GOVERNMENT OF BERMUDA
Ministry of the Environment

Department of Environment and Natural Resources
Marine Management Section

Summary of the Spiny Lobster Fishery for the 2016-2017 Season

During the 2016-2017 season, the spiny lobster fishery once again had 29 participants operating allotments of 12 traps each for a total of 348 traps in the fishery (Table 1). As in recent seasons, 5 traps were allowed inshore from the start of the season, for a potential maximum of 145 traps inshore, with the remaining traps offshore. All traps could be brought inshore from December 1st.

For the third season in a row, a hurricane disrupted fishing activity during October, usually a strong month for the fishery, and resulted in significant loss of traps. Further, having brought their traps in during the bad weather, many participants kept at least some of their traps inshore at a time when they might usually have been deployed offshore. Further, the wider impact of these repeated disturbances to the marine environment during the fall is unknown at this time.

A total of 23,792 lobsters were landed this season, compared to 27,823 in 2015/16, 28,632 in 2014/15, and 30,052 in 2013/14 (Table 2). Landings this season are down 14% from last season and also from the average annual landings of 27,615 lobsters over the past 15 seasons.

A total of 12,172 traps were hauled, with an overall catch per unit effort (CPUE) of 1.95 lobsters per trap (Table 2). Total effort was down 6% from the approximately 13,000 hauls made during the previous three seasons. The average number of sets per participant was 38.5, compared to 41 last year, but numbers ranged from 24 to 52, with a mode of 32. Some participants fished less often because of boat trouble or hurricane-related damage, but several participants reported hauling less frequently because of reduced catches. The overall CPUE is the second lowest value seen during the past 15 years, and translates to ~2 fewer lobsters per 12-trap haul than last season's value of 2.15, and ~6 fewer lobsters per 12-trap haul than the 15-year average of 2.44.

Offshore trapping landed 10,708 lobsters, which made up 45.0% of total landings (Table 2). This value falls between last season's offshore landings of 11,160 and the 10,203 lobsters landed offshore the previous season. However, this season's offshore catches made a greater contribution to the total landings. Although offshore landings for the past four seasons have been lower than the record-breaking seasons between 2010 and 2013, they are well within the range of values for the offshore fishery for the past 15 seasons and similar to the average annual landings of 10,950 over that period. Average offshore CPUE was 2.55 lobsters per trap, the same as the previous season but down from the previous five seasons and the 15-year average of 2.66, yet still substantially above the reference CPUE of 1.87 (Figure 1).

The 13,084 lobsters landed inshore made up 55.0% of total landings, a decrease of 3,579 lobsters, or 21.5%, from the 16,663 lobsters landed inshore last season, and 29% fewer than the 18,429 lobsters landed inshore two seasons ago (Table 2). These inshore landings are 20.6% lower than the average for the previous 15 seasons (16,473 lobsters), and the lowest since 2004-05. Another relevant reference point is the average for the previous 7 seasons (starting from 2009-10), when the practice of permitting 5 traps inshore from the start of the season began. This season's inshore landings are 31% lower than the average inshore landings of 18,882 lobsters for the seasons 2009-10 through 2015-16. Further, the relative contribution of inshore catches to the total landings was 5% less than the long term average of 60%.

Along with the decrease in landings, average CPUE for the inshore fishery decreased to 1.64 lobsters per trap, down from the average of 2.05 last season and the values of 2.13 - 2.86 for the previous four seasons. This is

35% lower than the reference CPUE of 2.50, 32% lower than the 15-year average of 2.41, and the lowest inshore CPUE recorded since the fishery reopened in 1996 (Figure 1). CPUE was similarly low in both the eastern and western inshore areas, with 1.65 and 1.63 lobsters per trap respectively. There was slightly greater fishing effort in the western area, which supports 15 fishers and saw 4,108 traps hauled, compared to the eastern area, which supports 14 fishers and saw 3,864 traps hauled. However, the average number of traps hauled per fisher was similar across the two areas.

On a broad scale, the catches reflect the distribution of trapping effort, with the 4,200 offshore hauls contributing 35% of total effort and the 7,972 inshore hauls contributing 65% of total effort. This represents a more typical distribution of effort compared to the previous two seasons. However, it is worth noting that the 65% of the effort directed inshore only returned 55% of the catch.

Monthly analysis of catch and effort (Figures 2 and 3) showed a slower than average start to the season in all areas, particularly inshore, followed by an increase in CPUE in October and then the typical decline as the season progressed. Offshore catches dropped gradually from September through November, paralleling effort, and declined steeply in December as more traps were moved inshore. Offshore fishing ceased by the end of January. Offshore CPUE peaked at 2.9 lobsters per trap in October, declined through December, then experienced a slight uptick in January because of the greatly reduced number of traps offshore. Inshore, harvest generally tracked effort as well, being low during the first three months of the season, increasing in December, and then remaining roughly stable through the end of the season. Inshore CPUE also peaked in October after the slow start in September, and ranged between 1.4 and 1.7 in the western area and between 1.3 and 1.7 in the eastern area for the remainder of the season. These late season catch rates reflect a notable decrease in inshore catches over last season, when CPUE during the same months was between 1.6 and 1.9 in the western area and between 1.9 and 2.1 in the eastern area

5,625 undersized lobsters were reported released this season, similar to the 5,773 reported released during the previous season but down from the 6,281 and 6,408 individuals released in the previous two seasons. This value is within the range recorded for the past 15 seasons, but lower than the average of 6,487. Short lobsters made up 23% of the catch offshore, the same as last season but less than the 15-year average of 26% and in the lower region of the 21% to 30% range recorded (Figure 4). The proportion of shorts inshore increased in comparison to last season and, at 16%, was at the upper end of the 15 year range (6% to 18%) (Figure 4). However, in absolute terms, there were fewer shorts this year, with a greater difference offshore (3,206 compared to the 15-year average of 4,011) than inshore (2,419 compared to the 15-year average of 2,602). The apparent increase in the percentage of short lobsters inshore is due to the decline in the number of landed legal lobsters.

Size data collected for both the offshore (N=73) and inshore (N=283) fisheries this year covered less than 2% of total landings, and it was not possible to construct valid population distributions from such a small sample. However, the lobsters measured ranged in size from the minimum legal size up to 197mm carapace length and, as has typically been observed, mean sizes were slightly larger for males than females in each area, with inshore lobsters being, on average, larger than offshore lobsters. The average sizes for lobsters measured in each of these categories this season were comparable to those from previous seasons. (Figures 5 and 6, showing the population distributions from the previous nine seasons, have been included for reference.)

Bycatch reporting this season was much less comprehensive than in recent seasons, because many fishers were utilising old statistical returns forms that do not have the specific boxes for noting bycatch. This is unfortunate, in that we do not have a good idea of how many lionfish were caught in the lobster traps this season, and this had been one of the most consistent measures of the relative abundance of invasive lionfish over time. However, from those reports of bycatch that are available, it appears that a similar range of species was caught in fairly similar numbers to recent seasons. Lionfish were still the most commonly reported bycatch species, with 375 reported, and many fishers are now regularly marketing them either whole or as fillet. The other commonly reported bycatch species were coneys and guinea chicks, followed by grunts and octopus. However, more complete reporting of bycatch is to be encouraged. Various fishermen also reported releasing 6 lobsters

with eggs in September and 1 lobster with eggs in March. Other reports of lobsters carrying eggs outside of the main reproductive months have also surfaced this season.

The spiny lobster fishery overall had a below average season when compared to records for the past 15 years. In particular, the heavy trapping that has taken place inshore over the past several seasons appears to have negatively affected both overall catches and CPUE there, even with the slight reduction in effort. Figure 1 shows inshore catch rates declining fairly steadily over the past 6 seasons, in concert with the increased effort since a percentage of traps have been allowed inshore from the beginning of the season, and inshore CPUE has been below the 15-year average for the past four seasons.

Such a decline in CPUE would be expected if there were a noticeable decline in recruitment, however this does not appear to be the case (Table 2), and factors other than density may affect catchability in fixed gear fisheries. Poor winter weather with heavy southwesterly winds has been mentioned by some fishermen as a possible reason for reduced catch rates inshore, but a quick comparison of February meteorological data indicates that this winter was no worse than any of the 5 preceding, and may have actually been slightly milder. It is also possible that hurricane-related conditions may have encouraged lobsters to remain offshore or led to other behavioural alterations.

While the exact reasons for the declining inshore CPUE are unclear, the high density of traps likely plays a role. Therefore, the Marine Management Section believes that some action should be taken to reduce the amount of trapping taking place in the inshore areas. However, although the offshore catch rates are currently good, a significant increase in the level of trapping offshore (e.g. keeping all traps offshore until December 1st as in seasons prior to 2008), would likely reduce CPUE there instead. Recommended options for reducing fishing effort inshore include the following, either alone or in combination:

1) Allow 4 traps inshore at the start of the season, requiring 8 traps to be set offshore until December 1st.
2) Reduce the total number traps allowed inshore as of December 1st to either 11 or 10. Similar measures were in place prior to 2011. The surplus trap(s) could be surrendered or trapping could continue offshore.

If all participants had been taking advantage of the 5 trap inshore allowance and then brought all their traps inshore as of December 1st, while making weekly hauls during the entire season, the potential reduction in inshore effort for these two options would be approximately as follows:

1) 377 traps not hauled inshore, but hauled offshore instead
2) 493 - 986 traps not hauled inshore, depending on whether 11 or 10 traps were allowed

When considering these options, it is important to bear in mind that the lowest catch rates occurred inshore during the second half of the season, when trap densities were at their highest. A reduction in trap numbers, and thus density, during this period could therefore be cost effective, reducing hauling time but likely leaving overall catches unaffected.

Recreational diver catch should also be taken into account. This past season, there were 509 licensed recreational lobster divers. An analysis of lobster diver data shows an average of 543 divers registered each season, catching an average of 2,026 lobsters. The number of divers has ranged from 471 to 618 over the past 15 years, while the catch has ranged from 1,491 to 2,672. Both divers and their catch have varied up and down, but there is no indication of an increasing trend. This translates to an average catch of about 5 lobsters per diver per season, which is corroborated by our discussions with lobster divers in 2013, as part of a study of specialised recreational fishing. As is typical of recreational fisheries, there are many participants with a low level of engagement, and a small minority of very active participants. In order to share the burden of restrictions, a temporary moratorium could be placed on recreational lobster divers, such that no new licences would be issued for this season.

Table 1. Summary of participants, traps, dates and areas fished for the lobster between 1998/99 and 2015/16.

Season	Number of participants	Total number of traps		Number of traps per fisherman		Date when traps were allowed inshore	Inshore areas
		Offshore	Inshore	Offshore	Inshore		
1998-1999	22	330	220	15	10	1-Dec-98	West 1 and 2, East 1 and 2
1999-2000	22	330	220	15	10	1-Dec-99	Same area as in 1998/99 but boundaries were expanded slightly
2000-2001	27	324	216	12	8	1-Dec-00	Same as in 1999/2000
2001-2002	18	270	126	15	7	1-Dec-01	Same as in 1999/2000
2002-2003	18	270	162	15	9	1-Dec-02	Same as in 1999/2000 but boundaries were expanded slightly
2003-04, 2004-05	22	308	220	14	10	1 December	Same as in 2002/03
2005-2006	28	336	252	12	9	1-Dec-05	Eastern inshore boundary extended westward to meet Western inshore boundary. South Shore open for inshore fishery - boundary between West and East, Devonshire Bay.
2006-2007	28	336	252	12	9*	1-Dec-06	Same as 2005/06 *participants were allowed to keep all 12 traps after 1-Dec but 3 traps had to remain offshore.
2007-2008	28	336	252	12	9*	1-Dec-07	Same as 2006/07 *as above
2008-2009	31	341	279	11	9*	1-Nov-08	Same as 2007/08 *6 traps allowed inside 1-Nov.; 9 traps allowed inside 1-Dec, 2 traps offshore
2009-10, 2010-11	30	330	330	11	11*	1 September	*5 traps allowed inside 1-Sept; All 11 traps allowed inside 1-Dec. Boundaries of reservoir changed slightly, expanding both East and West inshore areas.
2011-2012	30*	348	348	12	12**	1-Sep-11	*29 allotments. 28 participants with a full allotment and 2 participants sharing; **5 traps per fisher allowed inside 1-Sept; 12 traps allowed inside 1-Dec. Inshore areas as previous.
2012-2013	29*	336	348	12	12**	1-Sep-12	*28 allotments. 27 participants with a full allotment and 2 participants sharing. 1 participant suspended; **5 traps per fisher allowed inside 1-Sept; 12 traps allowed inside 1-Dec. Inshore areas as previous.
2013-2014	29	348	348	12	12*	1-Sep-13	29 allotments. 1 participant suspended first half; *5 traps per fisher allowed inside 1-Sept; 12 traps allowed inside 1-Dec. Inshore areas as previous.
2014-15, 2015-16	29	348	348	12	12*	1 September	29 allotments. *5 traps per fisher allowed inside 1-Sept; 12 traps allowed inside 1-Dec. Inshore areas as previous.
2016-2017	29	348	348	12	12*	1-Sep-16	29 allotments. *5 traps per fisher allowed inside 1-Sept; 12 traps allowed inside 1-Dec. Inshore areas as previous.

Table 2. Lobster fishery catch and effort over time.

Total

Year	No. of Hauls	Mean Soak Days	No. of Legals	No. of Shorts	Mean CPUE
1996-97	10468	3.7	27544	12709	2.86
1997-98	12152	3.4	26178	3329	2.38
1998-99	14101	3.5	32725	7095	2.48
1999-00	14235	3.6	36515	9356	2.60
2000-01	12076	4.1	19147	4594	1.61
2001-02	8318	4.3	17393	5189	2.18
2002-03	10022	3.9	23377	5260	2.43
2003-04	10457	4.4	28051	6863	2.69
2004-05	11328	4.6	20392	4307	1.82
2005-06	10937	4.8	23756	5349	2.20
2006-07	11497	5.1	26745	4960	2.29
2007-08	12237	4.8	26059	4570	2.10
2008-09	11766	4.8	27367	6588	2.32
2009-10	11332	5.3	30156	7623	2.69
2010-11	11461	5.3	30460	8707	2.75
2011-12	12287	5.4	37323	10592	3.08
2012-13	11560	5.5	36642	10725	3.32
2013-14	13021	4.9	30052	6406	2.34
2014-15	12990	5.0	28632	6281	2.25
2015-16	13040	5.3	27823	5773	2.15
2016-17	12172	5.4	23792	5625	1.95

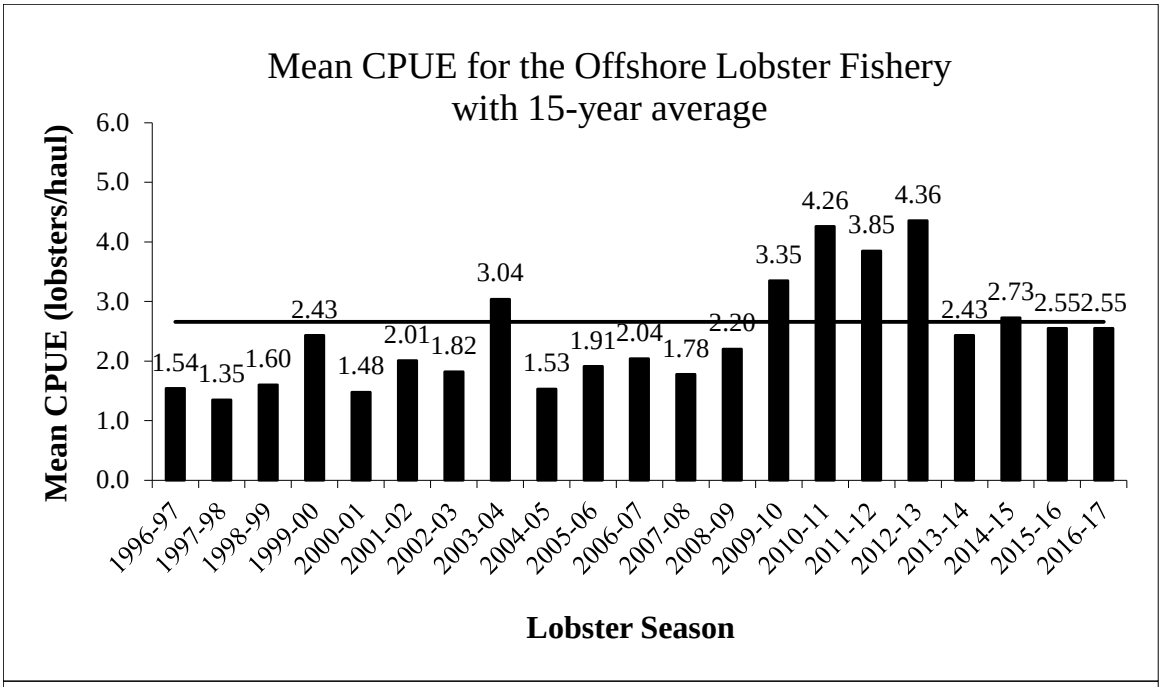
Offshore

Year	No. of Hauls	Mean Soak Days	No. of Legals	No. of Shorts	Mean CPUE	
1996-97	5557	4.8	8155	8198	1.54	
1997-98	5999	4.1	7671	2008	1.35	
1998-99	5881	4.1	8608	3143	1.60	
1999-00	6043	4.2	14441	5407	2.43	
2000-01	5714	4.9	8308	2826	1.48	
2001-02	4427	5.6	8480	3226	2.01	
2002-03	4447	4.9	8026	2964	1.82	
2003-04	3809	5.5	11115	4103	3.04	Sept. 03 - Fabian
2004-05	5852	4.5	8999	2398	1.53	
2005-06	4883	5.2	9253	3355	1.91	
2006-07	4828	5.7	10025	2886	2.04	
2007-08	5915	5.3	10557	2863	1.78	
2008-09	4619	5.0	11249	4000	2.20	
2009-10	3051	5.8	10304	4049	3.35	
2010-11	3253	5.6	12899	5514	4.26	Sept. 10 - Igor
2011-12	4054	5.7	15561	6549	3.85	
2012-13	4278	5.6	18123	7731	4.36	
2013-14	4645	5.1	11156	3907	2.43	
2014-15	3739	5.4	10203	3367	2.73	Oct. - Fay, Gonzalo
2015-16	4379	5.5	11160	3255	2.55	Oct. - Joaquim
2016-17	4200	5.4	10708	3206	2.55	Oct - Nicole

Inshore

Year	No. of Hauls	Mean Soak Days	No. of Legals	No. of Shorts	Mean CPUE
1996-97	4911	2.8	19389	4511	3.92
1997-98	6153	3.0	18507	1321	3.10
1998-99	8220	3.1	24117	3952	2.96
1999-00	8192	3.2	22074	3949	2.70
2000-01	6362	3.6	10839	1768	1.70
2001-02	3891	3.5	8913	1963	2.29
2002-03	5575	3.4	15351	2296	2.75
2003-04	6648	3.9	16926	2760	2.52
2004-05	5476	4.6	11393	1909	2.07
2005-06	6054	4.4	14503	1994	2.39
2006-07	6669	4.5	16720	2074	2.51
2007-08	6322	4.3	15502	1707	2.45
2008-09	7147	4.6	16118	2588	2.26
2009-10	8281	5.1	19852	3574	2.48
2010-11	8208	5.2	17561	3193	2.32
2011-12	8233	5.2	21762	4043	2.84
2012-13	7282	5.5	18519	2994	2.74
2013-14	8376	4.8	18896	2499	2.32
2014-15	9251	4.9	18429	2914	2.13
2015-16	8661	5.4	16663	2518	2.05
2016-17	7972	5.4	13084	2419	1.64

Figure 1. Catch Per Unit Effort (CPUE) over time



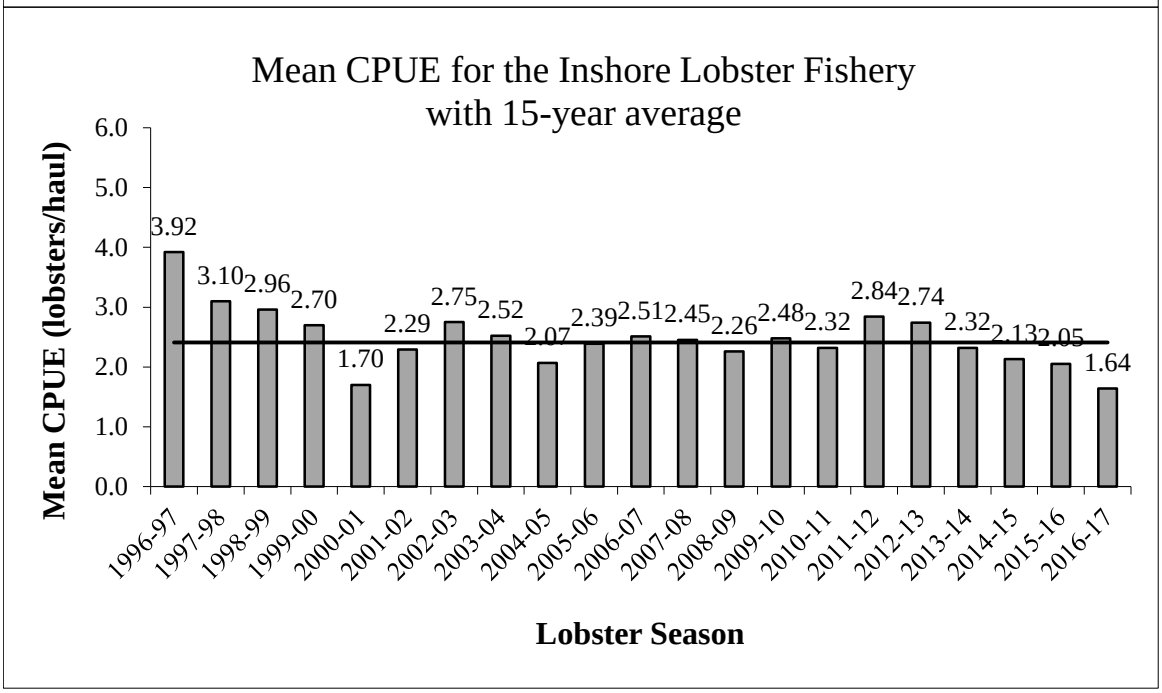


Figure 2. Comparison of harvest, effort and CPUE between offshore and inshore areas for 2016-2017

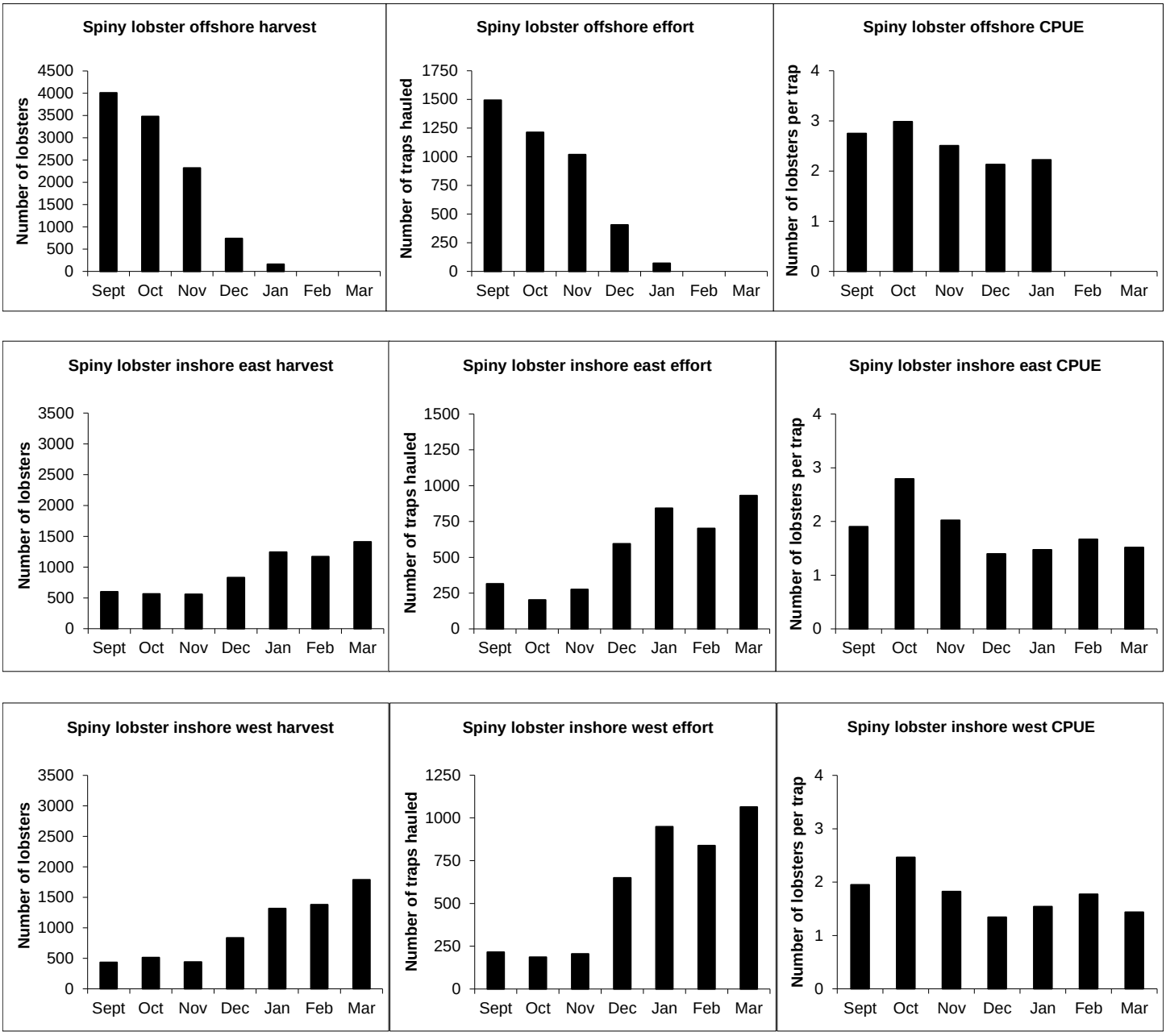


Figure 3. Variation in Catch Per Unit Effort in different areas through the season

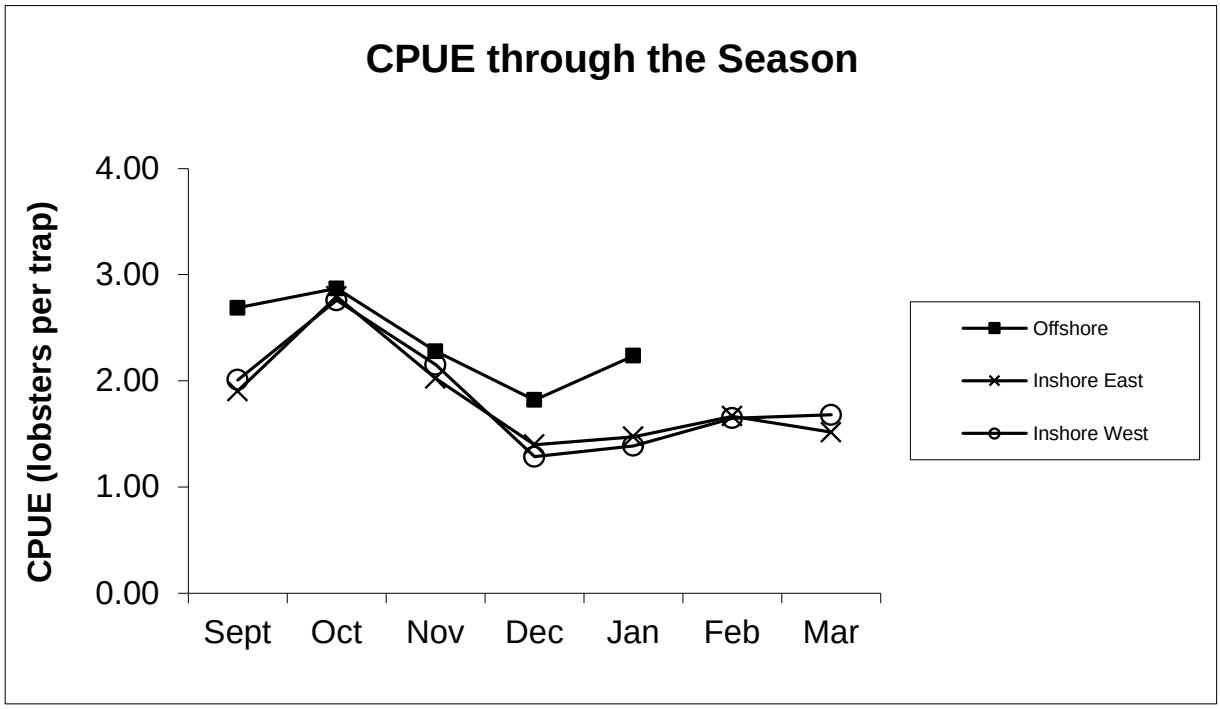


Figure 4. Percentages of legal versus undersized lobsters captured offshore versus inshore

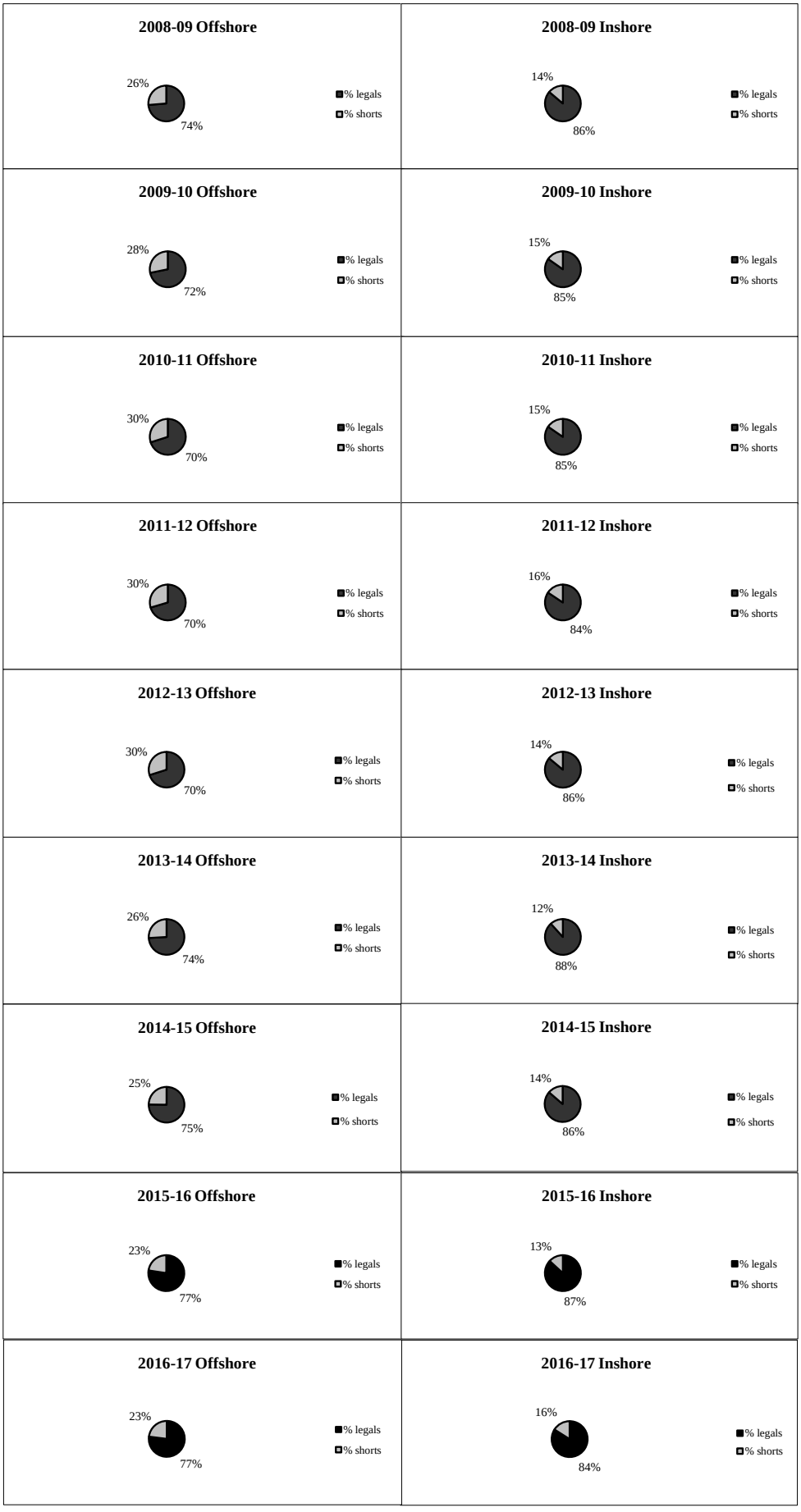


Figure 5. Offshore population structure from landings

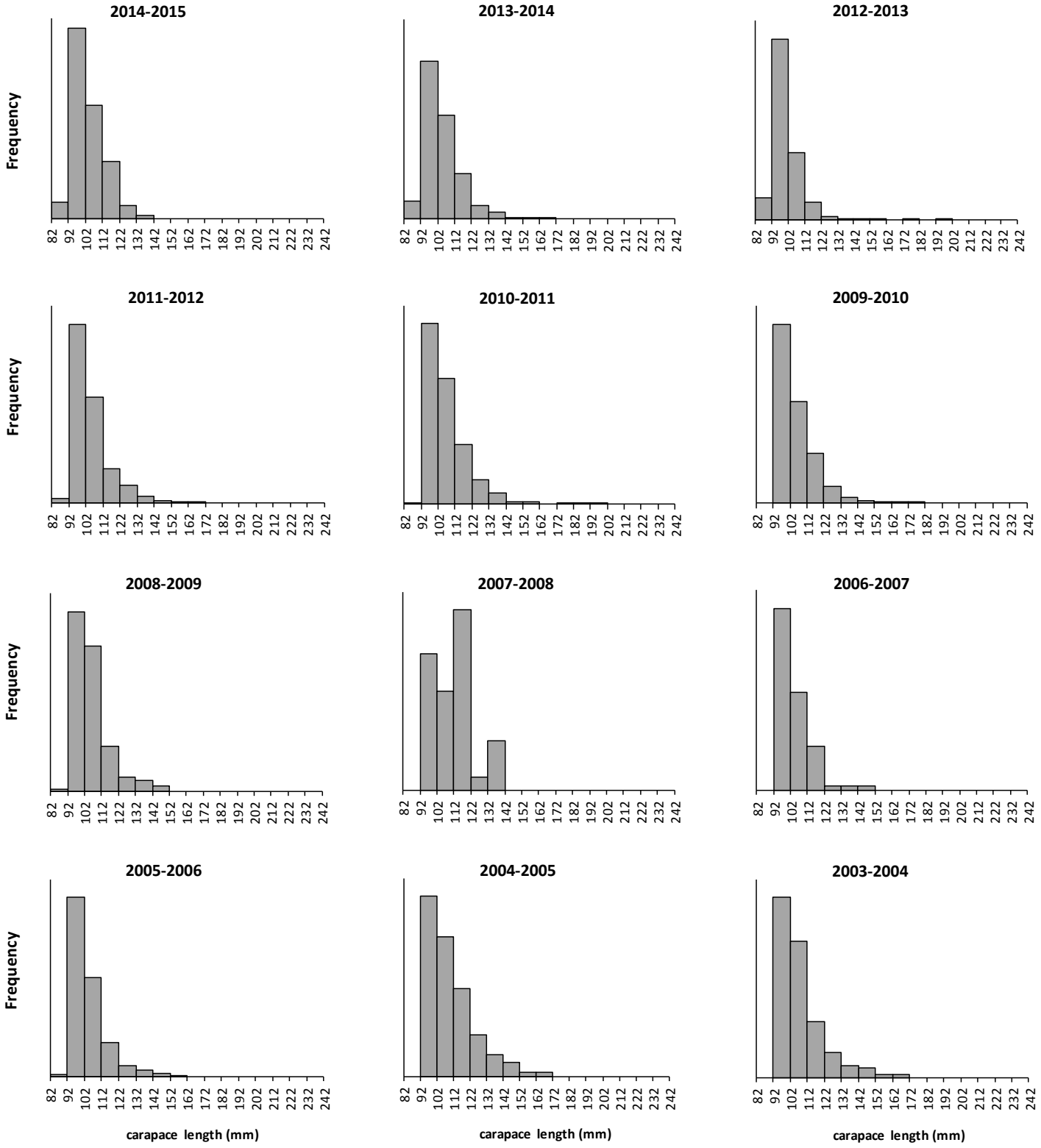


Figure 6. Inshore population structure from landings