this addendum, the management tools implemented in this document will be re-evaluated. Furthermore, in order to determine the extent of future management action, model-free abundance indicators for SNE will be updated each year as a part of the annual Fishery Management Plan Review. This includes information on spawning stock abundance, full recruit abundance, recruit abundance, young-of-year indices, and survey encounter rates.

5.0 Compliance

If the existing lobster management program is revised by approval of this draft addendum, the American Lobster Management Board will designate dates by which states will be required to implement the addendum. The compliance schedule will take the following format:

XXXXX:	States must submit programs to implement Addendum XXV for approval by the American Lobster Management Board
XXXXX:	The American Lobster Board Approves State Proposals
XXXXX:	All states must implement Addendum XXV through their approved management programs. States may begin implementing management programs prior to this deadline if approved by the Management Board.

6.0 Recommendation for Federal Waters

The SNE lobster resource has been reduced to very low levels. ASMFC believes additional fishery restrictions are necessary to prevent further depletion of the resource.

The management of American lobster in the EEZ is the responsibility of the Secretary of Commerce through the National Marine Fisheries Service (NMFS). ASMFC recommends the federal government promulgate all necessary regulations in Section 3.0 to implement complementary measures to those approved in this addendum.

7.0 References

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Appendix 1: LCMAs, stock boundaries, and NMFS statistical areas.

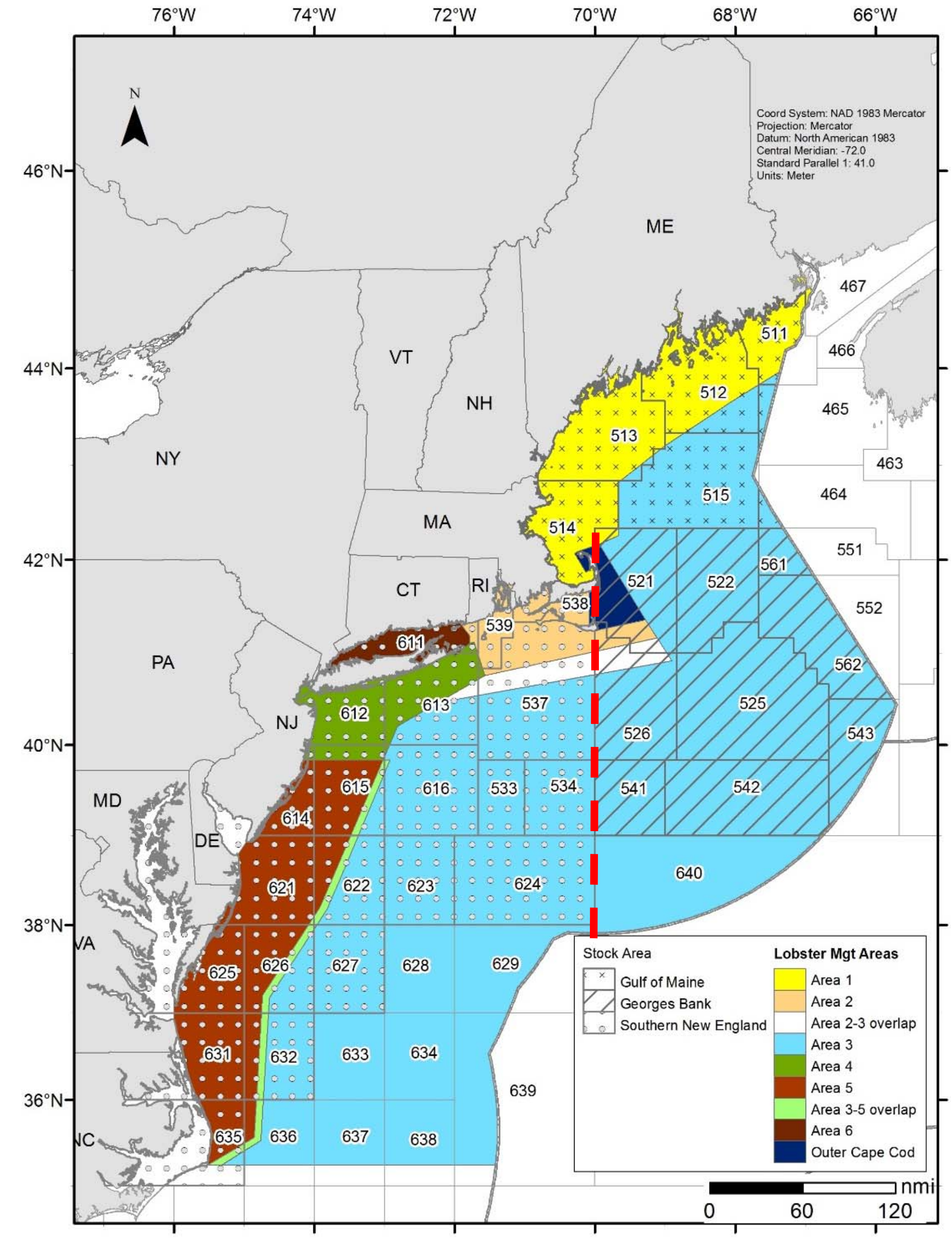

Figure 32.1. Statistical areas used to define the American lobster, *Homarus americanus*, stock.

Figure 1. Chart of Lobster stock units (GOM, GMB, and SNE), management conservation areas (1-6 and OCC), and NMFS statistical areas. The red dashed line represents the 70^{o}W longitude line

Appendix 2: Southern New England Model Free Abundance Indicators

SPAWNING STOCK ABUNDANCE Mean weight (g) per tow of mature females								
Survey	***NESFC***		***MA***		***RI***		***CT***	
	Fall	*spring*	*fall*	*spring*	*Fall*	*spring*	*Fall*	*spring*
1981	198.93	15.71	9.21	99.78	161.55	111.57		
1982	156.07	118.29	50.04	26.42	53.52	43.52		
1983	120.20	35.51	0.72	59.62	87.86	141.69		
1984	192.38	44.50	4.04	51.67	203.58	259.91	2331.33	
1985	132.96	138.13	1.88	36.90	125.09	60.22	1040.42	1155.01
1986	59.83	61.35	87.60	19.06	128.49	136.78	1548.94	751.75
1987	143.76	67.33	44.51	35.12	475.51	86.13	1869.91	932.49
1988	122.36	121.34	13.16	46.33	662.07	100.75	1081.60	639.82
1989	124.57	44.65	233.88	70.68	363.92	151.06	853.74	1193.87
1990	175.83	75.87	59.02	150.21	230.17	258.72	1818.59	2369.93
1991	160.99	53.14	125.79	236.11	367.25	698.35	2185.29	2692.42
1992	178.88	61.38	179.80	47.84	321.95	117.18	1905.99	3598.02
1993	139.25	71.48	99.33	25.59	1286.74	1595.77	3335.55	2320.25
1994	54.70	36.40	126.00	82.42	359.96	164.37	3402.43	1170.49
1995	145.39	10.18	10.89	92.76	410.53	153.14	2253.58	3302.56
1996	227.08	32.01	59.61	54.16	861.32	353.55	3018.00	3882.27
1997	121.74	137.20	29.11	225.15	654.91	439.93	7173.56	5994.27
1998	161.20	44.97	52.73	138.81	251.53	286.59	2573.44	7738.30
1999	69.56	122.59	24.53	81.12	171.54	324.62	2546.24	8261.90
2000	95.66	60.02	20.08	142.78	268.99	303.32	1744.69	4430.68
2001	95.78	36.43	21.28	16.61	267.62	535.45	1513.56	3363.78
2002	85.56	146.86	0.00	44.75	35.68	572.35	365.12	2044.42
2003	52.83	31.71	0.00	5.97	205.85	110.43	1187.14	698.04
2004	47.10	47.01	37.18	3.58	288.49	591.60	626.96	522.99
2005	110.36	42.31	101.87	23.02	353.53	243.36	473.26	479.71
2006	65.03	90.62	0.00	60.77	465.26	788.63	219.99	465.37
2007	44.60	34.20	41.79	10.32	350.43	206.96	188.98	595.89
2008	25.90	58.14	0.00	19.67	401.73	194.57	248.63	760.88
2009	36.92	24.49	3.95	31.29	184.35	250.00	305.31	371.95
2010	101.74	46.39	130.73	32.09	166.07	177.64	na	361.72
2011	89.95	22.79	36.96	8.55	148.47	152.43	30.24	64.00
2012	205.12	39.64	14.13	9.93	31.16	118.13	6.28	88.85
2013	52.95	42.05	23.96	35.49	2.02	67.76	24.56	39.81
2014	50.93	198.30	0.10	20.95	190.12	24.98	23.00	34.02
2015	na	44.83	54.57	1.72	62.34	15.60	na	23.02
2011 - 2015 ave.	**99.74**	**69.52**	**25.95**	**15.33**	**86.82**	**75.78**	**21.02**	**49.94**
25th	93.14	42.48	12.59	36.45	205.28	131.88	1431.95	1162.75
median	128.76	60.69	36.81	52.92	295.47	259.32	1887.95	2369.93
75th	161.04	87.24	90.53	104.27	426.78	375.15	2553.04	3740.14

FULL RECRUIT ABUNDANCE (SURVEY) Abundance of lobsters > 85 mm CL (sexes combined)								
Survey	***NEFSC***		***MA***		***RI***		***CT***	
	Fall	*spring*	*fall*	*spring*	*Fall*	*spring*	*Fall*	*spring*
1981	0.24	0.03	0.00	0.02	0.01	0.03		
1982	0.17	0.13	0.07	0.02	0.04	0.03		
1983	0.13	0.03	0.00	0.07	0.13	0.08		
1984	0.24	0.04	0.07	0.03	0.16	0.31	2.67	
1985	0.12	0.07	0.00	0.00	0.10	0.07	0.81	1.06
1986	0.06	0.12	0.05	0.00	0.08	0.11	2.73	0.63
1987	0.19	0.05	0.05	0.05	0.31	0.04	1.62	0.99
1988	0.15	0.04	0.00	0.03	0.83	0.09	1.26	0.82
1989	0.20	0.07	0.20	0.07	0.24	0.05	1.00	1.41
1990	0.19	0.05	0.05	0.05	0.38	0.10	2.39	1.35
1991	0.20	0.04	0.23	0.19	0.44	0.37	1.34	3.26
1992	0.20	0.07	0.22	0.05	0.34	0.10	2.37	1.44
1993	0.14	0.10	0.12	0.02	1.12	1.42	1.55	0.68
1994	0.08	0.03	0.00	0.00	0.55	0.10	3.75	0.50
1995	0.15	0.01	0.01	0.05	0.33	0.07	2.20	1.85
1996	0.22	0.02	0.06	0.08	0.82	0.19	1.97	1.96
1997	0.11	0.19	0.02	0.10	0.98	0.08	4.00	4.44
1998	0.25	0.00	0.04	0.00	0.17	0.17	1.48	4.10
1999	0.08	0.07	0.00	0.16	0.27	0.26	1.70	3.27
2000	0.08	0.08	0.08	0.08	0.30	0.32	0.95	2.44
2001	0.10	0.07	0.02	0.03	0.10	0.32	0.35	2.47
2002	0.08	0.08	0.00	0.08	0.00	0.20	0.03	1.35
2003	0.08	0.05	0.00	0.06	0.29	0.07	0.62	0.35
2004	0.07	0.04	0.04	0.00	0.26	0.41	0.27	0.30
2005	0.12	0.07	0.06	0.00	0.30	0.33	0.21	0.25
2006	0.11	0.06	0.00	0.14	0.24	0.65	0.03	0.20
2007	0.07	0.03	0.05	0.01	0.32	0.15	0.03	0.24
2008	0.07	0.06	0.00	0.02	0.74	0.12	0.19	0.66
2009	0.07	0.03	0.00	0.01	0.17	0.19	0.24	0.32
2010	0.11	0.05	0.15	0.07	0.07	0.12	na	0.26
2011	0.10	0.04	0.07	0.00	0.14	0.16	0.01	0.07
2012	0.19	0.05	0.03	0.02	0.02	0.09	0.03	0.06
2013	0.08	0.09	0.03	0.07	0.00	0.02	0.03	0.07
2014	0.07	0.18	0.00	0.02	0.00	0.00	0.01	0.04
2015	na	0.06	0.05	0.02	na	0.00	na	0.02
2011 - 2015 ave.	**0.11**	**0.08**	**0.03**	**0.03**	**0.04**	**0.06**	**0.02**	**0.05**
25th	0.08	0.04	0.00	0.03	0.17	0.07	0.99	0.91
median	0.14	0.06	0.04	0.05	0.31	0.10	1.59	1.41
75th	0.20	0.08	0.07	0.08	0.46	0.28	2.38	2.46

RECRUIT ABUNDANCE (SURVEY)								
Abundance of lobsters 71 - 80 mm CL (sexes combined)								
Survey	***NEFSC***		***MA***		***RI***		***CT***	
	Fall	***spring***	***fall***	***spring***	***Fall***	***spring***	***Fall***	***spring***
1981	0.40	0.05	0.07	0.65	1.31	0.89		
1982	0.29	0.24	0.04	0.10	0.62	0.26		
1983	0.28	0.14	0.04	0.09	0.43	0.94		
1984	0.19	0.04	0.01	0.42	1.21	1.03	8.62	
1985	0.34	0.78	0.09	0.34	0.97	0.26	5.03	4.73
1986	0.14	0.09	0.20	0.17	1.30	0.75	8.22	3.45
1987	0.20	0.33	0.17	0.27	2.53	0.79	9.46	3.90
1988	0.26	0.09	0.16	0.24	4.14	0.42	4.82	2.16
1989	0.52	0.04	0.43	0.14	3.26	0.93	6.32	5.51
1990	0.36	0.29	0.31	2.29	1.38	2.17	10.31	9.53
1991	0.24	0.18	0.87	1.18	3.05	4.77	14.23	15.39
1992	0.38	0.06	0.57	0.10	1.97	0.67	12.25	16.55
1993	0.17	0.29	0.52	0.25	8.29	7.81	21.46	10.69
1994	0.12	0.10	0.42	0.95	3.64	1.00	18.87	5.90
1995	0.28	0.00	0.03	1.14	4.48	1.36	15.30	16.31
1996	0.77	0.14	0.32	0.40	6.42	1.60	14.91	16.30
1997	0.56	0.62	0.12	1.45	6.10	2.58	40.43	25.49
1998	0.46	0.37	0.11	1.09	3.38	1.63	18.61	37.56
1999	0.20	0.92	0.19	0.75	2.10	1.64	20.22	40.84
2000	0.40	0.30	0.13	0.54	1.83	1.54	12.71	20.72
2001	0.17	0.14	0.03	0.18	2.21	3.03	11.94	19.12
2002	0.17	0.62	0.00	0.34	0.75	2.73	3.52	11.44
2003	0.12	0.21	0.00	0.07	1.00	0.29	5.56	4.58
2004	0.12	0.11	0.00	0.05	1.48	1.86	4.52	2.92
2005	0.08	0.06	0.00	0.08	2.48	1.02	2.14	2.67
2006	0.12	0.14	0.03	0.08	2.26	3.63	1.38	2.12
2007	0.11	0.12	0.00	0.08	2.76	0.73	1.35	2.86
2008	0.12	0.14	0.01	0.16	2.98	0.64	1.43	3.10
2009	0.05	0.05	0.05	0.16	1.36	1.14	1.72	1.55
2010	0.14	0.05	0.18	0.06	1.21	0.44	na	1.41
2011	0.12	0.03	0.00	0.18	1.02	0.42	0.19	0.42
2012	0.16	0.04	0.21	0.07	0.27	0.61	0.14	0.50
2013	0.10	0.02	0.04	0.11	0.02	0.18	0.06	0.23
2014	0.14	0.52	0.00	0.04	0.14	0.02	0.05	0.15
2015	NA	0.01	0.30	0.07	na	0.05	na	0.15
2011 - 2015 ave.	**0.13**	**0.12**	**0.11**	**0.09**	**0.36**	**0.26**	**0.11**	**0.29**

25th	0.17	0.09	0.08	0.23	1.36	0.78	7.74	5.12
median	0.25	0.20	0.17	0.37	2.37	1.45	12.09	11.44
75th	0.38	0.34	0.35	0.99	3.77	2.27	16.13	17.84

YOUNG-OF-YEAR INDICES				
	YOY	YOY	Larvae	Postlarvae
Survey	***MA***	***RI***	***CT / ELIS*** *Summer*	***CT_NY / WLIS*** *Summer*
1981				
1982				
1983				14.48
1984			0.43	6.89
1985			0.53	66.75
1986			0.90	4.58
1987			0.78	18.98
1988			0.74	49.27
1989			0.74	5.88
1990		1.31	0.81	19.66
1991		1.49	0.55	9.97
1992		0.63	1.44	14.12
1993		0.51	1.19	26.23
1994		1.23	0.98	96.52
1995	0.17	0.33	1.46	18.20
1996	0.00	0.15	0.31	12.07
1997	0.08	0.99	0.21	13.69
1998	0.20	0.57	0.55	4.85
1999	0.03	0.92	2.83	39.70
2000	0.33	0.34	0.78	14.28
2001	0.10	0.75	0.32	9.46
2002	0.10	0.25	0.64	1.99
2003	0.03	0.79	0.25	2.60
2004	0.03	0.42	0.45	6.10
2005	0.13	0.53	0.49	6.90
2006	0.17	0.44	0.71	1.70
2007	0.10	0.36	0.37	18.10
2008	0.00	0.14	0.37	8.10
2009	0.03	0.08	0.19	7.62
2010	0.00	0.11	0.35	9.91
2011	0.03	0.00	0.26	5.90
2012	0.00	0.09	0.12	2.77
2013	0.13	0.22	0.16	no data
2014	0.07	0.22	0.06	no data
2015	0.00	0.14	na	no data
2011 - 2015 ave.	**0.05**	**0.13**	**0.15**	**4.34**

25th	0.03	0.39	0.50	6.64
median	0.10	0.69	0.74	13.91
75th	0.17	0.97	0.92	21.30

SURVEY LOBSTER ENCOUNTER RATE								
Proportion of postive tows								
Survey	*NEFSC*		*MA*		*RI*		*CT*	
	Fall	*spring*	*fall*	*spring*	*Fall*	*spring*	*Fall*	*spring*
1981			0.15	0.38	0.54	0.49		
1982	0.34	0.24	0.21	0.28	0.59	0.30		
1983	0.22	0.14	0.16	0.21	0.36	0.45		
1984	0.27	0.09	0.18	0.40	0.45	0.59	0.76	0.72
1985	0.30	0.20	0.22	0.51	0.50	0.31	0.69	0.57
1986	0.25	0.19	0.38	0.39	0.43	0.64	0.61	0.67
1987	0.23	0.13	0.18	0.28	0.47	0.33	0.76	0.63
1988	0.27	0.08	0.21	0.39	0.59	0.49	0.66	0.65
1989	0.37	0.11	0.33	0.50	0.55	0.52	0.63	0.75
1990	0.43	0.14	0.44	0.66	0.54	0.66	0.76	0.73
1991	0.29	0.13	0.39	0.41	0.69	0.77	0.78	0.81
1992	0.31	0.23	0.23	0.51	0.57	0.41	0.69	0.78
1993	0.26	0.09	0.26	0.54	0.73	0.50	0.77	0.74
1994	0.23	0.09	0.20	0.51	0.57	0.56	0.74	0.73
1995	0.33	0.06	0.13	0.44	0.67	0.55	0.68	0.77
1996	0.41	0.08	0.16	0.30	0.76	0.79	0.78	0.68
1997	0.28	0.24	0.21	0.45	0.71	0.75	0.81	0.71
1998	0.30	0.11	0.13	0.54	0.55	0.59	0.71	0.83
1999	0.29	0.18	0.21	0.41	0.59	0.76	0.79	0.78
2000	0.30	0.13	0.15	0.45	0.63	0.68	0.73	0.82
2001	0.24	0.18	0.18	0.28	0.61	0.64	0.58	0.77
2002	0.21	0.19	0.03	0.28	0.45	0.63	0.59	0.73
2003	0.25	0.11	0.03	0.14	0.40	0.53	0.63	0.71
2004	0.20	0.10	0.03	0.28	0.50	0.54	0.66	0.61
2005	0.20	0.08	0.15	0.34	0.45	0.50	0.55	0.63
2006	0.23	0.13	0.03	0.43	0.61	0.81	0.53	0.61
2007	0.19	0.15	0.10	0.34	0.54	0.43	0.53	0.70
2008	0.24	0.11	0.10	0.33	0.52	0.55	0.65	0.63
2009	0.28	0.16	0.05	0.50	0.40	0.57	0.55	0.49
2010	0.30	0.09	0.24	0.23	0.45	0.47	na	0.54
2011	0.32	0.11	0.05	0.18	0.23	0.29	0.28	0.46
2012	0.32	0.12	0.15	0.18	0.16	0.29	0.20	0.44
2013	0.24	0.09	0.08	0.18	0.09	0.20	0.15	0.28
2014	0.24	0.23	0.08	0.13	0.23	0.07	0.10	0.26
2015	na	0.054	0.05	0.10	na	0.12	0.10	0.27
2011 - 2015 ave.	**0.28**	**0.12**	**0.08**	**0.15**	**0.18**	**0.19**	**0.17**	**0.34**

25th	0.25	0.09	0.16	0.37	0.49	0.52	0.65	0.70
median	0.29	0.13	0.20	0.42	0.57	0.59	0.72	0.73
75th	0.31	0.18	0.24	0.51	0.64	0.66	0.76	0.77

Appendix 3. Bottom Water Temperatures

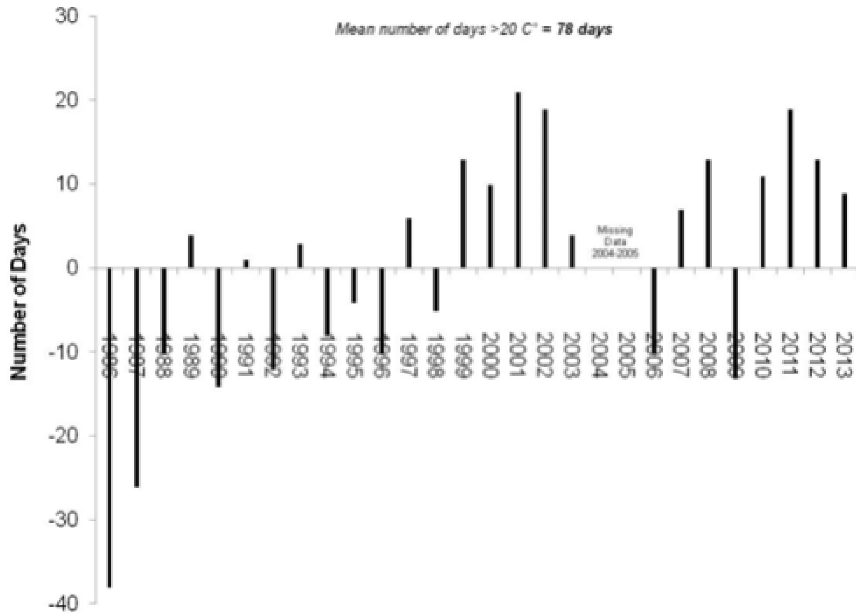

Figure 1: Bottom water (11m) temperature anomalies from the mean number of days >20°C at Cleveland Ledge, Buzzards Bay, MA, 1986-2013. Source: 2015 Benchmark Stock Assessment.

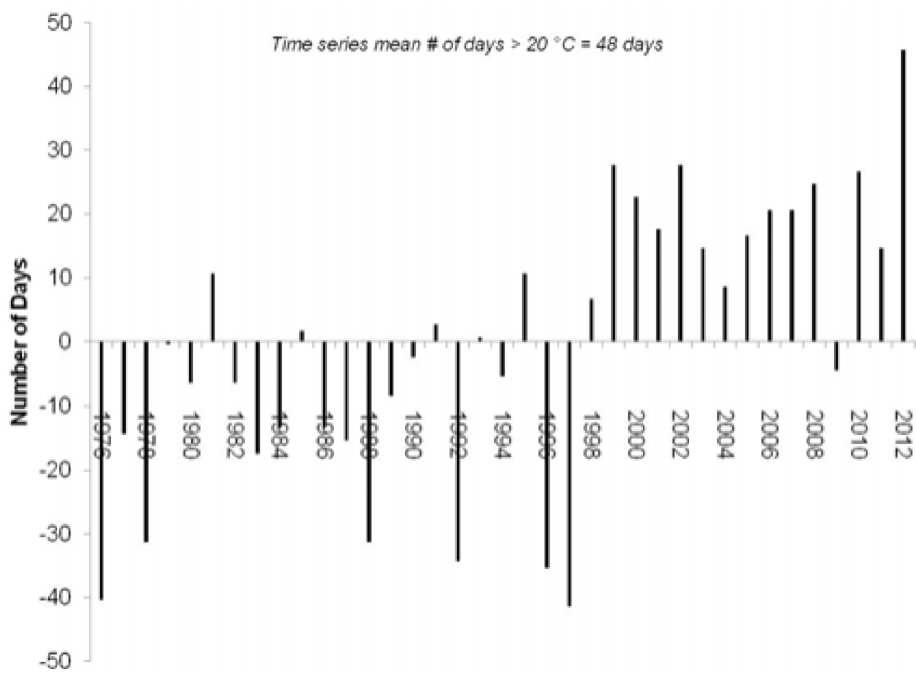

Figure 2: Bottom water (11m) temperature anomalies from the mean number of days >20°C at Dominion Nuclear Power Station, eastern Long Island Sound, CT, 1976-2012.

Appendix 4: Southern New England Stock Projections

The American Lobster Technical Committee (TC) met on December 8th to review projections for the Southern New England (SNE) lobster stock. Below are the series of projections that the TC unanimously recommends for Board consideration. These projections represent two potential scenarios. In the first scenario, recruitment is assumed to be independent of stock biomass and stable at current estimated levels. While this can limit the potential for rebuilding, it is perhaps the more realistic of the two scenarios given that recruitment has been declining for the past couple decades.

In the second scenario, future recruitment is linked to the spawning stock via a Beverton-Holt stock-recruitment relationship. This is perhaps less realistic than the first scenario with regards to stock rebuilding but more realistic for the continued decline of the population because recruitment decreases with further depletion of the spawning stock.

Under the first scenario with fixed recruitment, an 80% to 90% reduction in harvest rate is projected to stabilize the stock at current levels, assuming natural mortality also stabilizes at current levels; even lower harvest rates show some potential for recovery. Under the second scenario with recruitment linked to spawning stock, a 75% reduction in harvest rate would be needed to stabilize the stock under current natural mortality conditions.

The TC ran stock projections to examine population responses under various levels of natural mortality (M) and fishing mortality (F). It is important to note that here F is used to represent the proportion of current catch levels by weight, not a fishery removal rate as is typical. In plots where F was fixed at zero, M varied from 0.15 to 0.5. The effect of varying M on population projections is presented and highlights the sensitivity to the assumed value of M.

The projections are shown in two different units: reference abundance (N) and spawning stock biomass (SSB). Reference abundance is the number of lobsters 78+ mm carapace length on January 1st plus the number that will molt and recruit to the 78+ group during the year. Current reference points are also expressed in N. SSB is the total weight of mature lobsters (both sexes) in the stock. In the projections, SSB shows greater recovery potential than reference abundance because SSB is the product of abundance at-size, the probability of maturity at-size, and weight at-size. As a result, SSB increases more rapidly than N because larger individuals weigh more than smaller lobsters.

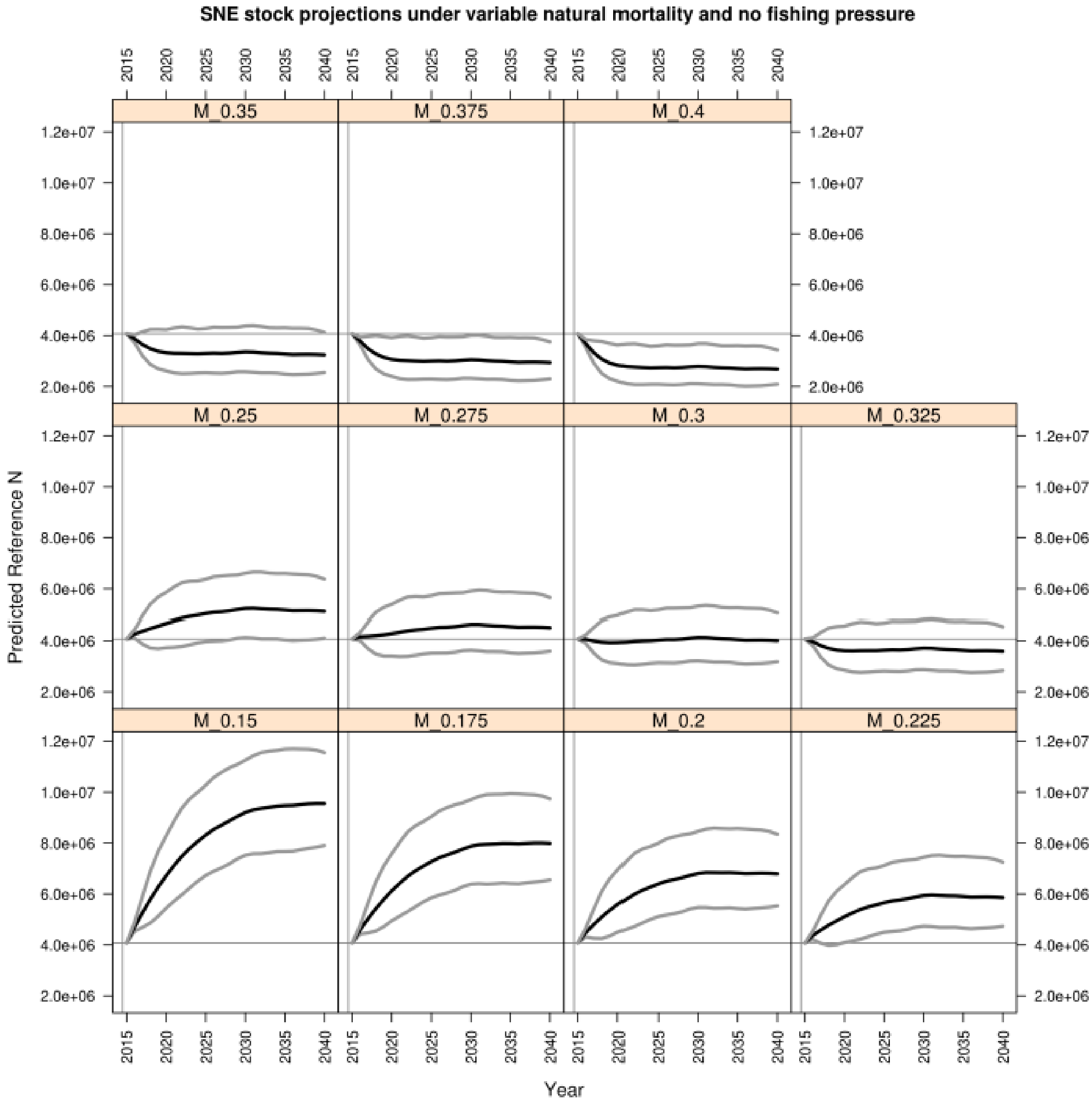

Figure 1: SNE stock projections assuming constant recruitment (similar to levels seen from 2011 to 2014) under various levels of M. F is fixed at zero. The units are reference abundance. Black line is the mean trend +/- 2SD (gray lines).

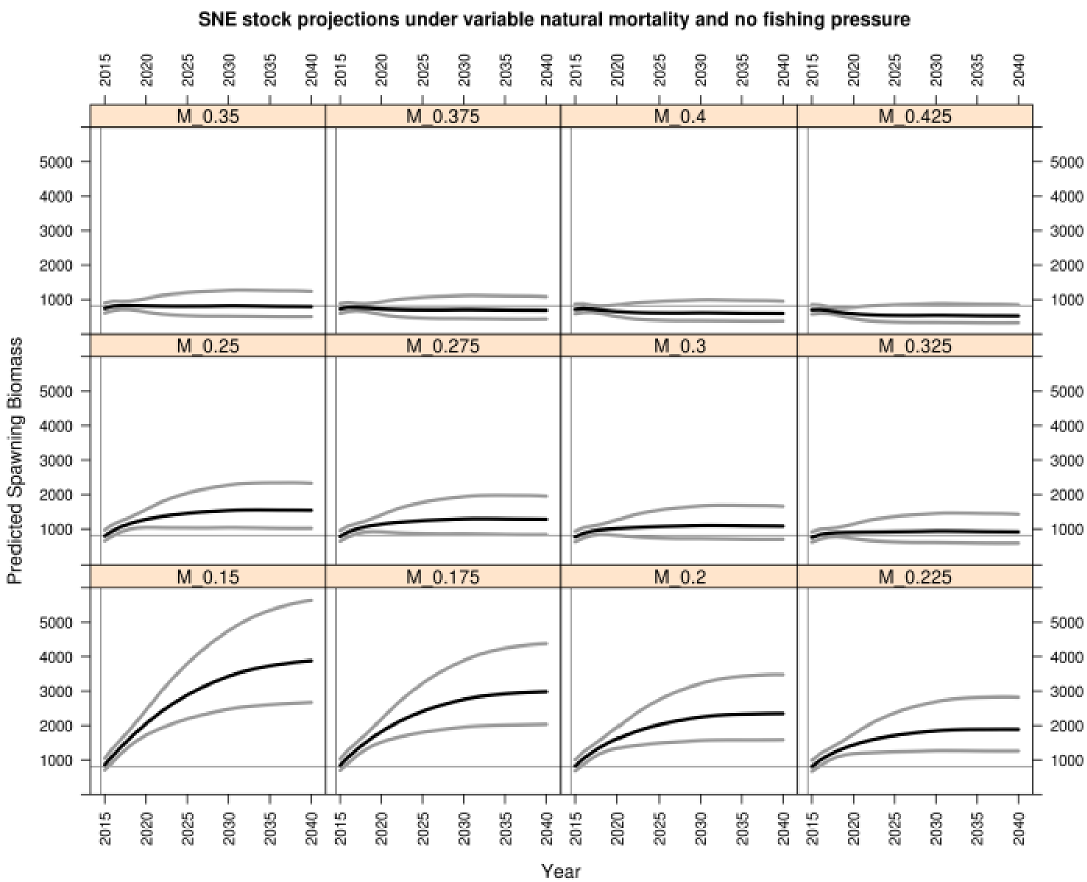

Figure 2: SNE stock projections assuming constant recruitment (similar to levels seen from 2011 to 2014) under various levels of M. F is fixed at zero. The units are SSB. Black line is the mean trend +/- 2SD (gray lines).

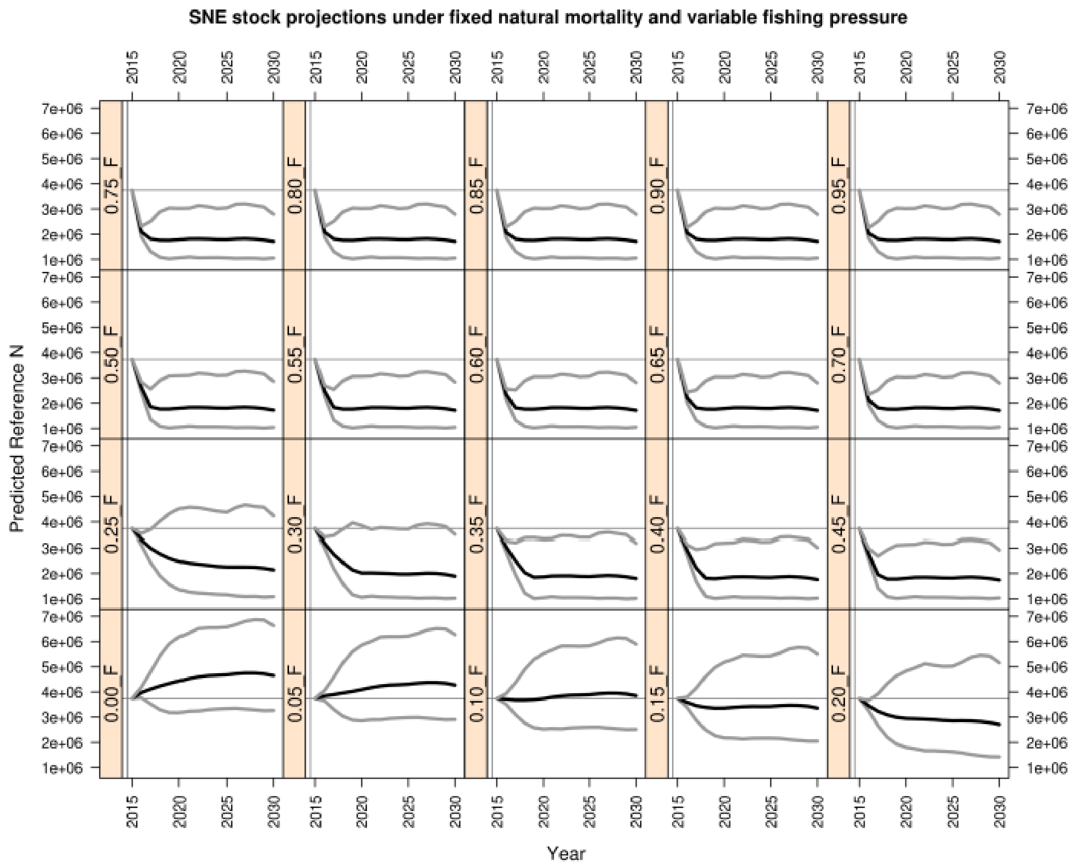

Figure 3: SNE stock projections assuming constant recruitment (similar to levels seen from 2011 to 2014) under various levels of F. M is fixed at 0.285. The units are reference abundance. Black lines is the mean trend 2 +/-2SD (gray lines).

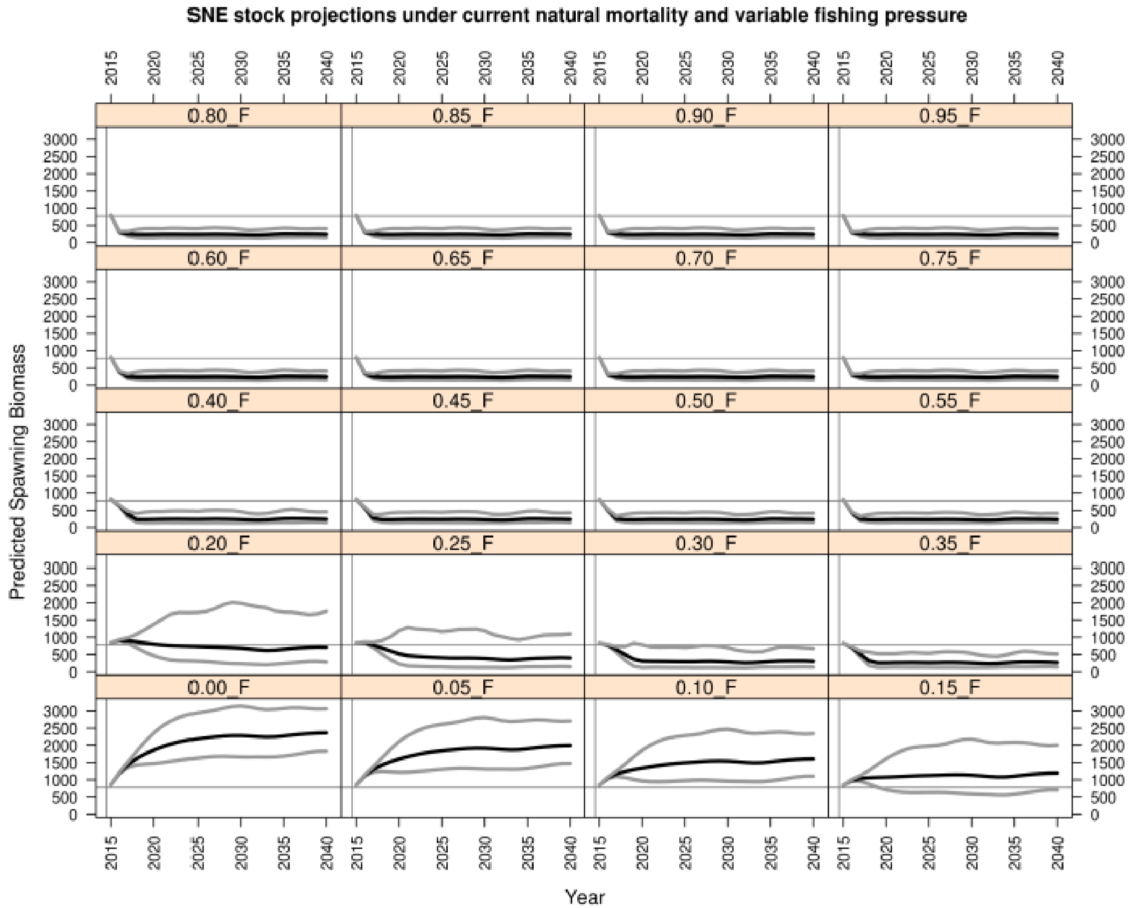

Figure 4: SNE stock projections assuming constant recruitment (similar to levels seen from 2011 to 2014) under various levels of F. M is fixed at 0.285. The units are SSB. Black line is the mean trend +/1 2SD (gray lines).

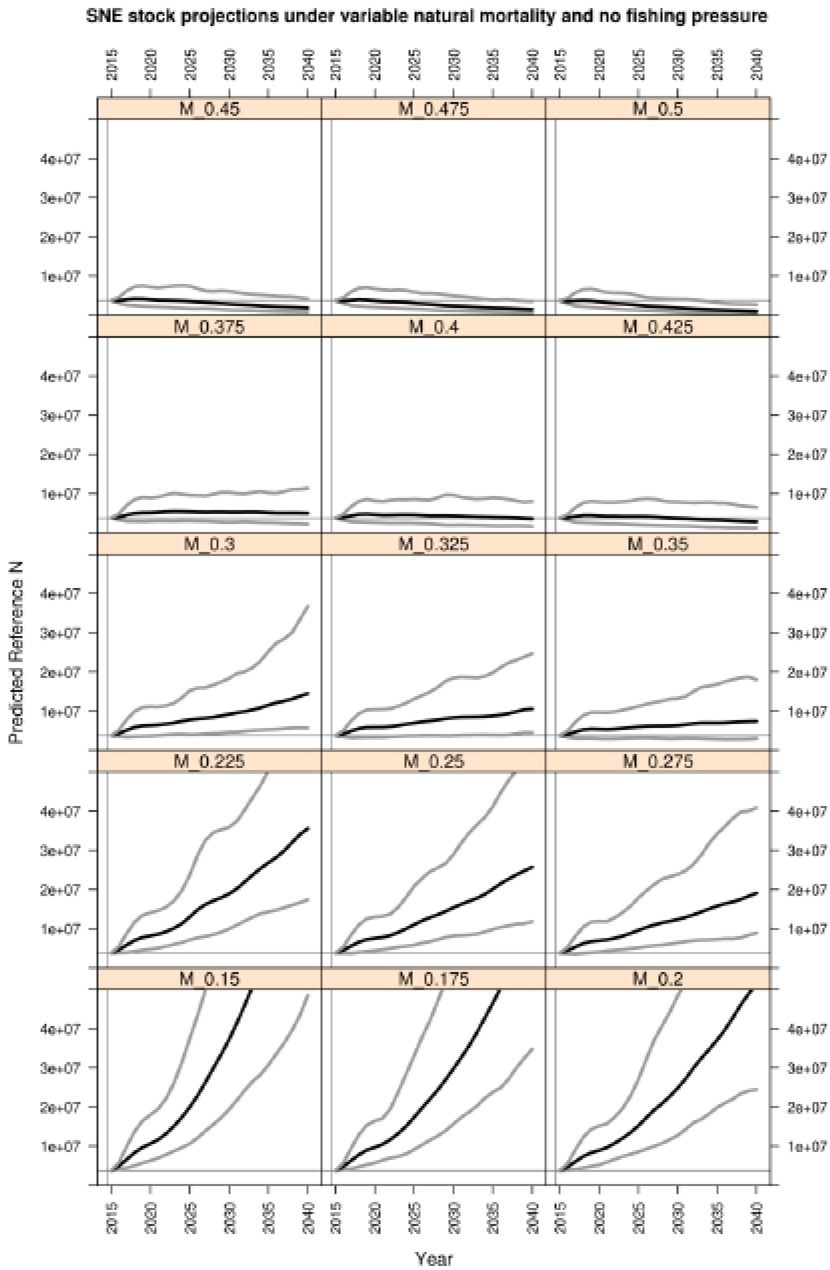

Figure 5. SNE stock projections assuming a Beverton-Holt stock recruit relationship under various levels of M. F is fixed at zero. The units are reference abundance.

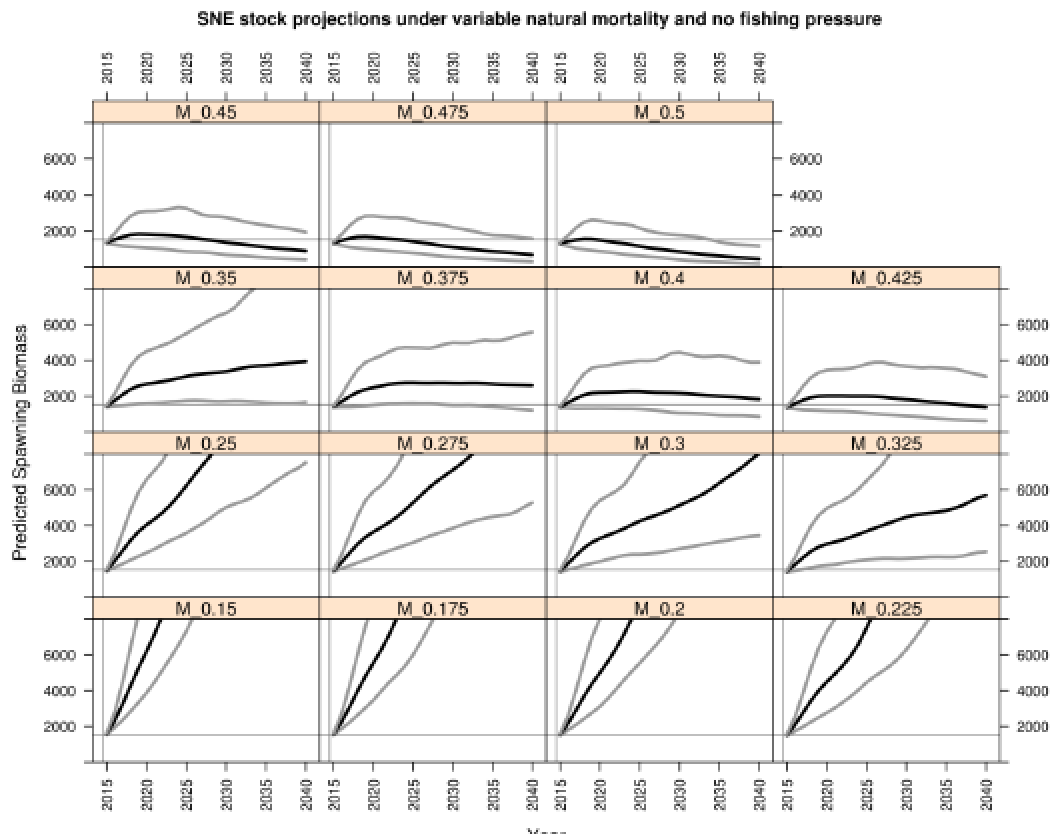

Figure 6: SNE stock projections assuming Beverton-Holt recruitment under various levels of M. F is fixed at zero. The units are SSB.

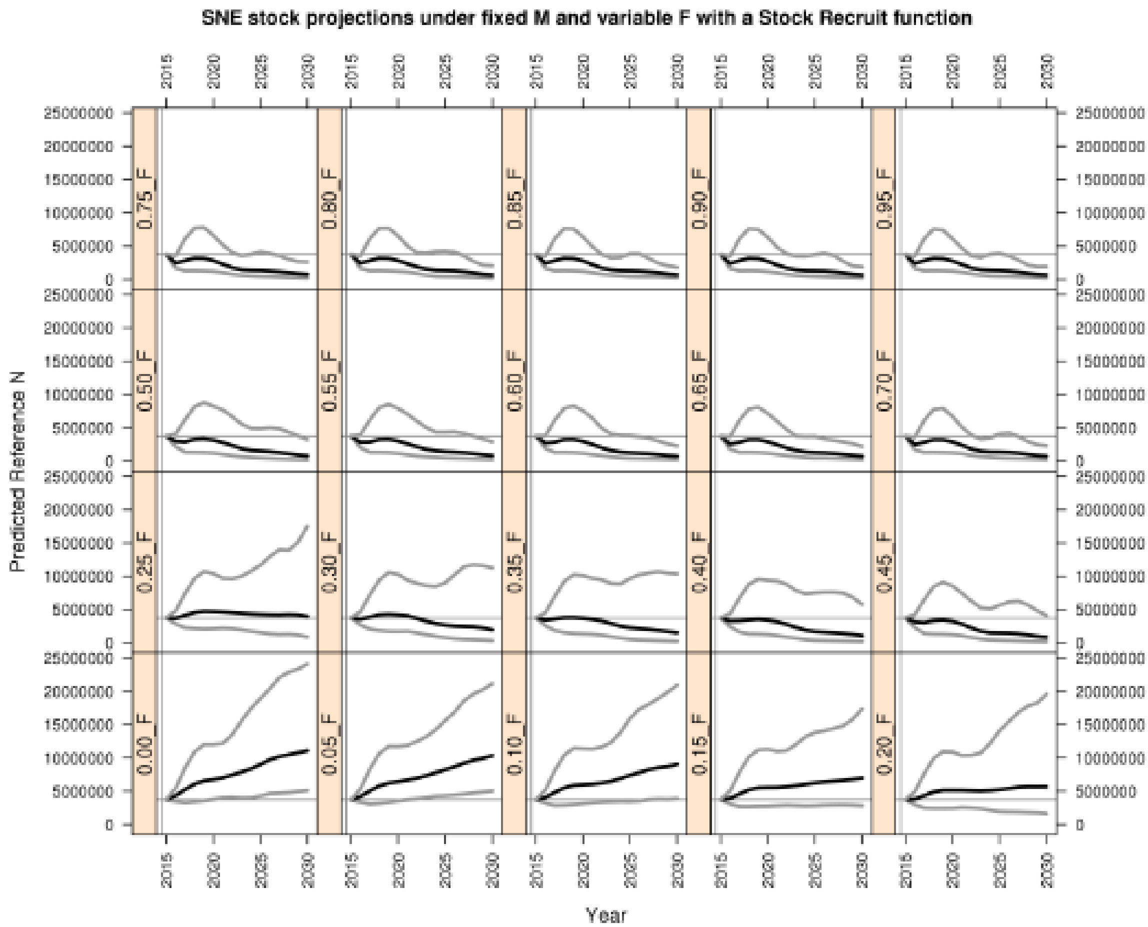

Figure 7: SNE stock projections assuming Beverton-Holt recruitment under various levels of F.M is fixed at 0.285. The units are reference abundance.

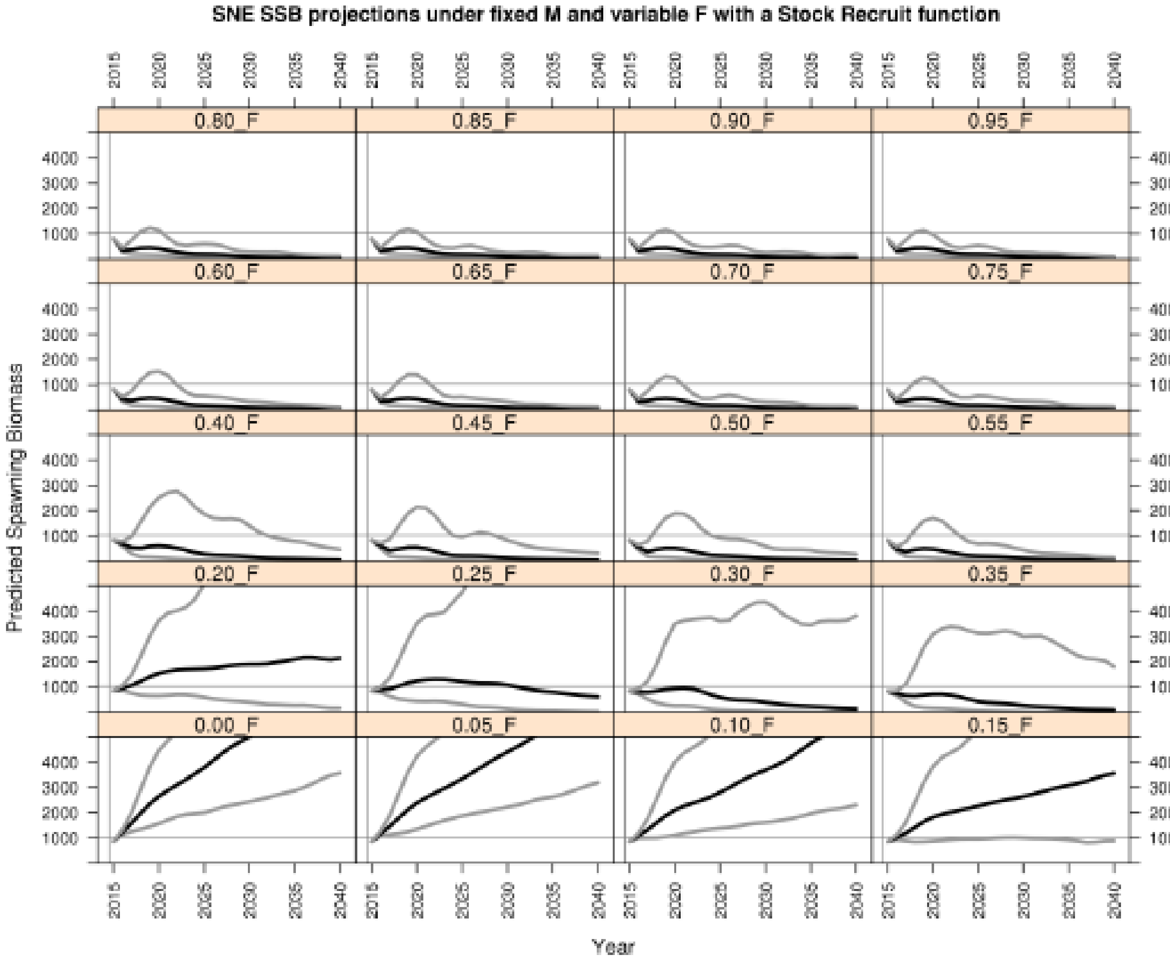

Figure 8: SNE stock projections assuming Beverton-Holt recruitment under various levels of F. M is fixed at 0.285. The units are SSB.

Appendix 5: TC Memo to Board on Gauge Size Changes

MEMORANDUM

TO: American Lobster Management Board

FROM: American Lobster Technical Committee

DATE: July 25, 2016

SUBJECT: Effect of Gauge Changes on Exploitation, SSB, Reference Abundance, and Catch

The following analysis looks at the effect of gauge size changes on egg production, exploitation, spawning stock biomass (SSB), reference abundance, and catch. This work is intended to provide a holistic view of stock and fishery changes that may result from alterations to the minimum and maximum gauge size. Table 1 summarizes scenarios in which a 20% or 60% increase in egg production is achieved, per the motion of the Board at the May 2016 meeting. Tables 2-6 look at all combinations of gauge changes in regards to egg production, exploitation, SSB, reference abundance, and catch.

Table 1. Minimum and maximum size window necessary to achieve a 20% and 60% increase in egg production respectively. Includes % change in exploitation, spawning stock biomass, reference abundance, and catch associated with the size windows presented. *Assumes changes in gauge size from the current 86 mm minimum and 133 mm maximum size inshore, and an 89 mm minimum size and a 171 mm maximum size offshore. English unit conversions are approximate.

	Min	Max	Egg Production	Exploitation	Spawning Stock Biomass	Reference Abundance	Catch
Inshore	88 mm ($3\,^{15}/_{32}$")	105 mm ($4\,^{1}/_{8}$")	20%	-18%	20%	9%	-11%
	91 mm ($3\,^{9}/_{16}$")	115 mm ($4\,^{1}/_{2}$")	18%	-22%	22%	11%	-14%
	92 mm ($3\,^{5}/_{8}$")	165 mm ($6\,^{1}/_{2}$")	20%	-27%	25%	13%	-17%
Offshore	91 mm ($3\,^{9}/_{16}$")	105 mm ($4\,^{1}/_{8}$")	22%	-21%	22%	9%	-13%
	94 mm ($3\,^{11}/_{16}$")	115 mm ($4\,^{1}/_{2}$")	20%	-26%	24%	12%	-17%
	95 mm ($3\,^{3}/_{4}$")	165 mm ($6\,^{1}/_{2}$")	21%	-28%	26%	13%	-19%
Inshore	99 mm ($3\,^{7}/_{8}$")	115 mm ($4\,^{1}/_{2}$")	60%	-56%	71%	32%	-42%
	101 mm ($3\,^{29}/_{32}$")	165 mm ($6\,^{1}/_{2}$")	59%	-59%	76%	35%	-45%
Offshore	102 mm (4")	115 mm ($4\,^{1}/_{2}$")	62%	-60%	71%	31%	-47%
	103 mm ($4\,^{1}/_{16}$")	165 mm ($6\,^{1}/_{2}$")	63%	-63%	75%	34%	-50%

Table 2. Inshore and offshore minimum/maximum gauge change scenarios and corresponding egg production changes from the current gauge sizes. Egg production is expressed as percent increases from the current conditions.

Inshore; Min=86, Max=133

Min Size \ Max size	105	115	125	135	145	155	165
82	2%	-7%	-8%	-8%	-8%	-8%	-8%
83	3%	-6%	-7%	-7%	-7%	-7%	-7%
84	5%	-4%	-5%	-5%	-5%	-5%	-5%
85	8%	-1%	-3%	-3%	-3%	-3%	-3%
86	12%	1%	0%	0%	0%	0%	0%
87	15%	5%	3%	3%	3%	3%	3%
88	20%	8%	6%	6%	6%	6%	6%
89	23%	11%	9%	9%	9%	9%	9%
90	27%	14%	12%	12%	12%	12%	12%
91	33%	18%	16%	16%	16%	16%	16%
92	39%	22%	20%	20%	20%	20%	20%
93	46%	28%	26%	25%	25%	25%	25%
94	51%	31%	29%	28%	28%	28%	28%
95	NA	35%	32%	32%	32%	32%	32%
96	NA	40%	37%	37%	37%	37%	37%
97	NA	47%	43%	43%	43%	43%	43%
98	NA	56%	51%	51%	51%	51%	51%
99	NA	59%	54%	54%	54%	54%	54%
100	NA	63%	58%	57%	57%	57%	57%
101	NA	69%	63%	62%	62%	62%	62%
102	NA	76%	70%	69%	69%	69%	69%
103	NA	87%	79%	78%	78%	78%	78%
104	NA	91%	82%	81%	81%	81%	81%
105	NA	NA	85%	84%	84%	84%	84%
106	NA	NA	90%	89%	89%	89%	89%
107	NA	NA	97%	96%	95%	95%	95%
108	NA	NA	107%	105%	105%	105%	105%
109	NA	NA	110%	108%	107%	107%	107%
110	NA	NA	113%	111%	110%	110%	110%

Offshore; Min=89, Max=171

Min Size \ Max size	105	115	125	135	145	155	165
82	-7%	-14%	-15%	-16%	-16%	-16%	-16%
83	-6%	-14%	-15%	-15%	-15%	-15%	-15%
84	-3%	-12%	-13%	-13%	-13%	-13%	-13%
85	0%	-9%	-10%	-11%	-11%	-11%	-11%
86	3%	-7%	-8%	-8%	-8%	-8%	-8%
87	6%	-4%	-5%	-5%	-5%	-5%	-5%
88	10%	-1%	-2%	-2%	-2%	-2%	-2%
89	13%	2%	0%	0%	0%	0%	0%
90	17%	5%	3%	3%	3%	3%	3%
91	22%	8%	6%	6%	6%	6%	6%
92	27%	12%	11%	10%	10%	10%	10%
93	34%	18%	15%	15%	15%	15%	15%
94	39%	20%	18%	18%	18%	18%	18%
95	NA	24%	22%	21%	21%	21%	21%
96	NA	29%	26%	26%	25%	25%	25%
97	NA	35%	32%	31%	31%	31%	31%
98	NA	43%	39%	39%	39%	39%	39%
99	NA	46%	42%	41%	41%	41%	41%
100	NA	50%	45%	45%	45%	45%	45%
101	NA	55%	50%	49%	49%	49%	49%
102	NA	62%	56%	55%	55%	55%	55%
103	NA	72%	64%	64%	63%	63%	63%
104	NA	75%	67%	66%	66%	66%	66%
105	NA	NA	70%	69%	69%	69%	69%
106	NA	NA	75%	74%	73%	73%	73%
107	NA	NA	81%	80%	79%	79%	79%
108	NA	NA	90%	89%	88%	88%	88%
109	NA	NA	92%	91%	90%	90%	90%
110	NA	NA	95%	93%	93%	93%	93%

Table 3. Inshore and offshore minimum/maximum gauge change scenarios and corresponding exploitation changes from the current gauge sizes. Exploitation is expressed as percent increases from the current conditions.

Inshore; Min=86, Max=133

Min Size ↓ / Max size →	105	115	125	135	145	155	165
82	7%	14%	14%	14%	14%	14%	14%
83	5%	12%	13%	13%	13%	13%	13%
84	1%	8%	9%	9%	9%	9%	9%
85	-4%	4%	4%	4%	5%	5%	5%
86	-8%	-1%	0%	0%	0%	0%	0%
87	-13%	-6%	-5%	-5%	-5%	-5%	-5%
88	-18%	-11%	-10%	-10%	-10%	-10%	-10%
89	-22%	-14%	-13%	-13%	-13%	-13%	-13%
90	-26%	-18%	-17%	-17%	-17%	-17%	-17%
91	-31%	-22%	-22%	-21%	-21%	-21%	-21%
92	-37%	-28%	-27%	-27%	-27%	-27%	-27%
93	-43%	-33%	-32%	-32%	-32%	-32%	-32%
94	-46%	-36%	-35%	-35%	-35%	-35%	-35%
95	NA	-39%	-38%	-38%	-38%	-38%	-38%
96	NA	-43%	-42%	-42%	-42%	-42%	-42%
97	NA	-48%	-46%	-46%	-46%	-46%	-46%
98	NA	-54%	-53%	-53%	-52%	-52%	-52%
99	NA	-56%	-54%	-54%	-54%	-54%	-54%
100	NA	-58%	-56%	-56%	-56%	-56%	-56%
101	NA	-61%	-59%	-59%	-59%	-59%	-59%
102	NA	-65%	-63%	-63%	-63%	-63%	-63%
103	NA	-71%	-68%	-68%	-68%	-68%	-68%
104	NA	-72%	-69%	-69%	-69%	-69%	-69%
105	NA	NA	-71%	-70%	-70%	-70%	-70%
106	NA	NA	-73%	-72%	-72%	-72%	-72%
107	NA	NA	-75%	-75%	-75%	-75%	-75%
108	NA	NA	-80%	-79%	-79%	-79%	-79%
109	NA	NA	-81%	-80%	-80%	-80%	-80%
110	NA	NA	-81%	-81%	-81%	-81%	-81%

Offshore; Min=89, Max=171

Min Size ↓ / Max size →	105	115	125	135	145	155	165
82	23%	31%	32%	32%	32%	32%	32%
83	21%	29%	30%	30%	30%	30%	30%
84	16%	24%	25%	25%	25%	25%	25%
85	11%	20%	20%	21%	21%	21%	21%
86	6%	14%	15%	15%	15%	15%	15%
87	0%	9%	10%	10%	10%	10%	10%
88	-6%	3%	4%	4%	4%	4%	4%
89	-10%	-1%	0%	0%	0%	0%	0%
90	-15%	-5%	-4%	-4%	-4%	-4%	-4%
91	-21%	-11%	-10%	-9%	-9%	-9%	-9%
92	-27%	-16%	-15%	-15%	-15%	-15%	-15%
93	-34%	-23%	-22%	-22%	-22%	-22%	-22%
94	-38%	-26%	-25%	-25%	-25%	-25%	-25%
95	NA	-30%	-28%	-28%	-28%	-28%	-28%
96	NA	-34%	-33%	-33%	-33%	-33%	-33%
97	NA	-40%	-38%	-38%	-38%	-38%	-38%
98	NA	-47%	-45%	-45%	-45%	-45%	-45%
99	NA	-49%	-47%	-47%	-47%	-47%	-47%
100	NA	-52%	-50%	-50%	-49%	-49%	-49%
101	NA	-55%	-53%	-53%	-53%	-53%	-53%
102	NA	-60%	-57%	-57%	-57%	-57%	-57%
103	NA	-66%	-63%	-63%	-63%	-63%	-63%
104	NA	-68%	-64%	-64%	-64%	-64%	-64%
105	NA	NA	-66%	-66%	-66%	-66%	-66%
106	NA	NA	-68%	-68%	-68%	-68%	-68%
107	NA	NA	-72%	-71%	-71%	-71%	-71%
108	NA	NA	-77%	-76%	-76%	-76%	-76%
109	NA	NA	-78%	-77%	-77%	-77%	-77%
110	NA	NA	-79%	-78%	-78%	-78%	-78%

Table 4. Inshore and offshore minimum/maximum gauge change scenarios and corresponding spawning stock biomass (SSB) changes from the current gauge sizes. SSB is expressed as percent increases from the current conditions.

Inshore; Min=86, Max=133

Min Size \ Max size	105	115	125	135	145	155	165
82	-1%	-9%	-10%	-10%	-10%	-10%	-10%
83	0%	-8%	-9%	-9%	-9%	-9%	-9%
84	4%	-5%	-6%	-6%	-6%	-6%	-6%
85	7%	-2%	-3%	-3%	-3%	-3%	-3%
86	11%	1%	0%	0%	0%	0%	0%
87	16%	5%	4%	4%	4%	4%	4%
88	20%	9%	8%	8%	8%	8%	8%
89	25%	13%	11%	11%	11%	11%	11%
90	30%	17%	15%	15%	15%	15%	15%
91	36%	22%	20%	20%	20%	20%	20%
92	43%	27%	26%	25%	25%	25%	25%
93	51%	34%	32%	32%	32%	32%	32%
94	57%	38%	36%	36%	36%	35%	35%
95	NA	43%	40%	40%	40%	40%	40%
96	NA	49%	46%	46%	46%	46%	46%
97	NA	57%	54%	53%	53%	53%	53%
98	NA	67%	63%	63%	63%	63%	63%
99	NA	71%	67%	66%	66%	66%	66%
100	NA	76%	71%	71%	71%	71%	71%
101	NA	82%	77%	76%	76%	76%	76%
102	NA	90%	84%	84%	84%	84%	84%
103	NA	102%	95%	94%	94%	94%	94%
104	NA	106%	98%	97%	97%	97%	97%
105	NA	NA	102%	101%	101%	101%	101%
106	NA	NA	107%	106%	106%	106%	106%
107	NA	NA	115%	113%	113%	113%	113%
108	NA	NA	125%	124%	124%	124%	124%
109	NA	NA	128%	126%	126%	126%	126%
110	NA	NA	131%	129%	129%	129%	129%

Offshore; Min=89, Max=171

Min Size \ Max size	105	115	125	135	145	155	165
82	-11%	-18%	-19%	-19%	-19%	-19%	-19%
83	-10%	-17%	-18%	-18%	-18%	-18%	-18%
84	-7%	-15%	-16%	-16%	-16%	-16%	-16%
85	-4%	-12%	-13%	-13%	-13%	-13%	-13%
86	0%	-9%	-10%	-10%	-10%	-10%	-10%
87	4%	-6%	-7%	-7%	-7%	-7%	-7%
88	8%	-2%	-3%	-3%	-3%	-3%	-3%
89	12%	1%	0%	0%	0%	0%	0%
90	17%	5%	4%	4%	4%	4%	4%
91	22%	9%	8%	8%	8%	8%	8%
92	29%	15%	13%	13%	13%	13%	13%
93	36%	21%	19%	19%	19%	19%	19%
94	41%	24%	22%	22%	22%	22%	22%
95	NA	28%	26%	26%	26%	26%	26%
96	NA	34%	31%	31%	31%	31%	31%
97	NA	41%	38%	38%	38%	38%	38%
98	NA	50%	47%	46%	46%	46%	46%
99	NA	54%	50%	50%	49%	49%	49%
100	NA	58%	54%	53%	53%	53%	53%
101	NA	64%	59%	59%	59%	59%	59%
102	NA	71%	66%	65%	65%	65%	65%
103	NA	82%	75%	75%	75%	75%	75%
104	NA	85%	78%	77%	77%	77%	77%
105	NA	NA	82%	81%	81%	81%	81%
106	NA	NA	87%	86%	85%	85%	85%
107	NA	NA	93%	92%	92%	92%	92%
108	NA	NA	103%	101%	101%	101%	101%
109	NA	NA	105%	103%	103%	103%	103%
110	NA	NA	108%	106%	106%	106%	106%

Table 5. Inshore and offshore minimum/maximum gauge change scenarios and corresponding reference abundance changes from the current gauge sizes. Reference abundance is expressed as percent increases from the current conditions.

Inshore; Min=86, Max=133

Min Size \ Max size	105	115	125	135	145	155	165
82	-3%	-6%	-6%	-6%	-6%	-6%	-6%
83	-2%	-5%	-5%	-5%	-5%	-5%	-5%
84	0%	-3%	-4%	-4%	-4%	-4%	-4%
85	2%	-2%	-2%	-2%	-2%	-2%	-2%
86	4%	0%	0%	0%	0%	0%	0%
87	6%	3%	2%	2%	2%	2%	2%
88	9%	5%	5%	5%	5%	5%	5%
89	11%	7%	6%	6%	6%	6%	6%
90	13%	9%	8%	8%	8%	8%	8%
91	16%	11%	10%	10%	10%	10%	10%
92	19%	14%	13%	13%	13%	13%	13%
93	23%	17%	16%	16%	16%	16%	16%
94	25%	19%	18%	18%	18%	18%	18%
95	NA	21%	20%	20%	20%	20%	20%
96	NA	23%	22%	22%	22%	22%	22%
97	NA	26%	25%	25%	25%	25%	25%
98	NA	31%	30%	30%	30%	30%	30%
99	NA	32%	31%	31%	31%	31%	31%
100	NA	34%	33%	33%	33%	33%	33%
101	NA	36%	35%	35%	35%	35%	35%
102	NA	40%	38%	38%	38%	38%	38%
103	NA	45%	42%	42%	42%	42%	42%
104	NA	46%	43%	43%	43%	43%	43%
105	NA	NA	45%	44%	44%	44%	44%
106	NA	NA	46%	46%	46%	46%	46%
107	NA	NA	49%	49%	49%	49%	49%
108	NA	NA	53%	53%	53%	53%	53%
109	NA	NA	54%	54%	54%	54%	54%
110	NA	NA	55%	55%	55%	55%	55%

Offshore; Min=89, Max=171

Min Size \ Max size	105	115	125	135	145	155	165
82	-8%	-11%	-11%	-11%	-11%	-11%	-11%
83	-8%	-10%	-11%	-11%	-11%	-11%	-11%
84	-6%	-9%	-9%	-9%	-9%	-9%	-9%
85	-4%	-7%	-8%	-8%	-8%	-8%	-8%
86	-2%	-5%	-6%	-6%	-6%	-6%	-6%
87	0%	-3%	-4%	-4%	-4%	-4%	-4%
88	2%	-1%	-1%	-2%	-2%	-2%	-2%
89	4%	0%	0%	0%	0%	0%	0%
90	6%	2%	2%	2%	2%	2%	2%
91	9%	4%	4%	4%	4%	4%	4%
92	12%	7%	7%	7%	6%	6%	6%
93	16%	10%	10%	10%	10%	10%	10%
94	18%	12%	11%	11%	11%	11%	11%
95	NA	14%	13%	13%	13%	13%	13%
96	NA	16%	15%	15%	15%	15%	15%
97	NA	19%	18%	18%	18%	18%	18%
98	NA	23%	22%	22%	22%	22%	22%
99	NA	25%	23%	23%	23%	23%	23%
100	NA	26%	25%	25%	25%	25%	25%
101	NA	28%	27%	27%	27%	27%	27%
102	NA	31%	30%	30%	30%	30%	30%
103	NA	36%	34%	34%	34%	34%	34%
104	NA	37%	35%	35%	35%	35%	35%
105	NA	NA	36%	36%	36%	36%	36%
106	NA	NA	38%	38%	38%	38%	38%
107	NA	NA	40%	40%	40%	40%	40%
108	NA	NA	44%	44%	44%	44%	44%
109	NA	NA	45%	45%	45%	45%	45%
110	NA	NA	46%	46%	46%	46%	46%

Table 6. Inshore and offshore minimum/maximum gauge change scenarios and corresponding catch changes from the current gauge sizes. Catch is expressed as percent increases from the current conditions.

Inshore; Min=86, Max=133

Max size →

Min Size ↓

	105	115	125	135	145	155	165
82	4%	7%	8%	8%	8%	8%	8%
83	3%	6%	7%	7%	7%	7%	7%
84	0%	4%	5%	5%	5%	5%	5%
85	-2%	2%	2%	2%	2%	2%	2%
86	-5%	0%	0%	0%	0%	0%	0%
87	-8%	-3%	-3%	-3%	-3%	-3%	-3%
88	-11%	-6%	-6%	-6%	-6%	-6%	-6%
89	-14%	-9%	-8%	-8%	-8%	-8%	-8%
90	-17%	-11%	-10%	-10%	-10%	-10%	-10%
91	-20%	-14%	-13%	-13%	-13%	-13%	-13%
92	-25%	-18%	-17%	-17%	-17%	-17%	-17%
93	-30%	-22%	-21%	-21%	-21%	-21%	-21%
94	-33%	-24%	-23%	-23%	-23%	-23%	-23%
95	NA	-27%	-26%	-26%	-26%	-26%	-26%
96	NA	-30%	-29%	-29%	-29%	-29%	-29%
97	NA	-34%	-33%	-33%	-33%	-33%	-33%
98	NA	-40%	-39%	-38%	-38%	-38%	-38%
99	NA	-42%	-40%	-40%	-40%	-40%	-40%
100	NA	-44%	-42%	-42%	-42%	-42%	-42%
101	NA	-47%	-45%	-45%	-45%	-45%	-45%
102	NA	-51%	-49%	-49%	-49%	-49%	-49%
103	NA	-58%	-55%	-54%	-54%	-54%	-54%
104	NA	-59%	-56%	-56%	-56%	-56%	-56%
105	NA	NA	-58%	-57%	-57%	-57%	-57%
106	NA	NA	-60%	-60%	-60%	-59%	-59%
107	NA	NA	-63%	-63%	-63%	-63%	-63%
108	NA	NA	-69%	-68%	-68%	-68%	-68%
109	NA	NA	-70%	-69%	-69%	-69%	-69%
110	NA	NA	-71%	-71%	-71%	-71%	-71%

Offshore; Min=89, Max=171

Max size →

Min Size ↓

	105	115	125	135	145	155	165
82	13%	17%	17%	17%	17%	17%	17%
83	12%	16%	16%	16%	16%	16%	16%
84	9%	13%	14%	14%	14%	14%	14%
85	6%	11%	11%	11%	11%	11%	11%
86	3%	8%	9%	9%	9%	9%	9%
87	0%	5%	6%	6%	6%	6%	6%
88	-4%	2%	2%	2%	2%	2%	2%
89	-6%	-1%	0%	0%	0%	0%	0%
90	-10%	-3%	-3%	-3%	-3%	-3%	-3%
91	-13%	-7%	-6%	-6%	-6%	-6%	-6%
92	-18%	-11%	-10%	-10%	-10%	-10%	-10%
93	-24%	-15%	-14%	-14%	-14%	-14%	-14%
94	-27%	-17%	-17%	-16%	-16%	-16%	-16%
95	NA	-20%	-19%	-19%	-19%	-19%	-19%
96	NA	-24%	-23%	-22%	-22%	-22%	-22%
97	NA	-28%	-27%	-27%	-27%	-27%	-27%
98	NA	-35%	-33%	-33%	-33%	-33%	-33%
99	NA	-37%	-35%	-35%	-35%	-35%	-35%
100	NA	-39%	-37%	-37%	-37%	-37%	-37%
101	NA	-42%	-40%	-40%	-40%	-40%	-40%
102	NA	-47%	-44%	-44%	-44%	-44%	-44%
103	NA	-54%	-51%	-50%	-50%	-50%	-50%
104	NA	-56%	-52%	-52%	-52%	-52%	-52%
105	NA	NA	-54%	-54%	-53%	-53%	-53%
106	NA	NA	-56%	-56%	-56%	-56%	-56%
107	NA	NA	-60%	-60%	-60%	-60%	-60%
108	NA	NA	-66%	-66%	-66%	-66%	-66%
109	NA	NA	-67%	-67%	-67%	-67%	-67%
110	NA	NA	-69%	-68%	-68%	-68%	-68%

Atlantic States Marine Fisheries Commission

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MEMORANDUM

TO: American Lobster Management Board

FROM: American Lobster Technical Committee

DATE: October 14, 2016

SUBJECT: Season Closures and Trip Limits in the SNE Lobster Fishery

During their September 27th -28th meeting in Gloucester, MA, the American Lobster Technical Committee (TC) discussed ways to analyze the effects of season closures and trip limits on egg production in Southern New England (SNE). This discussion was prompted by a request from the Plan Development Team (PDT), who was interested in learning more about the potential impacts of these management tools on the stock.

Model simulations show a season closure during the summer results in the largest increase in egg production (21.6%), followed by spring (15%), fall (8.1%), and winter (3%). Importantly, this analysis is predicated on the assumption that fishermen do not adapt to the implementation of the season closure by increasing their fishing effort during the rest of the year. Thus, the results shown here likely represent an optimistic impact of closures, and realized effects on egg production would likely be lower.

In their discussion on trip limits, the TC identified several concerns with this management tool, including the ability for impacted fishermen to increase their number of trips to maintain harvest levels, the disproportionate impact on the offshore fleet, and the incentive for fishermen currently harvesting under the trip limit to increase their effort. Given these concerns, the TC noted that trip limits must be combined with a quota in order to effectively manage fishing mortality in SNE.

1. Simulated Season Closures on the SNE Lobster Fishery

The TC was asked to conduct an analysis on how short-term closures in the fishery would affect egg production. Such analysis is problematic as short-term (i.e. monthly) fishing mortality is not known and it is difficult to predict and model how fishermen might adapt to short-term closures by changing fishing effort before and after a closure. It is also difficult to predict any changes in the spatial distribution of lobsters and fishing effort as a result of the closure. In a best effort to analyze the effect of short-term closures, the TC chose to examine the effects of simulated quarterly closures as quarterly fishing mortality rates are estimated in the assessment model (quarter 1=January-March; quarter 2=April-June; quarter 3=July-September; quarter 4=October-December). These simulations make the following important assumptions:

1. Fishing effort or the fleet's capacity to fish lobsters will not change significantly in the near future.

2. Fishermen do not adapt to the implementation of seasonal closures by intensifying effort during the rest of the year.
3. Changing lobster length compositions as a result of the closure do not affect the ability of the fleet to fish the population.
4. Spatial distribution of lobsters does not change during the closure or in any way affect availability following the closure.

The TC also highlights that increases in egg production will benefit the stock only if environmental conditions are favorable for larval development and settlement. As mentioned in the April 2016 TC memo to the Lobster Board, recruitment appears to be decoupled from SSB. This could potentially be the result of reduced mating success, environmentally-mediated changes in survivorship, and/or increased predation. As a result, prospective increases in egg production will only benefit the stock if recruitment rates remain constant or improve.

A. Methods

The same lobster population simulation software previously used by the TC to analyze other scenarios, including trap reductions and changes in legal size, was used in this analysis. Current quarterly fishing mortality was estimated by averaging the model-estimated quarterly fishing mortality across 2011 – 2013. Seasonal closures in projection model runs were simulated by setting F=0 for the appropriate quarter (winter, spring, summer, fall) and comparing results to model runs with no seasonal closures. All simulation runs were conducted with no initial population so populations built monotonically to a stable value. Natural mortality was assumed to be 0.28 as in the original assessment model. For convenience, recruitment was always assumed to be one million individuals per year as only a comparison between scenarios is required for this analysis. As a result, the values presented in the figures should only be interpreted relative to other scenarios and <u>not as projections of the SNE stock</u>.

The case of closing the fishery for quarter 3 (summer) is special as most reproductive activities take place during this time. Female lobsters spawn (extrude eggs) in the fall. Thus, protecting pre-spawn females in the summer (when they are not egg-bearing and thus normally susceptible to harvest) would allow more to survive into the fall when they will have eggs and be protected from fishing until the next summer. As a result, the TC hypothesized if lobsters were protected during the summer, there may be enhanced reproductive activities and egg production. To attempt to specifically account for this seasonal impact, a separate adjusted Summer scenario was run in which it was assumed that at least 50% of females in the fall bear eggs (based on the 2 year reproductive cycle), and incorporated empirical data based on biosamples of egg-bearing females at-length to model resulting size compositions and egg production. For all population metrics, the regular and adjusted Summer scenarios were very similar indicating that the summer closure simulation run inherently accounts for these effects by increasing the total number of females available to spawn in the fall. Thus only the results for the regular Summer scenario are presented.

All simulations were allowed to run for 25 model years for populations to stabilize. Length composition and biomass (spawning stock biomass (SSB) and reproductive biomass (males and sexes combined; RB)) of the population in quarter 3 (summer hatching season), length composition of the total annual catch, total catch weight, and exploitation rates were then calculated and compared with an "Open" scenario with no closed seasons. Egg production was calculated by applying the fecundity-at-size relationship from Estrella and Cadrin (1995) to the female numbers at size during the summer, then summing across lengths within a scenario.

B. Results

Quarterly fishing mortality rates from the assessment model, used in the simulations, vary by sex and across seasons (Table 1). Male mortality rates are highest in the spring, then decline through the winter. Female mortality rates are comparable in the spring and summer, then decrease through the fall and winter. Mortality rates are consistently higher for males than females due to lower availability of females as a result of their egg-bearing status.

Reproductive Biomass increased between 2.7% and 19% for different seasonal closures, and differed by sex (Table 2). SSB increased most in the summer scenario, followed by spring, fall, and winter, but total increases in RB (both sexes included) were similar in spring (16.0%) and summer (15.5%). This order mirrors the fishing mortality otherwise applied to these seasons except that, as expected, protection through the summer for females had a higher effect than spring despite comparable quarterly fishing mortalities.

Similar to SSB, egg production was highest with a summer closure, increasing by 21.6%, compared to 15% for spring, 8.1% for fall, and 3% for winter (Table 2). Seasonal closures primarily benefitted populations by increased numbers of individuals and egg production for lobsters between 90 and 110mm (Figures 1 and 2).

Seasonal closures decreased total landings for all scenarios (Table 2). Decreases in total landings varied from 12.3% for summer closures to 0.7% for winter closures. Decreases in landings were always larger for females than males. The only case of increased landings was for male lobsters with spring closures, returning an increase of 0.3%. The simulations suggest that seasonal closures will generally decrease catches of lobsters below 100mm but may increase the catch of larger lobsters (Figure 3). Thus, the one case of increased (approximately equal) landings for males with spring closures occurs because lobsters are protected until the annual molt, resulting in a higher net harvest of larger lobsters.

Seasonal closures also had the effect of decreasing exploitation rates (Table 2). Both sexes saw the greatest benefit from summer closures, with decreased exploitation of 33.2% and 21% for females and males, respectively. Thus, overall exploitation decreased most in the summer (26%), followed by fall (13.6%), spring (10.8%), and winter (2.1%).

C. Discussion

Depending on the management goals for SNE, closing the fishery for a full quarter would have a measurable effect in the summer or spring, whereas a fall or winter closure would result in a <10% increase in egg production. We note that these estimates of increased egg production should be viewed as optimistic due to the assumptions listed in the introduction, particularly that fishermen will not change their fishing effort in other seasons if a quarterly closure is implemented.

Extending a closure from July through September would protect the lobster stock during the period of high water temperature. This would prevent handling stress and mortality when water temperatures are above 20°C, the threshold temperature causing immune, respiratory and cardiac trauma (Dove et al. 2005). Eliminating harvest during the molt and times of high water temperature may substantially reduce total mortality and aid in rebuilding the spawning stock by minimizing gear, and handling-induced, immediate and delayed mortality as well as sub-lethal stress. In inshore areas of SNE, late summer and fall (July-October) bottom water temperatures often exceed 20°C, with increasing duration since the early 2000s. Warm hypoxic waters are known to herd lobsters into 'islands' of marginally sustainable habitat. During this time of year, repeated catch and throwback into warm low-oxygen water can be stressful if not fatal, especially if major predators are actively feeding in the same area.

A summer closure may enhance reproductive capacity, not only by leaving more females in the water to spawn, but by:

- Allowing females who hatched eggs in early summer to molt (and mate), thus attaining larger sizes for harvest after the fishery re-opens, and increasing fecundity for those that escape harvest.
- For the unknown percentage of females who may be on 1 year reproductive cycle, allowing them to molt after hatching and spawn in the fall.
- Allowing large males who would otherwise be harvested during summer fishing the opportunity to mate with molting females.

Economic implications of seasonal closures in Maine were evaluated by Cheng and Townsend (1993); they found that gross revenues would increase from extended seasonal closures (e.g. August to November) due to a redistribution of landings across seasons which evened out prices and strengthened markets. This analysis also showed that short (1-2 month) regional closures in peak months (August and/or September) increased the value of landings, but only by a small amount because landings increased immediately after the closures, seriously depressing prices in the late fall (October-December). Closures of at least 3-4 months were required to stabilize the fishery from an economic standpoint. SNE markets are more tenuous than in Maine but may be strengthened by consolidation.

As mentioned above, this analysis is largely predicated on the assumption that creating a seasonal closure will not incentivize fishermen to increase effort in other seasons to make up lost catch, which seems implausible. Thus, the TC is concerned that a seasonal closure during the warmer months, when a closure is most likely to benefit the stock, will result in increased fishing activity in the colder, stormier months when conditions are more dangerous for fishermen.

2. Trip Limits in the SNE Lobster Fishery

The TC was also asked to analyze the impacts of various trip limits in the SNE fishery. During their discussion, the TC identified multiple concerns with the effectiveness of this management tool, primarily that trip limits are usually implemented to distribute catch through a designated time period (Pikitch et al., 1988), such as a year, rather than to limit harvest. Other concerns included the fact that fishermen landing above the proposed trip limit would be expected to increase the number of trips taken per year in order to maintain their current level of harvest. In contrast, fishermen who typically harvest less than the proposed trip limit may be incentivized to increase their catch up to the limit, further reducing the effectiveness of this management tool. Additionally, trip limits increase discards and promote high-grading of catch, which adds stress on lobsters as they are hauled and handled. There are also economic impacts of trip limits as fishermen will have reduced flexibility to respond to variations in catch and may have reduced profitability on each trip.

Given these concerns, the TC strongly recommends that, if the Board is interested in pursuing a trip limit, this management tool be combined with a quota for the SNE stock. A quota, if properly enforced, would cap landings in the fishery and allow managers to increase or decrease the total catch for the year in order to respond to the current stock status. Moreover, it is possible to control the exploitation rate by directly controlling the amount of lobsters taken through a quota.

Implementing a quota in the lobster fishery presents many challenges and raises many questions. The establishment of quotas also requires tough discussions on how the total allowable catch will be allocated among jurisdictions, LCMAs, and/or seasons. Implementation of a quota also requires the ability to model future abundance and recruitment, a challenge in the SNE fishery given the decreasing rate of recruitment per SSB. An effective quota also requires good monitoring and enforcement, both of which need to be carefully considered prior to implementation. Particular challenges in the lobster fishery include how states with fishermen harvesting from both the SNE stock and Gulf of Maine/Georges Bank stock should monitor landings, and how reporting will need to be altered to provide the temporal resolution needed to track the quota. Given these complexities, the TC recommends that further discussion, consideration, and guidance be given on trip limits and quotas. Should the Board be interested in pursuing trip limits and quotas, either in Addendum XXV, or a subsequent document, specific quotas and trip limits should be provided for analysis.

References

Cheng, H. and R. Townsend, 1993. Potential impact of seasonal closures in the US lobster fishery. Marine Resource Economics, 8:101-117.

Dove, A., A. Bassem, J. Powers, and M. Sokolowaki, 2005. A prolonged thermal stress experiment on the American lobster, Homarus americanus. J. Shellfish Research, 24(3):761-766.

Estrella B.T., S.X. Cadrin. 1995. Fecundity of the American lobster (Homarus americanus) in Massachusetts coastal waters. ICES J. Mar. Sci. Symp. 199:61-72.

Pikitch, E. K., Erickson, D. L., and Wallace, J. R. 1988. An Evaluation of the Effectiveness of Trip Limits as a Management Tool. Northwest and Alaska Fisheries Center Processed Report 88-27.

Table 1. Quarterly Fishing Mortalities as estimated in the 2015 SNE Basecase Lobster Assessment Model

Quarter	Months	Females	Males
1	Jan - March	0.07	0.09
2	May - June	0.37	0.59
3	July - Sept.	0.37	0.42
4	Oct. - Dec.	0.26	0.36

Table 2. Changes in Reproductive Biomass (SSB and RB), Egg Production, Catch Weight, and Exploitation for different seasonal closure scenarios.

		Seasonal Closure			
Metric	Sex	Winter	Spring	Summer	Fall
Increases in Reproductive Biomass	Females (SSB)	2.7%	13.4%	19.0%	7.3%
	Males (RB)	1.9%	18.9%	11.9%	9.7%
	Combined (RB)	2.3%	16.0%	15.5%	8.4%
Increases in Egg Production	Females	3.0%	15.0%	21.6%	8.1%
Changes in Catch Weight	Females	-1.4%	-4.8%	-19.0%	-5.3%
	Males	-0.2%	0.3%	-8.0%	-3.5%
	Total	-0.7%	-1.7%	-12.3%	-4.2%
Decreases in Exploitation	Females	-3.1%	-12.5%	-33.2%	-12.4%
	Males	-1.4%	-9.6%	-21.0%	-14.9%
	Combined	-2.1%	-10.8%	-26.0%	-13.6%

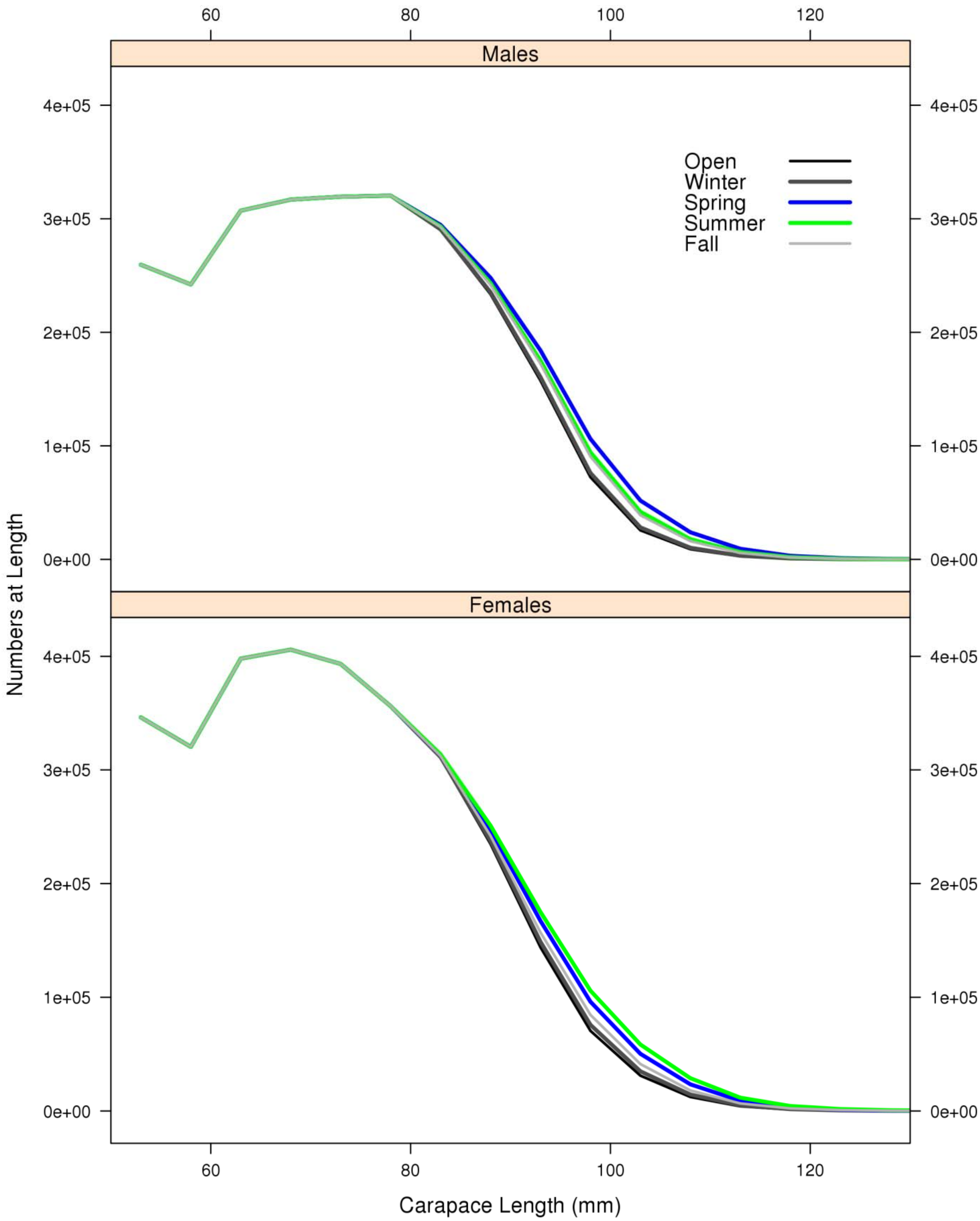

Figure 1. Numbers of lobsters at length by sex at the summer hatch under different seasonal closure scenarios; “Open” is the default scenario with no seasonal closures.

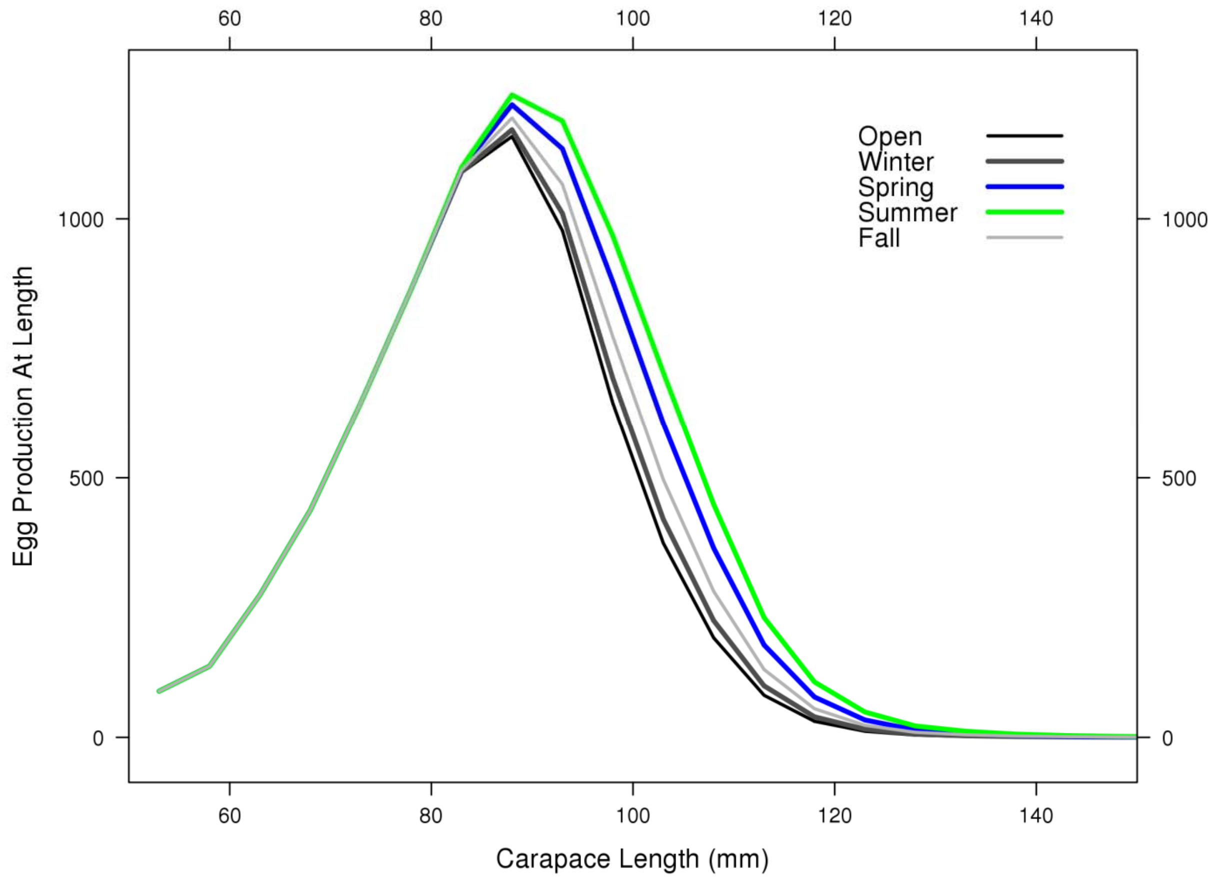

Figure 2. Egg production by size for different seasonal closure scenarios; “Open” is the default with no seasonal closures.

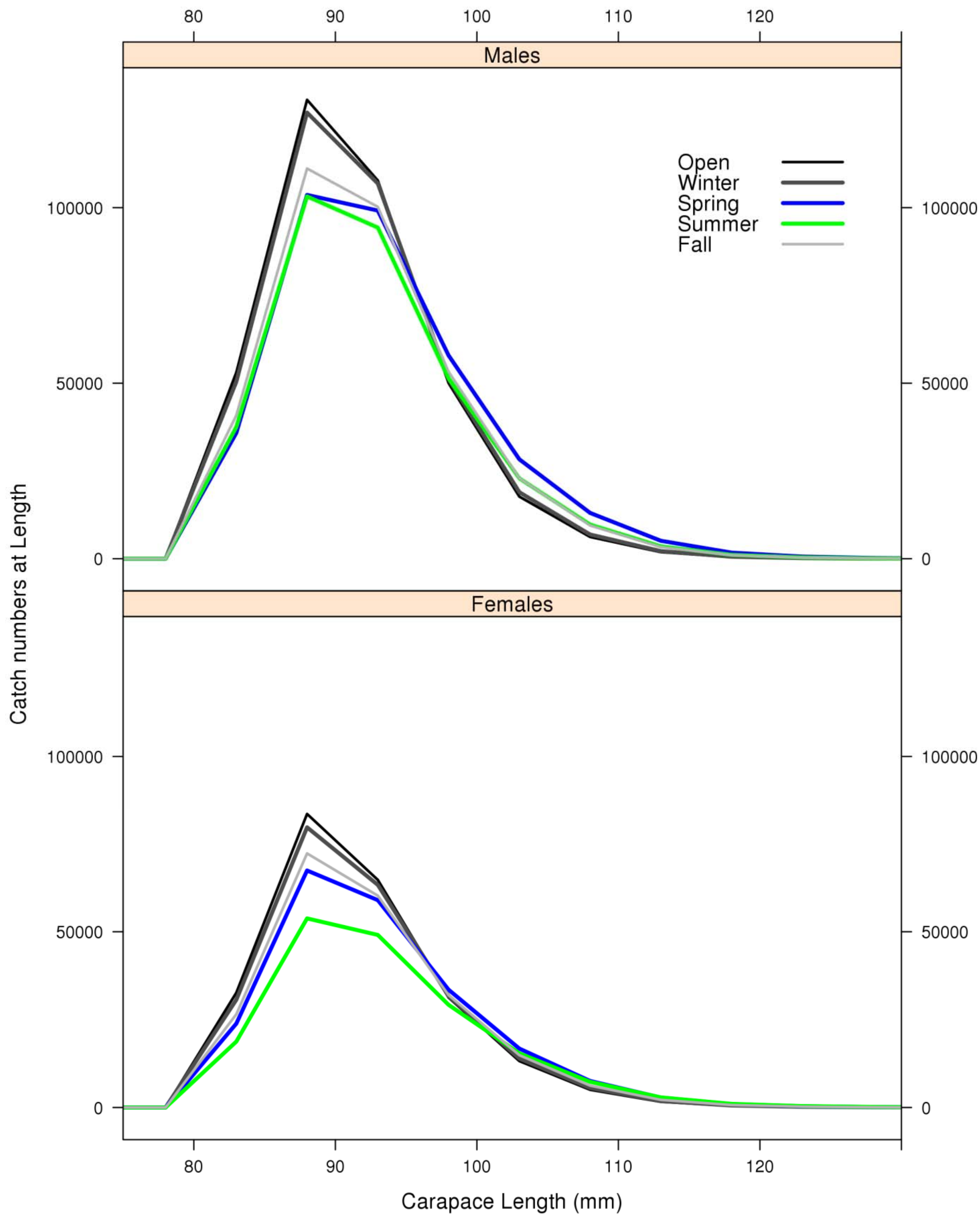

Figure 3. Catch numbers at length by sex under different seasonal closure scenarios; "Open" is the default with no seasonal closures.

2016 REVIEW OF THE ATLANTIC STATES MARINE FISHERIES COMMISSION FISHERY MANAGEMENT PLAN

FOR AMERICAN LOBSTER
(*Homarus americanus*)

2015 FISHING YEAR

Prepared by the Plan Review Team

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2016 REVIEW OF THE ATLANTIC STATES MARINE FISHERIES COMMISSION FISHERY MANAGEMENT PLAN FOR AMERICAN LOBSTER (*Homarus americanus*)

2015 FISHING YEAR

1.0 Status of the Fishery Management Plan

Year of ASMFC Plan's Adoption:	Amendment 3 (1997)
Framework Adjustments:	Addendum I (1999) Addendum II (2001) Addendum III (2002) Addendum IV (2003) Addendum V (2004) Addendum VI (2005) Addendum VII (2005) Addendum VIII (2006) Addendum IX (2006) Addendum X (2007) Addendum XI (2007) Addendum XII (2008) Addendum XIII (2008) Addendum XIV (2009) Addendum XV (2009) Addendum XVI (2010) Addendum XVII (2012) Addendum XVIII (2012) Addendum XIX (2013) Addendum XX (2013) Addendum XXI (2013) Addendum XXII (2013) Addendum XXIII (2014) Addendum XXIV (2015)
Management Unit:	Maine through North Carolina Lobster is managed in seven different Lobster Conservation Management Areas (LCMA, see Figure 1)
States with a Declared Interest:	Maine through Virginia (Excluding Pennsylvania and DC)
Active Committees:	American Lobster Management Board, Technical Committee, Lobster Conservation Management Teams, Plan Development Team, Plan Review Team, Advisory Panel

2.0 Status of the Fishery

2.1 Commercial Fishery

The lobster fishery has seen incredible expansion in effort and landings over the last 40 years. Between 1950 and 1975, landings were fairly stable around 30 million pounds; however, from 1976 – 2008 the average coastwide landings tripled, reaching 92 million pounds in 2006. Landings continued to increase and peaked in 2013 at over 150 million pounds. Over the last two years, landings have leveled off but remained high at 147 million pounds in both 2014 and 2015 (Table 1). The largest contributors to the fishery were Maine and Massachusetts with 83% and 11% of the landings, respectively. Landings, in descending order, also occurred in New Hampshire, Rhode Island, New Jersey, Connecticut, New York, Maryland, Delaware, and Virginia. The ex-vessel value for all lobster landings in 2015 was $617.7 million.

Table 2 shows the break-down of commercial landings by Lobster Conservation Management Area (LCMA). Area 1 has the highest landings and accounts for 80% of total harvest between 1981 and 2012. This is followed by LCMA 3 which accounts for 9% of total landings. Yearly trends in Table 2 show that while landings have generally increased in LCMA 1, they have decreased in LCMA's 2, 4, and 6.

2.2 Recreational Fishery

Lobster is also taken recreationally with pots, and in some states, by hand while SCUBA diving. While not all states collect recreational harvest data, Massachusetts reported an average recreational harvest from 2010 to 2015 of 224,932 pounds. This represents 1.4% of Massachusetts's total harvest. New Hampshire's recreational harvest was smaller at 7,731 pounds, representing less than 1% of total catch. Connecticut's recreational harvest ranged between 1% and 4% of the annual total from 2001-2011; however recreational landings declined in conjunction with commercial landings over time. Recreational harvest in New York was 2,130 pounds, roughly 1.5% of the state's total landings.

3.0 Status of the Stock

The 2015 peer-reviewed stock assessment report indicated a mixed picture of the American lobster resource, with record high stock abundance throughout most of the Gulf of Maine (GOM) and Georges Bank (GBK) and record low abundance and recruitment in Southern New England (SNE) (Table 3).

The assessment found the GOM/GBK stock is not overfished and not experiencing overfishing. GOM and GBK were previously assessed as separate stock units; however, due to evidence of seasonal migrations by egg-bearing females between the two stocks, the areas were combined into one biological unit. While model results show a dramatic overall increase in stock abundance in the GOM/GBK, population indicators show young-of-year estimates are trending downward. This indicates a potential decline in recruitment in the coming years.

Conversely, the assessment found the SNE stock is severely depleted and in need of protection. Recruitment indices show the stock has continued to decline and is in recruitment failure. The inshore portion of the SNE stock is in particularly poor condition with surveys showing a contraction of the population. This decline is expected to impact the offshore portion of the stock, which is dependent on recruitment from inshore. Landings in SNE are expected to decline since the extremely poor year classes which have settled since 2008 have yet to recruit to the fishery.

Both the Technical Committee and the Peer Review Panel highlighted the need for management action in SNE. Specifically, the Panel recommended close monitoring of the stock status along with implementing measures to protect the remaining lobster resource in order to promote stock rebuilding.

4.0 Status of Management Measure

4.1 Implemented Regulations

Amendment 3 established regulations which require coastwide and area specific measures applicable to commercial fishing (Table 4). The coastwide requirements are summarized below.

Coastwide Requirements and Prohibited Actions

- Prohibition on possession of berried or scrubbed lobsters
- Prohibition on possession of lobster meats, detached tails, claws, or other parts of lobsters by fishermen
- Prohibition on spearing lobsters
- Prohibition on possession of v-notched female lobsters
- Requirement for biodegradable “ghost” panel for traps
- Minimum gauge size of 3-1/4”
- Limits on landings by fishermen using gear or methods other than traps to 100 lobsters per day or 500 lobsters per trip for trips 5 days or longer
- Requirements for permits and licensing
- All lobster traps must contain at least one escape vent with a minimum size of 1-15/16” by 5-3/4”
- Maximum trap size of 22,950 cubic inches in all areas except area 3, where traps may not exceed a volume of 30,100 cubic inches.

<u>Amendment 3 to the Interstate Fishery Management Plan for American Lobster (December 1997)</u>

American lobster is managed under Amendment 3 to the Interstate FMP for American Lobster. Amendment 3 establishes seven lobster management areas. These areas include the: Inshore Gulf of Maine (Area 1), Inshore Southern New England (Area 2), Offshore Waters (Area 3), Inshore Northern Mid-Atlantic (Area 4), Inshore Southern Mid-Atlantic (Area 5), New York and Connecticut State Waters (Area 6), and Outer Cape Cod (OCC). Lobster Conservation Management Teams (LCMTs) comprised of industry representatives were formed for each management area. The LCMTs are charged with advising the Lobster Board and recommending changes to the management plan within their areas.

Amendment 3 also provides the flexibility to respond to current conditions of the resource and fishery by making changes to the management program through addenda. The commercial fishery is primarily controlled through minimum/maximum size limits, trap limits, and v-notching of egg-bearing females.

Addendum I (August 1999)
Establishes trap limits in the seven lobster conservation management areas (LCMAs).

Addendum II (February 2001)
Establishes regulations for increasing egg production through a variety of LCMT proposed management measures including, but not limited to, increased minimum gauge sizes in Areas 2, 3, 4, 5, and the Outer Cape.

Addendum III (February 2002)
Revises management measures for all seven LCMAs in order to meet the revised egg-rebuilding schedule.

Technical Addendum 1 (August 2002)
Eradicates the vessel upgrade provision for Area 5.

Addendum IV (January 2004)
Changes vent size requirements; applies the most restrictive rule on an area trap cap basis without regard to the individual's allocation; establishes Area 3 sliding scale trap reduction plan and transferable trap program to increase active trap reductions by 10%; and establishes an effort control program and gauge increases for Area 2; and a desire to change the interpretation of the most restrictive rule.

Addendum V (March 2004)
Amends Addendum IV transferability program for LCMA 3. It establishes a trap cap of 2200 with a conservation tax of 50% when the purchaser owns 1800 to 2200 traps and 10% for all others.

Addendum VI (February 2005)
Replaces two effort control measures for Area 2 – permits an eligibility period.

Addendum VII (November 2005)
Revises Area 2 effort control plan to include capping traps fished at recent levels and maintaining 3 3/8" minimum size limit.

Addendum VIII (May 2006)
Establishes new biological reference points to determine the stock status of the American lobster resource (fishing mortality and abundance targets and thresholds for the three stock assessment areas) and enhances data collection requirements.

Addendum IX (October 2006)
Establishes a 10% conservation tax under the Area 2 trap transfer program.

Addendum X (February 2007)
Establishes a coastwide reporting and data collection program that includes dealer and harvester reporting, at-sea sampling, port sampling, and fishery-independent data collection replacing the requirements in Addendum VIII.

Addendum XI (May 2007)
Establishes measures to rebuild SNE stock, including a 15-year rebuilding timeline (ending in 2022) with a provision to end overfishing immediately. The Addendum also establishes measures to discourage delayed implementation of required management measures.

Addendum XII (February 2009)
Addresses issues which arise when fishing privileges are transferred, either when whole businesses are transferred, when dual state/federal permits are split, or when individual trap allocations are transferred as part of a trap transferability program. In order to ensure the various LCMA-specific effort control plans remain cohesive and viable this addendum does three things. First, it clarifies certain foundational principles present in the Commission's overall history-based trap allocation effort control plan. Second, it redefines the most restrictive rule. Third, it establishes management measures to ensure history-based trap allocation effort control plans in the various LCMAs are implemented without undermining resource conservation efforts of neighboring jurisdictions or LCMAs.

Addendum XIII (May 2008)
Solidifies the transfer program for OCC and stops the current trap reductions.

Addendum XIV (May 2009)
Alters 2 aspects of the LCMA 3 trap transfer program. It lowers the maximum trap cap to 2000 for an individual that transfers traps. It changes the conservation tax on full business sales to 10% and for partial trap transfers to 20%.

Addendum XV (November 2009)
Establishes a limited entry program and criteria for Federal waters of LCMA 1.

Addendum XVI: Reference Points (May 2010)
Establishes new biological reference points to determine the stock status of the American lobster resource (fishing mortality and abundance targets and thresholds for the three stock assessment areas). The addendum also modifies the procedures for adopting reference points to allow the Board to take action on advice following a peer reviewed assessment.

Addendum XVII (February 2012)
Institutes a 10% reduction in exploitation for LCMAs within Southern New England (2, 3, 4, 5, and 6). Regulations are LCMA specific but include v-notch programs, closed seasons, and size limit changes.

Addendum XVIII (August 2012)
Reduces traps allocations by 50% for LCMA 2 and 25% for LCMA 3.

Addendum XIX (February 2013)
Modifies the conservation tax for LCMA 3 to a single transfer tax of 10% for full or partial business sales.

Addendum XX (May 2013)
Prohibits lobstermen from setting or storing lobster traps in Closed Area II from November 1 to June 15 annually. Any gear set in this area during this time will be considered derelict gear. This addendum represents an agreement between the lobster industry and the groundfish sector.

Addendum XXI (August 2013)
Addresses changes in the transferability program for Areas 2 and 3. Specific measures include the transfer of multi-LCMA trap allocations and trap caps.

Addendum XXII (November 2013)
Implements Single Ownership and Aggregate Ownership caps in LCMA 3. Specifically, it allows LCMA 3 permit holders to purchase lobster traps above the cap of 2000 traps; however, these traps cannot be fished until approved by the permit holder's regulating agency or once trap reductions commence. The Aggregate Ownership Cap limits LCMA fishermen or companies from owning more traps than five times the Single Ownership Cap.

Addendum XXIII (August 2014)
Updates Amendment 3's habitat section to include information on the habitat requirements and tolerances of American lobster by life stage.

Addendum XXIV (May 2015)
Aligns state and federal measure for trap transfer in LCMA's 2, 3, and the Outer Cape Cod regarding the conservation tax when whole businesses are transferred, trap transfer increments, and restrictions on trap transfers among dual permit holders.

4.2 Current Management Action
The 2015 stock assessment concluded the SNE stock is in poor condition with record low abundance and recruitment failure. In response, the Board charged the Technical Committee (TC) with several tasks including an examination of the relationship between inshore and offshore stocks, stock projections under various assumptions of fishing and natural mortality, and methods to increase egg production. In May 2016, the Board initiated Addendum XXV to address the poor condition of the SNE stock by reducing fishing mortality and increasing egg production. In order to further develop the goal of the addendum, the Board tasked the Technical Committee with analyzing management tools which would achieve a 20% to 60% increase in egg production. Following a presentation of the TC's analysis, the Board specified that the goal of Addendum XXV is to respond to the decline of the SNE stock and its decline in recruitment while preserving a functional portion of the lobster fishery in this area. Noting the

impact of climate change on the stock, the Board tasked the Plan Development Team with crafting management options which include a 20%, 40%, and 60% increase in egg production. The Board also stated this addendum is intended to be an initial response to the most recent stock assessment.

At the August 2016 meeting, the Board also established a Lobster Reporting Work Group. This group was created in response to the Technical Committee's recommendation that catch and biological data be improved in the lobster fishery. The group will investigate data deficiencies in the lobster fishery and suggest solutions to improve reporting.

5.0 Ongoing Trap Reductions

Addendum XVIII established trap reductions in LCMA 2 and 3. The intention of this Addendum was to scale the size of the SNE fishery to the size of the resource by prescribing a series of trap reductions in LCMAs 2 and 3. Specifically, a 25% reduction in year 1 followed by a series of 5% reductions for 5 years were established in LCMA 2; a series of 5% reductions over five years were established in LCMA 3. The first of these reductions took place at the start of 2016 fishing year. Per Addendum XVIII, states with fishermen in Areas 2 and 3 are required to report on the degree of consolidation that has taken place. In total, 33,880 traps were retired in Area 2 and 8,663 traps were retired in Area 3. Trap reductions by jurisdiction can be found in Table 5. It is important to note that trap reductions can also occur as the result of trap transfers as, per Addendum XIX, there is a 10% conservation tax on partial business transfers. These transfers are also included in Table 5.

6.0 Fishery Monitoring

Addendum X requires states conduct sufficient biological sampling to characterize commercial catch. Specifically, it requires states weight sampling intensity by area and season to match the 3-year average of the area's seasonal commercial catch. This volume of sampling, however, well exceeds current state budgets for lobster biological sampling. Addendum X also requires states to conduct 100% mandatory dealer reporting and at least 10% reporting of active harvesters. Table 6 describes the level of reporting and sampling by each state.

Overviews of the states' port and sea sampling are as follows:

- Maine: Completed 153 sea sampling trips aboard 145 boats from 56 different ports. In total they sampled 229,837 lobsters from 37,126 traps. Maine suspended its port sampling program following the 2011 sampling year.
- New Hampshire: Sampled 14,549 lobsters during 20 sea sampling trips and 1,200 lobsters through 12 port sampling trips.
- Massachusetts: Sampled a total of 76 trips and 44,845 lobsters in LCMA's 1, 2, and OCC through sea sampling. No port sampling was conducted.
- Rhode Island: Sampled 992 trap hauls at sea and sampled 1,916 lobsters. RI also conducted port sampling where staff sampled 2,200 lobsters harvested from NMFS stat area 525.
- Connecticut: No sea sampling or port sampling trips were conducted in 2015.

- New York: Staff conducted 5 sea sampling trips in 2015 and sampled 431 lobsters. NY also inspected 2 vessels through port sampling and sampled 171 lobsters.
- New Jersey: Conducted 10 sea sampling trips and sampled 6,352 lobsters.
- Delaware: No sea sampling or port sampling trips were conducted in 2015.
- Maryland: Conducted 3 sea sampling trips and sampled 730 lobsters.
- Virginia: No sea sampling or port sampling trips were conducted in 2015.

7.0 Status of Surveys

Addendum X also requires fishery independent data collection by requiring statistical areas be sampled through one of the following methods: annual trawl survey, ventless trap survey, or young-of-year survey. *De minimis* states are not required to conduct biological sampling of their lobster fishery.

7.1 Trawl Surveys

Maine and New Hampshire: The Maine-New Hampshire Inshore Trawl survey began in 2000 and covers approximately two-thirds of the inshore portion of Gulf of Maine. The spring portion of the survey completed 123 tows and sampled 20,488 lobsters. Spring survey abundance indices declined from 2014, particularly the abundance of sub-legal lobsters in statistical areas 512 and 513. The fall survey completed 80 tows and sampled 29,033 lobsters. Fall survey abundance indices increased from 2014 with upturns in the number of legal and sub-legal lobsters in statistical areas 511 and 512 (Figure 2).

Massachusetts: The Division of Marine Fisheries conducts spring and autumn bottom trawl surveys in the territorial waters of Massachusetts. Only data collected from the autumn portion of the inshore trawl survey is used to calculate lobster relative abundance indices. In the GOM, relative abundance indices have generally increased over the last decade. In contrast, relative abundance indices in SNE remain low with the most recent values near or below the time series median. In 2015, the sub-legal abundance in SNE was slightly elevated relative to the last several years (Figure 3).

Rhode Island: In 2015, the RIDFW Trawl Survey program conducted seasonal surveys in the spring and fall. In 2015, 43 trawls were conducted in both the fall and spring. Spring 2015 mean CPUEs were 0 and 0.14 for legal and sub-legal lobsters, respectively. Fall 2015 CPUE were 0.05 for legal lobsters and 0.98 for sub-legal lobsters. All abundances were low except for the fall sub-legal abundance which showed a slight increase in 2015 (Figure 4).

Connecticut and New York: Juvenile and adult abundance are monitored through the Long Island Sound Trawl Survey (LISTS) during the spring (April, May, June) and the fall (September and October) cruises. The spring 2015 lobster abundance index (geometric mean = 0.31 lobster/tow) was the lowest in the time series but similar to the 2013-14 indices (0.44, 0.45, respectively). The fall 2015 index (0.08) also ranked lowest in the time series, joining all indices since 2005 as collectively the lowest in the 31-year time series (Figure 5).

New Jersey: An independent Ocean Trawl Survey is conducted from Sandy Hook, NJ to Cape May, NJ each year. The survey stratifies sampling in three depth gradients, inshore (18'-30'), mid-shore (30'-60'), offshore (60'-90'). The mean CPUE, which is calculated as the sum of the mean number of lobsters per size class collected in each sampling area weighted by the stratum area, decreased from 2014 to 2015 for all three size classes (Figure 6).

7.2 Young of Year Index

Several states conduct young-of-year (YOY) surveys to detect trends in abundance of newly-settled and juvenile lobster populations. These surveys attempt to provide an accurate picture of the spatial pattern of lobster settlement. States hope to track juvenile populations and generate predictive models of future landings.

Maine: In 2000, settlement surveys were expanded to cover all seven of Maine's lobster management zones (LMZ) in order to create a statewide index of settlement. Settlement surveys in 2015 showed declines in all statistical areas sampled (Figure 7). Furthermore, survey index values were below the average in all statistical areas.

New Hampshire: New Hampshire Fish and Game (NHF&G) conducted a portion of the coastwide American Lobster Settlement Index (ALSI). In 2015, a total of 24 juvenile lobsters were sampled from three sites, 2 were YOY, 5 were one year old (Y+), and 17 were older juveniles. Figure 8 depicts the CPUE of YOY, Y+, YOY/Y+ and "all lobsters" for all NH sites combined, from 2008 through 2015. For each of these four indices, CPUE shows a general upward trend to a time series high in 2011, with subsequent declines in 2012 and 2014, followed by a slight increase in 2015.

Massachusetts: Annual sampling for early benthic phase/juvenile (EBP) lobsters was conducted using SCUBA and airlift suction sampling equipment from August to September in 2015. Sampling was completed at 21 sites spanning 7 regions in Massachusetts coastal waters. Data for all sites were used to generate annual density estimates of EBP lobster and other decapod crustaceans. In 2015, densities of YOY lobsters were extremely low or non-existent in all sampling locations (Figure 9). In LCMA 1, there were no YOY lobsters found in any of the three regions with long a time series (Salem Sound, Boston Harbor, and Cape Cod Bay). In 2015, there were no YOY lobsters found in the Buzzards Bay sampling locations.

Rhode Island: For 2015, the YOY Settlement Survey (Suction Sampling) was conducted at a total of six fixed stations with twelve randomly selected 0.5-meter quadrats sampled at each survey station. Average site abundance of lobster at suction sampling sites has generally declined since the mid-1990's with a time-series low in 2011 (Figure 10). The 2015 YOY settlement survey index was 0.47 YOY lobster/m^2.

Connecticut: The CT DEEP Larval Lobster Survey in western Long Island Sound (WLIS) was discontinued in 2013. Alternative monitoring data are available for the eastern Sound (ELIS) from the Millstone Power Station entrainment estimates of all stages of lobster larvae. Both programs show a decline in abundance following the 1999 die-off (Figure 11).

7.3 Ventless Trap Survey

To address a need for a reliable index of lobster recruitment, a cooperative random stratified ventless trap survey was designed to generate accurate estimates of the spatial distribution of lobster length frequency and relative abundance while attempting to limit the biases identified in conventional fishery dependent surveys. In the past, fishery-dependent trap sampling data have not been included in generating relative abundance indices for American lobster due to associated bias with the data collection method. In order to collect unbiased data, a fishery-independent survey provides greater control over the sampling design and data quality and quantity necessary to maintain a stratified sampling approach.

Maine: The Maine Ventless Trap Survey changed strategies in 2015 to cover more area by eliminating the vented traps at each site. This change allowed the survey to double the number of sites with ventless traps and increase the sampling coverage spatially to 276 sites. The stratified mean was calculated for each area using depth and statistical area. The survey catches 90% sub-legal lobsters. Traps were set during the months of June, July, and August. Overall, there was a slight decline in the number sub-legal and legal lobsters in 2015 (Figure 12).

New Hampshire: Since 2009, NHF&G has been conducting the coastwide Random Stratified Ventless Trap Survey in state waters (statistical area 513). A total of six sites were surveyed twice a month from June through September in 2015. Catch per unit effort (stratified mean catch per trap haul) from 2009 through 2015 is presented in Figure 13. The highest catch values of the time series were recorded in 2015 followed by 2012, and the lowest were observed in 2014.

Massachusetts: The coast-wide ventless trap survey was initiated in 2006 and expanded in 2007 with the intention of establishing a standardized fishery-independent survey designed specifically to monitor lobster relative abundance and distribution. The survey was not conducted in 2013 due to a lack of funding; however, starting in 2014 the survey has been funded with lobster license revenues and will continue as a long-term survey. Relative abundance of sub-legal (< 83 mm CL) and legal-sized (≥ 83 mm CL) lobsters for Area 514 (part of LCMA 1) is shown in Figure 14 as the stratified mean CPUE. The average catch of sub-legal lobsters was much higher than the catch of legal-sized lobsters, and showed an increasing trend from 2006 - 2012. The mean CPUE in 2015 increased after the large decline observed in 2014, and was above the time series average of 4.83. The catch of legal-sized lobsters in 2015 was the second highest observed at 0.64, above the time series average of 0.52.

Figure 15 shows the time series of relative abundance (stratified mean CPUE) for sub-legal (<86 mm CL) and legal-sized (≥ 86 mm CL) lobsters in the southern MA region (Area 538 and northern Area 537; part of LCMA 2). The average catch of sub-legal lobsters was higher than the catch of legal-sized lobsters, and generally declined from 2006 through 2010 (the original time series). The spatial extent of the survey area was expanded in 2011 to include deeper waters outside Buzzards Bay, where thermal conditions are more tolerable. This expansion in survey area necessitates that the data from 2011 onwards be treated as a new survey index. During the 2011-2015 time period relative abundance of sub-legals was generally higher than during the original survey period, likely reflecting the better overlap of the survey area with tolerable environmental conditions (as opposed to an actual increase in abundance). The sub-legal catch peaked in 2012 and has declined since. The legal-size CPUE has also been slightly higher during the new survey time period (2011-2015), but has remained below 0.5 throughout both time series.

Rhode Island: In 2015, the Ventless Trap Survey was conducted during the months of June-August over 18 sampling sites. A total of 4,042 lobsters were collected from 854 traps. All sampling was conducted in LCMA 2, NMFS Statistical Area 539. In general, the CPUE of legal lobsters has remained steady since 2006 while the CPUE of sub-legal lobsters has declined. The mean CPUE Index values for 2015 were 0.22 and 1.57 per trap for legal and sub-legal lobsters, respectively (Figure 16).

8.0 State Compliance

All states are currently in compliance with all required measures under Amendment 3 and Addendum I-XXIV.

9.0 De Minimis Requests.

The states of Virginia, Maryland, and Delaware have requested *de minimis* status. According to Addendum I, states may qualify for *de minimis* status if their commercial landings in the two most recent years for which data are available do not exceed an average of 40,000 pounds. Virginia and Delaware meet the *de minimis* requirement. The current two year average of lobster harvest for Maryland was slightly above 40,000 pounds.

10.0 Regulatory Changes

Maine:

- Maine DMR adopted regulations to remove the requirement that a trap tag be attached to the trap only by the means for which the tag was designed. Without that specification, fishermen are allowed to securely attach the tag by other means (for example, hog rings) which enables them to change gear over and reuse tags already in their possession.
- The trawl limit in the vicinity of Kittery was moved from law to regulation, for consistency with other trawl limits, and to allow for ease of modification if needed in the future. The trawl limit in Hancock County was amended so it would not conflict with changes to minimum trawl lengths necessary for compliance with NOAA Fisheries vertical line regulations published June 27, 2014, and which went into effect in Maine on June 1, 2015. Under the new requirements, there is a minimum number of lobster traps per trawl required based on the different lobster zones and distance from shore, to reduce the number of buoy lines in the water column.
- Regulations regarding the island limited program were amended to include the island of Frenchboro.
- Statutes were amended to increase the lobster trap limit in the Swans Island Lobster Conservation Area from 550 to 600.

- Statutes were amended to change the penalty for scrubbing egged lobsters from a one year suspension to mandatory permanent revocation of the license for the first offense.

Massachusetts:

- MA DMF amended its regulations at 322 CMR 4.00 and 12.00 to adopt relevant provisions of the ALWTRP (as amended in 2015). DMF consolidated its lobster gear marking regulations at 322 CMR 4.00. DMF consolidated its lobster management regulations by moving its minimum and maximum size regulations from 322 CMR 6.01 to 6.02.

Rhode Island:

- On November 2, 2015 Rhode Island amended Sections 8.4.3 and 8.4.10 to correct the minimum escape vent size and season closure dates for LCMA 4 for consistency with the federal management plan.

Connecticut

- Changes made in 2015 which went into effect on January 1, 2016 (PA 15-52) to Connecticut's commercial fishery licensing laws. The new law requires qualifying license holders to renew their moratorium lobster license(s) by March 31st annually in order to maintain their eligibility to renew their license in the future. The law also requires a Commercial Fishing Vessel Permit be purchased annually to remain eligible to renew their moratorium license. Having both a moratorium license and associated commercial fishing vessel permit demonstrates the intent of license holder to remain active in the fishery. After March 31st any moratorium license not renewed is retired. Public Act 15-52 also created a new open access license that is available to anyone without regard to previous history in commercial fishing. The open access Restricted Commercial Lobster Pot Fishing License ($125 residents, $250 nonresidents) can be used to fish up to 50 lobster pots. No Commercial Fishing Vessel Permit is required, but holders must already have a lobster pot allocation to purchase this license. This license is non-transferrable.

New York

- NY is developing regulations to be able to change NY trap tag allocations for LCMA 4 and 6. This would allow NY to change State allocations for instances when multi-area dual permit holders that include LCMA 4 and/or 6 allocations transfer their LCMA 2 and/or 3 allocations.

11.0 Research Recommendations

The following research recommendations are from the 2015 Stock Assessment and were compiled by the Lobster TC and Stock Assessment Subcommittee.

- ***Ventless Trap Survey***- Calibration work is needed to determine how catch in ventless trap surveys relates to catch in the bottom trawl surveys. It is likely that at low densities, when trawl survey indices have dropped to near zero, ventless trap surveys will still catch lobsters due to the attractive nature of the gear and the ability to fish the gear over all habitat types. Conversely, it is possible that trawl surveys may be able to detect very high levels of lobster abundance, if trap saturation limits the capacity of the ventless traps. Ventless traps may be limited in their ability to differentiate between moderately high and extremely high abundance, and calibration with bottom trawl surveys may help to clarify how catchability might change with changes in lobster density.

- ***Maturation and Growth -*** Increases in water temperatures over the past several decades have likely resulted in changes to size at maturity and growth patterns. Maturity data currently used are more than 20 years old. Changes in size at maturity will subsequently affect growth, since female molting frequency decreases after reaching sexual maturity. It is critical to collect updated information on maturity and growth in order to appropriately assign molt probabilities to lobsters.
- ***Stock Connectivity -*** There is need for a comprehensive large scale tagging study to examine stock connectivity between the GOM and GBK. Historical tagging studies demonstrate movement from the inshore GOM to locations east of Cape Cod in the inshore portions of GBK, and from inshore areas east of Cape Cod to inshore GOM. What is lacking is a tagging study of lobsters in the fall/winter on GBK proper, prior to seasonal migrations which occur in the spring. This information would be extremely valuable to help complement other data used to justify the combination of the GOM and GBK stock and to confirm the connectivity of the GOM and GBK.
- ***Temperature –*** Given the importance of temperature in the life history of lobster, techniques should be developed to incorporate environmental data into population modeling.
- ***Post-Larval Settlement –*** There is a need to examine post-larval settlement dynamics in relation to the movement and re-distribution of spawning stock. Habitat suitability models for spawning stock and settling post-larvae should be developed.
- ***Natural Mortality –*** Methods should be explored to determine age or length-varying natural mortality, as well as looking at more rigorous ways of determining time-varying natural mortality for lobster. These may be driven by climactic shifts and changing predator fields.
- ***Shell Disease -*** With the high prevalence of shell disease in the SNE stock, particularly in ovigerous females, some exploration of the potential sub-lethal effects of disease should be examined. These effects could include negative impacts to larval quality, fecundity issues in females who need to re-direct physiological resources to dealing with the disease, and male sperm quality

12.0 Plan Review Team Recommendations

The following are issues the Plan Review Team would like to raise to the Board as well as general recommendations:

- The PRT recommends the Board approve the *de minimis* requests of DE and VA.
- Consistent with the 2015 FMP Review, the PRT encourages the full implementation of data collection programs specified in the lobster Plan. Addendum X (2007) requires "*100% mandatory dealer reporting and at least 10% of active harvesters reporting (with the expectation of 100% of license holders reporting in time)*". Currently, not all states require 100% harvester reporting and federal lobster-only permit holders are not required to fill out VTRs. Noting financial constraints in ME, the PRT recommends states increase harvester reporting and that a fixed-gear VTR form is created and required for all federal lobster permit holders in order to improve harvester data collection.

- The PRT recommends research is conducted to investigate stock connectivity and larval transport between inshore and offshore areas. In addition to the 2015 stock assessment recommendation (Section 11.0) to investigate connectivity between GOM and GBK, the PRT also recommends stock connectivity between the inshore and offshore portions of SNE be further studied.
- There are significant inconsistencies between regulations in several portions of the fishery.
    - OCC: The v-notch definition in state and federal waters differs, with a "¼ inch without setal hair" definition in state waters and a "1/8 inch with or without setal hair" definition in federal waters. This reduces the effectiveness of the management tool and impacts the standard for commerce in Massachusetts.
    - GOM/GBK: The PRT notes that regulations, especially in regards to the gauge sizes, differ in GBK and GOM. Now that these two areas have been combined into a single stock, the PRT recommends the Board consider the pros and cons of consistent management regulations.
    - SNE: Gauge sizes and seasonal closures differ in the inshore and offshore portions of SNE. The PRT recommends the Board consider the impacts of consistent regulations in this stock.
- The PRT recommends improved enforcement of lobster management measures, especially the at-sea enforcement of trap limits. For areas which rely on permit specific trap limits as the primary metric for management, marine patrol enforcement needs to have a greater presence, particularly as trap reductions take place in LCMAs 2 and 3.
- The PRT suggests the costs of complying with mandated FMP requirements be estimated for the purpose of determining the relationship between the value of the lobster fishery in a particular state and the cost of mandated FMP requirements.
- The PRT recommends to the Law Enforcement Committee that the status of enforcement in the lobster fishery be reported each year in state compliance reports. This could include the number of violations in the fishery as well as the number of hours marine patrol was on the water.
- The PRT recommends the TC discuss standard practices for reporting results of the YOY settlement surveys as well as ventless trap surveys. This includes the use of statistical areas vs. ports and the separation of indices into sub-legal and legal lobsters.

13.0 Tables

Table 1. Landings (in pounds) of American Lobster by the states of Maine through Virginia.
C= confidential data

Year	ME	NH	MA	RI	CT	NY	NJ	DE	MD	VA	Total
1981	22,631,600	793,400	11,220,500	1,871,067	1,010,800	890,200	593,700	55,700	63,200	2,200	39,132,367
1982	22,730,100	807,400	13,150,900	2,254,930	1,094,100	1,121,600	846,300	90,700	64,800	4,700	42,165,530
1983	21,976,500	1,310,560	12,421,000	5,020,895	1,854,000	1,207,500	769,900	56,700	86,500	600	44,704,155
1984	19,545,600	1,570,724	14,701,800	5,064,760	2,011,600	1,308,100	927,700	103,800	98,900	17,400	45,350,384
1985	20,125,000	1,193,881	16,295,100	5,080,163	1,676,000	1,240,900	1,079,600	118,500	82,300	1,100	46,892,544
1986	19,704,400	941,100	15,057,600	5,513,831	1,656,100	1,407,100	1,123,000	109,000	57,700	1,000	45,570,831
1987	19,747,800	1,256,170	15,116,800	5,217,300	1,735,591	1,146,700	1,397,100	84,100	49,900	1,000	45,752,461
1988	21,738,800	1,118,900	15,866,312	4,758,990	2,053,800	1,779,890	1,557,300	66,200	23,000	300	48,963,492
1989	23,368,800	1,430,400	15,444,300	5,725,641	2,096,900	2,345,051	2,059,600	76,500	17,500		52,564,692
1990	28,068,238	1,658,200	17,054,434	7,258,175	2,645,800	3,431,111	2,198,867	68,300			62,383,125
1991	30,788,646	1,802,035	16,528,168	7,445,170	2,674,000	3,128,246	1,673,031	54,700			64,093,996
1992	26,830,448	1,529,292	15,823,077	6,763,085	2,439,600	2,651,067	1,213,255	21,000			57,270,824
1993	29,926,464	1,693,347	14,336,032	6,230,855	2,177,022	2,667,107	906,498	24,000			57,961,325
1994	38,948,867	1,650,751	16,094,226	6,474,399	2,212,000	3,954,634	581,396	8,400			69,924,673
1995	37,208,324	1,834,794	15,755,840	5,363,810	2,536,177	6,653,780	606,011	500	2,855		69,962,091
1996	36,083,443	1,632,829	15,323,277	5,579,874	2,888,683	9,408,519	640,198		28,726	1,252	71,586,801
1997	47,023,271	1,414,133	15,087,096	5,766,534	3,468,051	8,878,395	858,426	648	34,208	2,240	82,533,002
1998	47,036,836	1,194,653	13,277,409	5,618,440	3,715,310	7,896,803	721,811			1,306	79,462,568
1999	53,494,418	1,380,360	15,533,654	8,155,947	2,595,764	6,452,472	931,064			6,916	88,550,595
2000	57,215,406	1,709,746	15,802,888	6,907,504	1,393,565	2,883,468	891,183			311	86,804,071
2001	48,617,693	2,027,725	12,132,807	4,452,358	1,329,707	2,052,741	579,753			19	71,192,803
2002	63,625,745	391	12,853,380	3,835,050	1,067,121	1,440,483	264,425	551			83,087,146
2003	54,970,948		11,385,049	3,474,509	671,119	946,449	209,956	2,831	22,778		71,683,639
2004	71,574,344	2,097,396	11,295,474	3,064,412	646,994	996,109	370,112	15,172	14,931	13	90,074,957
2005	68,729,861	2,556,232	9,879,983	4,343,736	713,901	1,154,470	369,264	5,672	39,237	21,255	87,813,611
2006	72,662,294	2,666,344	10,966,322	3,749,432	792,894	1,242,601	470,877	3,315	26,349	28,160	92,608,588
2007	63,959,191	2,468,811	10,143,301	3,268,075	568,696	716,300	680,392	5,918	6,128	26,765	81,843,577
2008	69,863,132	2,567,031	10,597,614	3,528,445	426,292	712,075	632,545	4,884	32,429	17,701	88,382,148
2009	81,175,847	2,985,166	11,781,490	3,174,618	451,156	731,811	179,740	6,067	30,988	21,472	100,538,355
2010	95,506,383	3,658,894	12,768,448	3,258,221	432,491	813,513	641,556	4,574	30,005	16,345	117,130,430
2011	104,693,316	3,917,461	13,717,192	2,513,255	191,594	344,232	627,077	C	C	C	126,066,050
2012	125,759,424	4,236,740	14,917,238	2,932,388	236,846	275,220	919,260	C	C	C	149,336,623
2013	127,773,264	3,822,844	15,738,792	2,149,266	133,008	248,267	660,367	C	C	C	150,621,935
2014	124,440,799	4,939,310	15,060,352	2,387,321	141,988	216,630	526,367	C	C	C	147,805,965
2015	122,212,133	4,716,084	16,418,796	2,879,874	158,354	146,624	445,195	C	C	C	147,037,850

Table 2. Estimated lobster landings (in pounds) by lobster conservation management area (LCMA)* (*Source, ASMFC Lobster Data Warehouse*). This table can only be update in years when stock assessment reports are being conducted.

Coastwide Estimated Lobster Landings (lbs) by Lobster Conservation Management Area (LCMA)*								
Year	LCMA 1	LCMA 2	LCMA 3	LCMA 4	LCMA 5	LCMA 6	LCMA OCC	Grand Total
1981	32,369,320	527,284	4,321,500	441,478	115,653	1,220,159	134,327	39,129,721
1982	32,123,750	1,656,479	4,961,680	622,674	99,093	1,359,058	163,105	40,985,839
1983	32,826,685	2,958,366	5,645,179	633,254	71,804	2,428,633	198,448	44,762,369
1984	29,862,411	2,978,985	6,409,741	795,180	135,652	2,704,070	208,832	43,094,871
1985	31,590,759	2,992,330	5,853,851	964,043	170,998	2,273,337	261,929	44,107,247
1986	30,080,507	3,081,903	5,829,275	1,084,282	125,969	2,362,128	298,747	42,862,811
1987	30,682,754	3,219,900	5,357,273	1,473,841	98,486	2,378,765	276,250	43,487,269
1988	32,362,492	3,259,336	5,132,943	1,666,439	85,142	3,195,208	295,985	45,997,545
1989	36,800,166	4,175,114	5,450,786	2,232,935	106,126	3,735,250	352,155	52,852,532
1990	41,720,481	4,374,062	8,783,629	2,431,198	237,410	4,250,654	581,447	62,378,881
1991	43,648,773	4,140,145	8,537,053	2,096,138	115,020	4,393,986	740,267	63,671,382
1992	39,055,380	3,795,367	7,124,248	1,448,866	77,854	4,362,551	738,026	56,602,292
1993	40,962,969	3,772,494	6,773,992	1,597,447	89,495	3,968,663	938,486	58,103,546
1994	51,597,880	5,602,507	5,684,252	554,367	26,013	5,738,398	848,181	70,051,598
1995	49,771,715	4,960,453	5,008,551	962,077	45,054	8,564,325	1,000,609	70,312,784
1996	47,992,628	4,880,328	4,896,782	978,376	52,758	11,705,439	852,532	71,358,843
1997	58,016,197	5,324,775	5,549,295	1,162,862	36,623	11,650,701	849,126	82,589,579
1998	56,187,841	5,273,463	5,043,939	1,534,067	41,963	10,575,143	797,019	79,453,435
1999	65,375,535	6,938,658	6,166,601	1,346,509	77,621	8,331,142	739,904	88,975,970
2000	69,265,611	5,651,160	5,436,618	1,123,486	53,364	3,802,880	765,801	86,098,920
2001	57,531,942	3,862,054	5,525,209	762,408	55,537	3,013,551	611,242	71,361,943
2002	73,607,600	3,445,004	5,483,983	442,425	14,838	2,230,869	786,137	86,010,856
2003	63,005,041	1,110,534	6,978,808	423,583	17,394	1,448,011	804,355	73,787,725
2004	80,448,651	1,184,942	6,722,671	480,203	93,270	1,534,130	993,689	91,457,556
2005	76,240,627	1,464,433	7,442,771	457,275	54,181	1,673,396	966,787	88,299,470
2006	80,846,400	1,853,505	7,588,539	516,130	59,928	1,840,308	1,048,051	93,752,862
2007	70,862,089	1,430,836	6,375,646	617,978	56,866	1,263,648	1,132,991	81,740,055
2008	78,914,865	1,168,921	6,124,979	440,108	322,916	920,951	1,127,422	89,020,163
2009	91,133,844	1,051,241	6,960,119	488,792	308,212	896,594	1,256,201	102,095,002
2010	106,458,701	1,022,528	7,955,472	522,037	184,409	966,505	1,209,482	118,319,134
2011	116,042,515	730,889	7,890,340	488,977	148,587	306,079	1,244,299	126,851,685
2012	138,762,843	627,051	8,111,396	782,684	154,455	286,215	1,223,279	149,947,922
Grand Total	1,886,148,973	98,515,048	201,127,121	31,572,119	3,332,690	115,380,746	23,445,109	2,359,521,806

*Landings data are not collected by LCMA in all states. To separate landings by LCMA, NMFS statistical areas are placed into a single LCMA. For a complete description of how estimates are completed contact Megan Ware, at mware@asmfc.org

Table 3. Threshold reference points with stock status variables for lobsters in each stock area. (Source: 2015 Benchmark Stock Assessment).

Variable	GOM	GBK	GOM/GBK	SNE
Effective Exploitation				
Effective exploitation threshold	0.54	1.83	0.5	0.41
Recent effective exploitation (2011-2013)	0.48	1.54	0.48	0.27
Effective exploitation below threshold?	YES	YES	YES	YES
Reference Abundance (millions)				
Abundance threshold	52	0.8	66	24
Recent abundance (2011-2013)	247	1.57	248	10
Abundance above threshold?	YES	YES	YES	NO

Table 4. 2015 LCMA specific management measures

Mgmt Measure	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	OCC
Min Gauge Size	3 $^{1}/_{4}$”	3$^{3}/_{8}$”	3 $^{17/32}$”	3$^{3}/_{8}$”	3$^{3}/_{8}$”	3 3/8”	3$^{3}/_{8}$”
Vent Rect.	1$^{15}/_{16}$ x 5$^{3}/_{4}$”	2 x 5$^{3}/_{4}$”	2 $^{1}/_{16}$ x 5$^{3}/_{4}$”	2 x 5$^{3}/_{4}$”	2 x 5$^{3}/_{4}$”	2 x 5$^{3}/_{4}$”	2 x 5$^{3}/_{4}$”
Vent Cir.	2 $^{7}/_{16}$”	2 $^{5}/_{8}$”	2 $^{11}/_{16}$”	2 $^{5}/_{8}$”	2 $^{5}/_{8}$”	2 $^{5}/_{8}$”	2 $^{5}/_{8}$”
V-notch requirement	Mandatory for all eggers	Mandatory for all legal size eggers	Mandatory for all eggers above 42°30’	Mandatory for all eggers in federal waters. No v-notching in state waters.	Mandatory for all eggers	None	None
V-Notch Definition[1] (possession)	Zero Tolerance	$^{1}/_{8}$” with or w/out setal hairs[1]	$^{1}/_{8}$” with or w/out setal hairs[1]	$^{1}/_{8}$” with or w/out setal hairs[1]	$^{1}/_{8}$” with or w/out setal hairs[1]	$^{1}/_{8}$” with or w/out setal hairs[1]	State Permitted fisherman in state waters 1/4” without setal hairs Federal Permit holders $^{1}/_{8}$” with or w/out setal hairs[1]
Max. Gauge (male & female)	5”	5 ¼”	6 $^{3}/_{4}$”	5 ¼”	5 ¼”	5 ¼”	State Waters none Federal Waters 6 $^{3}/_{4}$”
Season Closure				April 30-May 31[2]	February 1-March 31[3]	Sept 8-Nov 28[4]	February 1-April 30

[1] A v-notched lobster is defined as any female lobster that bears a notch or indentation in the base of the flipper that is at least as deep as 1/8”, with or without setal hairs. It also means any female which is mutilated in a manner that could hide, obscure, or obliterate such a mark.

[2] Pots must be removed from the water by April 30 and un-baited lobster traps may be set one week prior to the season reopening.

[3] During the February 1 – March 31 closure, trap fishermen will have a two week period to remove lobster traps from the water and may set lobster traps one week prior to the end of the closed season.

[4] Two week gear removal and a 2 week grace period for gear removal at beginning of closure. No lobster traps may be baited more than 1 week prior to season reopening.

Table 5: Trap allocations, transfers, and reductions as required by Addendum XVIII for LCMA 2 and 3 fishermen. Trap reductions for MA, RI, and CT in LCMA 2 include state, federal, and dual permit holders.

	Jurisdiction	# of Trap Allocated (2015)	# of Trap Transferred	# of Traps Retired due to Reductions
LCMA 2	**MA**	44,798	1,880	11,158
	RI	80,065	1,308	20,146
	CT	5,550	220	1,387
	NOAA (ME, NH, NY, NJ)	4757		1,189*
LCMA 3	**NOAA**	145,433		8,663*

*includes traps retired due to the partial trap transfer conservation tax.

Table 6. 2015 sampling requirements and state implementation.

State	100% Dealer reporting	10% Harvester Reporting	Sea Sampling	Port Sampling	Ventless Trap Survey	Settlement Survey	Trawl Survey
ME	✓	✓ (10%)	✓		✓	✓	✓
NH	✓	✓	✓	✓	✓	✓	✓ (ME)
MA	✓	✓	✓		✓	✓	✓
RI	✓	✓	✓	✓	✓	✓	✓
CT	✓	✓	✓ (none conducted in 2015)			✓	✓
NY	✓	✓	✓	✓			✓ (CT)
NJ	✓	✓	✓				✓
DE	✓	✓					✓ (no lobsters encountered)
MD	✓	✓	✓				✓
VA	✓	✓					

14.0 Figures

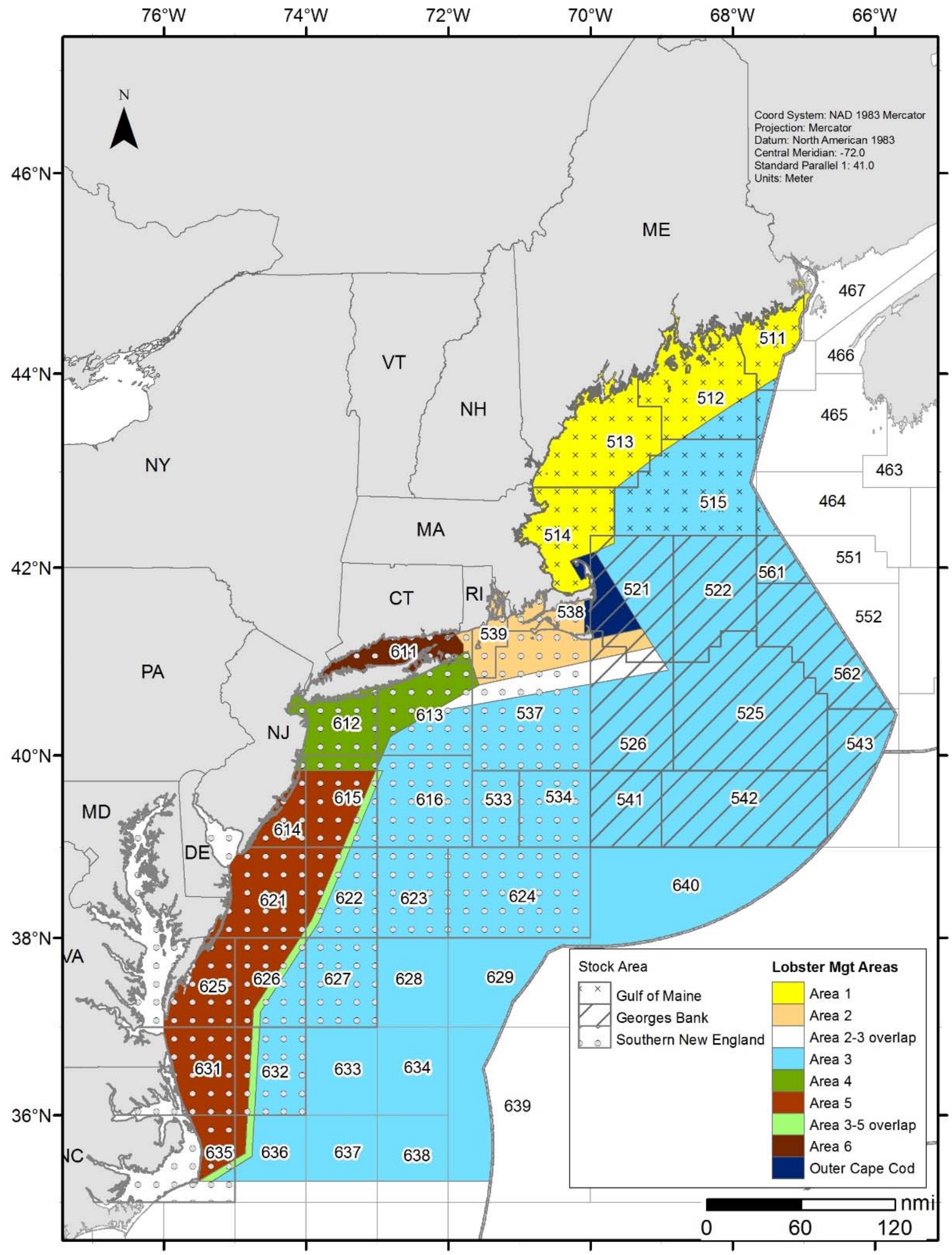

Figure 1: Lobster Conservation Management Areas (LCMAs) and stock boundaries for American lobster.

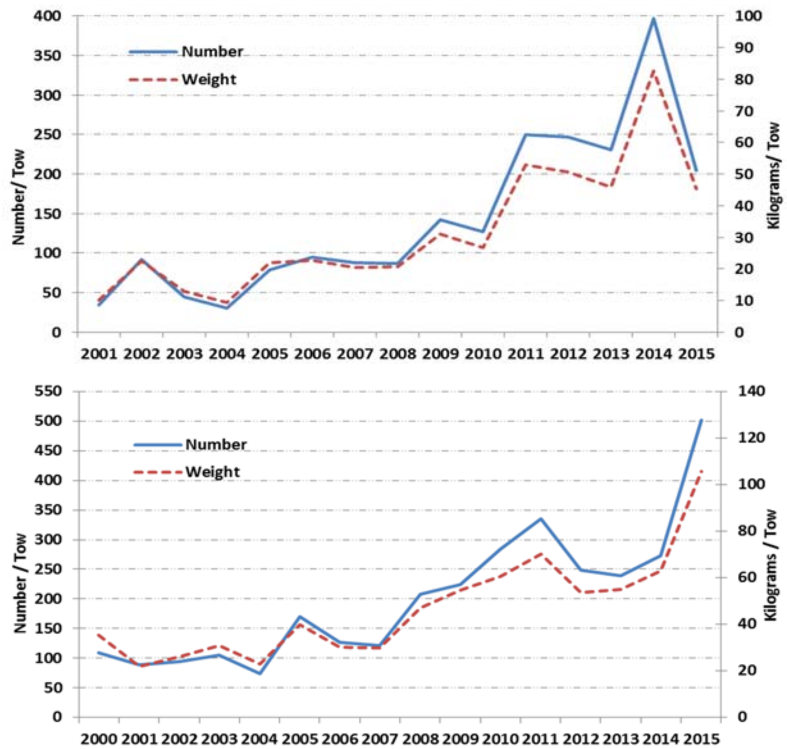

Figure 2: Maine-New Hampshire survey abundance indices for lobster, 2001-2015. Results of the spring survey are on the top and results from the fall survey are on the bottom.

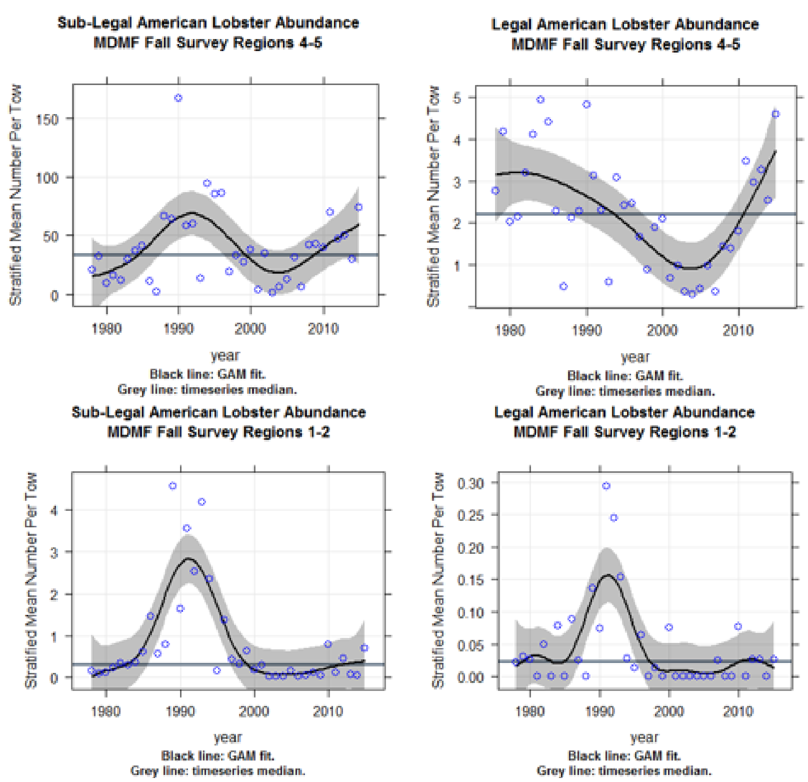

Figure 3: MADMF Fall Trawl Survey sub-legal and legal indices from 1978-2015. The top charts are from Gulf of Maine and the bottom charts are from Southern New England.

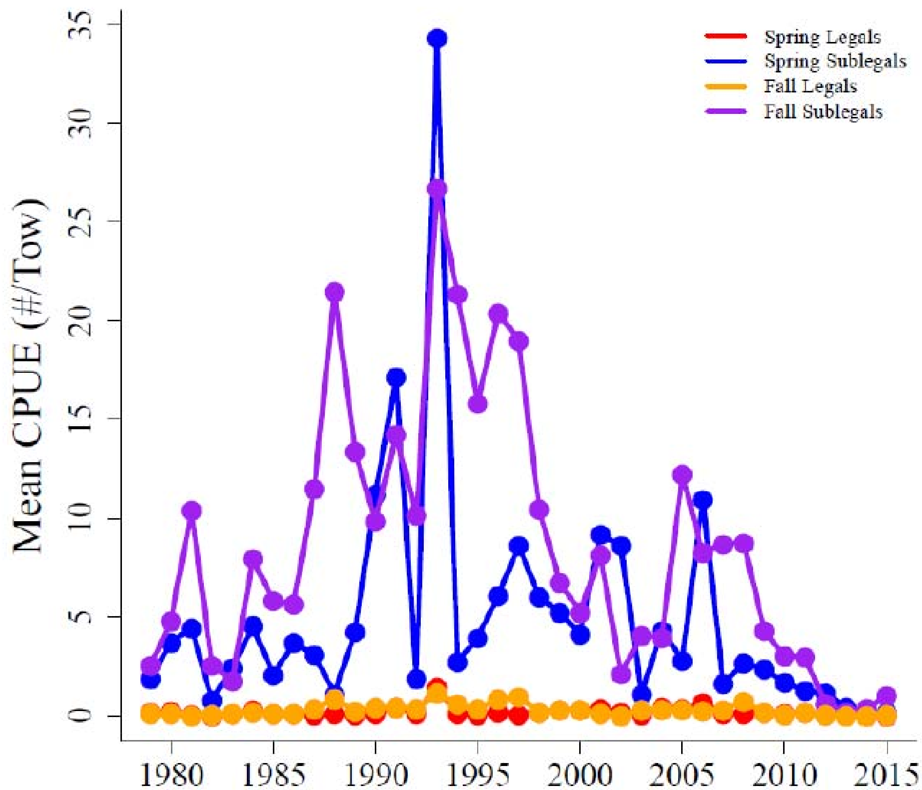

Figure 4: RIDFW Seasonal (Spring and Fall) Trawl lobster abundances. CPUE is expressed as the annual mean number per tow for sub-legal (<85.725mm CL) and legal sized (>=85.725mm CL) lobsters.

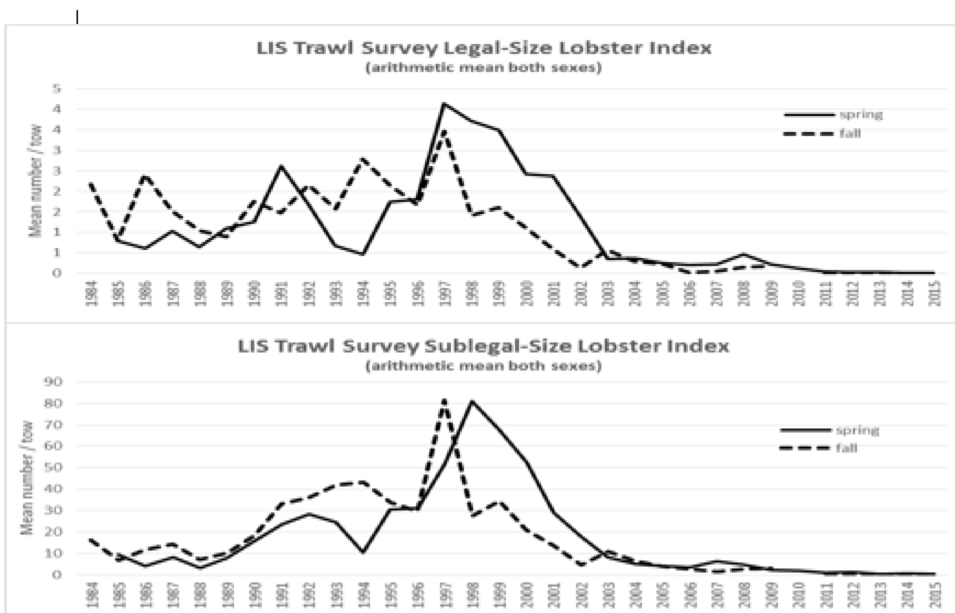

Figure 5: Results of the Long Island Sound Trawl Survey during spring (April-June) and fall (September-October) within NMFS statistical area 611.

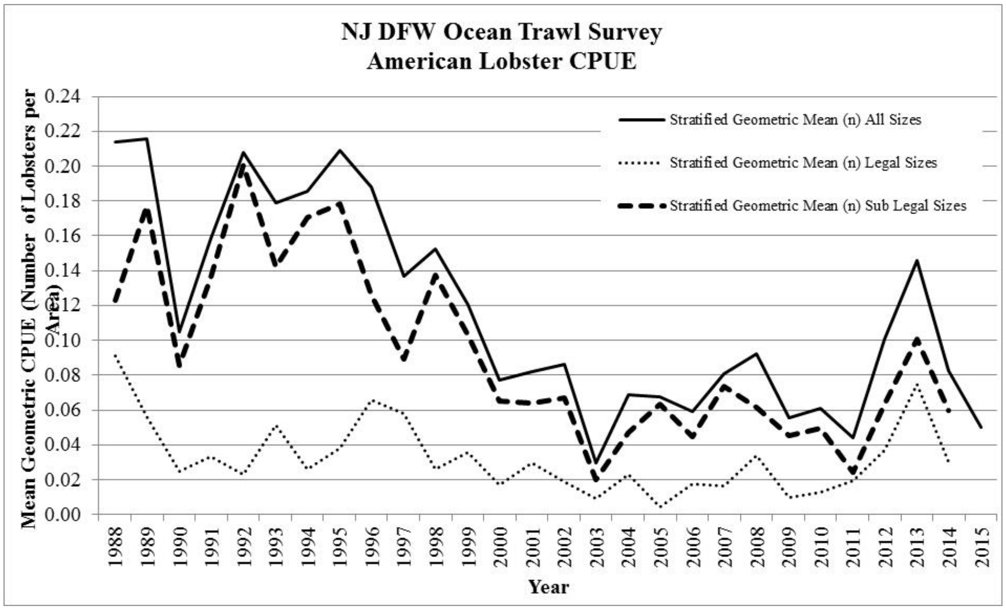

Figure 6: Stratified mean CPUE of all lobsters collected aboard the NJDFW Ocean Trawl Survey. The survey stratifies sampling in three depth gradients, inshore (18'-30'), mid-shore (30'-60'), offshore (60'-90'). The mean CPUE was calculated as the sum of the mean number of lobsters per size class collected in each sampling area weighted by the stratum area.

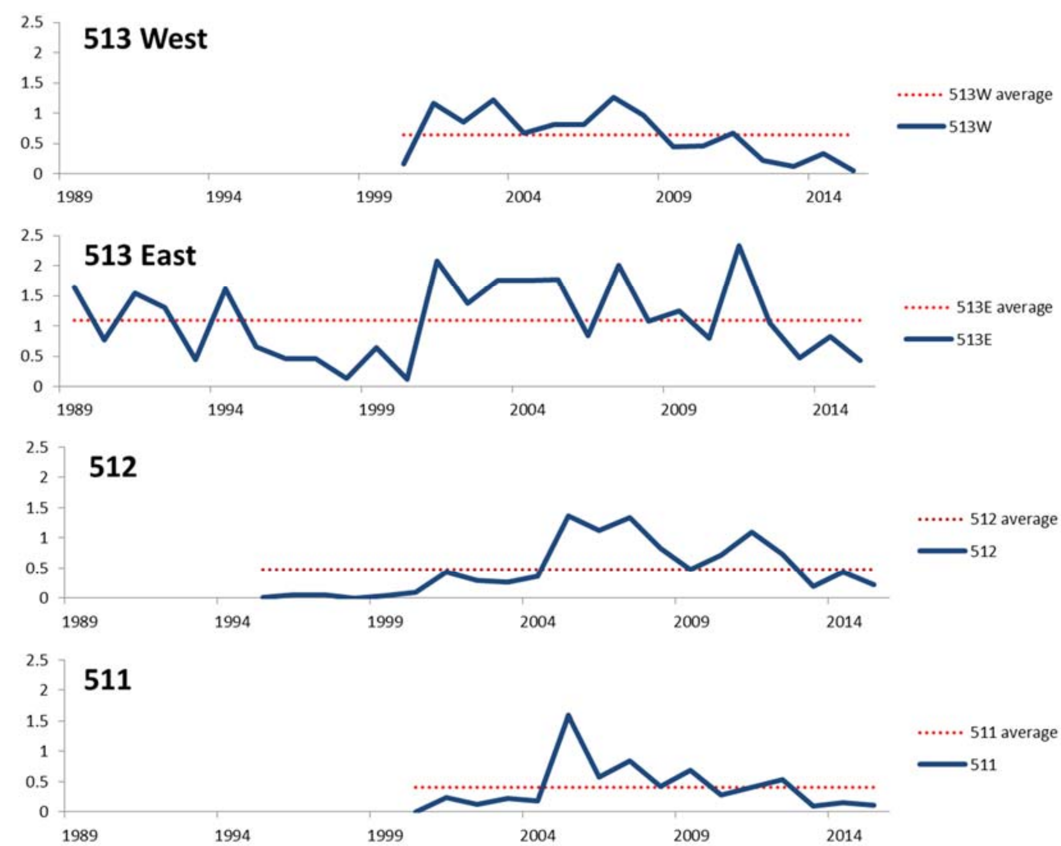

Figure 7: Settlement survey index for each statistical area in Maine (1989-2015).

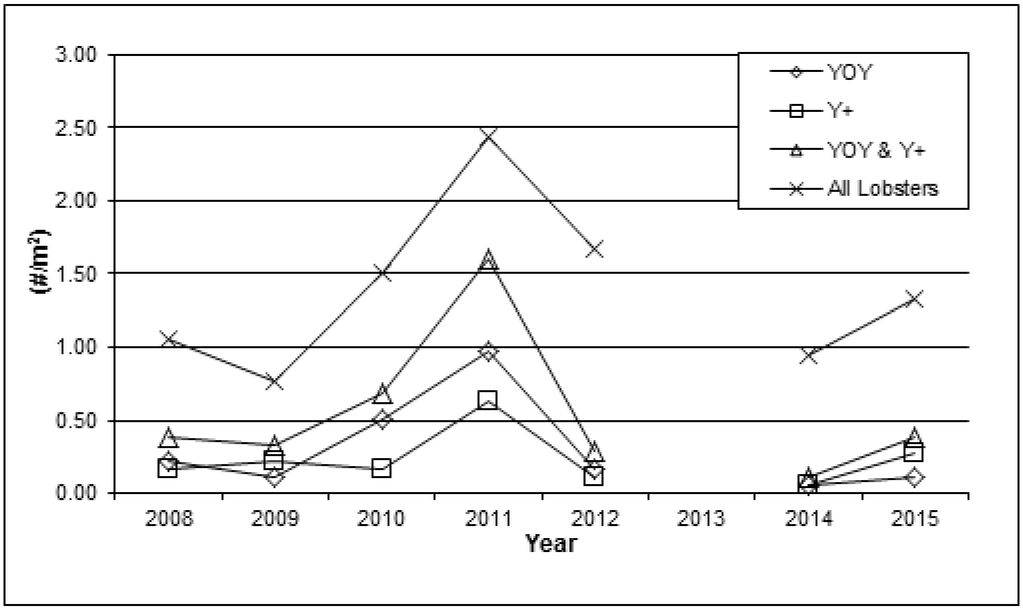

Figure 8: Catch per unit effort (#/m2) of YOY, Y+, and YOY/Y+ combined and all lobsters during the American Lobster Settlement Index, by location, in New Hampshire, from 2008 through 2015.

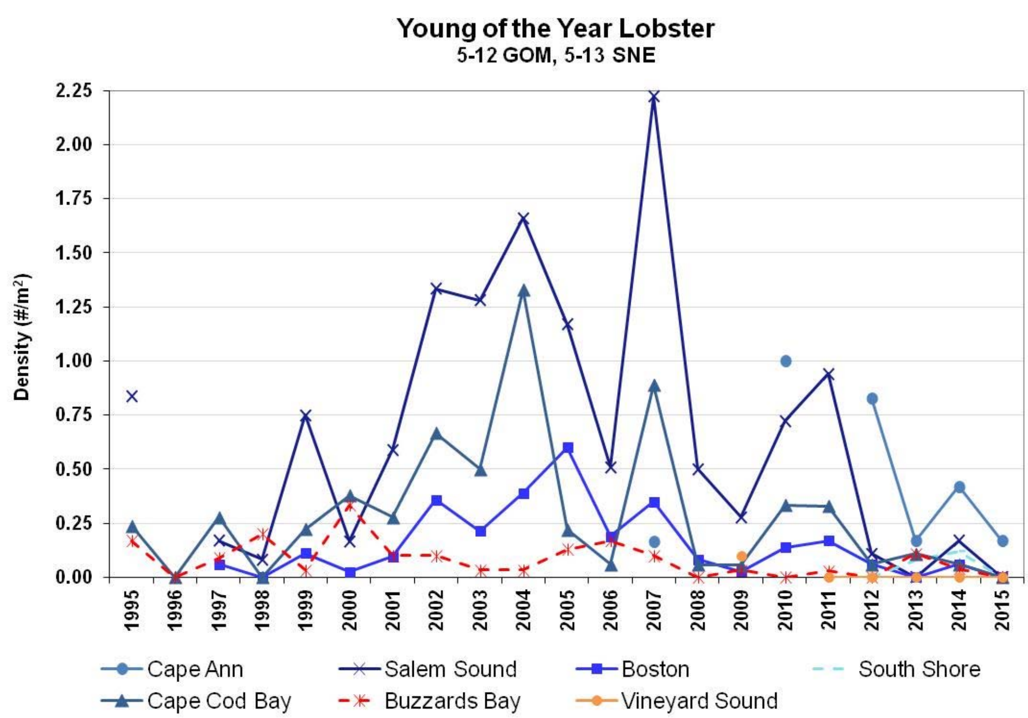

Figure 9: Young-of-year lobster density in seven Massachusetts regions; LCMA 1 – Cape Ann, Salem Sound, Boston, South Shore, Cape Cod Bay, LCMA 2 - Buzzards Bay, Vineyard Sound.

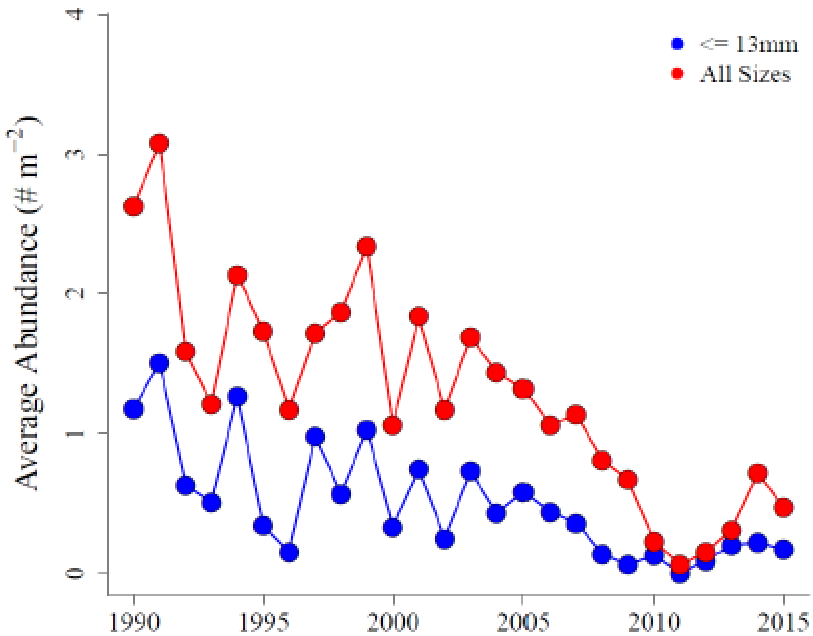

Figure 10: Average abundance of American lobster in Rhode Island suction sampling sites. Abundances are presented for lobsters less than or equal to 13mm (blue) and all lobster collected in sampling (red).

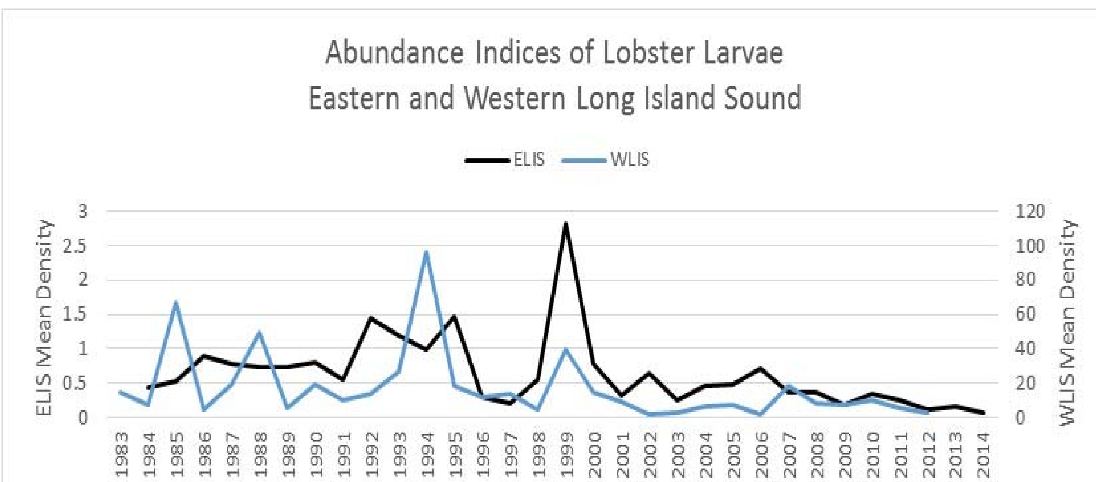

Figure 11: Abundance indices of lobster larvae from the Connecticut DEEP Larval Lobster Survey in western Long Island Sound and from the Millstone Power Station entrainment estimates in eastern Long Island Sound. The Connecticut DEEP survey was discontinued in 2013.

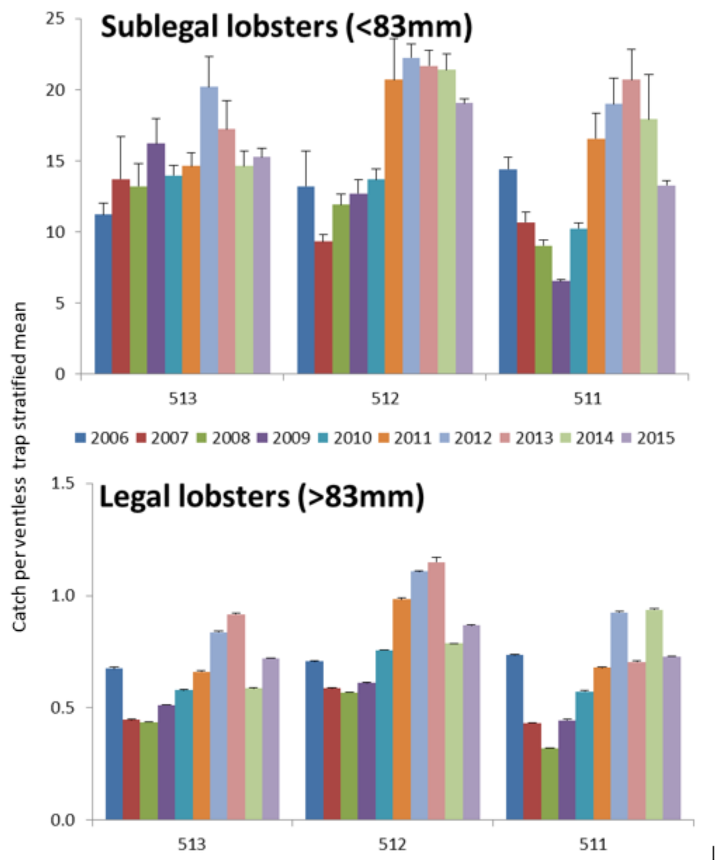

Figure 12: CPUE stratified mean for both sublegal and legal lobsters from Maine's Ventless Trap survey, 2006-2015, by statistical area. Only ventless traps were included in the analysis.

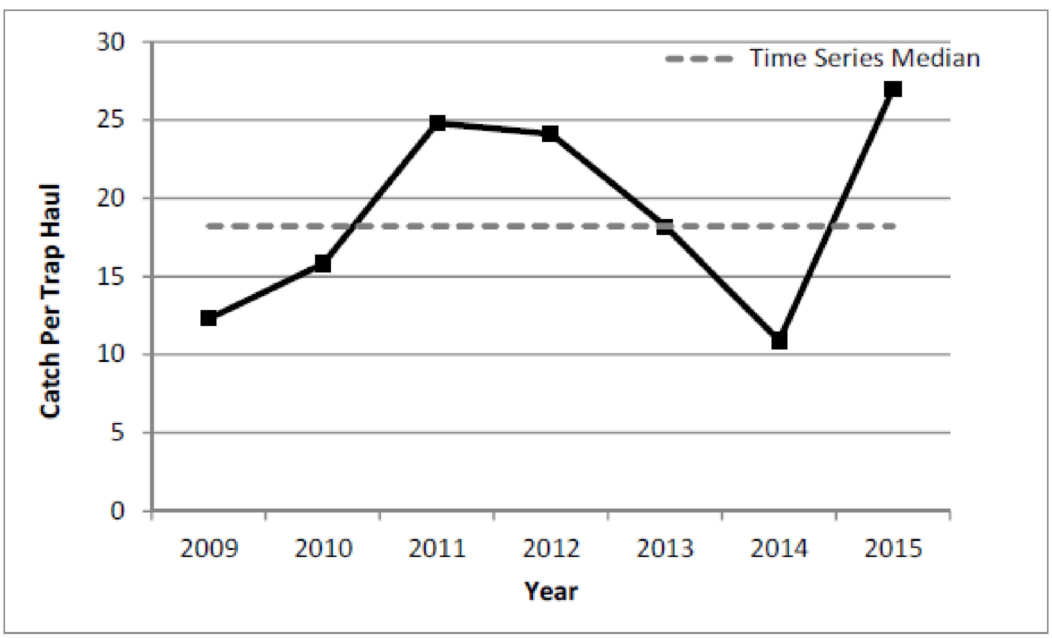

Figure 13: Stratified mean catch per trap haul, for all lobsters captured during the coast-wide random stratified Ventless Trap Survey in New Hampshire state waters from 2009 through 2015.

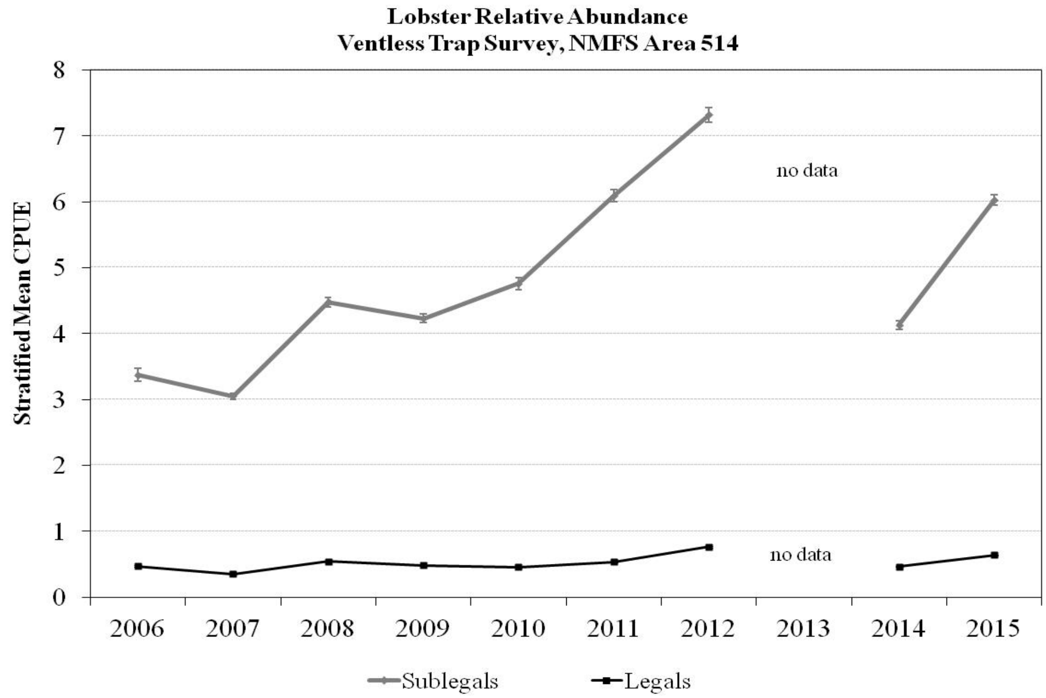

Figure 14: Stratified mean catch per trap haul (±S.E.) of sublegal (< 83 mm, grey line) and legal (≥ 83 mm, black line) lobsters in NMFS Area 514 from MADMF ventless trap survey.

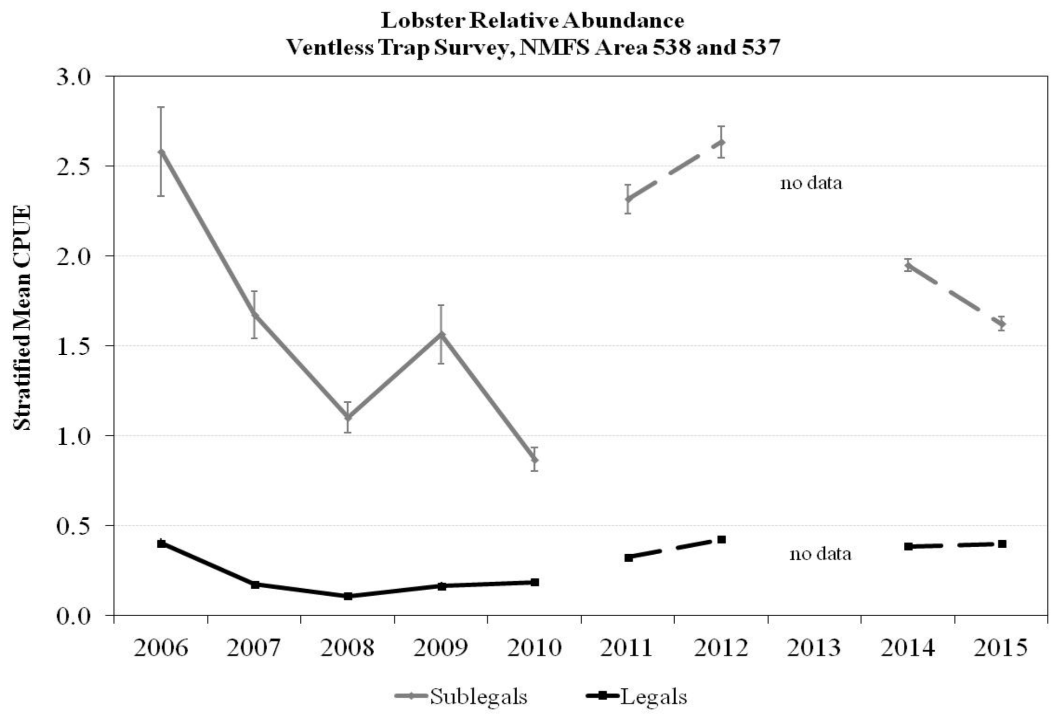

Figure 15: Stratified mean catch per trap haul (±S.E.) of sublegal (< 86 mm, grey line) and legal (≥ 86 mm, black line) lobsters in Area 538 and northern 537 (2011-2014) from MADMF ventless trap survey. The break in the time series from 2010 to 2011 and the subsequent dashed lines illustrate when the survey was expanded (starting in 2011), which should be interpreted as a new time series relative to the 2006-2010 time period.

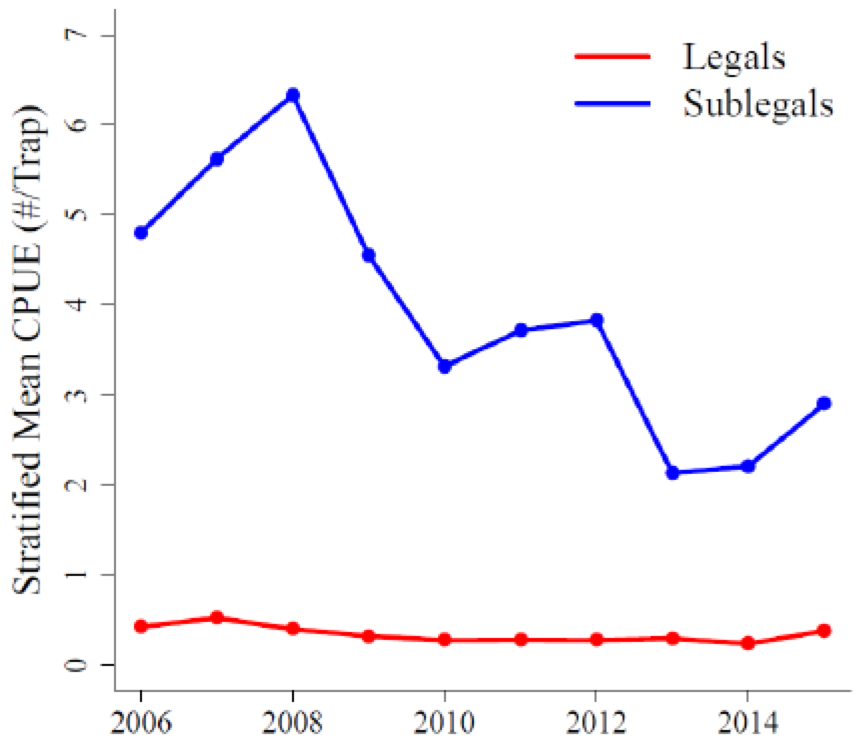

Figure 16: Stratified mean catch (#) per trap-haul for sublegal (<85.725 mm CL) and legal-sized (>=85.725mm CL) lobsters from RIDEM ventless trap survey.