

Victorian Rock Lobster Fishery

Stock Assessment Report 2014/15 Season

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VICTORIAN ROCK LOBSTER FISHERY STOCK ASSESSMENT REPORT: 2014/15 SEASON

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SUMMARY

Western Zone

In 2014/15, the catch in Western Zone Rock Lobster Fishery over the fishing year (November – September) was 224 tonnes (t). This was the sixth consecutive season that the total allowable commercial catch (TACC) was fully taken. The TACC is set for a quota year (June – July) and was 230 t in 2014/15 (decreased from 260 t in 2013/14). Effort required to take the fishing year catch was 416,000 potlifts.

The newly proposed harvest strategy for the fishery uses standardised catch per unit effort (CPUE) as a primary indicator of rock lobster abundance¹. All references to CPUE in this report are therefore standardised values. Between 1991/92 to 2003/04, CPUE was relatively stable at 0.47–0.62 kg/potlift, but then progressively declined over the next five years to an all-time low of 0.34 kg/potlift in 2008/09. Between 2009/10 and 2013/14, CPUE recovered to 0.48 kg/potlift, but in 2014/15 decreased to 0.46 kg/potlift.

While CPUE has increased over recent seasons, the abundance of undersized lobsters obtained from fixed-site surveys, as well as modelled estimates of recruitment, indicate that recruitment levels to the fishery have been low since 2010/11. The 2014/15 estimate of undersized lobsters was 0.85 undersized/potlift, the lowest on record. Mean weight of legal sized lobsters has also increased over the last four seasons, providing further evidence that recruitment into the fishery is currently low.

The fishery stock assessment model estimated egg production in 2014/15 at 69% of the egg production in the 2001/02 reference year (based on 90% probability). This was well above the limit reference point of 35%.

In 2014/15, the available biomass was estimated to be 650 tonnes, with a corresponding fishing exploitation rate of 34.4%.

In summary, despite some increases in CPUE in recent seasons, current catch rates remain low historically. Combined with signals of reduced recruitment in the short-to-medium term, this report confirms that conservative TACCs are warranted to maintain the resource on which the Western Zone rock lobster fishery depends.

Eastern Zone

In 2014/15, the fishing year catch in the Eastern Zone Rock Lobster Fishery was 57 t. This reflected the fifth consecutive season that the TACC was fully taken (the quota year TACC was 59 t). Effort required to take the fishing year catch was 109,000 potlifts.

Standardised CPUE increased from 0.38 kg/potlift in 2008/09 to 0.59 kg/potlift in 2013/14. In 2014/15, it decreased to 0.55 kg/potlift.

¹ Note that standardised CPUE values have been scaled to enable a TACC determination under the newly proposed harvest strategy and therefore are slightly different to previous stock assessment reports.

As in the Western Zone, while CPUE has increased in recent seasons, the abundance of undersized lobsters obtained from fixed-site surveys and modelled estimates of recruitment indicate that recruitment levels to the fishery have also been low in recent seasons. The 2014/15 estimate of undersized lobsters was 0.03 undersized/potlift, which is the lowest on record. Further, mean weight of legal sized lobsters has also increased over the last three seasons.

The current stock assessment model estimated egg production in 2014/15 at 155% of the level of egg production in the reference year of 2001/02 (based on 90% probability). This estimate is well above the limit reference point of 104% of egg production in 2001/02. In 2014/15, the available biomass was estimated to be 319 tonnes, with a corresponding fishing exploitation rate of 17.8%.

In summary, as with the Western Zone fishery, despite recent increases in CPUE in the Eastern Zone fishery, information on future recruitment indicates that careful consideration of TACCs are warranted in the short-to-medium term.

INTRODUCTION

The *Victorian Rock Lobster Fishery Management Plan* requires annual assessment of the southern rock lobster (*Jasus edwardsii*) stock in Victoria to enable review of the Total Allowable Commercial Catch (TACC) (Department of Primary Industries 2009).

The primary control tool for the fishery is individual catch quotas, where each licence holder is annually assigned a proportion of the TACC through individual transferable quota units.

Catch Rate Standardisation

The stock assessment model uses standardised CPUE (Walker *et al.* 2012). All catch and effort data are obtained from mandatory logbook returns and are firstly checked for any errors before being entered into the Fisheries Victoria rock lobster database. Prior to standardisation, the data are filtered to ensure that only data from fishers contributing returns in more than two separate fishing years and contributing 200 or more records are included in the CPUE standardisation. CPUE is then standardised for each zone separately by adjusting for average long-term differences among the regions, depth ranges, fishing seasons, months, fishers and vessels. For standardisation, the regions are Portland, Warnambool and Apollo Bay in the Western Zone, and Queenscliff, San Remo and Lakes Entrance in the Eastern Zone. The fishing depth ranges are <40 m and ≥40 m. Only interactions between region and year are now included, which permits yearly estimates of standardised CPUE by region.

Stock Assessment Model

The stock assessment uses a model that has been designed for rock lobster fisheries in Victoria, South Australia, and Tasmania. It was developed through CSIRO and a series of FRDC projects (Hobday and Punt 2001; Hobday and Punt 2009; Hobday *et al.* 2005). The model is length-structured and currently set up in Victoria to account for numbers of rock lobsters in 5-mm-carapace length-classes.

The model infers change and absolute levels of stock abundance from three principal data sources: (i) standardised CPUE, to which biomass is assumed to vary in direct proportion, (ii) catches in both weight and number, which provide a highly precise measure of mean weight of lobsters in the catch, and (iii) length-frequency data interpreted in combination with the length-transition matrices to yield estimates of mortality rate and absolute biomass.

Recruitment in the model is dependent on changes in mean size and size distribution of the catch from length-frequency data, and on changes in CPUE, where, for example, a rise in CPUE and a

decrease in mean size signals an increase in recruitment and visa-versa. For males and females separately, the model tracks, for each month, the number of rock lobsters in the population of size equal to or larger than 60 mm carapace length. The model also accounts for both natural mortality and fishing mortality.

Growth is modelled using length-transition matrices that specify the proportion of lobsters in each length category that grow into larger length classes during each summer and autumn moulting period. Growth in the model is sex specific, as is length-selectivity. Catchability by month is non-sex specific. The length-transition matrices were estimated using extensive tag-recovery data.

STOCK ASSESSMENT RESULTS

Western Zone Stock Assessment

In the 2014/15 fishing year (Nov-Sept), 224 t of rock lobsters were harvested (Table 1, Figure 1). The TACC was reduced over a 10 year period following its introduction in 2001/02 at 450 t and has ranged between 230 t and 260 t for the past six fishing years (Table 2).

Effort levels have not decreased at the same rate as catch, averaging approximately 667,000 potlifts from 2001/02 to 2008/09. Since 2010/11 however, effort has declined and in 2014/15 was 416,000 potlifts.

The newly proposed harvest strategy for the fishery uses standardised catch per unit effort (CPUE) as a primary indicator of rock lobster abundance. All CPUE values reported in the text are therefore standardised values. Between 1991/92 to 2003/04, CPUE was relatively stable at 0.47–0.62 kg/potlift, but then progressively declined over the next five years to an all-time low of 0.34 kg/potlift in 2008/09. Between 2009/10 and 2013/14, CPUE recovered to 0.48 kg/potlift, but in 2014/15 decreased to 0.46 kg/potlift (Figure 2).

Within the regions, the highest catch in 2014/15 came from the Portland region (101 t), followed by Warrnambool (81 t) and Apollo Bay (42 t). Standardised catch rates in Portland and Apollo Bay remained relatively stable while declines over the last two seasons were evident in Warrnambool (Figure 3), where effort has been rising over the last three seasons.

Despite increases in CPUE, the abundance of undersized lobsters obtained from fixed-site surveys, as well as modelled estimates of recruitment, indicate that recruitment levels to the fishery have been low in recent seasons (Figures 4 and 5). The survey catch rate of undersized lobsters has declined over the last four seasons, with the 2014/15 estimates of 0.85 undersized/potlift, the lowest on record (Figure 4). Mean weight of legal sized lobsters has also increased over the last four seasons, providing further evidence that recruitment into the fishery is currently low (Figure 6). In addition, mean weight is likely rising due to lower yearly effort inducing lower levels of exploitation, allowing lobsters to survive and grow to a larger size prior to harvest.

The current stock assessment model estimated egg production in 2014/15 at 69% of the level of egg production in the reference year of 2001/02. This estimate is well above the limit reference point of 35% of egg production in 2001/02 (Figure 7) by more than 90% probability.

In 2014/15, the available biomass was estimated to be 650 tonnes, with a corresponding fishing exploitation rate of 34.4% (Figure 8).

Length frequency data (used as input to the fishery model) from both the onboard observer and fixed site sampling sources in the Western Zone are provided in Figures 9 through to 12.

Eastern Zone Stock Assessment

Since the implementation of a TACC in 2001, catches in the Eastern Zone have ranged between 39 t (2008/09) and 66 t (2010/11) (Table 3, Figure 13). In 2014/15, the fishing year catch (Nov-Sept) was 57 tonnes. This reflected the fifth consecutive season that the TACC was fully taken (Table 4). Effort required to take the fishing year catch was 109,000 potlifts (Table 3).

Between 2008/09 and 2013/14 standardised CPUE improved from 0.38 kg/potlift to 0.59 kg/potlift (Figure 14). In 2014/15, it decreased to 0.55 kg/potlift. The breakdown of catch within the regions was consistent with that of previous years, with the majority of catch coming from Queenscliff and San Remo (Figure 15). Between 2013/14 and 2014/15, standardised CPUE decreased in Queenscliff and San Remo, and increased in Lakes Entrance.

While CPUE levels have improved in the Eastern Zone, trends in undersized lobsters obtained from fixed-site surveys and levels of modelled recruitment suggest that recruitment levels to the fishery have been low for the past four to five seasons (Figures 16 and 17). The abundance of undersized lobsters has declined over the last three seasons, with the 2014/15 estimates of 0.03 undersized/potlift, the lowest on record. As in the Western Zone, mean weight of legal sized lobsters in the Eastern Zone has also increased over the last four seasons (Figure 18).

The current stock assessment model estimated egg production in 2014/15 at 155% of the level of egg production in the reference year of 2001/02. This estimate is well above the limit reference point of 104% of egg production in 2001/02 (Figure 19), exceeding it by more than the 90% probability threshold.

In 2014/15, the available biomass was estimated to be 319 tonnes, with a corresponding fishing exploitation rate of 17.8% (Figure 20).

Length frequency data (used as input to the fishery model) from both the onboard observer and fixed site sampling sources in the Eastern Zone are provided in Figures 21 through to 24.

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WESTERN ZONE

Table 1. Western Zone catch, fishing effort and CPUE (Fishing Year: November-September; SRL: Southern rock lobster; CPUE: Catch per unit effort).

Fishing Year	Catch (tonne)	Catch ('000)	Nominal effort ('000 potlifts)	Nominal CPUE (kg per potlifts)	Standardised CPUE (kg per potlifts)	Mean mass of SRL (kg)
1951-52	102		42	2.41		
1952-53	132		54	2.43		
1953-54	177		69	2.56		
1954-55	292		115	2.54		
1955-56	177		87	2.03		
1956-57	134		75	1.79		
1957-58	152		93	1.64		
1958-59	147		84	1.75		
1959-60	182		104	1.75		
1960-61	268		138	1.95		
1961-62	396		202	1.96		
1962-63	326		226	1.44		
1963-64	279		201	1.39		
1964-65	233		175	1.33		
1965-66	325		250	1.30		
1966-67	308		288	1.07		
1967-68	372		373	1.00		
1968-69	413		455	0.91		
1969-70	430		495	0.87		
1970-71	441		497	0.89		
1971-72	458		583	0.79		
1972-73	463		638	0.73		
1973-74	429		555	0.77		
1974-75	286		430	0.67		
1975-76	303		406	0.75		
1976-77	339		464	0.73		
1977-78	309		433	0.71		
1978-79	486	485	622	0.78	1.04	1.00
1979-80	453	444	576	0.79	0.89	1.02
1980-81	549	548	680	0.81	0.89	1.00
1981-82	499	499	637	0.78	0.85	1.00
1982-83	460	455	608	0.76	0.88	1.01
1983-84	421	414	571	0.74	0.80	1.02
1984-85	406	394	578	0.70	0.73	1.03
1985-86	345	346	569	0.61	0.63	1.00
1986-87	351	353	595	0.59	0.63	0.99
1987-88	345	349	557	0.62	0.62	0.99
1988-89	304	322	577	0.53	0.55	0.94
1989-90	331	355	613	0.54	0.56	0.93
1990-91	317	337	650	0.49	0.52	0.94
1991-92	408	439	712	0.57	0.62	0.93
1992-93	408	433	779	0.52	0.59	0.94
1993-94	448	456	754	0.59	0.61	0.98
1994-95	435	444	789	0.55	0.54	0.98
1995-96	423	442	761	0.56	0.53	0.96
1996-97	402	414	787	0.51	0.47	0.97
1997-98	466	492	841	0.55	0.51	0.95
1998-99	516	568	861	0.60	0.57	0.91
1999-00	521	592	897	0.58	0.54	0.88
2000-01	525	598	895	0.59	0.53	0.88
2001-02	438	510	704	0.62	0.57	0.86
2002-03	430	495	630	0.68	0.60	0.87
2003-04	461	515	659	0.70	0.60	0.89
2004-05	408	451	667	0.61	0.53	0.90
2005-06	358	405	705	0.51	0.43	0.88
2006-07	336	392	698	0.48	0.43	0.86
2007-08	289	338	668	0.43	0.37	0.85
2008-09	235	268	606	0.39	0.34	0.88
2009-10	239	277	650	0.37	0.35	0.86
2010-11	254	307	590	0.43	0.41	0.83
2011-12	233	279	475	0.49	0.45	0.83
2012-13	259	296	485	0.53	0.47	0.87
2013-14	269	299	486	0.55	0.48	0.90
2014-15	224	242	416	0.54	0.46	0.93

Data Source: Fisheries Victoria Catch and Effort Database (December 2014) for period 1978-79 to 2014-15.

Table 2. Western Zone history of TACCs for each quota period from 2001-02 to 2014-15 (TACC: Total Allowable Commercial Catch).

		TACC set (tonne)	TACC Caught		Number of months fished	Number of active licenses	Number of vessels
			(tonne)	per cent			
2001-02*	1 Nov - 31 Mar	320					
2002-03	1 Apr - 31 Mar	450	440	98	12	79	83
2003-04	1 Apr - 31 Mar	450	436	97	12	80	79
2004-05	1 Ap - 31 Mar	450	421	94	12	79	86
2005-06	1 Apr - 31 Mar	450	405	90	12	75	77
2006-07	1 Apr - 31 Mar	450	329	73	12	71	68
2007-08	1 Apr - 31 Mar	380	319	84	12	68	64
2008-09	1 Apr - 31 Mar	320	244	76	12	61	60
2009	1 Apr – 30 Jun	55.2	36	64	3	54	53
2009-10	1 Jul – 30 Jun	240	230	96	12	54	55
2010-11	1 Jul – 30 Jun	240	237	99	12	54	55
2011-12	1 Jul – 30 Jun	240	237	99	12	51	54
2012-13	1 Jul – 30 Jun	260	258	99	12	47	46
2013-14	1 Jul – 30 Jun	260	260	100	12	48	48
2014-15	1 Jul – 30 Jun	230	230	100	12	48	47

* Quota was introduced 1 November 2001 for a shortened quota period.
Data Source: Fisheries Victoria FILS Database.

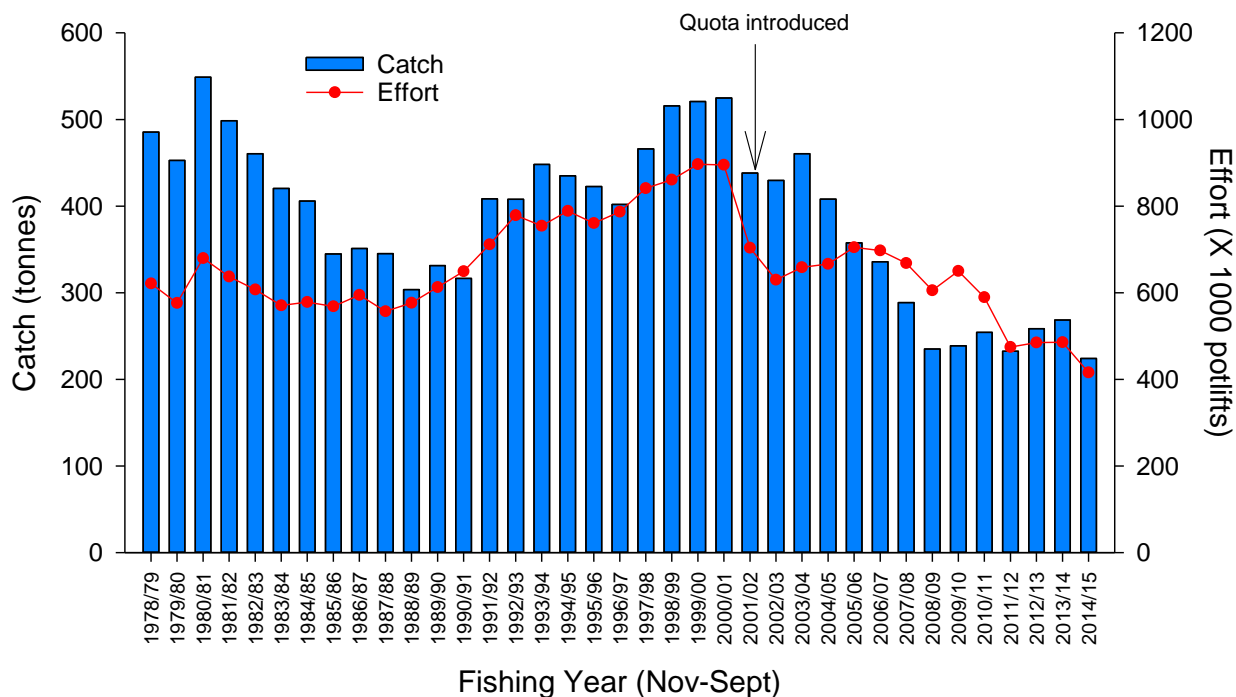


Figure 1. Total catch (tonnes) and nominal effort (x1000 potlifts) in the Western Zone from 1978/79–2014/15. Arrow indicates TACC introduction (450 t) in 2001/02.

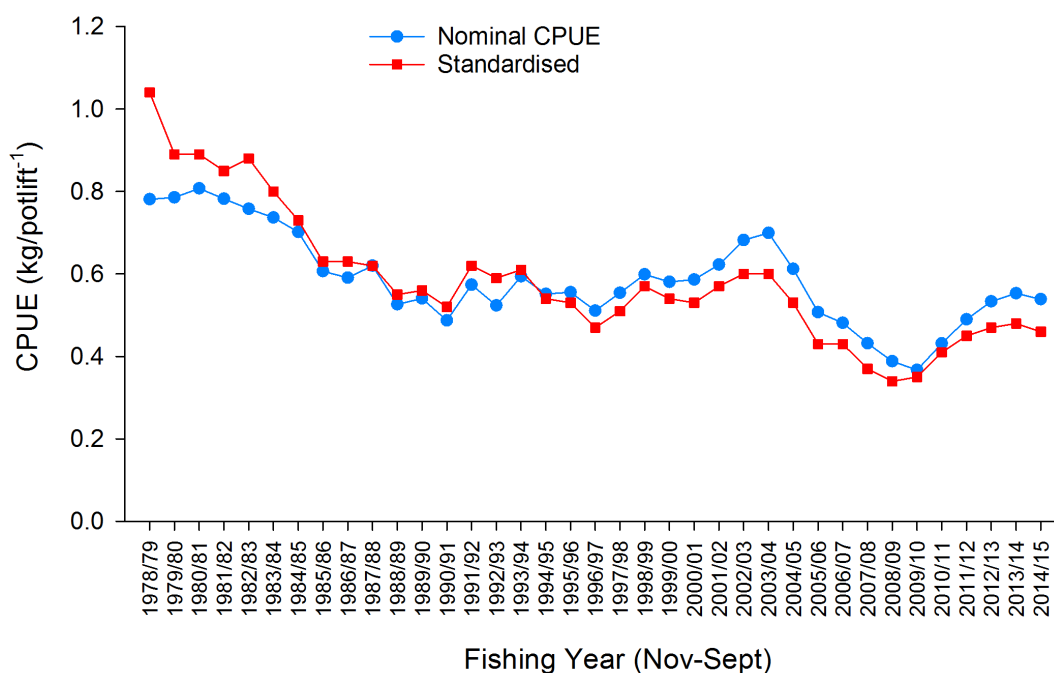


Figure 2. Standardised versus nominal CPUE (kg/potlift) in the Western Zone from 1978/79–2014/15.

Note: standardised CPUE values marginally differ from those previously presented due to the need to rescale CPUE each year so that the mean of yearly standardised CPUE equals the mean of nominal CPUE over the 1978-2013 period. This fixes the average historical level of standardised CPUE to a constant that will not change from year to year from this point forward, giving a more precise yearly zonal CPUE as input to the harvest strategy table for quota setting.

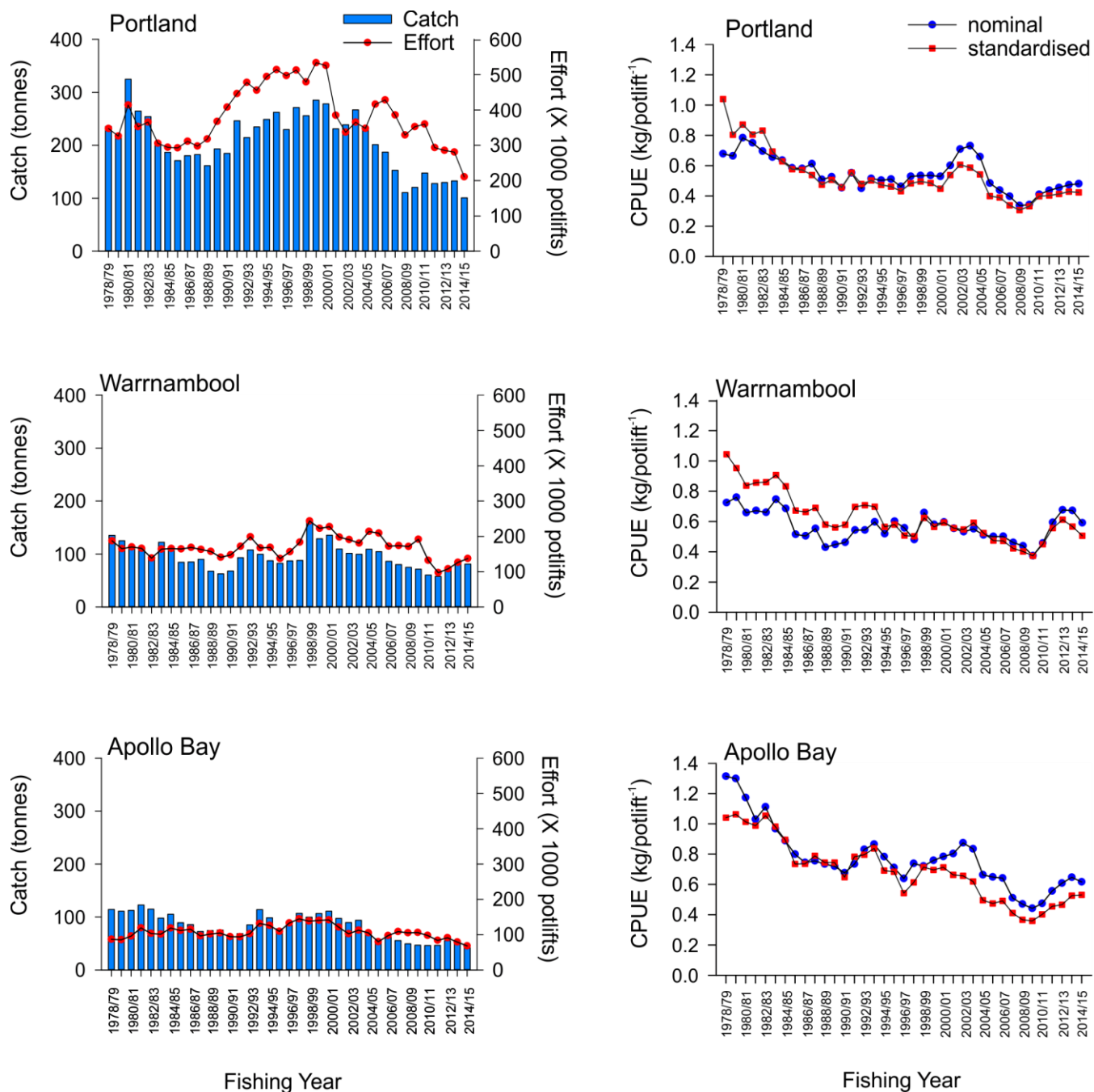


Figure 3. Regional catch (tonnes), effort (x1000 potlifts), and standardised CPUE (kg/potlift) in the Western Zone from 1978/79-2014/15.

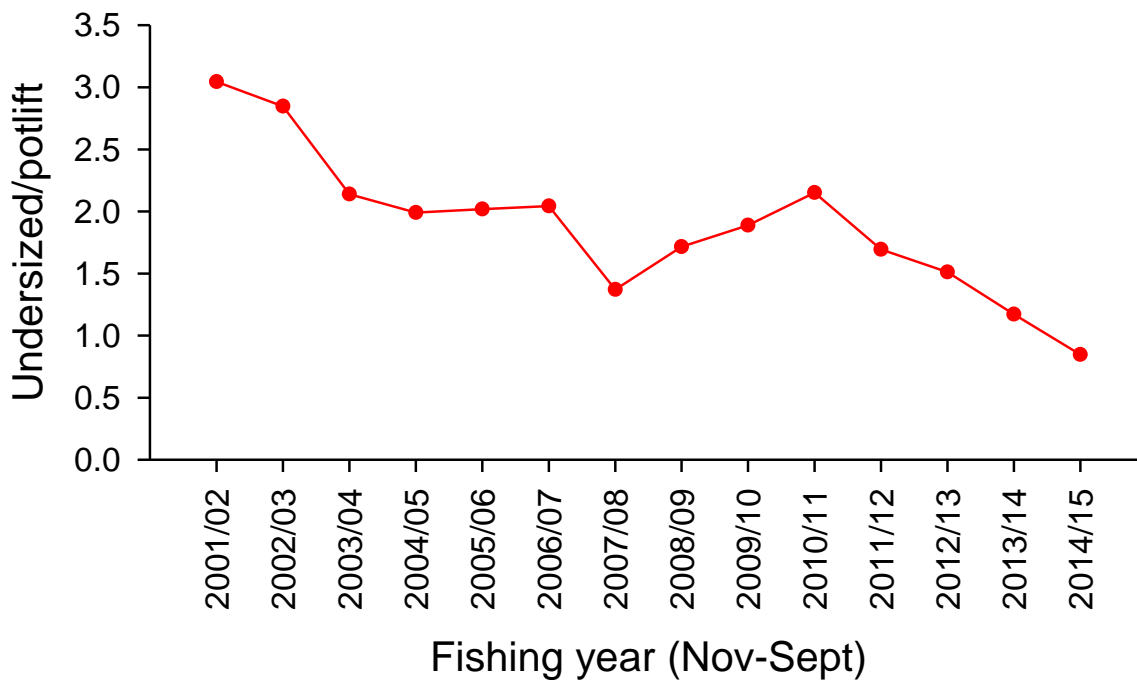


Figure 4. Number of undersized female (LML = 105 mm CL) and male (LML = 110 mm CL) lobsters per potlift combined in fixed-site surveys in the Western Zone fishery from 2001/02 to 2014/15.

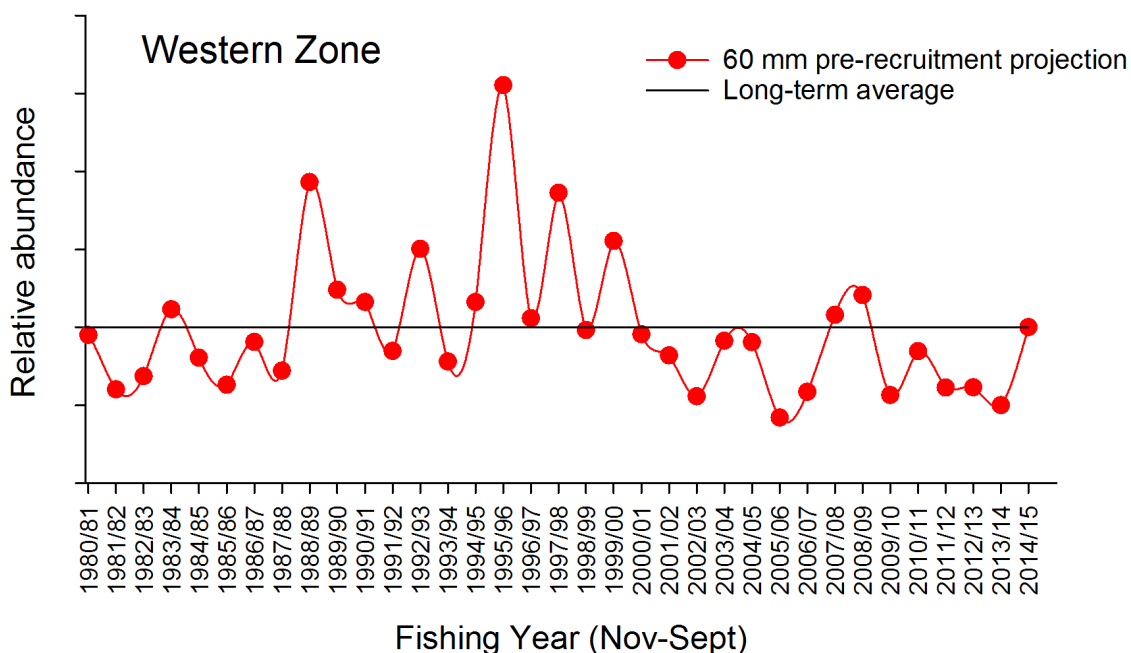


Figure 5. Relative abundance of recruits (to 60 mm in CL) in the Western Zone Fishery. These data are used in the length-frequency model. The long-term historical average is also indicated (solid black line).

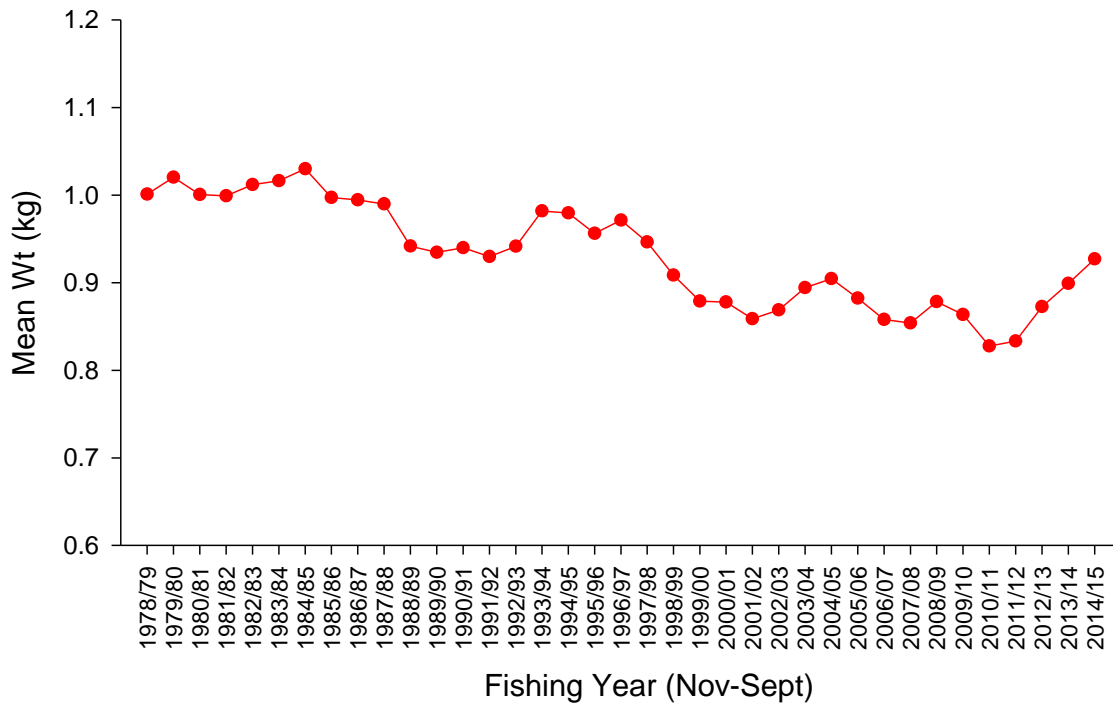


Figure 6. Mean weight of legal sized lobster in the Western Zone fishery from 1978/79 to 2014/15.

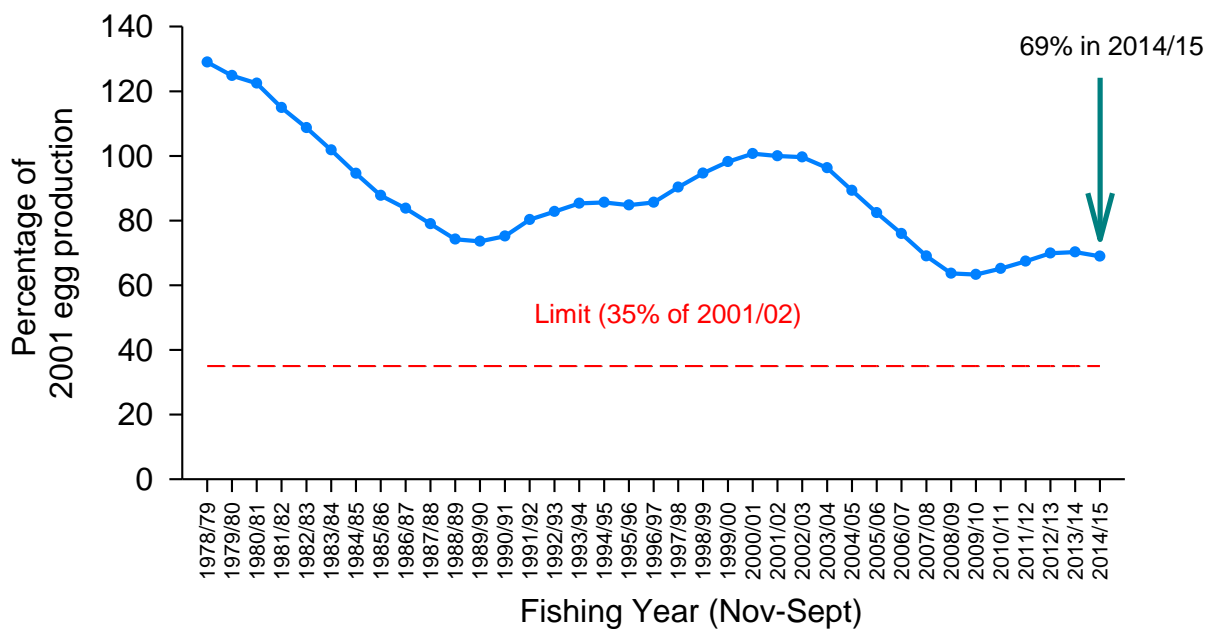


Figure 7. Model estimated level of egg production through time in the Western Zone fishery (with 90% probability; blue line) with limit reference point of 35% of egg production in 2001/02 (red line). Note, the limit reference point of 35% of egg production in 2001/02 is equivalent to the 20% of egg production estimated in 1951 (E_{1951}) as defined under the 2016 harvest strategy.

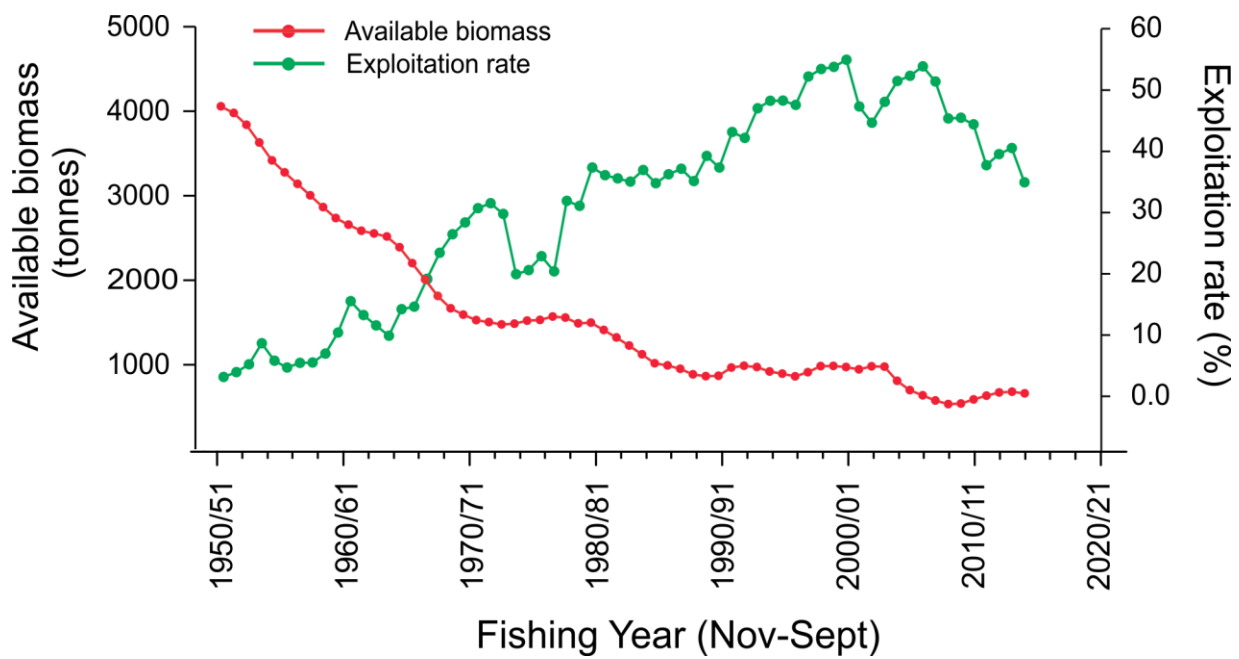


Figure 8. Model estimated levels of available biomass (solid red line) and associated fishing exploitation rates (green line) in the Western Zone fishery between 1951 and 2014.

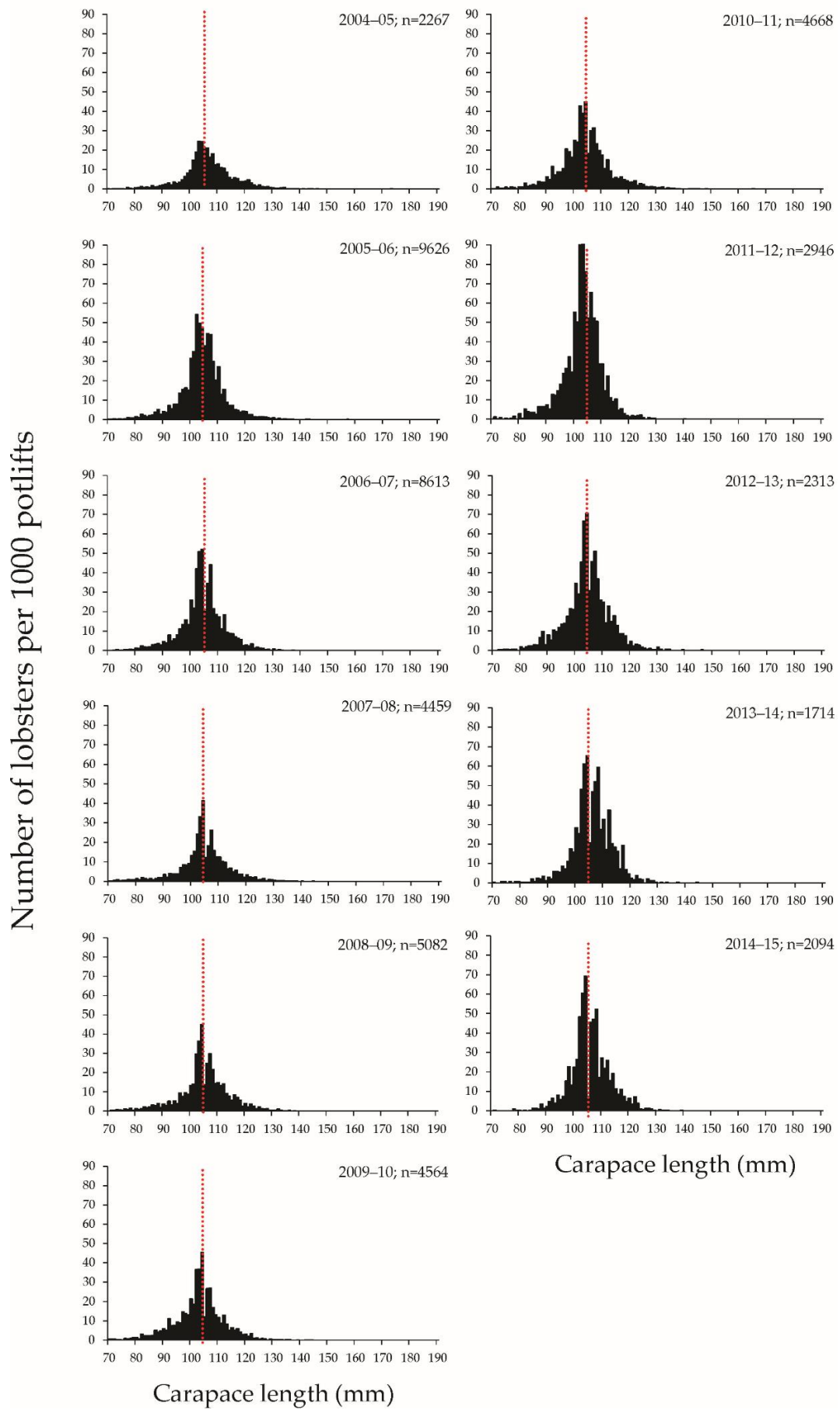


Figure 9. Length-frequency distribution of the number of female rock lobsters per 1,000 potlifts caught in the Western Zone onboard observer program from 2004–05 to 2014–15 fishing years (Nov–Sept). n, total number of lobsters measured.

Number of lobsters per 1000 potlifts

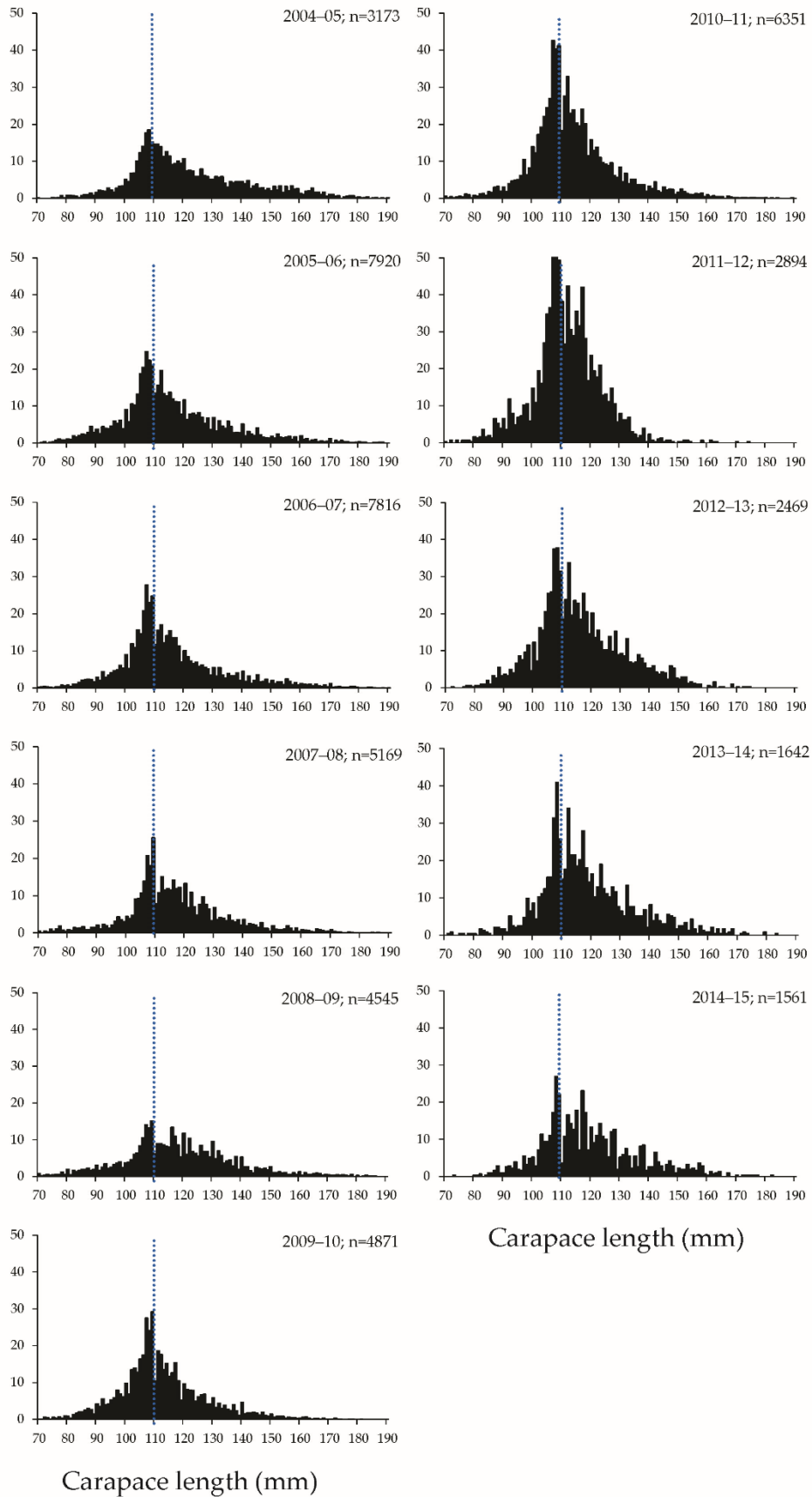


Figure 10. Length-frequency distribution of the number of male rock lobsters per 1,000 potlifts caught in the Western Zone onboard observer program from 2004–05 to 2014–15 fishing years (Nov–Sept). n, total number of lobsters measured.

Number of lobsters per 1000 potlifts

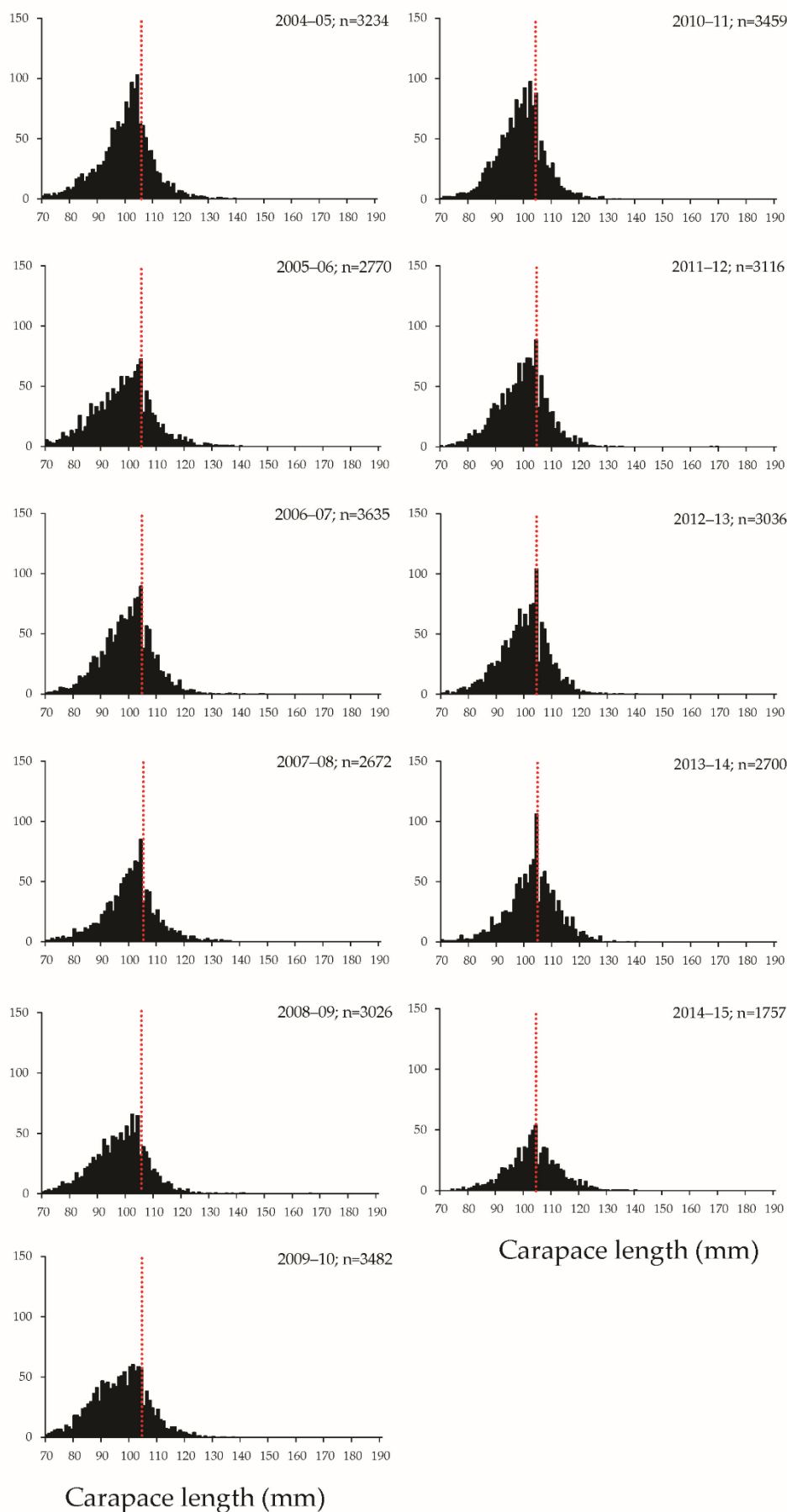


Figure 11. Length-frequency distribution of the number of female rock lobsters per 1,000 potlifts caught in the Western Zone fixed-site survey program from 1995–96 to 2014–15 fishing years (Nov–Sept). n, total number of lobsters measured.

Number of lobsters per 1000 potlifts

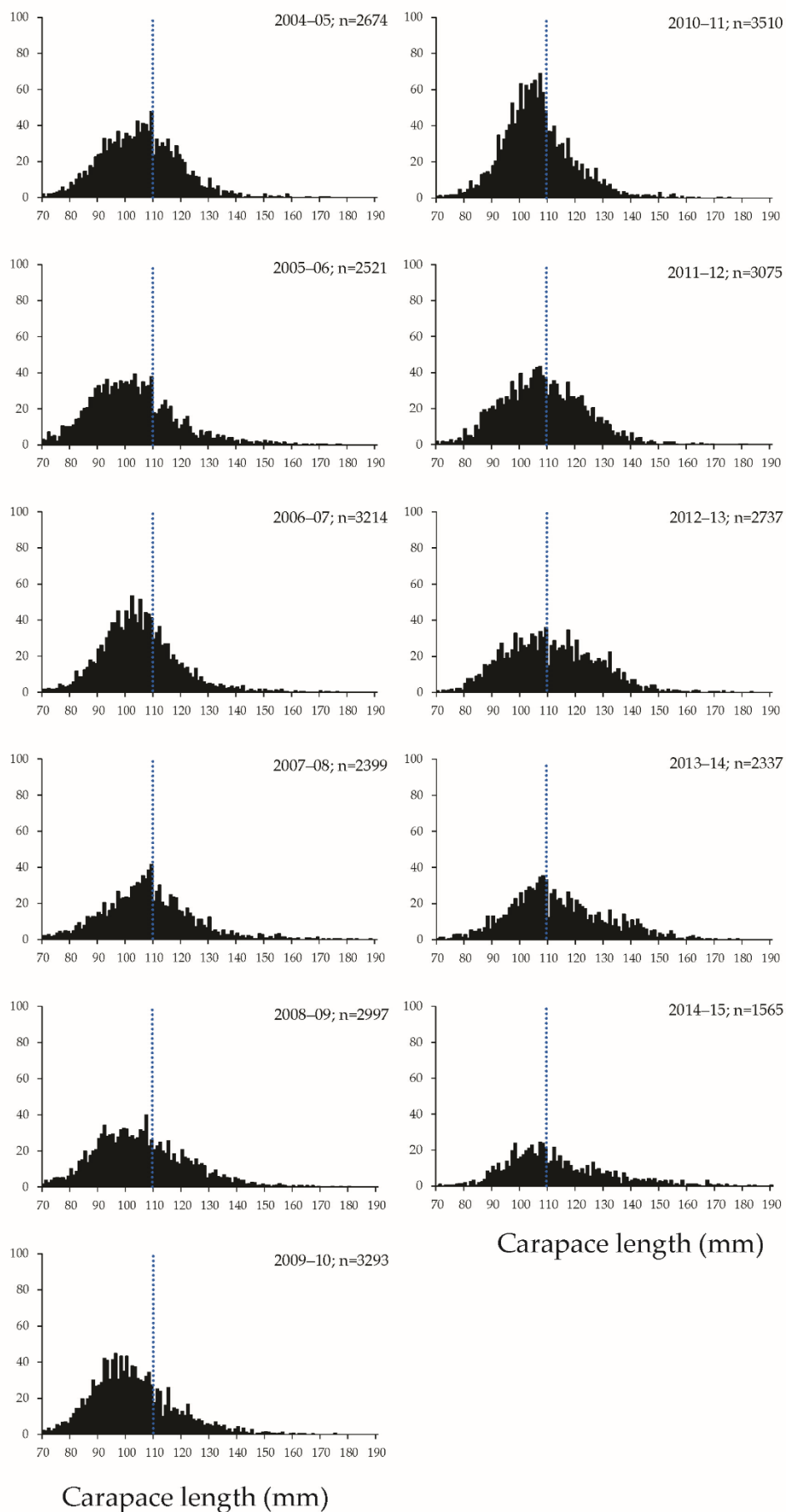


Figure 12. Length-frequency distribution of the number of male rock lobsters per 1,000 potlifts caught in the Western Zone fixed-site survey program from 1995–96 to 2014–15 fishing years (Nov–Sept). n, total number of lobsters measured.

EASTERN ZONE

Table 3. Eastern Zone catch, fishing effort and CPUE (Fishing Year: November-September; SRL: Southern rock lobster; CPUE: Catch per unit effort).

Fishing year	Catch (tonne)	Catch ('000)	Nominal effort ('000 potlifts)	Nominal CPUE (kg per potlifts)	Standardised CPUE (kg per potlifts)	Mean mass of SRL (kg)
1951-52	92		34	2.70		
1952-53	141		68	2.07		
1953-54	166		77	2.16		
1954-55	182		66	2.75		
1955-56	116		51	2.27		
1956-57	116		57	2.01		
1957-58	147		76	1.93		
1958-59	123		82	1.50		
1959-60	135		73	1.84		
1960-61	147		86	1.70		
1961-62	177		92	1.92		
1962-63	158		84	1.88		
1963-64	139		91	1.52		
1964-65	121		99	1.22		
1965-66	131		105	1.25		
1966-67	120		109	1.10		
1967-68	77		77	1.01		
1968-69	107		93	1.15		
1969-70	174		159	1.10		
1970-71	160		176	0.91		
1971-72	123		183	0.97		
1972-73	118		169	0.70		
1973-74	128		152	0.84		
1974-75	93		114	0.81		
1975-76	104		123	0.84		
1976-77	108		130	0.83		
1977-78	102		122	0.83		
1978-79	139	123	192	0.72	0.95	1.13
1979-80	116	108	171	0.67	0.73	1.07
1980-81	133	123	180	0.74	0.75	1.09
1981-82	131	120	193	0.68	0.65	1.09
1982-83	143	132	212	0.68	0.71	1.09
1983-84	136	128	230	0.59	0.65	1.06
1984-85	113	96	201	0.56	0.54	1.17
1985-86	95	81	175	0.54	0.47	1.17
1986-87	78	66	145	0.54	0.48	1.18
1987-88	70	62	130	0.54	0.42	1.13
1988-89	64	60	145	0.44	0.40	1.06
1989-90	83	85	198	0.42	0.40	0.99
1990-91	72	72	172	0.42	0.43	1.00
1991-92	65	64	175	0.37	0.38	1.02
1992-93	69	63	224	0.31	0.32	1.10
1993-94	79	68	260	0.30	0.29	1.16
1994-95	72	58	253	0.28	0.26	1.24
1995-96	57	48	220	0.26	0.25	1.19
1996-97	60	48	222	0.27	0.24	1.25
1997-98	66	54	221	0.30	0.26	1.23
1998-99	67	58	220	0.31	0.30	1.16
1999-00	75	71	232	0.32	0.31	1.05
2000-01	73	67	219	0.33	0.30	1.08
2001-02	53	50	151	0.35	0.34	1.08
2002-03	52	48	134	0.39	0.36	1.09
2003-04	56	51	133	0.42	0.40	1.09
2004-05	55	49	136	0.40	0.40	1.13
2005-06	52	46	122	0.43	0.41	1.14
2006-07	54	48	136	0.40	0.41	1.13
2007-08	46	39	123	0.37	0.38	1.19
2008-09	39	32	108	0.37	0.38	1.24
2009-10	55	50	146	0.38	0.40	1.11
2010-11	66	62	150	0.44	0.44	1.05
2011-12	62	55	114	0.54	0.54	1.13
2012-13	48	43	94	0.51	0.56	1.11
2013-14	59	48	114	0.52	0.59	1.22
2014-15	57	44	109	0.52	0.55	1.28

Data Source: Fisheries Victoria Catch and Effort Database (December 2014) for period 1978-79 to 2014-15.

Table 4. Eastern Zone history of TACCs for each quota period from 2001/02 to 2014/15 (TACC: Total Allowable Commercial Catch).

		TACC set (tonne)	TACC Caught		Number of months fished	Number of active licenses	Number of vessels
			(tonne)	Per cent			
2001-02*	1 Nov - 31 Mar	42					
2002-03	1 Apr - 31 Mar	60	49.9	83	12	39	34
2003-04	1 Apr - 31 Mar	60	54.4	91	12	41	36
2004-05	1 Apr - 31 Mar	60	53.2	89	12	41	39
2005-06	1 Apr - 31 Mar	60	55.7	93	12	30	29
2006-07	1 Apr - 31 Mar	60	53.5	89	12	30	30
2007-08	1 Apr - 31 Mar	66	50.1	76	12	31	31
2008-09	1 Apr - 31 Mar	66	41.3	63	12	26	24
2009-09	1 Apr - 30 Jun	6.9	5.8	84	3	19	20
2009-10	1 Jul - 30 Jun	66	43.9	67	12	22	21
2010-11	1 Jul - 30 Jun	66	64.8	98	12	29	28
2011-12	1 Jul - 30 Jun	66	65.3	99	12	25	26
2012-13	1 Jul - 30 Jun	48	47.3	99	12	26	25
2013-14	1 Jul - 30 Jun	51	50.8	100	12	27	27
2014-15	1 Jul - 30 Jun	59	59	100	12	25	23

* Quota was introduced 1 November 2001 for a shortened quota period.

Data Source: Fisheries Victoria FILS Database.

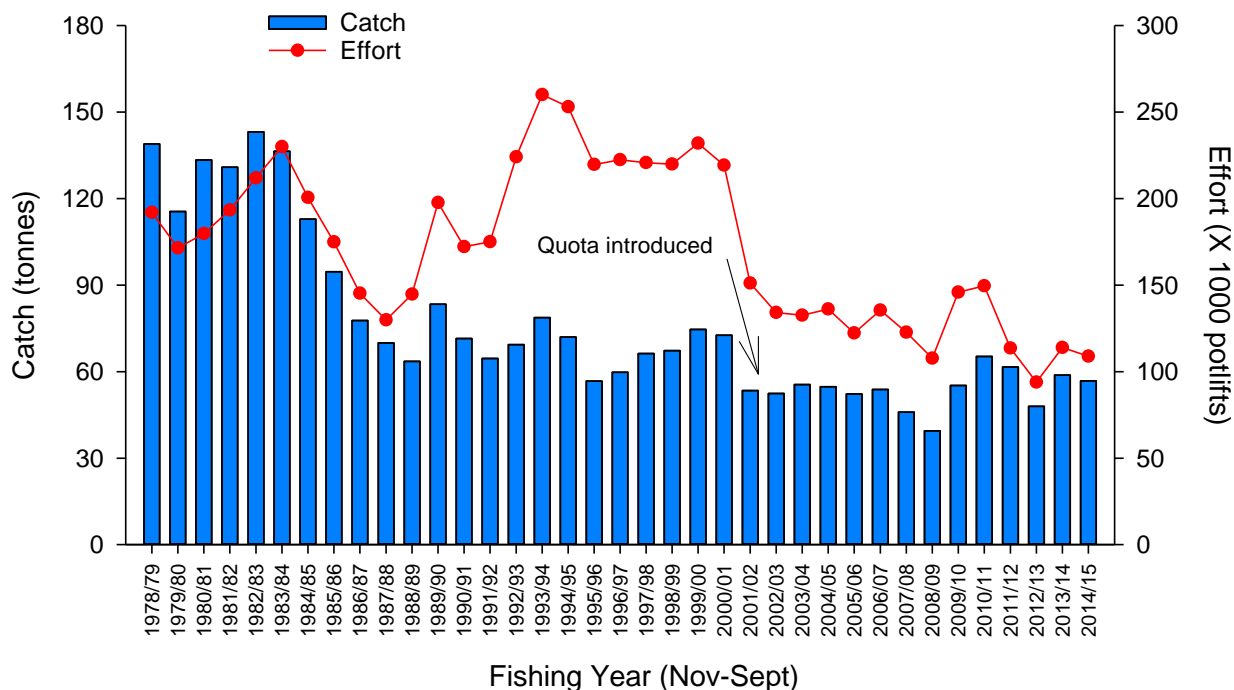


Figure 13. Total catch (tonnes) and nominal effort (x1000 potlifts) in the Eastern Zone from 1978/79–2014/15. Arrow indicates TACC introduction (60 t) in 2001/02.

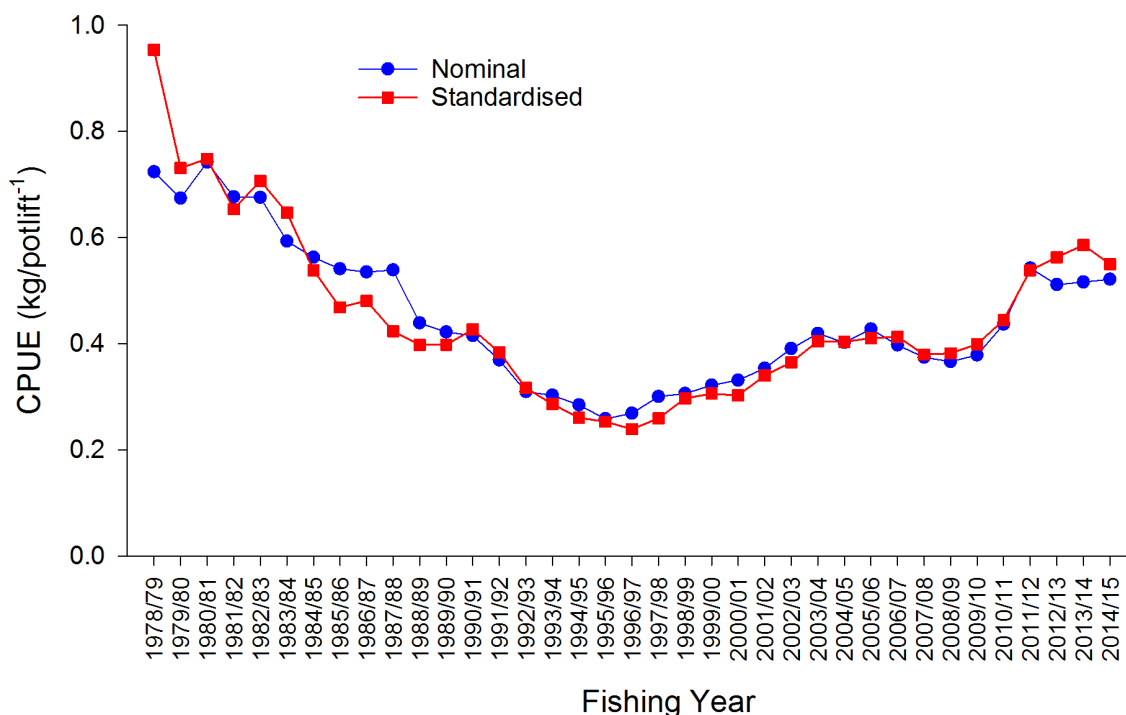


Figure 14. Standardised CPUE (kg/potlift) in the Eastern Zone from 1978/79–2014/15.

Note: standardised CPUE values marginally differ from those previously presented due to the need to rescale CPUE each year so that the mean of yearly standardised CPUE equals the mean of nominal CPUE over the 1978-2013 period. This fixes the average historical level of standardised CPUE to a constant that will not change from year to year from this point forward, giving a more precise yearly zonal CPUE as input to the harvest strategy table for quota setting.

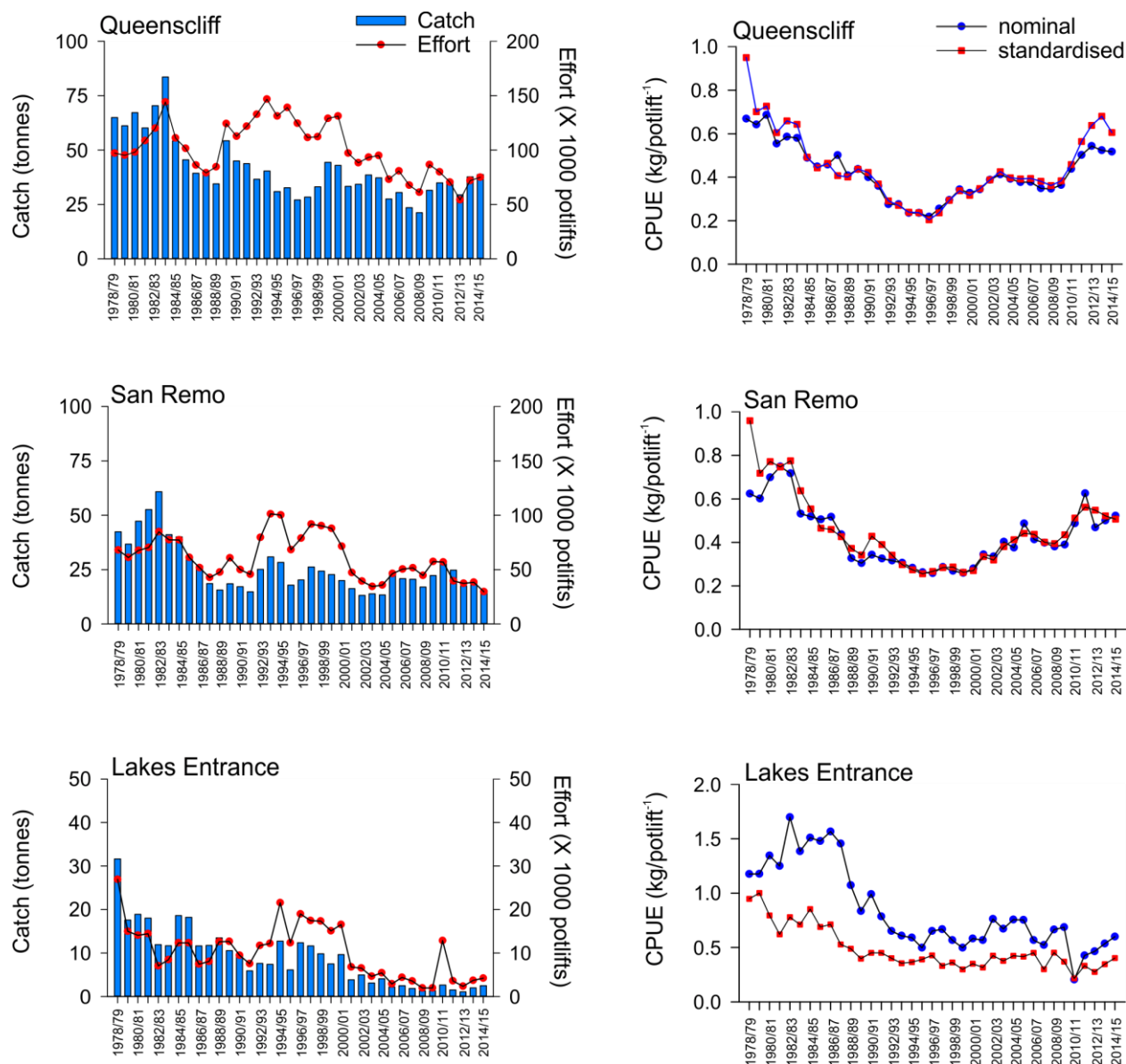


Figure 15. Regional catch (tonnes), effort (x1000 potlifts) and standardised CPUE (kg/potlift) in the Eastern Zone from 1978/79-2014/15.

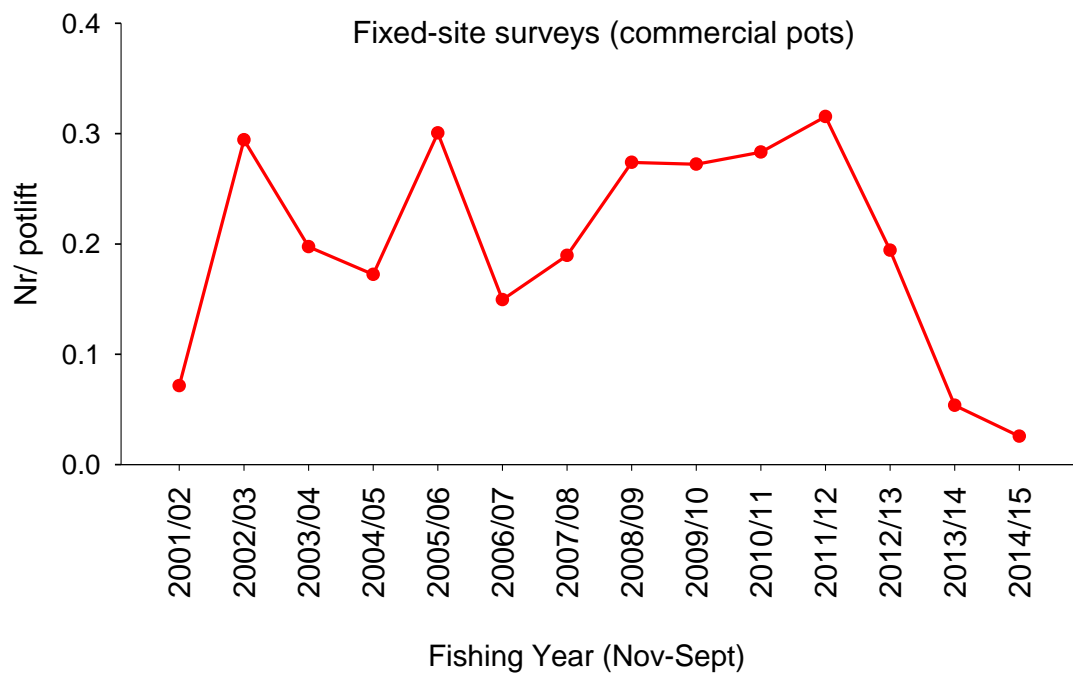


Figure 16. Number of undersized female (LML = 105 mm CL) and male (LML = 110 mm CL) lobsters per potlift combined in fixed-site surveys in the Eastern Zone fishery from 2001/02 to 2014/15

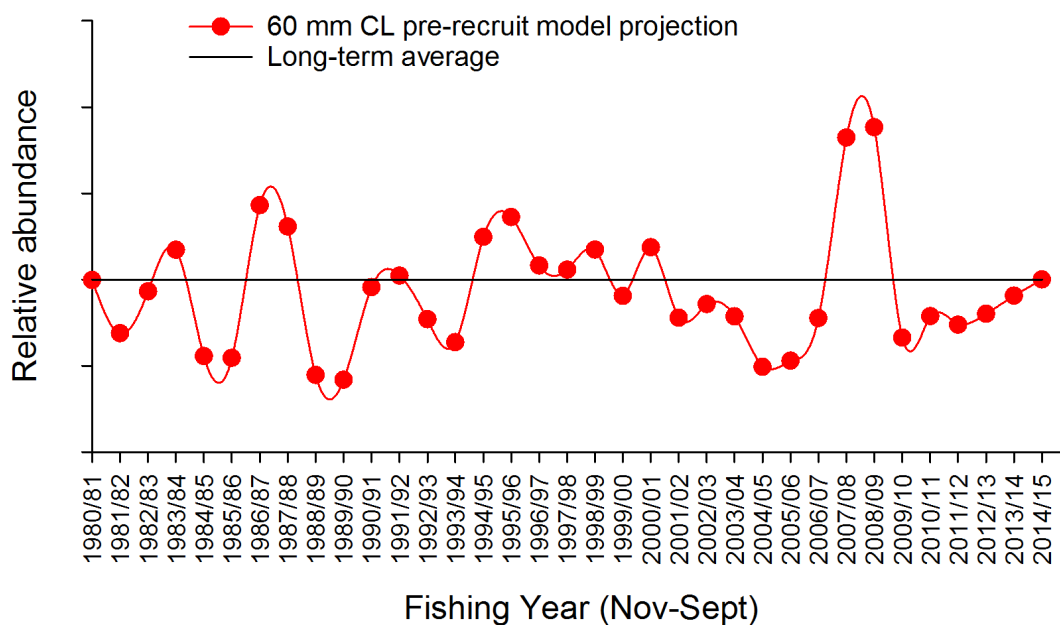


Figure 17. Relative abundance of recruits (to 60 mm in CL) in the Eastern Zone Fishery. These data are applied in the length-frequency model. The long-term historical average is also indicated (solid black line).

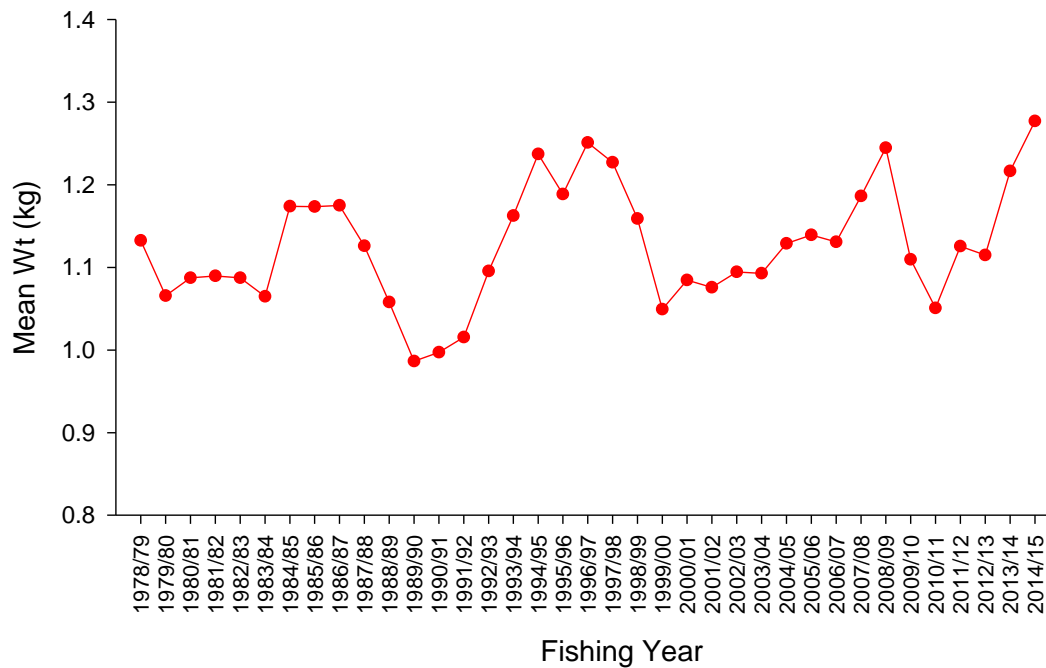


Figure 18. Mean weight of legal sized lobster in the Eastern Zone fishery from 1978/79 to 2014/15.

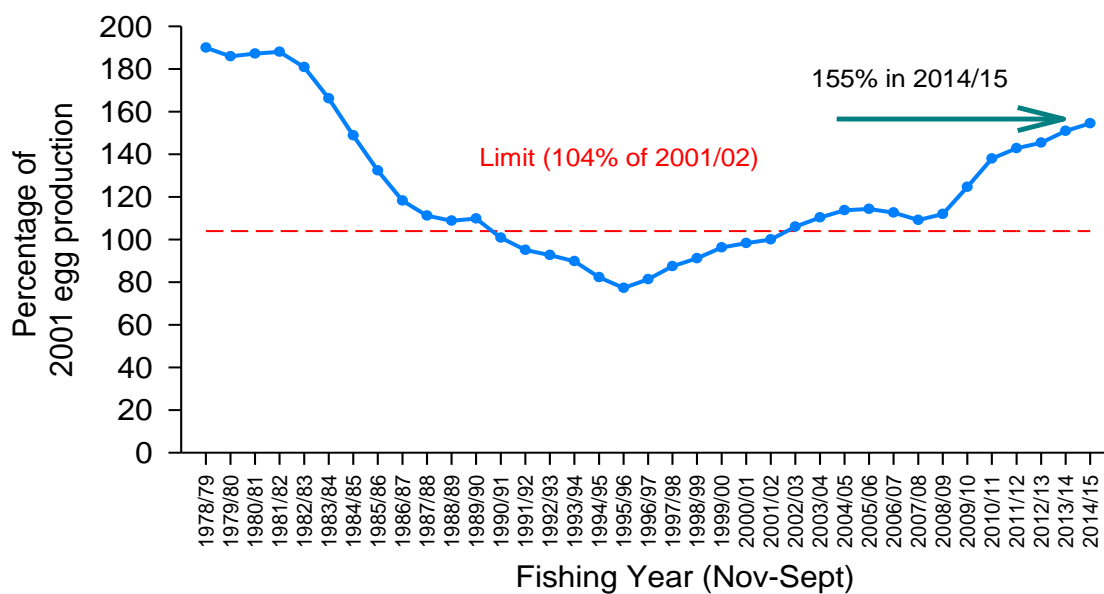


Figure 19. Model estimated level of egg production through time in the Eastern Zone fishery (with 90% probability; blue line) with limit reference point of 104% of egg production in 2001/02 (red line). Note, the limit reference point of 104% of egg production in 2001/02 is equivalent to the 20% of egg production estimated in 1951 (E_{1951}) as defined under the 2016 harvest strategy.

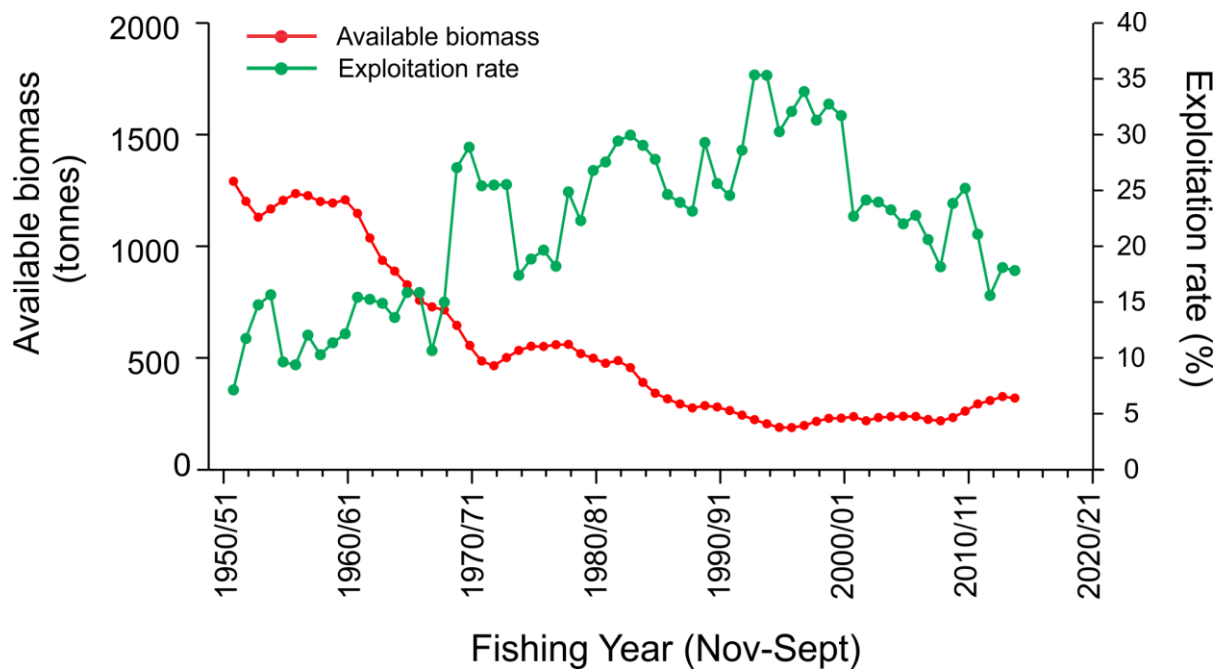


Figure 20. Model estimated levels of available biomass (red line) and associated fishing exploitation rates (green line) in the Eastern Zone fishery between 1951 and 2014.

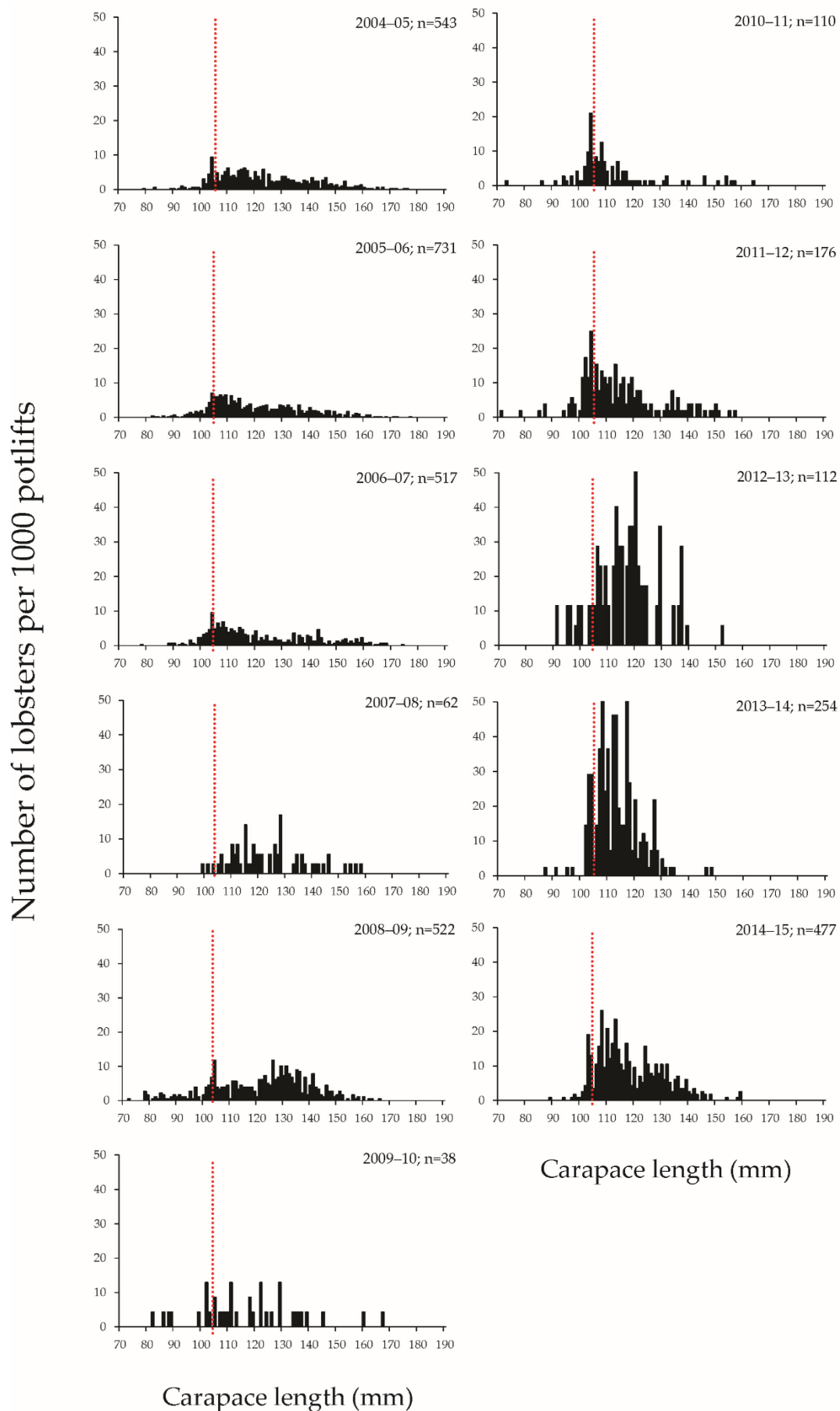


Figure 21. Length-frequency distribution of the number of female rock lobsters per 1,000 potlifts caught in the Eastern Zone onboard observer program from 1995–96 to 2014–15 fishing years (Nov–Sept). n, total number of lobsters measured.

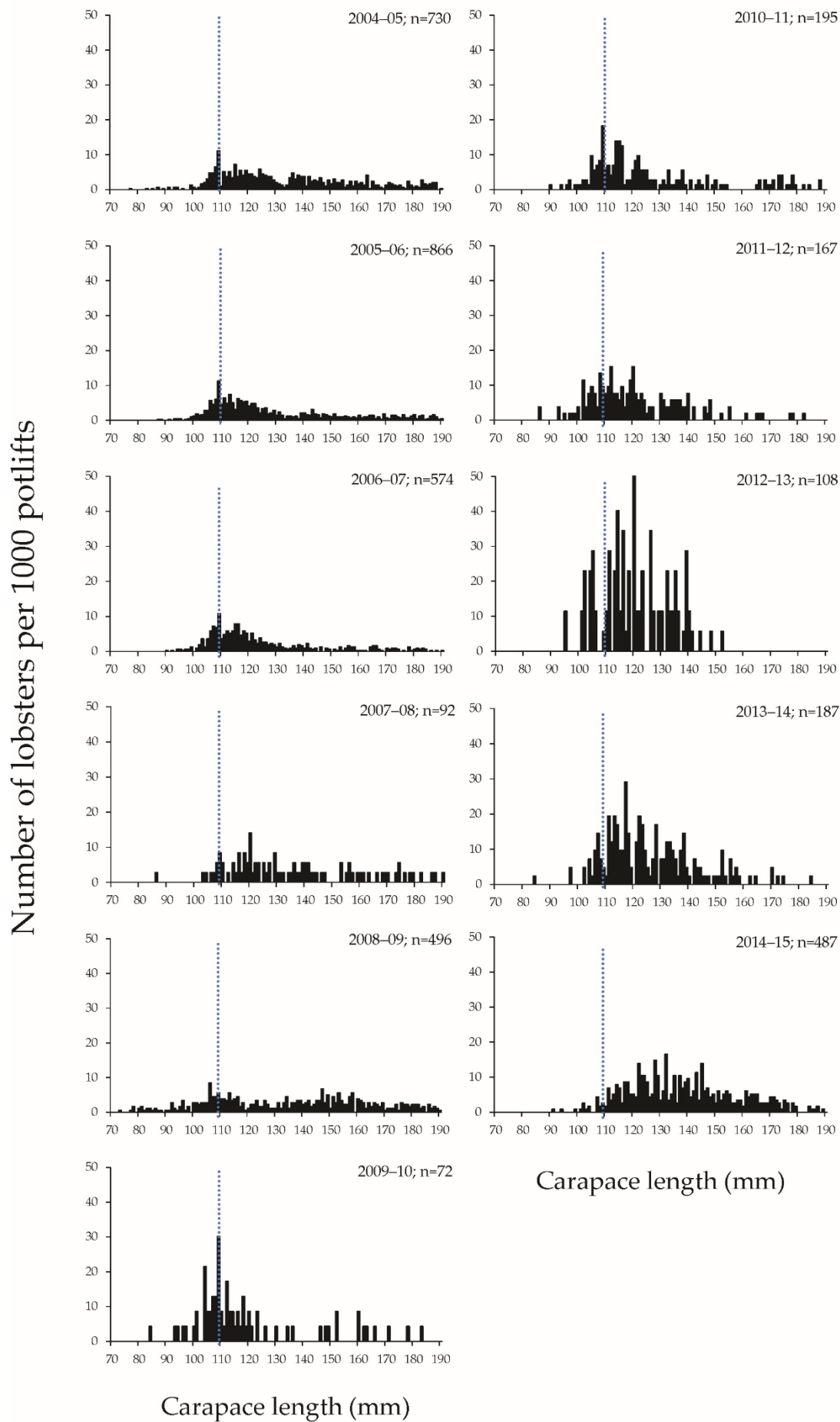


Figure 22. Length-frequency distribution of the number of male rock lobsters per 1,000 potlifts caught in the Eastern Zone onboard observer program from 1995–96 to 2014–15 fishing years (Nov–Sept). n, total number of lobsters measured.

Number of lobsters per 1000 potlifts

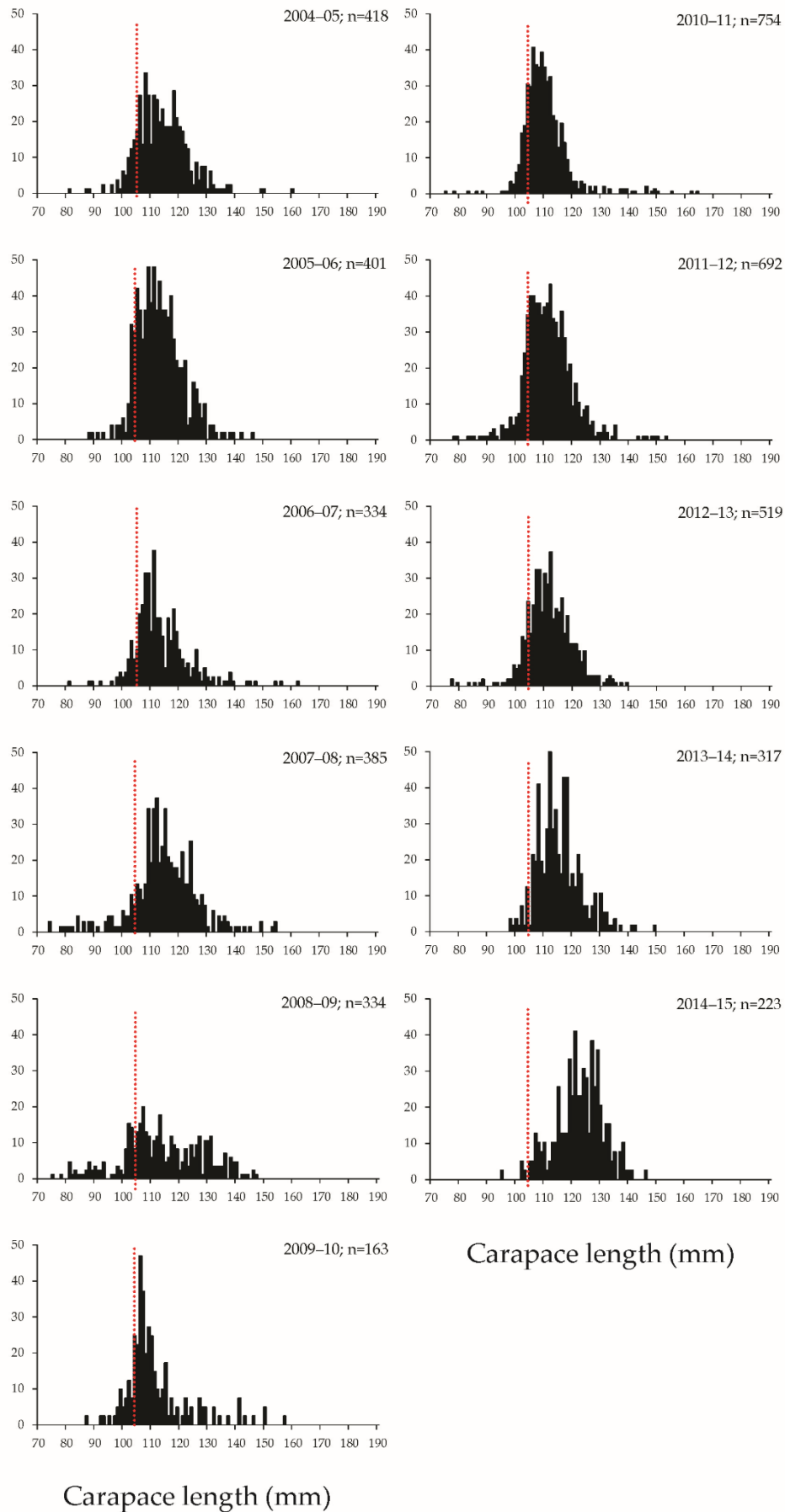


Figure 23. Length-frequency distribution of the number of female rock lobsters per 1,000 potlifts caught in the Eastern Zone fixed-site survey program using commercial pots from 1995–96 to 2014–15 fishing years (Nov–Sept). n, total number of lobsters measured.

Number of lobsters per 1000 potlifts

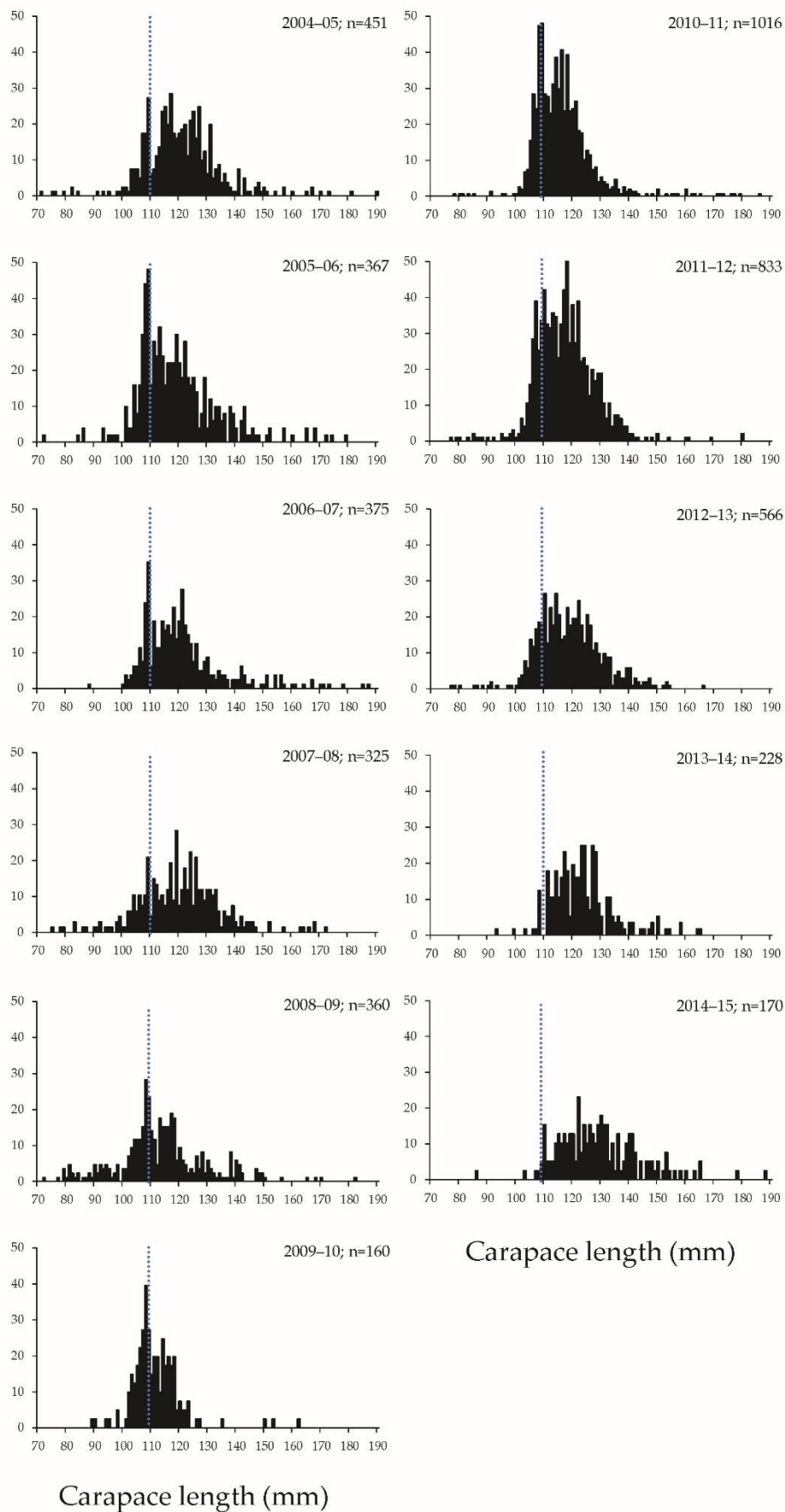


Figure 24. Length-frequency distribution of the number of male rock lobsters per 1,000 potlifts caught in the Eastern Zone fixed-site survey program using commercial pots from 1995–96 to 2014–15 fishing years (Nov–Sept). n, total number of lobsters measured.

