Victorian rock lobster fishery stock assessment report 2012

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Summary

In the Western Zone of the Victorian rock lobster fishery, nominal fishing effort rose from 1951–52 (first fishing year when effort first record) to a peak of 897 thousand potlifts in 1999–00 (shortly before introduction of quota management in 2001–02), but subsequently fell to below two-thirds of the peak level. During the 11-year period from 1993–94 to 2003–04, nominal catch per unit effort (CPUE) was stable at 0.59–0.70 kg per potlift, but then progressively declined over the next six years to an all-time low of 0.37 kg per potlift in 2009–10, before increasing to 0.43 kg per potlift in 2010–11. The stock assessment model, upgraded from past assessments to use undersized length-frequency, updated growth and standardised CPUE, estimated 'egg production' in 2010–11 at 72% of the 'egg production' in reference year 2001–02 (well above the 35% limit) and estimated 'available biomass' at 70% of the 'available biomass' in 2001–02 (well below the 173% target). CPUE from logbooks (nominal and standardised), monitoring by onboard observer, and fixed-site survey are consistent with the model available biomass trajectory indicating a general decline in abundance and then an increase from 2009–10 to 2010–11 and to November–February of 2011–12. The harvest of more than 40% of the available biomass annually immediately prior to the introduction of quota management reduced to below 30% during the past two years. Well above average recruitment during the 1990s fell to below average during the 2000s, when there was a trend of weakening recruitment from west to east across the Western Zone.

In the Eastern Zone, for most of the period since 1951–52, nominal fishing effort climbed to a peak of 260 thousand potlifts in 1993–94 and then fell to below half this level at 108 thousand potlifts in 2008–09, before increasing again during the past two years. Nominal CPUE fell to its lowest levels in the mid-1990s, but subsequently recovered marginally as fishing effort declined. In 2010–11, catch (65 t), fishing effort (150 thousand potlifts), and CPUE (0.43 kg per potlift) all reached their highest levels since the beginning of the past decade. The upgraded stock assessment model using standardised CPUE estimated 'egg production' in 2010–11 at 137% of the 'egg production' in reference year 2001–02 (above the limit of 104%) and estimated 'available biomass' in 2010–11 at 110% of the 'available biomass' in 2001–02 (well below the 219% target). CPUE from logbooks (nominal and standardised), onboard observer, and fixed-site survey are all consistent with model biomass trajectory indicating steady abundance with an increase from 2009–10 to 2010–11 and to November–February of 2011–12. Harvest of about 30% of the available biomass annually during the 1990s gradually reduced to about half this level over the past decade.

The fishery in both zones is experiencing an upturn in CPUE following full recruitment of the 80-mm pre-recruits estimated by the model to be above average for 2007–08 and 2008–09. The recruitment pulse is expected to persist into 2012–13; however, the model pre-recruit trajectory for the subsequent two years and puerulus settlement monitoring for the subsequent four years indicate full recruitment for the 3–4 years after 2012–13 will approximate to the long-term average. Two conclusions are drawn against the decision rules of the Management Plan.

1. Egg production is above the limit in each of Western Zone and Eastern Zone.
2. The model available biomass trajectory is consistent with an upward trend in nominal CPUE from 2008–09 to 2010–11 in each of Western Zone and Eastern Zone.

Introduction

The Rock Lobster Fishery Management Plan requires annual stock assessment of the southern rock lobster (*Jasus edwardsii*) (SRL) resource of Victoria to enable review of the Total Allowable Catch (TAC) by the TAC Forum open to all key stakeholders in each of Western Zone (WZ) and Eastern Zone (EZ). The Management Plan requires the fishery to be assessed using prescribed stock performance indicators, biological reference points, triggers, rebuild rates, and risk levels associated with uncertainty (Department of Primary Industries 2009).

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

Understanding of the stock dynamics and maintenance of data and current knowledge of the population biology of SRL in response to fishing and environmental effects continues through a program of monitoring, research, and ongoing stock assessment maintained by Fisheries Victoria.

Stock assessment method

The stock assessment uses the 'rock lobster fishery stock assessment model' designed for assessment of the rock lobster fisheries in Victoria, South Australia, and Tasmania 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 (accounts for numbers of SRLs in 5-mm length-classes) and assesses risk associated with uncertainty. For males and females separately, the model tracks for each month the number of SRLs in the population larger than 60 mm carapace length, and accounts for natural mortality, fishing mortality, and variation with length of SRL in annual growth-increment, selectivity of pots fitted with escape-gaps, body mass, and number of eggs produced by females. The model is fitted simultaneously to several data sets: monthly standardised catch per unit effort (CPUE) expressed as kilograms per potlift, monthly mass and number of SRLs landed, and length-frequency distribution of the catch landed in port (above-size SRLs only) and of the catch observed at-sea (above-size and below-size SRLs). The model accounts for Marine Protected Areas (8% in WZ and 16% in EZ) and assumed levels of recreational catch.

The model estimates two stock performance indicators prescribed in the Management Plan: 'egg production' and 'available biomass'. 'Egg production' is a measure of the number of eggs produced by mature female SRLs. 'Available biomass' is a measure of the stock biomass of SRLs that can be legally caught (dependent on separate open seasons for males and females and size of SRLs relative to their legal minimum lengths). Each of these stock performance indicators (expressed with a specific probability) can be produced for the history of the fishery since 1951–52, when CPUE data first became available, and for various forward projections based on assumed constant catches adopted as proxies for alternative TACCs. Backward and forward projections, referred as trajectories from hereon, to represent any required level of uncertainty made by the model through sampling probability distributions of several parameters estimated when fitting to the data and through sampling recruitment indices (model estimates of number of SRLs at 80 mm carapace length for the period since the 1978–79 fishing year). The only trajectories shown for the purpose of the present stock assessment are the 75% probability trajectory for egg production (i.e. '75% chance of being above and 25% chance of being below) and the 50% trajectory for available biomass (i.e. 50% chance of being above and 50% chance of being below).

The decision rules of the Management Plan require comparing the stock performance indicators with biological reference points (BRP) referred to as the 'limit BRP' and the 'target BRP'. Originally, the 'limit BRP' was 20% of the 1951–52 estimated egg production on the 75% probability trajectory and the 'target BRP' was 40% of the 1951–52 estimated available biomass on the 50% probability trajectory. In each case, the trajectories were drawn relative to 1951–52 (i.e. 100% in 1951–52). For each of WZ and EZ, separately, the egg production and available biomass trajectories produced for the 2011 stock assessment were transposed to express the target BRP and the limit BRP as percentages of their values relative to 2001–02, rather than 1951–52, as the 'reference year'. On this basis, the limit BRP adjusts from 20% of 1951–52 egg production to 35% in WZ and 104% in EZ of 2001–02 egg production. Similarly, the target BRP adjusts from 40% of 1951–52 available biomass to 173% in WZ and 219% in EZ of 2001–02 available biomass.

Under the decision rules, if a stock assessment indicates egg production is below the limit BRP (i.e. limit BRP triggered), the Management Plan prescribes adoption of the reduced TACC required to lift egg production above the limit BRP within 2 years. Otherwise, the Management Plan prescribes adoption of the TACC required to reach the target BRP for available biomass by 2020–21.

All assessments, including 2012, applied the model as a single area for each zone, but several changes applied to the 2012 stock assessment. Past stock assessments operated the model in one-year time-steps, but the 2012 stock assessment operated in one-month time-steps. Other changes were inclusion of pre-recruit (below-size SRLs) length-frequency data from fixed-site survey and onboard observer monitoring, updating size at female maturity, and merging updated growth estimates determined from analysis of tag release-recapture length-increment data at 14 separate sites (12 in WZ and 2 in EZ). In addition, the model was fitted to 'standardised CPUE' rather than 'nominal CPUE' as in the past (Walker *et al.* 2012). CPUE was standardised for each zone separately by adjusting for differences among the regions, fishing depth ranges, fishing years, fishing months and vessel-fishers. For standardisation, the regions were Portland, Warrnambool and Apollo Bay in WZ and Queenscliff, San Remo and Lakes Entrance in EZ, and fishing depth ranges were <40 m and ≥40 m. Only data from vessel-fishers contributing data in more than two separate fishing years and contributing 200 or more records were included in the CPUE standardisation.

The Management Plan also requires consideration of whether there is agreement between the trend in the model available biomass trajectory and nominal CPUE over the last two years of the assessment. For the present 2012 stock assessment, the 2-year period is from 2008–09 to 2010–11.

Western Zone Stock Assessment 2012 Results

Western Zone trends from commercial catch and effort logbook data available from 1951–52 to 2010–11 (fishing year November–September) indicate continual growth in fishing effort until 1999–00, shortly before introduction of quota management in 2001–02, followed by progressive decline to two-thirds of peak effort (Table 1.1 and Figure 1.1). Catch initially peaked in 1980–81 at 549 t taken by 680 thousand potlifts and then peaked again in 2000–01 at 525 t, with 32% higher fishing effort at 895 thousand potlifts. Since adoption of quota management, catch declined to a minimum of 235 t in 2008–09, a level not reported since the 1950s. During the 11-year period from 1993–94 to 2003–04, CPUE was stable at 0.59–0.70 kg per potlift, but then progressively declined over the next six years to an all-time low of 0.37 kg per potlift in 2009–10, before increasing to 0.43 kg per potlift in 2010–11. The present TACC of 240 tonne is 90% caught with less than three months of the present licensing period (1 July 2011–30 June 2012) remaining, and was 96% and 99% caught during the two preceding licensing periods (Table 1.2).

Onboard observer (from 2004–05 to 2010–11) and fixed-site survey (from 2001–02 to 2011–12) monitoring indicate a general decline in CPUE for males and females with an increase at the end of the period. Above-size SRLs increased for the two fishing years 2010–11 and 2011–12 and while there was a slight continuing rise for below-size SRLs from 2006–07 to 2010–11 there was a marked decline in below-size SRLs during 2011–12 (Figure 1.2) (Trinnie *et al.* 2012).

The current stock assessment model applied with standardised CPUE, estimated egg production in 2010–11 at 72% of the level of egg production in the reference year of 2001–02, which is well above the limit BRP of 35% of the level egg production in 2001–02 (Figure 1.3a). The model estimated available biomass at 70% of the level of available biomass in the reference year of 2001–02, which is well below the target BRP of 173% of the level of available biomass in 2001–02 (Figure 1.3b). The harvest of more than 40% of the available biomass annually immediately prior to the introduction of quota management reduced to below 30% during the past two years. The model indicated pre-recruitment (relative number of SRLs of 80 mm total carapace) improved through the past decade, with a spike during 2008–09, but was well below the levels during the previous decade and the long-term average from 1978–79 to 2010–11. The model also indicated a progressive weakening of recruitment from west to east across the Western Zone. Average annual nominal CPUE from logbook returns and average nominal CPUE for the 4-month period November–February are consistent with the model 50% probability trajectory of available biomass indicating an increase in abundance during the 2-year period from 2008–09 to 2010–11 (Figure 1.3c). This increasing trend persists through November–February of the 2011–12 fishing year.

Reaching the available biomass target by 2020–21 depends on average abundances of pre-recruits similar to the average for the period from 1978–79 to 2010–11 (Figure 1.3d). The fishery is presently experiencing an upturn in CPUE following recruitment of a major proportion of the 80-mm pre-recruit spike estimated by the model to be of well above average abundance in 2007–08 and 2008–09. Full recruitment of this pre-recruit spike is expected to persist during 2012–13 before weakening, as indicated by the model and puerulus settlement monitoring together, to approximate to the long-term average recruitment for the subsequent 3 or 4 years.

Eastern Zone Stock Assessment 2012 Results

During the period from 1951–52 to 2010–11, the Eastern Zone commercial catch peaked in 1954–55 at 182 t taken by nominal fishing effort of 66 thousand potlifts and the catch mostly exceeded 100 t until the mid-1980s (Table 2.1, Figure 2.1). The catch then ranged 57–95 t until 2000–01, then 52–56 t until 2006–07, and for the past four years stepped down to 46 and 39 t, before a final upturn of 55 and 65 t. Since 1951–52, fishing effort climbed to a peak of 260 thousand potlifts in 1993–94 and then fell to well below half this level at 108 thousand potlifts in 2008–09, before recovering to 150 thousand potlifts by 2010–11. Nominal CPUE progressively declined to its lowest level of 0.26 kg per potlift in the mid-1990s, but subsequently recovered marginally as fishing effort declined. In 2010–11, catch (65 t), fishing effort (150 thousand potlifts), and CPUE (0.43 kg per potlift) all reached their highest levels since the beginning of the past decade. The present TACC of 66 tonne is 88% caught with less than three months of the present licensing period (1 July 2011–30 June 2012) remaining, and was 98% caught during the preceding licensing period (Table 2.2).

Onboard observer (from 2004–05 to 2010–11) and fixed-site survey (from 2001–02 to 2010–11) monitoring indicate a general decline in CPUE for above-size males and females from 2005–06 to 2008–09 followed by a marked increase in 2010–11. Below-size SRLs have increased from a low level in 2006–07 to a stable level subsequently (Figure 2.2) (Trinnie *et al.* 2012).

The current model applied with standardised CPUE estimated egg production in 2010–11 at 137% of the level of egg production in the reference year of 2001–02, which is above the limit BRP of 104% of the level of egg production in 2001–02 (Figure 2.3a). The model estimated available biomass at 110% of the level of available biomass in the reference year of 2001–02, which is well below the target BRP of 219% of the level of available biomass in 2001–02 (Figure 2.3b). The model indicated that pre-recruitment (relative number of SRLs of 80 mm total carapace) was similar to the long-term average during the past decade.. About 30% of the available biomass was taken annually during the 1990s, but this has gradually been reduced to about half that level over the past decade. CPUE from logbooks (nominal and standardised) and monitoring by onboard observer and fixed-site survey are consistent with the model 50% probability trajectory of available biomass indicating a general decline in abundance recently and then a slight increase from 2009–10 to 2010–11 and then to November–February of 2011–12 (Figure 2.3c).

Reaching the available biomass target by 2020–21 depends on average recruitment strengths similar to the long-term average from 1978–79 to 2010–11 (Figure 2.3d). Although recruitment has been slightly below the long-term average during the past decade, the fishery is presently experiencing an upturn in CPUE following full recruitment of the 80-mm pre-recruits estimated by the model to be above average during 2007–08 and 2008–09. Full recruitment of this pre-recruit spike is expected to persist during 2012–13 before weakening, as indicated by the model and puerulus settlement monitoring together, to approximate to the long-term average recruitment for the subsequent 3 or 4 years.

Comparison of pre-recruitment trends between Western Zone and Eastern Zone

Although not prescribed in the Management Plan, an independent indicator of pre-recruitment strength is the number of puerulus on collector plates examined monthly at sites in Port Campbell and Apollo Bay. In WZ, relative abundance of puerulus shown by fishing year (Figure 3a) indicates remarkable agreement between the two sites; data for fishing years 2007–08 and 2008–09 are absent for Apollo Bay because of harbour redevelopment during those years.

There is also remarkably good agreement between the model 80-mm pre-recruit hind-cast (backward) abundance trajectories for WZ and EZ (Figure 3b); the only divergences occur during 2004–05 and 2007–08. This indicates that puerulus monitoring at the Port Campbell and Apollo Bay sites in WZ are not only a

valuable independent indicator of pre-recruitment strength in WZ, but also in EZ. For each of the WZ and EZ, there is remarkable consistency between the trends in number of puerulus settled and the trends of the model hind-cast trajectory of the relative abundance of 80-mm pre-recruits, indicating a 2-year lag from puerulus settlement size (9–15 mm carapace length) to the model pre-recruit size (80 mm carapace length).

There is also reasonably good agreement in the relative abundance of each of below-size and above-size SRLs in the fixed-site surveys with the model 80-mm pre-recruit trajectory. Perfect agreement is unlikely because of large differences in growth rates between the two sexes and among individual SRLs, which have an averaging effect over 2–3 years. In WZ, the best agreement is when relative abundance of below-size SRLs from the fixed-site survey is lagged 2 years and abundance of above-size SRLs is lagged 4 years (Figure 3c). In EZ, the best agreement is when below-size SRLs is lagged 1 year and above-size SRLs is lagged 2 years until 2004–05, but after 2004–05 when below-size SRLs is lagged 2 years and above-size SRLs is lagged 3 years (Figure 3d). This change in lag time might be indicative of recent slowing growth rates of SRLs.

In summary, puerulus abundance provides an indicator of relative strength of recruitment to above legal minimum length 5–6 years into the future. The 80-mm pre-recruit model trajectory provides a measure of full recruitment 3–4 years ahead. These periods will vary because it is known from recent analysis of available tag release-recapture data from the Victorian fishery that growth rates not only vary between separate sites, but vary over time.

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Table 1.1. 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)	Recreational catch (t)
1951–52	102		42	2.41			2.1
1952–53	132		54	2.43			2.8
1953–54	177		69	2.56			3.7
1954–55	292		115	2.54			6.1
1955–56	177		87	2.03			3.7
1956–57	134		75	1.79			2.8
1957–58	152		93	1.64			3.2
1958–59	147		84	1.75			3.1
1959–60	182		104	1.75			3.8
1960–61	268		138	1.95			5.6
1961–62	396		202	1.96			8.3
1962–63	326		226	1.44			6.9
1963–64	279		201	1.39			5.9
1964–65	233		175	1.33			4.9
1965–66	325		250	1.30			6.8
1966–67	308		288	1.07			6.5
1967–68	372		373	1.00			7.8
1968–69	413		455	0.91			8.7
1969–70	430		495	0.87			9.1
1970–71	441		497	0.89			9.3
1971–72	458		583	0.79			9.6
1972–73	463		638	0.73			9.8
1973–74	429		555	0.77			9.0
1974–75	286		430	0.67			6.0
1975–76	303		406	0.75			6.4
1976–77	339		464	0.73			7.1
1977–78	309		433	0.71			6.5
1978–79	486	485	622	0.78	0.82	1.00	9.1
1979–80	453	444	576	0.79	0.85	1.02	9.5
1980–81	549	548	680	0.81	0.85	1.00	11.7
1981–82	499	499	637	0.78	0.81	1.00	10.6
1982–83	460	435	608	0.76	0.83	1.01	9.5
1983–84	421	414	571	0.74	0.75	1.02	9.5
1984–85	406	394	578	0.70	0.69	1.03	8.4
1985–86	345	346	569	0.61	0.60	1.00	7.4
1986–87	351	353	595	0.59	0.60	0.99	7.3
1987–88	345	349	557	0.62	0.60	0.99	7.5
1988–89	304	322	577	0.53	0.53	0.94	6.2
1989–90	331	355	613	0.54	0.53	0.93	7.0
1990–91	317	337	650	0.49	0.49	0.94	6.3
1991–92	408	439	712	0.57	0.59	0.93	8.1
1992–93	408	433	779	0.52	0.54	0.94	8.4
1993–94	448	456	754	0.59	0.56	0.98	9.6
1994–95	435	444	789	0.55	0.50	0.98	9.2
1995–96	423	442	761	0.56	0.49	0.96	9.1
1996–97	402	414	787	0.51	0.45	0.97	8.3
1997–98	466	492	841	0.55	0.49	0.95	9.5
1998–99	516	568	861	0.60	0.53	0.91	10.3
1999–00	521	592	897	0.58	0.51	0.88	10.9
2000–01	525	598	895	0.59	0.49	0.88	11.7
2001–02	438	510	704	0.62	0.53	0.86	22.5
2002–03	430	495	630	0.68	0.56	0.87	22.5
2003–04	461	515	659	0.70	0.56	0.89	22.5
2004–05	408	451	667	0.61	0.49	0.90	22.5
2005–06	358	405	705	0.51	0.41	0.88	22.5
2006–07	336	392	698	0.48	0.41	0.86	22.5
2007–08	289	338	668	0.43	0.36	0.85	19.0
2008–09	235	268	606	0.39	0.32	0.88	16.0
2009–10	239	277	650	0.37	0.33	0.86	16.0
2010–11	253	306	587	0.43	0.39	0.83	12.0

Data source: Fisheries Victoria CandE Database (16 November 2011) for period from 1978–79 to 2010–11.

Table 1.2. Western Zone history of TACCs for each quota period from 2002–03 to present

Present quota year (1 July2011–30 June 2012) is incomplete; TACC is Total Allowable Commercial Catch.

Quota year	Quota period	TACC set (tonne)	TACC caught		Number of months fished	Number of active licences	Number of vessels
			(tonne)	per cent			
2002–03	1 April–31 March	450	440	98	12	79	83
2003–04	1 April–31 March	450	436	97	12	80	79
2004–05	1 April–31 March	450	421	94	12	79	86
2005–06	1 April–31 March	450	405	90	12	75	77
2006–07	1 April–31 March	450	329	73	12	71	68
2007–08	1 April–31 March	380	319	84	12	68	64
2008–09	1 April–31 March	320	244	76	12	61	60
2009	1 April–30 June	55.2	36	64	3	54	53
2009–10	1 July–30 June	240	230	96	12	54	55
2010–11	1 July–30 June	240	237	99	12	55	55
2011–12	1 July–30 June	240	217	90	8	50	42

Data source: Fisheries Victoria, FILS Database (3 April 2012).

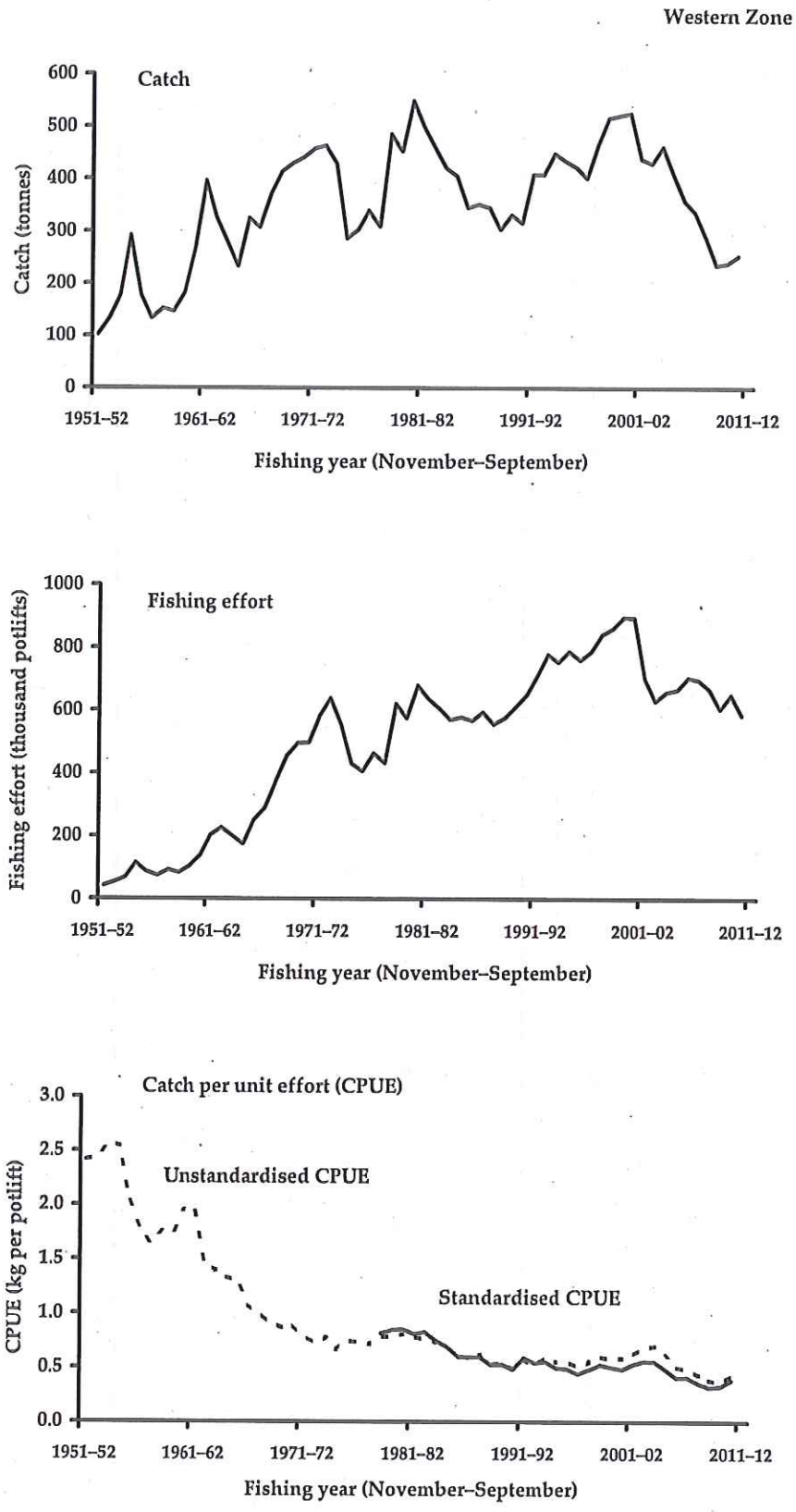

Figure 1.1. Western Zone catch, fishing effort, and CPUE from 1951–52 to 2010–11

CPUE, catch per unit effort.

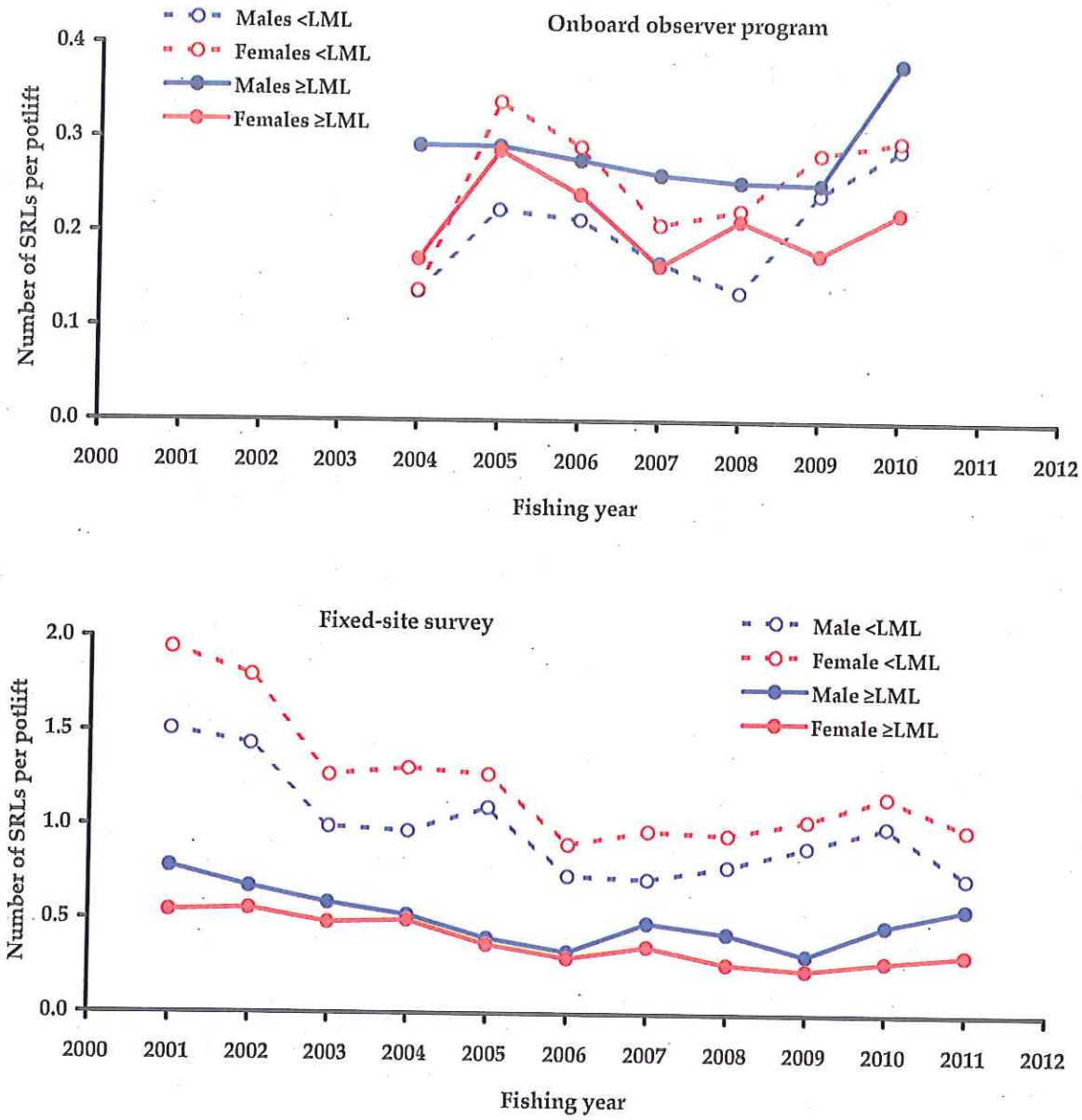

Figure 1.2. Western Zone onboard observer program and fixed site monitoring CPUE trends

The fishing year is labelled on the graph by the first of the two calendar years straddled; for example, the fishing year labelled 2010 is 2010–11 (16 November 2010–15 September 2011). Escape gaps open for onboard observer program and closed for fixed-site survey. SRL, southern rock lobster; LML, legal minimum length, CPUE, catch per unit effort
Source: Rock Lobster Program, Fisheries Victoria (22 March 2012)

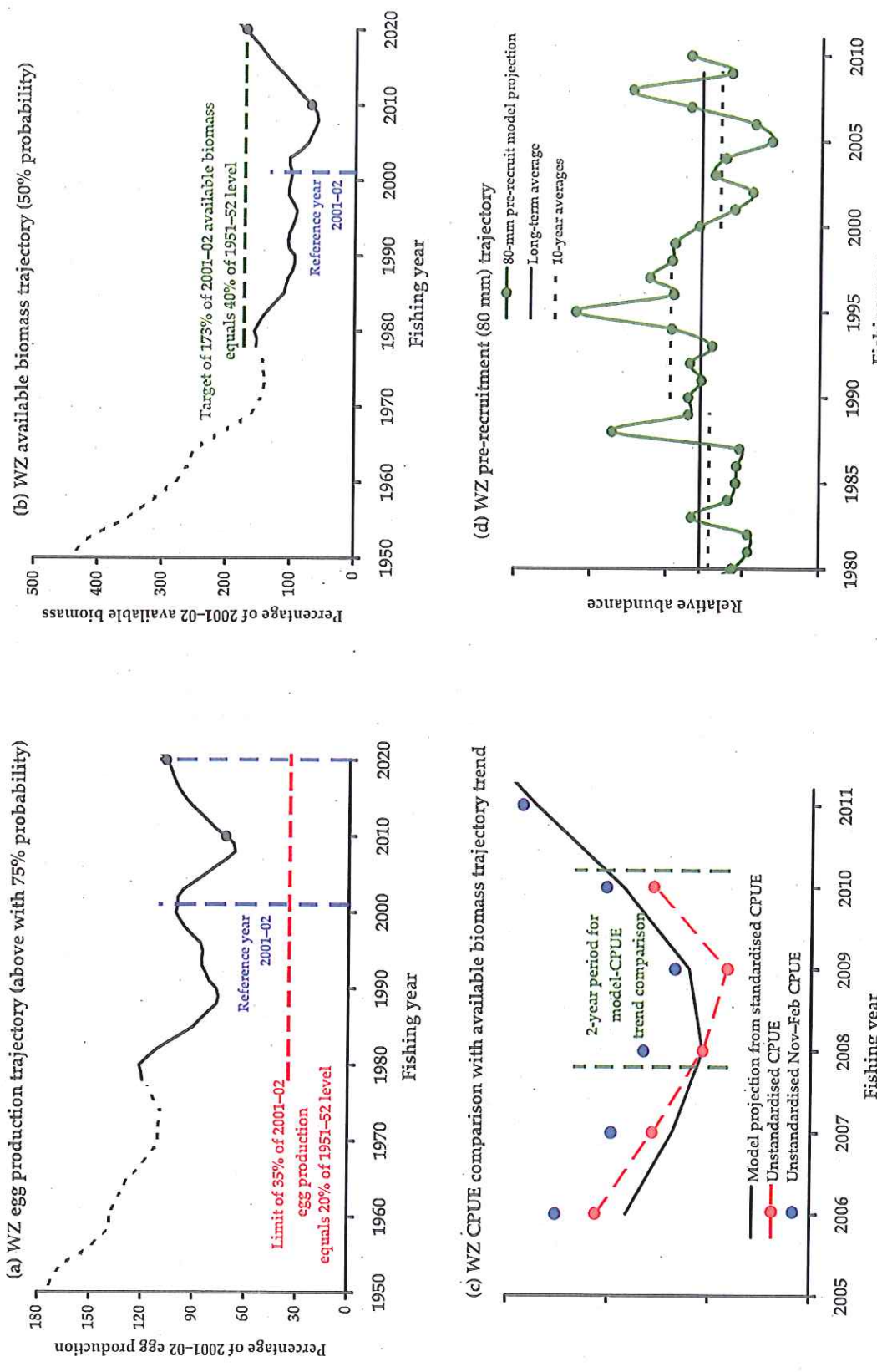

Figure 1.3. Western Zone model outputs

The fishing year is labelled on the graph by the first of the two calendar years straddled; for example, the fishing year labelled 2010 is 2010–11 (16 November 2010–15 September 2011).

Table 2.1. 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)	Recreational catch (t)
1951–52	92		34	2.70			9.2
1952–53	141		68	2.07			14.2
1953–54	166		77	2.16			16.8
1954–55	182		66	2.75			18.4
1955–56	116		51	2.27			11.7
1956–57	116		57	2.01			11.6
1957–58	147		76	1.93			14.8
1958–59	123		82	1.50			12.4
1959–60	135		73	1.84			13.6
1960–61	147		86	1.70			14.8
1961–62	177		92	1.92			17.8
1962–63	158		84	1.88			15.9
1963–64	139		91	1.52			14.0
1964–65	121		99	1.22			12.2
1965–66	131		105	1.25			13.2
1966–67	120		109	1.10			12.1
1967–68	77		77	1.01			7.8
1968–69	107		93	1.15			10.8
1969–70	174		159	1.10			17.6
1970–71	160		176	0.91			16.1
1971–72	123		183	0.67			12.4
1972–73	118		169	0.70			11.9
1973–74	128		152	0.84			12.9
1974–75	93		114	0.81			9.3
1975–76	104		123	0.84			10.5
1976–77	108		130	0.83			10.9
1977–78	102		122	0.83			10.2
1978–79	139	123	192	0.72	0.66	1.13	12.6
1979–80	116	108	171	0.67	0.65	1.07	12.3
1980–81	133	123	180	0.74	0.67	1.09	13.4
1981–82	131	120	193	0.67	0.58	1.09	13.3
1982–83	143	132	212	0.68	0.64	1.09	13.6
1983–84	136	128	230	0.59	0.59	1.06	14.1
1984–85	113	96	201	0.56	0.48	1.17	12.7
1985–86	95	81	175	0.54	0.41	1.17	9.8
1986–87	78	66	145	0.54	0.43	1.18	7.9
1987–88	70	62	130	0.54	0.37	1.13	7.8
1988–89	64	60	145	0.44	0.34	1.06	6.1
1989–90	83	85	198	0.42	0.36	0.99	8.0
1990–91	72	72	172	0.42	0.38	1.00	7.3
1991–92	65	64	175	0.37	0.34	1.02	6.6
1992–93	69	63	224	0.31	0.28	1.10	6.5
1993–94	79	68	260	0.30	0.25	1.16	8.3
1994–95	72	58	253	0.28	0.23	1.24	7.1
1995–96	57	48	220	0.26	0.22	1.19	6.1
1996–97	60	48	222	0.27	0.21	1.25	5.6
1997–98	66	54	221	0.30	0.23	1.23	6.8
1998–99	67	58	220	0.31	0.26	1.16	6.2
1999–00	75	71	232	0.32	0.27	1.05	7.3
2000–01	73	67	219	0.33	0.28	1.08	7.3
2001–02	53	50	151	0.35	0.31	1.08	6.0
2002–03	52	48	134	0.39	0.33	1.09	6.0
2003–04	56	51	133	0.42	0.36	1.09	6.0
2004–05	55	49	136	0.40	0.36	1.13	6.0
2005–06	52	46	122	0.43	0.36	1.14	6.0
2006–07	54	48	136	0.40	0.36	1.13	6.0
2007–08	46	39	123	0.37	0.34	1.19	6.6
2008–09	39	32	108	0.37	0.33	1.24	6.6
2009–10	55	50	146	0.38	0.35	1.11	6.6
2010–11	65	62	150	0.43	0.41	1.05	6.6

Data source: Fisheries Victoria CandE Database (16 November 2011) for period from 1978–79 to 2010–11.

Table 2.2. Eastern Zone history of TACs for each quota period from 2002–03 to present
Present quota year (1 July2011–30 June 2012) is incomplete; TACC is Total Allowable Commercial Catch.

Quota year	Quota period	TACC set (tonne)	TACC caught		Number of months fished	Number of active licences	Number of vessels
			(tonne)	Per cent			
2002–03	1 April–31 March	60	49.9	83	12	39	34
2003–04	1 April–31 March	60	54.4	91	12	41	37
2004–05	1 April–31 March	60	53.2	89	12	39	38
2005–06	1 April–31 March	60	55.7	93	12	33	32
2006–07	1 April–31 March	60	53.5	89	12	30	30
2007–08	1 April–31 March	66	50.1	76	12	31	31
2008–09	1 April–31 March	66	41.3	63	12	25	23
2009–09s	1 April–30 June	6.9	5.8	84	3	18	19
2009–10	1 July–30 June	66	43.9	67	12	22	21
2010–11	1 July–30 June	66	64.8	98	12	26	25
2011–12	1 July–30 June	66	58.1	88	9	26	21

Data source: Fisheries Victoria FILS Database (3 April 2012).

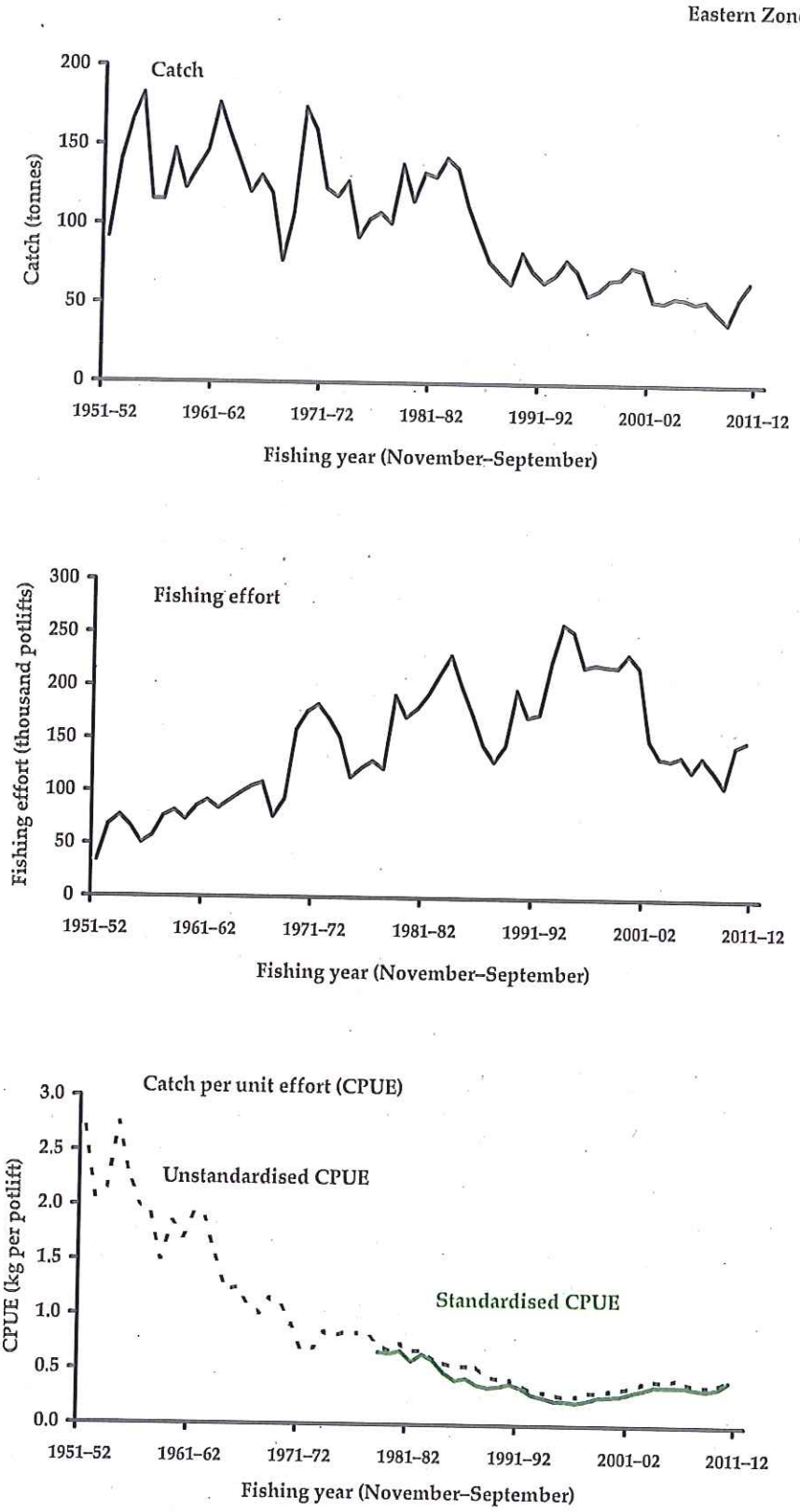

Figure 2.1. Eastern Zone catch, fishing effort, and CPUE from 1951–52 to 2010–11

CPUE, catch per unit effort.

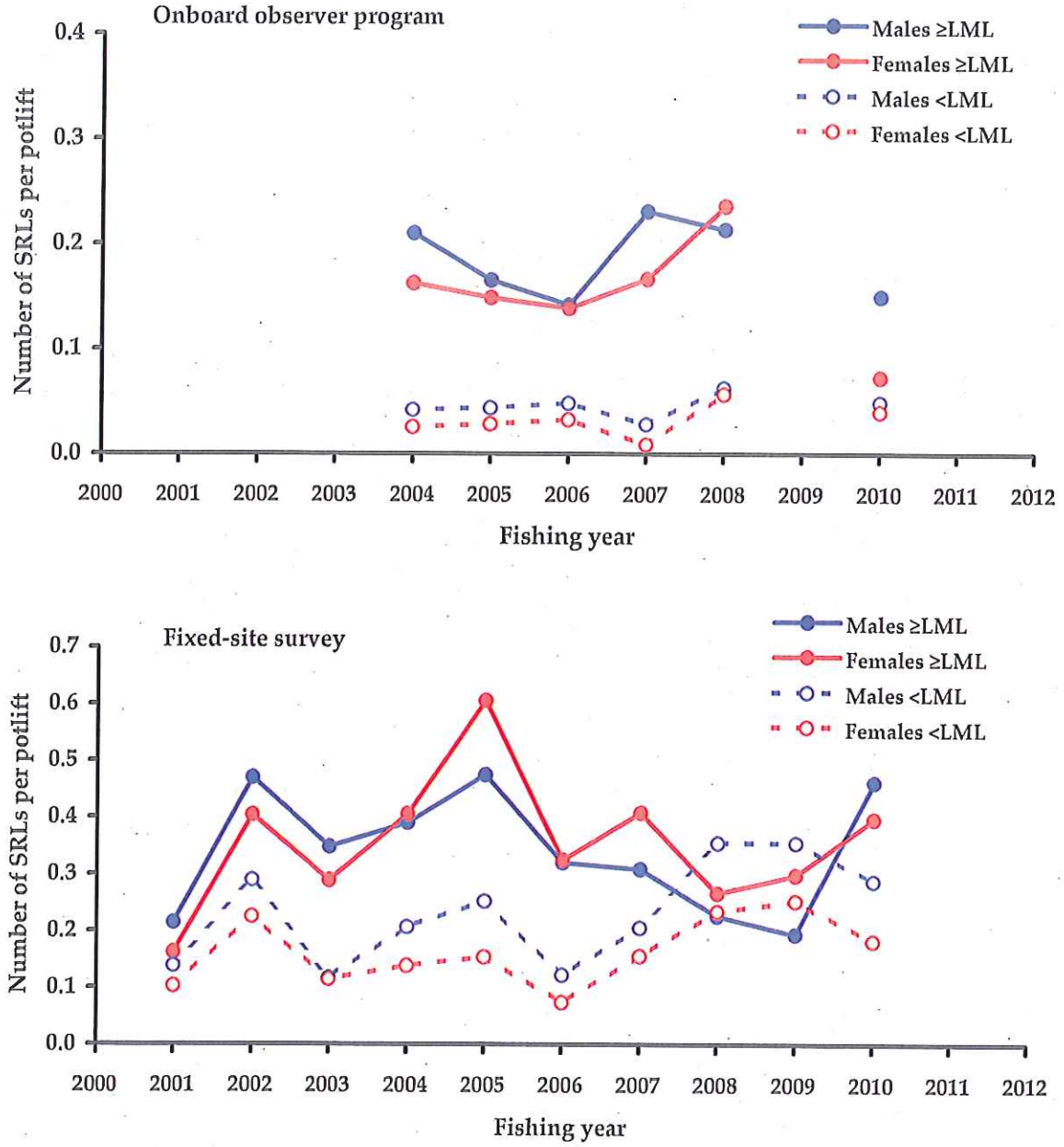

Figure 2.2. Eastern Zone onboard observer program and fixed site monitoring CPUE trends

The fishing year is labelled on the graph by the first of the two calendar years straddled; for example, the fishing year labelled 2010 is 2010–11 (16 November 2010–15 September 2011). Escape gaps open for onboard observer program and open for fixed-site survey. SRL, southern rock lobster; LML, legal minimum length, CPUE, catch per unit effort.

Source: Rock Lobster Program, Fisheries Victoria (15 December 2011)

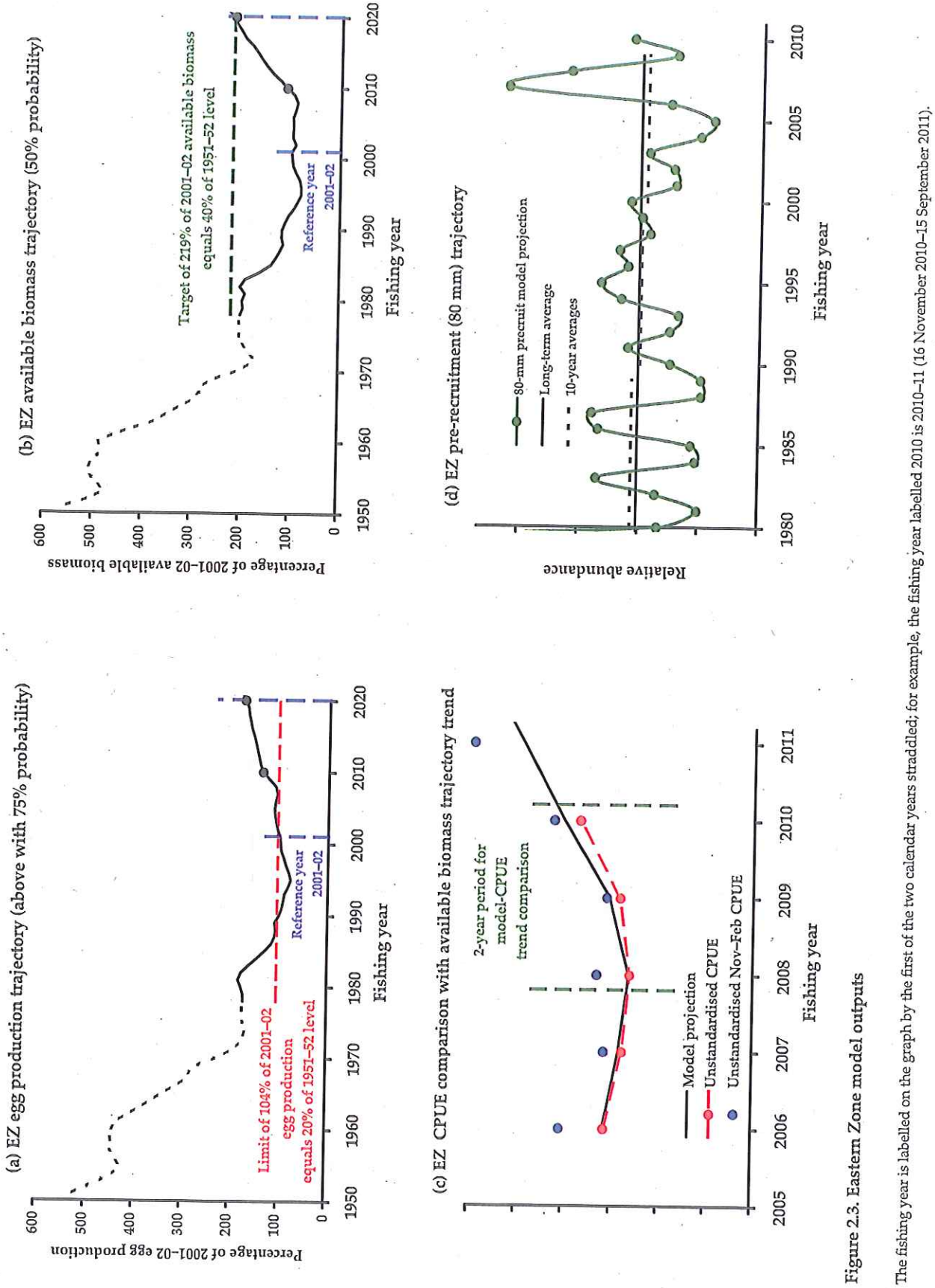

Figure 2.3. Eastern Zone model outputs

The fishing year is labelled on the graph by the first of the two calendar years straddled; for example, the fishing year labelled 2010 is 2010–11 (16 November 2010–15 September 2011).

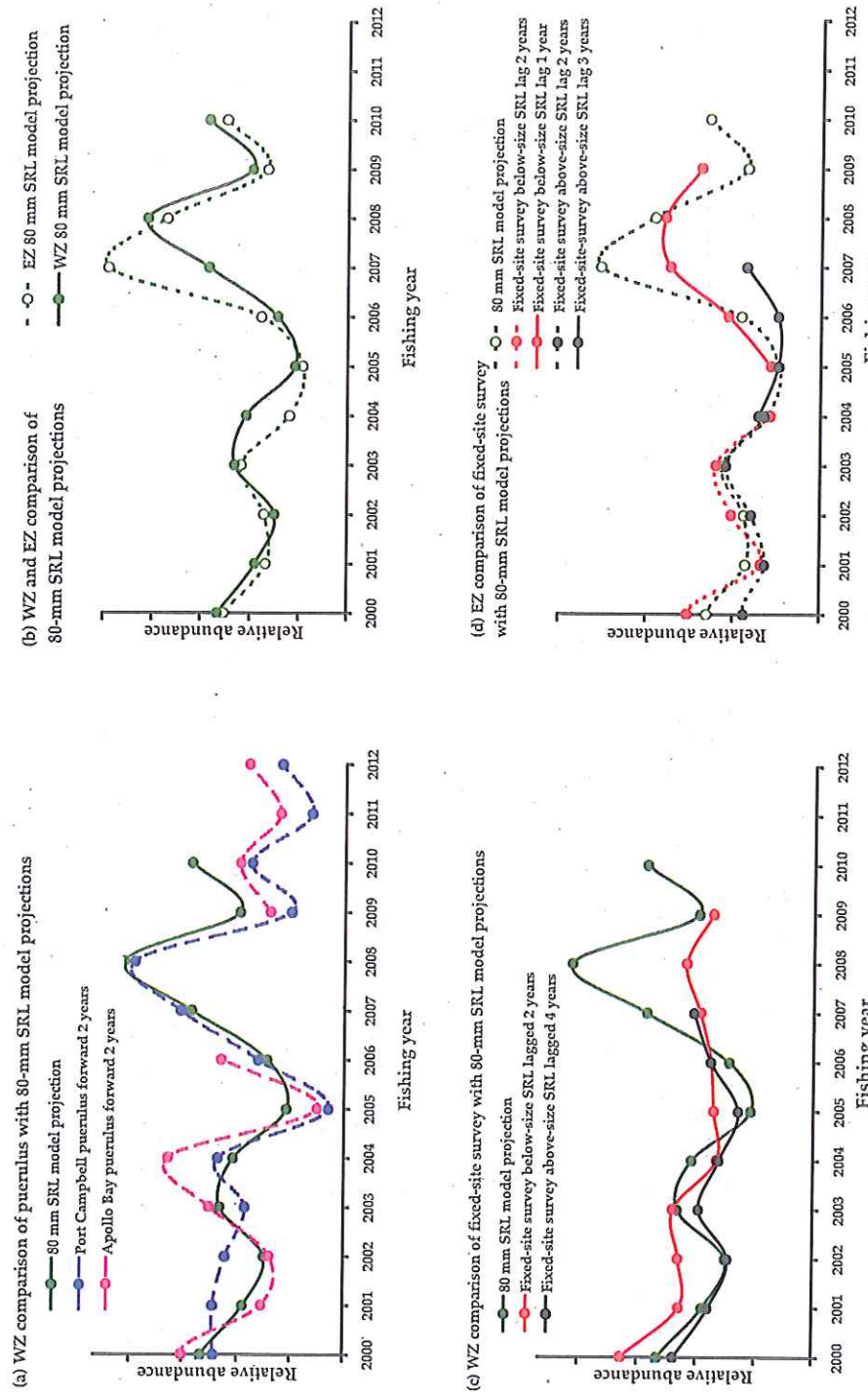

Figure 3. Comparison of model 80-mm pre-recruitment trajectories with pueulus and fixed-site survey SRL abundance trends

The fishing year is labelled on the graph by the first of the two calendar years straddled; for example, the fishing year labelled 2010 is 2010–11 (16 November 2010–15 September 2011). For abundance comparisons with the model 80-mm pre-recruit hind-cast (backward) trajectory, pueulus abundance trends have been moved forward 2 years and fixed-site survey above-size and below-size abundance trends have been variously moved backward. SRL, southern rock lobster; WZ, Western Zone; EZ, Eastern Zone.