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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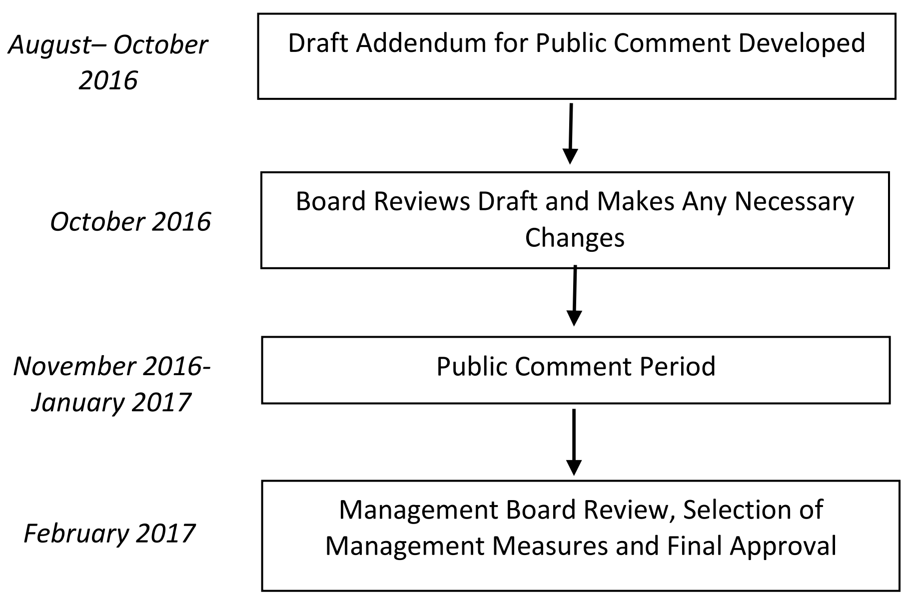

Executive Summary

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 25th 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.

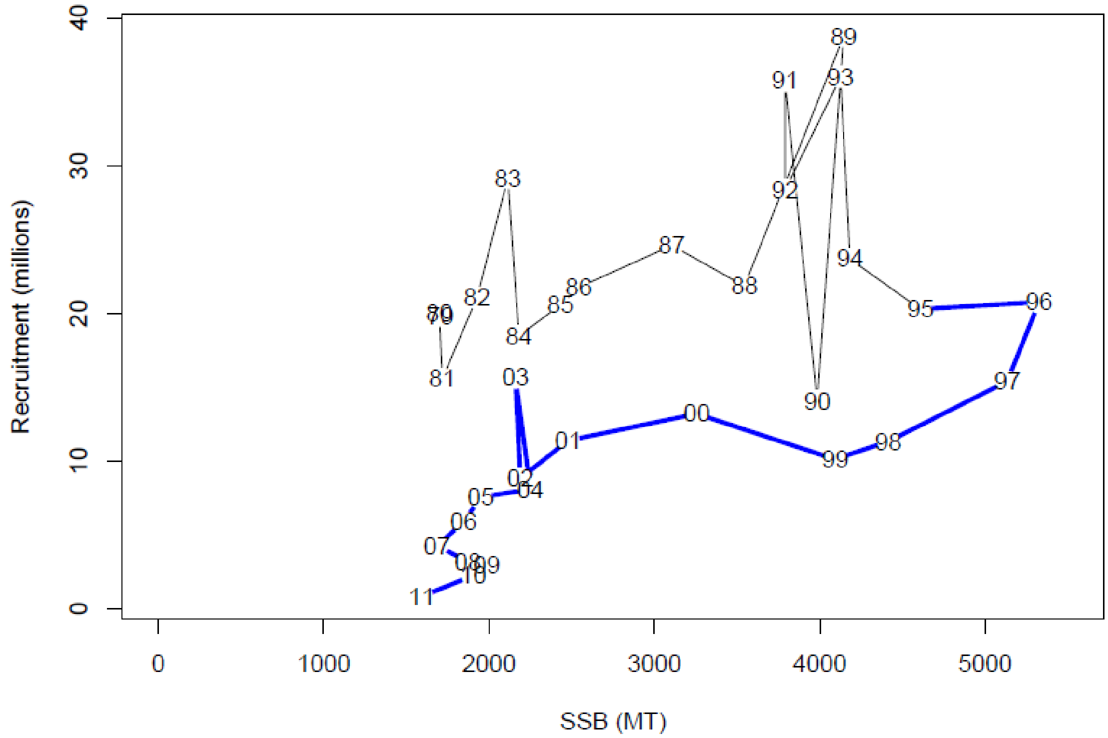

Figure 1: The relationship between model-based spawning stock biomass and recruits from 1979 to 2011. The blue line denotes the trajectory from 1995 – 2011 (recruiting to the model from 1998 to 2014).

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 (<10ºC) or too warm (>22ºC) increase mortality.[1] Adult lobsters also are impacted by warming waters as recent laboratory studies suggest lobsters have a threshold of ~20.5ºC, 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 20ºC 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.

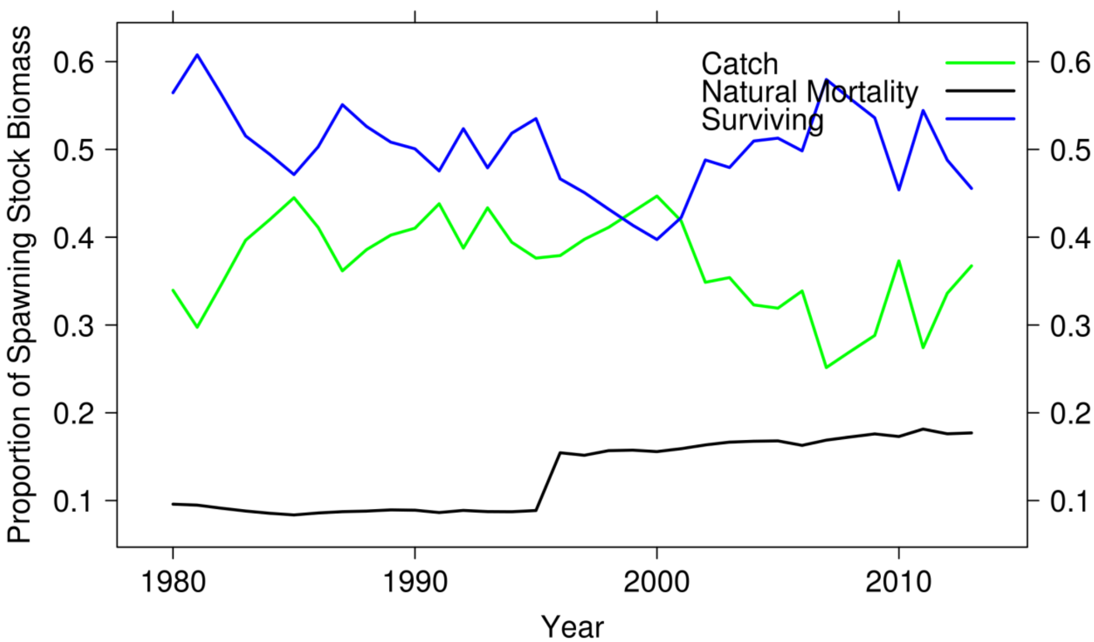

Figure 2: Proportion of SSB surviving or removed by fishing and natural mortality annually.

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.

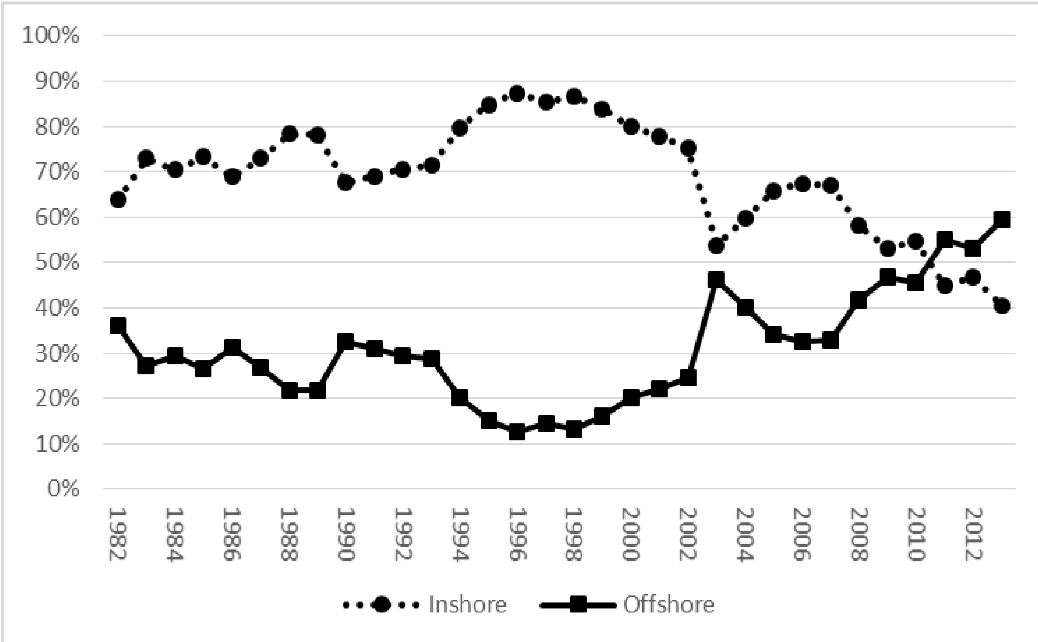

Figure 3: Percentage of landings in SNE occurring in the inshore and offshore fishery. The inshore fishery is defined as landings from statistical areas 538, 539, 611, 612, 613, 614, 621, 625, 631, and 635. The offshore fishery is defined as landings from statistical areas 533, 534, 537, 615, 616, 622,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

Option 1: Status Quo

Under this option no changes to management would be made through this addendum. All measures would remain the same as listed in Table 7.

Option 2: 20% Increase in Egg Production

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. 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 20% 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 20% 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 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°W Longitude Line

Under this option, LCMA 3 would be split along the 70°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°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°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.

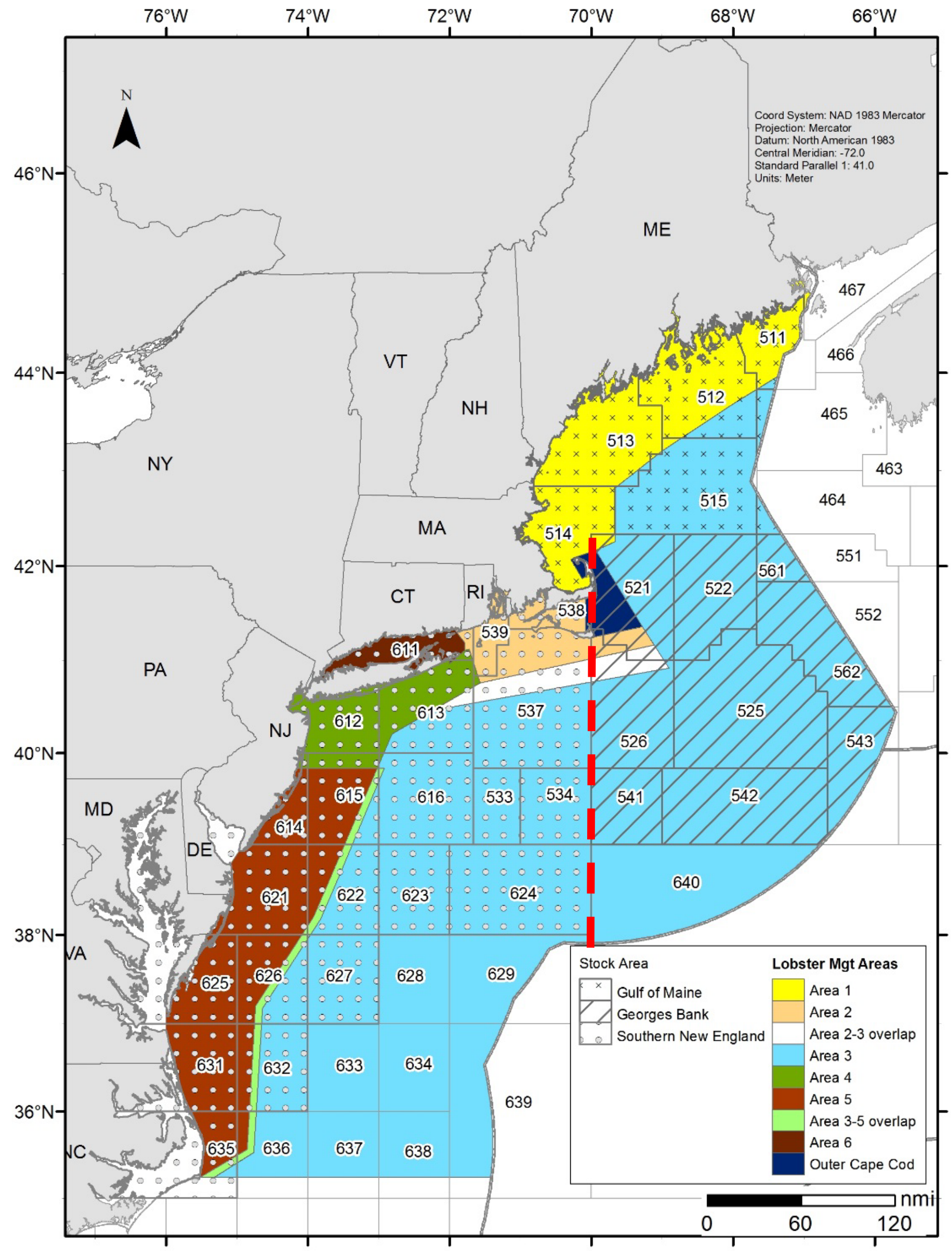

Figure 32.1. Statistical areas used to define the American lobster, *Homarus americanus*, stock.

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°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

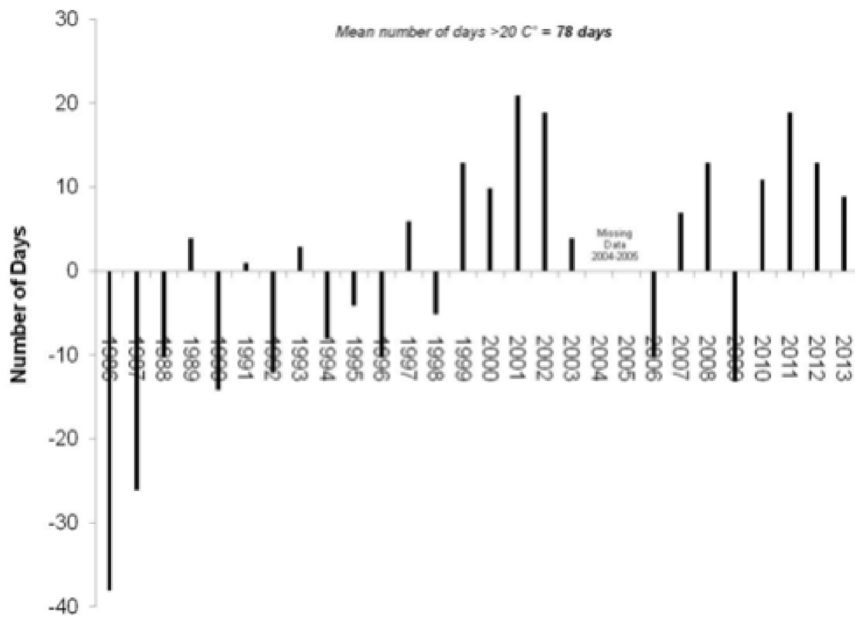

Figure 1: Bottom water (11m) temperature anomalies from the mean number of days >20^{o}C at Cleveland Ledge, Buzzards Bay, MA, 1986-2013. Source: 2015 Benchmark Stock Assessment.

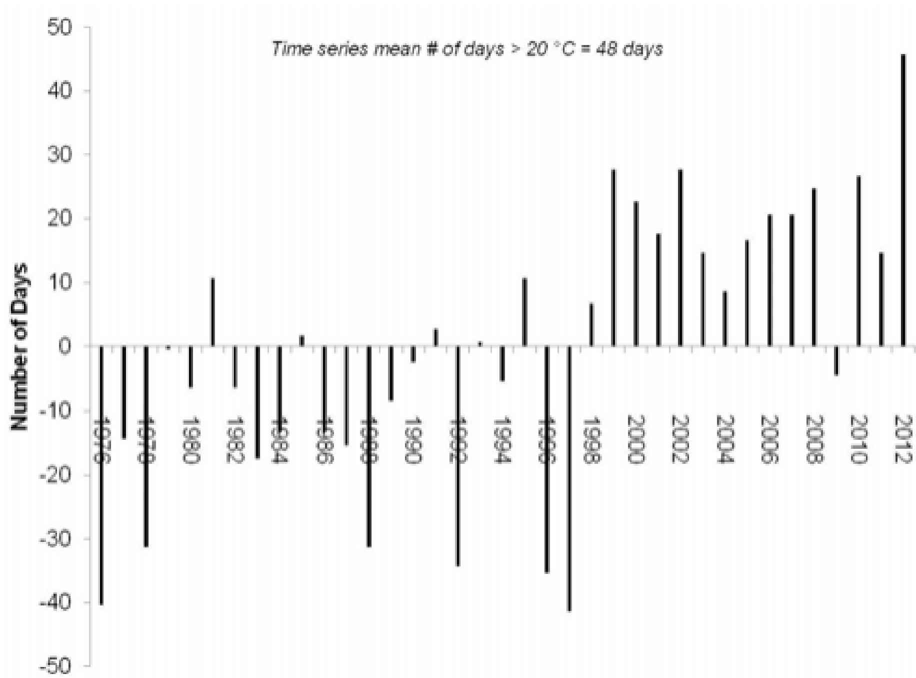

Figure 2: Bottom water (11m) temperature anomalies from the mean number of days >20^{o}C at Dominion Nuclear Power Station, eastern Long Island Sound, CT, 1976-2012.

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.

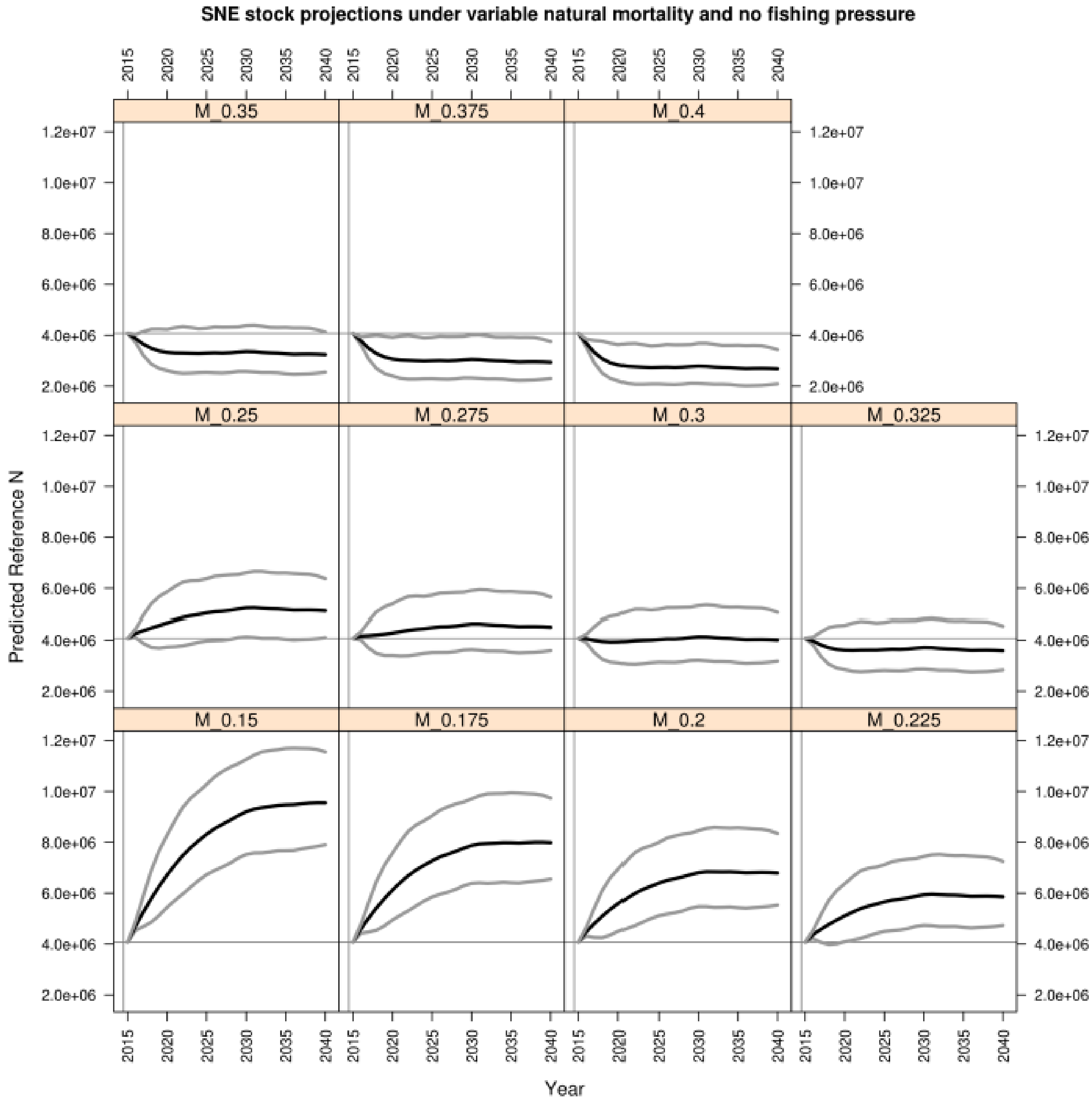

Figure 1: SNE stock projections assuming constant recruitment (similar to levels seen from 2011 to 2014) under various levels of M. F is fixed at zero. The units are reference abundance. Black line is the mean trend +/- 2SD (gray lines).

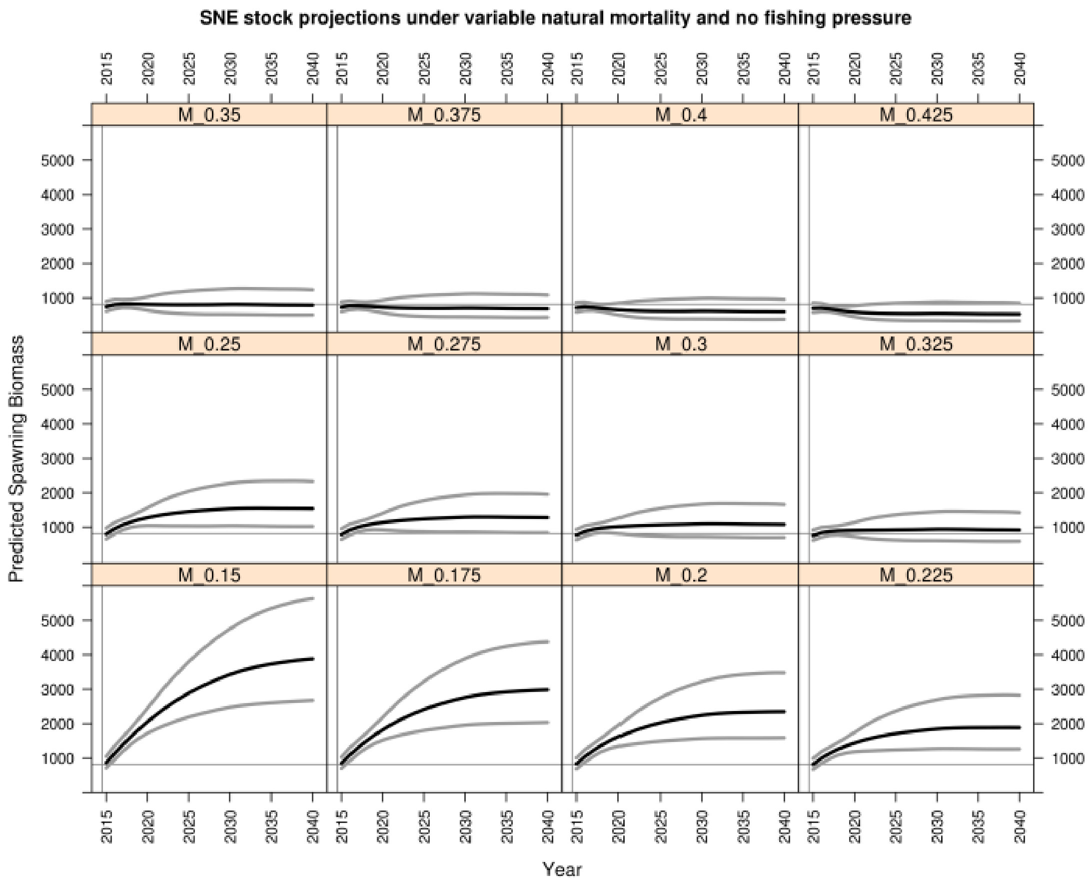

Figure 2: SNE stock projections assuming constant recruitment (similar to levels seen from 2011 to 2014) under various levels of M. F is fixed at zero. The units are SSB. Black line is the mean trend +/- 2SD (gray lines).

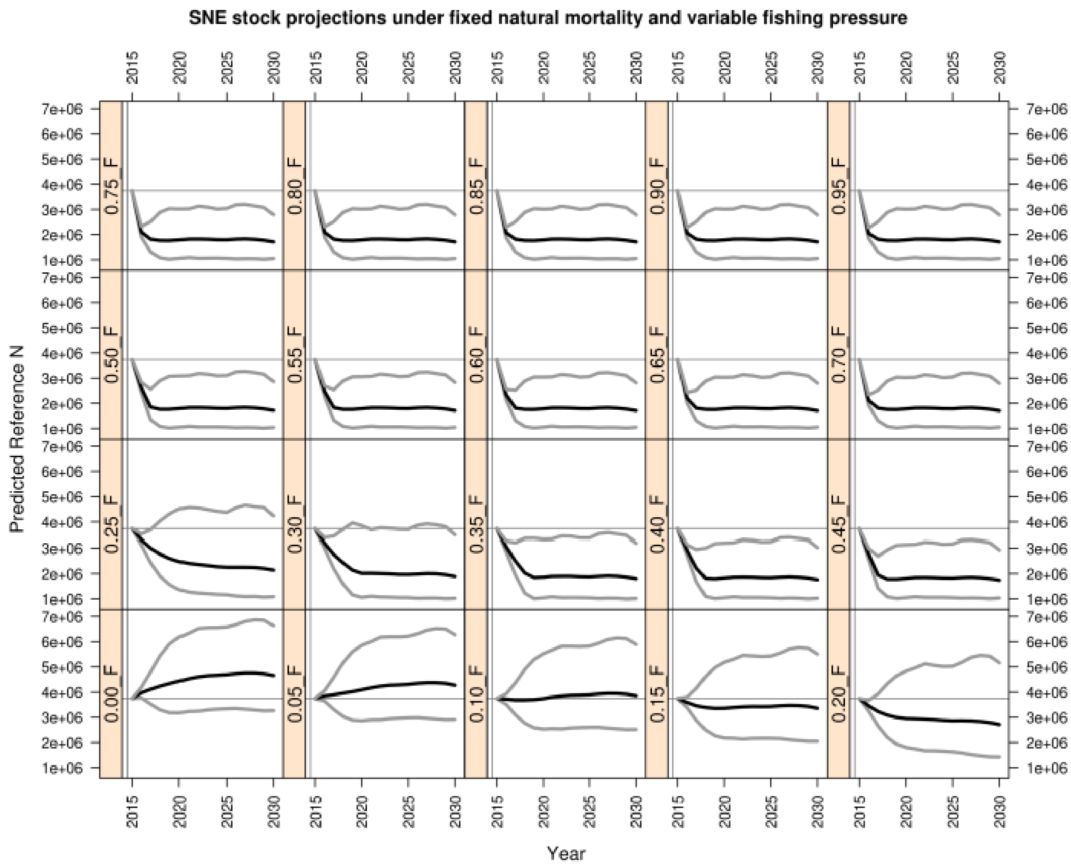

Figure 3: SNE stock projections assuming constant recruitment (similar to levels seen from 2011 to 2014) under various levels of F. M is fixed at 0.285. The units are reference abundance. Black lines is the mean trend 2 +/-2SD (gray lines).

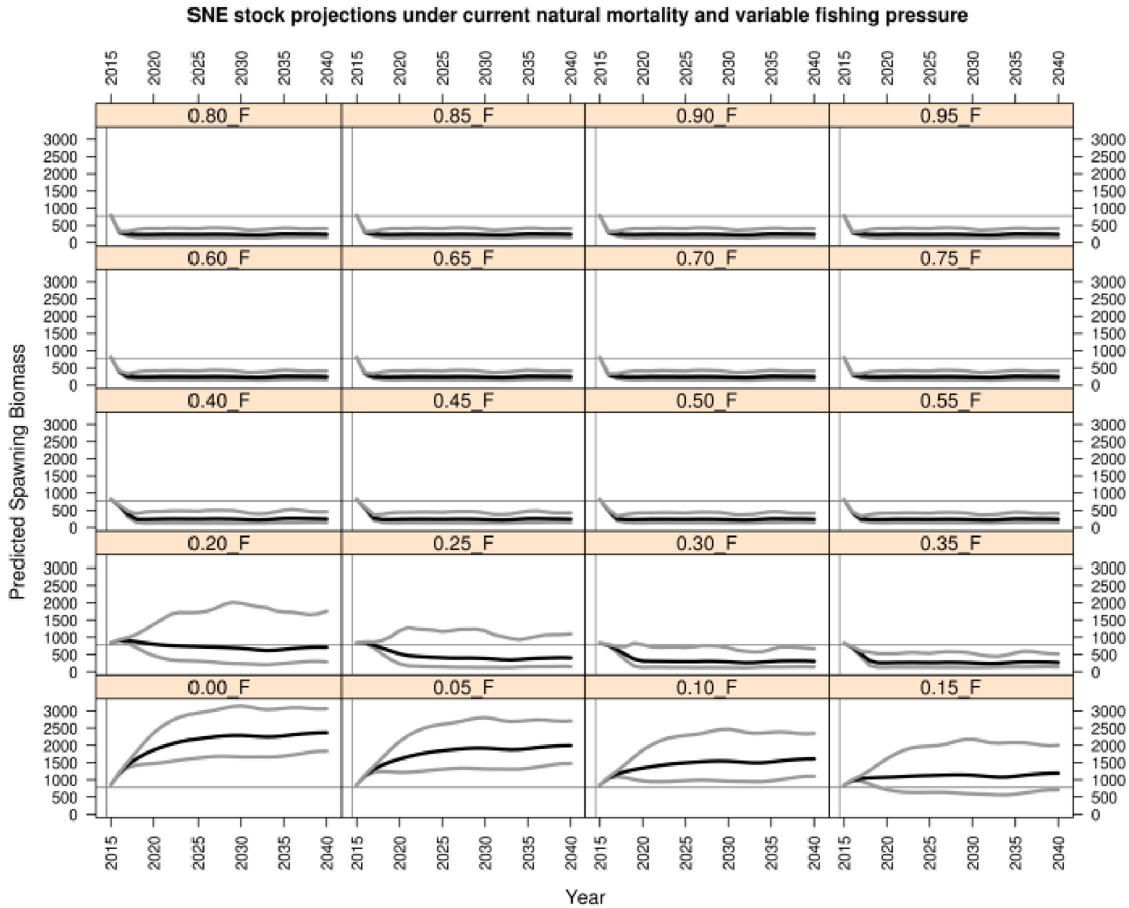

Figure 4: SNE stock projections assuming constant recruitment (similar to levels seen from 2011 to 2014) under various levels of F. M is fixed at 0.285. The units are SSB. Black line is the mean trend +/1 2SD (gray lines).

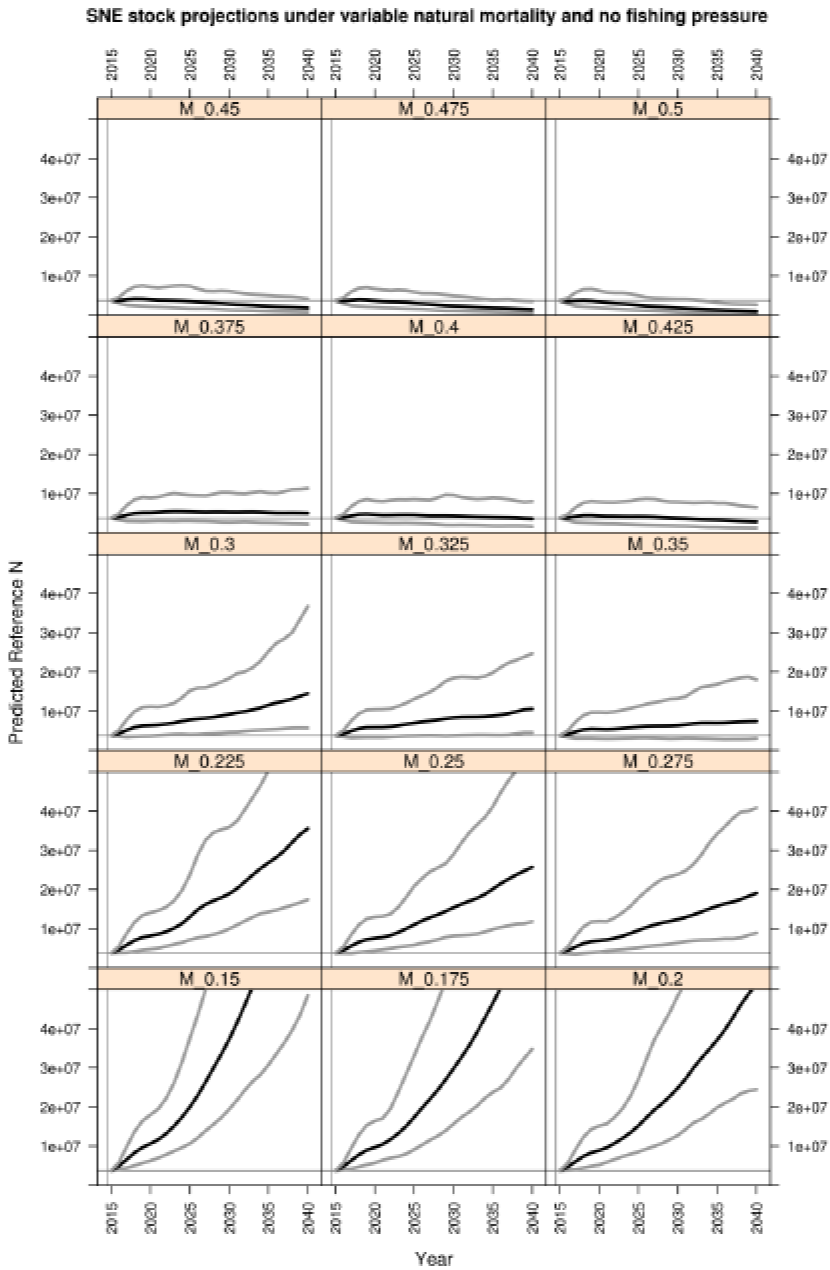

Figure 5. SNE stock projections assuming a Beverton-Holt stock recruit relationship under various levels of M. F is fixed at zero. The units are reference abundance.

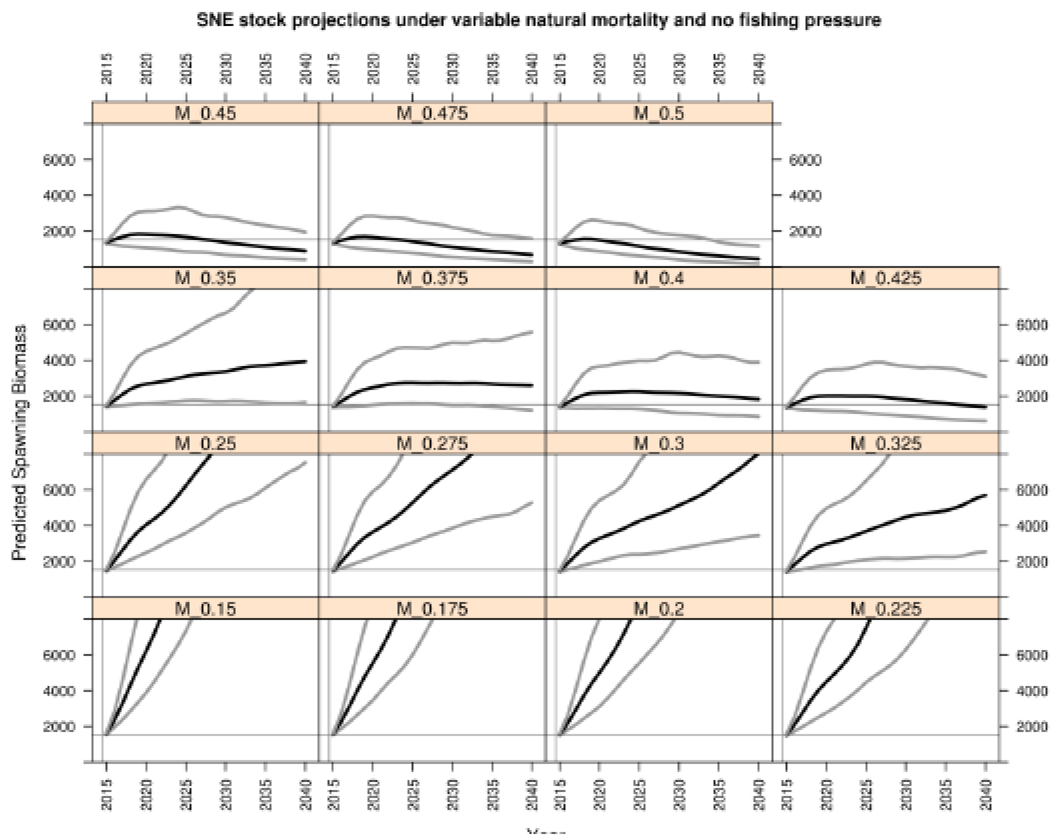

Figure 6: SNE stock projections assuming Beverton-Holt recruitment under various levels of M. F is fixed at zero. The units are SSB.

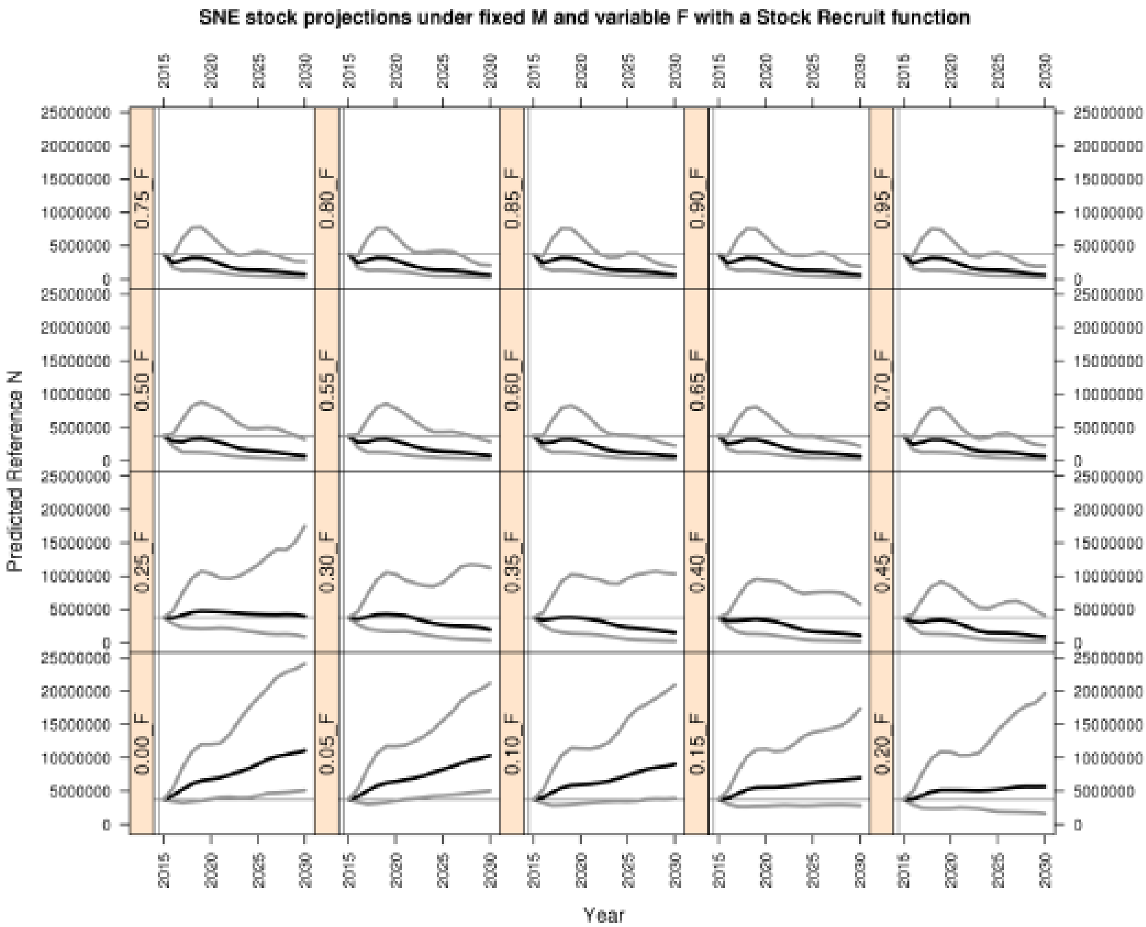

Figure 7: SNE stock projections assuming Beverton-Holt recruitment under various levels of F.M is fixed at 0.285. The units are reference abundance.

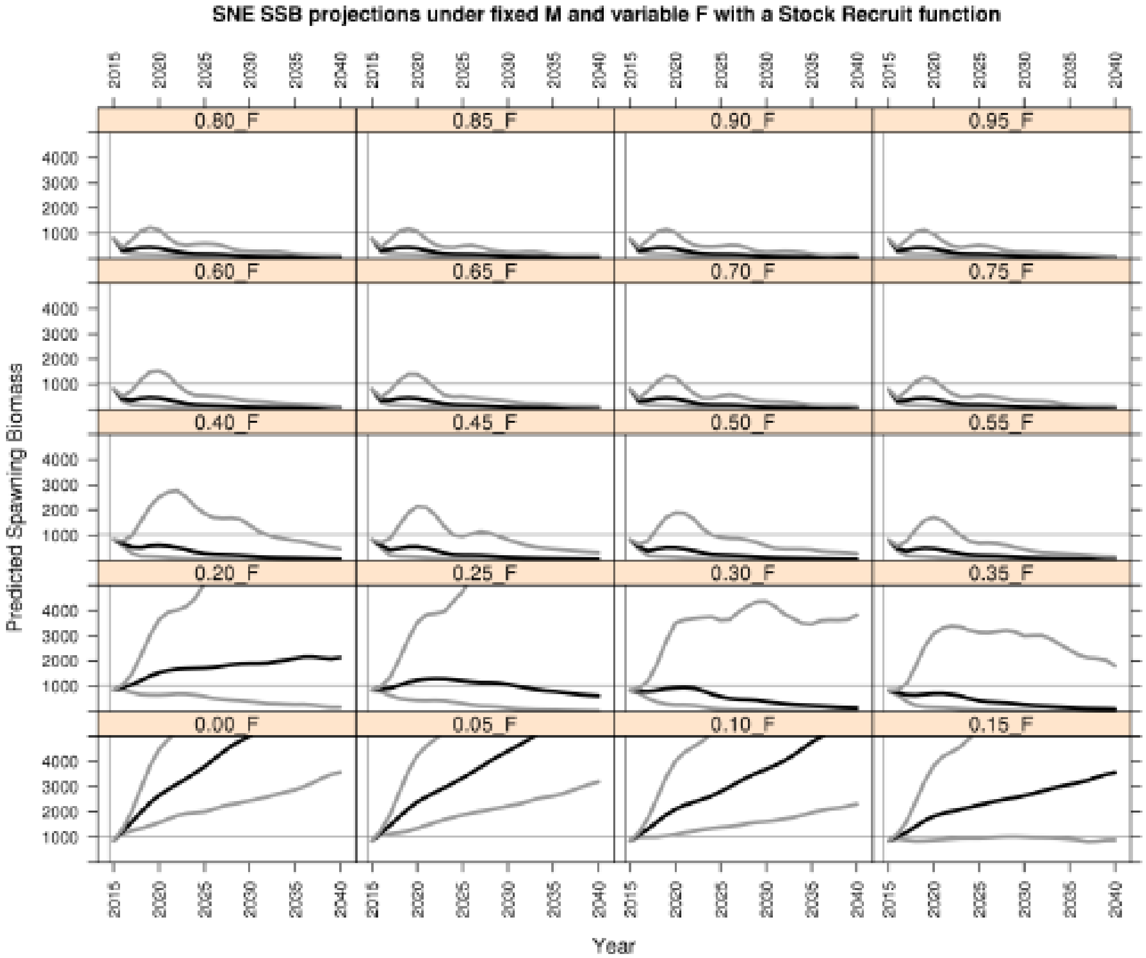

Figure 8: SNE stock projections assuming Beverton-Holt recruitment under various levels of F. M is fixed at 0.285. The units are SSB.

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

Max size →

Min Size ↓

Min 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

Max size →

Min Size ↓

Min 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

Max size →

Min 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

Max size →

Min 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 ↓

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 ↓

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%