

The western rock lobster fishery 1997/98 to 1998/99

C. F. Chubb and E. H. Barker



Department of **Fisheries**
Government of Western Australia



Fish for the future

Fisheries Research Division
WA Marine Research Laboratories
PO Box 20 NORTH BEACH
Western Australia 6920

Fisheries Research Report

Titles in the fisheries research series contain technical and scientific information that represents an important contribution to existing knowledge, but which may not be suitable for publication in national or international scientific journals.

Fisheries Research Reports may be cited as full publications. The full citation is: Chubb, C. F. and Barker, E. H. 2003. *The western rock lobster fishery 1997/98 to 1998/99*, Fisheries Research Report No. 140, Department of Fisheries, Western Australia, 47 pp.

Numbers 1-80 in this series were issued as Reports. Numbers 81-82 were issued as Fisheries Reports, and from number 83 the series has been issued under the current title.

Enquiries

Department of Fisheries
3rd floor The Atrium
168-170 St George's Terrace
PERTH WA 6000
Telephone (08) 9482 7333
Facsimile (08) 9482 7389
Website: <http://www.fish.wa.gov.au/res>



An electronic copy of this report will be available at the above website where parts may be shown in colour where this is thought to improve clarity.

Fisheries research in Western Australia

The Fisheries Research Division of the Department of Fisheries is based at the Western Australian Marine Research Laboratories, P.O. Box 20, North Beach (Perth), Western Australia, 6920. The Marine Research Laboratories serve as the centre for fisheries research in the State of Western Australia.

Research programs conducted by the Fisheries Research Division and laboratories investigate basic fish biology, stock identity and levels, population dynamics, environmental factors, and other factors related to commercial fisheries, recreational fisheries and aquaculture. The Fisheries Research Division also maintains the State data base of catch and effort fisheries statistics.

The primary function of the Fisheries Research Division is to provide scientific advice to government in the formulation of management policies for developing and sustaining Western Australian fisheries.

Contents

	Page
Abstract	1
1.0 Introduction	2
2.0 Methods	2
3.0 Results	3
3.1 Catch and effort data	3
3.2 Exports and grade categories	4
3.3 Mean size	5
3.4 Number of boats and pots	5
3.5 Forecast of recruitment	6
3.6 Introduction of new legislation	6
3.7 Effects of New Legislation	9
3.8 Innovations to boats and gear (including costs)	9
3.9 Bait	11
3.10 Distribution of fishing	13
3.11 Average number of days worked per boat per month	13
3.12 Price of rock lobsters (per kg)	13
3.13 Marketing	14
3.14 Value per pot on pot redistribution	15
3.15 Sea water temperatures and salinities	15
3.16 Spawning rock lobsters	15
4.0 Discussion	16
5.0 Acknowledgments	17
6.0 References	18
7.0 Tables	19
8.0 Figures	27
9.0 Appendices	33

The western rock lobster fishery 1997/98 to 1998/99

C.F. Chubb and E.H. Barker

Western Australian Marine Research Laboratories
PO Box 20, North Beach WA 6920

Abstract

This report is the latest in a series covering the West Coast Rock Lobster Managed Fishery (formerly the West Coast Rock Lobster Limited Entry Fishery), Western Australia's largest and most valuable fishery. These reports form an historical record of fishery data and information documented season by season for use by industry and research personnel now and in the future. The reports provide information on catch, fishing effort and biology; value of the product and licences; input costs (fuel, bait, etc.); changes in fishing practices, gear, technology and boats and management/legislative changes. By necessity, the information contained herein is summarised from the extensive and detailed data bases maintained by the Department of Fisheries. Commercial Fisheries Production Bulletins issued periodically, summarising the status of the fishery during each season, are included as an appendix to this report.

Season 1998/99 produced a record catch of 13,000 tonnes following an average catch of about 10,500 tonnes in 1997/98. The record season led to the highest ever catches for A and C zones of 1,970 and 6,870 tonnes respectively. The record catch was landed from 596 vessels, seven fewer than fished in 1997/98. Nominal fishing effort increased 1.4% in 1997/98 to 10.77 million pot lifts and remained relatively steady (0.3% down) during 1998/99. Catch rates improved in 1998/99 when 1.21 kg per pot lift was recorded compared to the 0.97 kg per pot lift the previous season.

Season 1997/98 saw adjustments to the maximum size rule to ensure uniformity over C zone. Of significance in the same season was the repeal of the "7 and 10 rule" which removed any constraint in vessel size associated with pot allocation in the fleet and allowed fishers to choose, on an economic basis, appropriate sized vessels for their fishing operations.

Throughout 1997/98 and 1998/99, Asian economies were depressed, stocks of product bought at high prices were high and consumption patterns were changing leading to decreased demand for Western Australian product in favour of cheaper options. During the initial part of 1998/99, buyers waited for price reductions in the wake of very high catches. However, a very successful domestic promotion by WestFish and the Western Rock Lobster Development Association saw the volume of product on offer to the international markets reduced considerably with a consequent increase in selling prices, and beach prices, achieved.

The stability of the management regime remained and the breeding stock continued to rebuild, so with record catches and the prospect of even larger catches in 1999/2000, the fleet maintained very strong support for the voluntary research log book programme, ensuring a continued very sound basis for research advice to the fishery's managers.

1.0 Introduction

The fishery for the western rock lobster, *Panulirus cygnus*, is the most important single species fishery in Australia and an important source of export income for Western Australia. During the two seasons covered by this report, Western Australia produced annual rock lobster catches of 10,500 and 13,000 tonnes. The fishery is governed by a complex management system designed to limit the exploitation rate to an acceptable level and to enforce regulations such as a legal minimum size (Bowen 1971, Hancock 1981, Bowen and Hancock 1989, Phillips and Brown 1989). Thus, it is important to monitor the state of the fishery constantly, both to ensure that the fishing effort remains within acceptable limits and that the regulations are adequately performing their function of maintaining sustainable catches. Inherent in this continual fishery assessment, is careful examination of changes in fishing practice, gear modifications and so on, as these innovations lead to increases in efficiency which may not be detectable through the usual calculations of fishing effort (Brown, Caputi and Barker 1995).

This paper is the twentieth in a series of reviews of the rock lobster seasons which discuss fishing practice, catches, fishing effort, mean size and various other factors which affect the rate of exploitation of the stock. This knowledge provides a good understanding of the status of the fishery and is documented herein to ensure historical data for the fishery are readily available. Each review follows a standardised format to allow season to season comparisons and examination of long term trends. This particular report covers the two seasons 1997/98 and 1998/99 and is the fifth of several reports intended to bring the series up to date. It includes, as an appendix, the Commercial Fisheries Production Bulletins issued for these two seasons.

2.0 Methods

Catch and effort data were extracted from figures obtained from fishermen's monthly returns supplied from the Department of Fisheries catch and effort statistical system (CAESS) and from voluntary rock lobster research log books. Catch composition and mean size information was gathered from measurements made by the Department of Fisheries research staff aboard commercial vessels fishing from Dongara, Jurien, Lancelin and Fremantle. Information on trends in fishing practice was gathered principally from interviews with fishermen at various ports as well as from comments made in research log books.

The percentage of rock lobster fishers who submitted rock lobster research records voluntarily during 1997/98 and 1998/99 was as follows:

Season	Percentage
1997/98	38.5
1998/99	37.6

3.0 Results

3.1 Catch and effort data

The fishing season extends from 15 November to 30 June following and may be subdivided into three distinct components:

- i. the “whites” fishery (George 1958) begins in late November, as pale-coloured newly-moulted rock lobsters migrate offshore from the shallow reef areas, and finishes arbitrarily on 31 December;
- ii. the “coastal reds” fishery begins on 1 January and ends on 30 June; and
- iii. the Abrolhos Islands fishery, which is restricted to the period 15 March to 30 June.

In fishing seasons prior to 1977/78, both the coastal and the Abrolhos Islands fisheries ended on 14 August. The season was shortened by six weeks in 1977/78 as a conservation measure (Hancock 1981). During the period covered by this report, the “whites” run commenced (initial large increases in catches of “whites”) in the Fremantle, Jurien and Geraldton areas approximately at the following times:

Season	Fremantle	Jurien	Geraldton
1997/98	22 November	23 November	24 November
1998/99	6 December	3 December	5 December

Total catches (kg) and fishing effort (number of pot lifts), recorded by fishermen in their monthly returns, were as follows (Figure 1):

Catch and effort	1997/98	1998/99
“Whites” catch (15 Nov-31 Dec)	3,182,504	3,786,864
“Whites” effort (15 Nov-31 Dec)	2,462,894	2,403,243
“Coastal reds” catch (1 Jan-30 June)	5,524,277	7,256,724
“Coastal reds” effort (1 Jan-30 June)	7,063,559	7,127,203
Abrolhos catch (15 March-30 June)	1,788,561	1,965,117
Abrolhos effort (15 March-30 June)	1,245,820	1,214,767
Total catch	10,495,342	13,008,705
Total effort	10,772,273	10,745,213

	1997/98	1998/99
B Zone Catch	3,597,947	4,171,955
B Zone Effort	3,866,277	5,416,196
C Zone Catch	5,108,834	6,871,633
C Zone Effort	5,660,176	4,114,250

Abrolhos catch (A Zone) figures are derived from statistical blocks 27131, 28130, 28131, 28141, 29131, 29141 and 97011 to 97015 (See Figures 2a and b).

Catch figures are corrected, for any unreported catches or missing records in the monthly returns, so that the table of catches agrees with processors monthly production figures.

However, since season 1992/93 (Chubb and Barker 1998) the difference between the two figures varied by less than 0.2% and therefore is considered negligible.

Not included in the above production figures are the estimated annual recreational catches listed below:

Season	Annual recreational catch (kg)	Percentage of commercial catch
1997/98	485,500	4.6%
1998/99	626,200	4.8%

Note: The recreational catches given in previous reports in this series, up to and including the 1994/95 season, were adjusted by a factor which estimated the illegal take of rock lobsters. This practice has been discontinued and the recreational catch is given here only as the catch actually reported by recreational fishers through research surveys. Thus, in the 1994/95 season report, the recreational catch was reported as 526 tonnes. Without the correction factor it was 308 tonnes. For more information see Melville-Smith, R. and Anderton, S.M. (2000) Western rock lobster mail surveys of licenced recreational fishers 1986/87 – 1998/99. *Fisheries WA Fisheries Research Report No. 122.*

Figure 1 shows comparative commercial catch (excluding the recreational component), fishing effort (*i.e.* the number of pot lifts [pulls]) and catch per pot lift data from 1944/45 to 1998/99. Fishing effort is measured as the number of pot lifts recorded by fishermen in their monthly returns. In the annual reports prior to 1977/78 fishing effort was calculated as effective fishing effort by the method of Gulland (1969). Catch and effort data from various statistical blocks (Figures 2a and b), are shown in Tables 1 and 2 with catches expressed by weight in kilograms and fishing effort as number of pot lifts. Tables 3 and 4 show catch per pot lift data for the same statistical blocks. The total levels of fishing effort recorded for each of the 1997/98 and 1998/99 seasons were as follows:

Season	Total fishing effort	Variation on previous season
1997/98	10,772,273	1.4% up
1998/99	10,745,213	0.3% down

3.2 Exports and grade categories

This section is based on data provided by all processing establishments from Fremantle to Geraldton. Over the years, the export of rock lobster products has changed from predominantly frozen raw tails to a mixture of live, frozen whole cooked, frozen whole raw and tails. Thus to compare the grade composition of the catch over the years, all product lines have been changed to the equivalent in numbers of cartons of tails (11.34 kg) in each grade. The following table represents each season's total production for all grades with all product lines expressed as percentages of the total equivalent number of cartons of tails by grade.

Percentage of each grade packed

Grades	Season	A	B	C	D	E	F	G	H
		% (140-179g)	% (180-239g)	% (240-279g)	% (280-359g)	% (360-479g)	% (480-599g)	% (600-667g)	% (>668g)
South	97/98	47.70	29.72	10.00	6.02	2.64	1.55	1.82	0.56
(Augusta to Wedge Is)	98/99	45.48	28.71	11.84	6.60	2.95	2.48	1.59	0.35
Central	97/98	49.02	31.03	9.98	6.38	0.95	0.86	0.47	1.31
(Green Islets to Green Head)	98/99	46.15	26.94	11.59	6.90	1.96	2.86	0.73	2.86
North*	97/98	47.02	33.02	9.66	4.80	2.24	2.01	1.23	0.02
(Leeman to Denham)	98/99	45.81	33.95	10.54	5.41	2.36	1.04	0.89	0.01
Total	97/98	47.52	31.61	9.82	5.43	2.21	1.70	1.33	0.38
	98/99	45.72	31.08	11.17	6.05	2.55	1.81	1.15	0.46

*Note: North includes the Abrolhos Islands.

3.3 Mean size

Samples of rock lobsters were measured aboard commercial vessels (from Fremantle, Lancelin, Jurien and Dongara) in four depth categories. The sample included all commercial size rock lobsters, plus some undersize which would have been reduced in number due to the escape gap (54 mm) selection (Bowen 1963; Brown and Caputi 1986), breeding females and females above a maximum size limit. Mean carapace lengths of males and females taken throughout the fishing season from the various depth categories at the four sites and the Abrolhos Islands in March, are compared in Tables 5 and 6. The omissions in the tables are due either to fishermen not fishing the area in question or to some circumstance which prevented the data from being collected (vessel breakdown, etc.).

3.4 Number of boats and pots

The number of boats licensed to fish for rock lobster in the various zones is controlled. Provided certain conditions are met, boat/licence owners are able to transfer their pot entitlement between fishing zones (A, B or C zones). The zones are defined as follows:

- Zone A - see Figures 2a and b;
- Zone B - coastal fishery from 21°44' S to 30° S excluding the A zone;
- Zone C - the water between 30° south latitude and 34°24' south latitude excluding all the waters on the south coast east of 115°8' east longitude;
- Big Bank - see Figure 2c.

The number of boats licensed to fish in the various zones was as follows:

Zone	Number of licensed boats			
	1997/98 (as at 31/12/97)	% Difference on previous season	1998/99 (as at 15/01/99)	% Difference on previous season
A	149	-0	148	-1
B	151	-2	150	-1
C	303	-5	298	-5
Total	603	-8	596	-7

Listed below are the numbers of licensed pots by the various zones for the seasons 1997/98 to 1998/99:

Zone	Number of licensed pots	
	1997/98 (as at 31/12/97)	1998/99 (as at 15/01/99)
A	16,875	16,921
B	16,672	16,626
C	35,744	35,741
Total	69,291	69,288

Note: Under the management arrangements only 82% of these pots were allowed to be fished.

3.5 Forecast of recruitment

The settlement of puerulus on collectors of artificial seaweed along the coast is monitored continually.

Annual indices of puerulus settlement to predict future recruitment were based on the mean of the number of puerulus settling per collector at Abrolhos, Seven Mile Beach and Alkimos (Caputi *et al.*). To ensure comparisons which historical data presented in this series of reports, the total catch and average puerulus settlement from Jurien and Seven Mile Beach are given in Figure 3.

Research indicates that puerulus settlement three years prior to the catch year provide a significant proportion of new recruits late in the reds catch for that year, while the puerulus settling four years prior to the catch year provides the whites catch (Caputi, Brown and Chubb 1995).

1997/98

Puerulus settlements in 1993/94 (49) and 1994/95 (89) produced a slightly below average commercial catch of 10.5 million kg in 1997/98.

1998/99

Puerulus settlements in 1994/95 (89) and 1995/96 (207) produced a very high commercial catch of 13.0 million kg in 1998/99.

3.6 Introduction of new legislation

Note: While these reports detail the legislative changes applicable to the Western Rock Lobster Fishery, it has been past policy to include legislative changes related to all rock lobster fisheries in Western Australia for information. This policy is continued herein.

1997/98

As from 30 September 1997 the Fish Resources Management Amendment Regulations (No. 4), Division 1 – Certain reproducing crustaceans, “(c) brought ashore from, the waters between 21°44' south latitude and 34°24' south latitude but excluding all waters on the south coast that are east of 115°08' east longitude”, were amended to “the waters south of 21°44' south latitude and west of 116° east longitude”. This amendment brought about protection for setose and tar-spotted female rock lobsters in the Windy Harbour-August Rock Lobster Managed Fishery.

As from 30 September 1997 the Fish Resources Management Amendment Regulations (No. 4) Division 5 – Crustaceans other than those listed in Division 1 (in Schedule 2 of the principal regulations), were amended to prohibit the landing of female western rock lobsters greater than 115mm carapace length, from the Windy Harbour – Augusta Rock Lobster Managed Fishery. This had the effect of bringing this fishery into line with the West Coast Rock Lobster Managed Fishery.

As from 12 September 1997 the Fish Resources Management Amendment Regulations (No. 3) amended the boundary at 30°48' south latitude (approximately Wedge Island) to 30° south latitude. The taking of female western rock lobsters with a carapace greater than 105mm was banned north of 30° south latitude, whilst the taking of female western rock lobsters with a carapace greater than 115mm was banned south of 30° south latitude.

As from 30 September 1997 the West Coast Rock Lobster Management Plan Amendment (No. 2) 1997 amended the Principal Plan to provide, amongst other things, grounds for refusal to transfer licences, or pot entitlements, grounds for cancellation of licences, payments of fees by instalments, temporary pot reduction to include the year commencing 1997, the use of boats not specified on a licence and numerous miscellaneous amendments consequential upon operation of the Act.

As from 12 September 1997 the Fish Resources Management Regulations (No. 3) added two new Regulations, which introduced bag limits and other restrictions in the Dampier Archipelago.

The two new Regulations are listed below:

Bag limits for rock lobsters within Dampier Archipelago. 29B For the purposes of section 50 of the Act, the bag limit in respect of rock lobsters taken from Dampier Archipelago waters or brought onto land in the Dampier Archipelago land area is 4 rock lobsters.

Boats used for fishing for rock lobsters within Dampier Archipelago waters. 29C(1) Despite the bag limit prescribed under regulation 29B, a boat used within the Dampier Archipelago waters to fish for rock lobsters must not be used to hold or transport more than 8 rock lobsters in any one day unless –

- a) the boat is a licensed fishing boat; and
- b) the rock lobsters are taken in accordance with an authorisation granted under section 66 of the Act or a rock lobster pot licence.

As from 30 September 1997 the West Coast Rock Lobster Management Plan Amendment (No. 2) removed the requirement to nominate to fish the Cape Inscription area, viz. the waters north of 25°30' south.

As from 30th September 1997 the West Coast Rock Lobster Management Plan Amendment (No. 2) removed the requirement, previously covered under subclause 18(5) for vessels to display pot numbers on wheelhouses.

As from 30 September 1997 the West Coast Rock Lobster Management Plan Amendment (No. 2) removed the 7 and 10 rule. The 7 and 10 rule was a formula which established a minimum and maximum overall length for replacement boats based on the pot entitlement of the boat to be replaced.

1998/99

As from 7 July 1998 the Fish Resources Management Amendment Regulations (No. 2) 1998 amended the Regulations to further define setose rock lobsters as; “setose” means a female

rock lobster that has or is developing fine hair-like filaments (*ovigerous setae*) for the attachment of eggs on branched structures (*biramous endopodites*) forming part of the swimmerets (*pleopods*) underneath its tail.

As from 13 November 1998 the West Coast Rock Lobster Management Plan Amendment 1998, amended the Principal Plan relating to the times that pots may be pulled, viz.

Clause 6 amended.

3. Clause 6 of the principal Plan is amended by deleting subclause (2) and substituting the following-

- “(2) A person shall not pull a pot in the Fishery -
- a) on any day from the commencement of the season to 31 March, at any time before 0430 hours or after 1930 hours on that day; or
 - b) on any day from 1 April to the end of the season -
 - (i) in any waters having a depth less than 36.6 metres, at any time before 0600 hours or after 1800 hours on that day; or
 - (ii) in any waters having a depth equal to or greater than 36.6 metres, at any time before 0430 hours or after 1930 hours on that day.”

As from 13 November 1998 the West Coast Rock Lobster Management Plan Amendment 1998 extended the period to which the temporary pot entitlement (82%) applied, viz.

Clause 18 amended.

4. Clause 18 of the Principal Plan is amended by deleting “1996 and 1997” and substituting the following – “1996, 1997 and 1998.”

During the 1997/98 and 1998/99 rock lobster seasons the following scale of licence fees and charges were introduced:

Rock lobster (managed fisheries)	1997/98	1998/99
West Coast	\$75.00 per pot	\$83.00 per pot
Windy Harbour/Augusta	\$5.00 per pot	\$5.00 per pot
Esperance	\$9.25 per pot	\$27.00 per pot*
Rock lobster pot licence (for areas outside the existing managed rock lobster fisheries)	\$55.00	\$55.00
Fishing boat licence	\$55.00	\$55.00
Carrier boat licence	\$55.00	\$55.00
Professional fisherman’s licence	\$55.00	\$55.00
Recreational fishing licence (rock lobster)	\$25.00	\$25.00
Processor’s licences (land based establishments)		
Rock lobster or prawns only	\$555.00	\$555.00
Rock lobster and prawns only	\$1110.00	\$1110.00
Rock lobster, prawns and wetfish	\$1380.00	\$1380.00
Rock lobster or prawns and wetfish only	\$825.00	\$825.00
Wetfish only	\$270.00	\$270.00
Seagoing processing establishment	\$270.00	\$270.00
Transfer of processor’s licence	\$350.00	\$350.00
Removal of processor’s licence	\$60.00	\$350.00**

* As a result of cost recovery and gross value of production (GVP) averaged across the “Big Fisheries”, can result in costs in the “Small Fisheries” to move either up or down.

** To bring it in line with other administrative costs, in 1988 the removal of a processors licence was increased to \$350.00.

3.7 Effects of New Legislation

1997/98

Significant changes in legislation occurred in 1997/98 such as the removal of the “7 and 10 rule”. The rule had its origins in the 1963 limited entry management arrangements whereby each licensed vessel was allocated pots at “three per foot length of boat” (equivalent to 10 pots per metre of length). Subsequently in July 1990, a rule was introduced allowing some flexibility in pot holdings to facilitate trading of pots. The minimum pot holding of any vessel became its length in metres multiplied by 7, the result rounded to the nearest whole number. The maximum pot allocation of 10 times the vessel length in metres was retained and the combination of both rules became known as the “7 and 10 rule”. The real effect of this rule, however, was to remove the control over the increase in vessel size and fleet development with a consequent increase in effective fishing effort. For example, under the original scheme, a 12.8 metre vessel was allowed 128 pots and the vessel would have been replaced by one of the same size, or smaller or larger if pots were sold or bought. Under the “7 and 10 rule” a 12.8 metre vessel could have a maximum of 128 pots and a minimum of 90. If the vessel carried 100 pots, then this allocation would be the minimum required for a 14.3 metre vessel and so new vessels of larger size were immediately introduced into the fleet. This was tempered by a 5% penalty in pot allocation if the new vessel replaced an existing licenced boat under 6 years old. However, the “6-year replacement rule” was repealed in July 1995 noting that the fleet had developed to such a degree that the rule was outdated. The repeal of the “7 and 10 rule” in 1997/98 continued that line of reasoning and allowed the fleet to develop further on the basis of economic efficiency. It was felt that to control future increases in effective effort, more general measures, such as effort reductions, would be utilised to limit the exploitation rate to that required to maintain egg production at target levels.

Enforcement of the setose, tar-spot and maximum size rules for females was slightly problematic in previous seasons, so in 1997/98 these rules were introduced into the Windy Harbour-Augusta Rock Lobster Managed Fishery to bring it into line with the adjacent West Coast Rock Lobster Managed Fishery. Similarly, enforcement difficulties with different maximum sizes of females in the north and south of C zone; ie, 105 mm north of 30° 48' (approximately Wedge Is) and 115 mm south of that latitude caused the regulation to be altered to ensure a single maximum size of 115 mm for all non-setose female lobsters in C zone. The maximum size of 105 mm in both A and B zones remained unaltered.

Other changes were more or less administrative in nature.

1998/99

Most amendments were administrative, but following a magistrate’s ruling in a prosecution, the definition of setose rock lobsters was amended to avoid any interpretation other than what was intended.

3.8 Innovations to boats and gear (including costs)

Data supplied by the Department of Transport showed that during the years 1997 to 1999 the following number of new boats were constructed each fiscal year (1 July to 30 June).

Year	Area	Construction material			Size range (m)	Average size (m)	% Change on previous season
		Wood	Fibre-glass	Aluminium			
1997/98	North 30° south	-	3	2	14.63-21.30	18.02	
	South 30° south	-	9	4	15.30-17.65	16.46	
	Total	-	12	6			10.0% down
1998/99	North 30° south	-	1	6	10.75-18.44	15.19	
	South 30° south	-	2	2	16.47-18.30	17.39	
	Total	-	3	8			39.0% down

Listed below are the approximate costs of new aluminium or fibre-glass vessels (approximate size 16 to 18 metres) designed specifically for rock lobster fishing. Also listed are the costs of navigational and fish finding equipment, viz. GPS, auto-pilot, radio, radar, colour and black and white echo-sounders, etc., which must be added onto the basic vessel costs. The cost of a new vessel varies greatly, depending on design, type and number of motors, and the type and amount of equipment installed. The prices were supplied by a major builder of vessels for the rock lobster industry:

Season	Cost of vessel (\$)	Approx. average size	Cost of navigational & fish finding equipment (\$)
1997/98	450,000-500,000	16-17 metres	55,000
1998/99	640,000-650,000	18 metres	50,000

The approximate price paid by fishermen for boat fuel (distillate) during the two seasons is listed below. The price paid by fishermen varies greatly, depending on location (cartage) and distributor. The prices were provided by a major distributor in the northern sector of the fishery. Fishermen are entitled to claim a diesel fuel rebate which also is listed and has not been deducted from the basic fuel price:

Season	Fuel price range (¢/litre)	Approx. average price (¢/litre)	Fuel rebate price range (¢/litre)	Approx average rebate price (¢/litre)
1997/98	58.49-65.62	61.82	34.70	34.70
1998/99	57.22-62.49	59.51	34.80-35.07	34.93

Data from research log books showed the following usage of the various types of rock lobster pots by fishermen north and south of 30° S:

Season	Area	TYPE OF POT				
		Stick & Cane Beehive	Batten	Steel Beehive	Plastic Beehive	Steel Bottom Beehive
1997/98	North 30° south	-	100%	-	-	-
	South 30° south	6%	98%	-	-	-
1998/99	North 30° south	-	100%	-	-	-
	South 30° south	3%	100%	-	-	-

Note: Total percentage greater than 100% is due to boats using a combination of pot types.

1997/98 and 1998/99 seasons

Throughout the period covered by this report the use of stick and cane beehive pots during the entire season (November to June) continued to decline in the southern sector of the fishery.

A majority of fishers used batten pots constructed of pine battens on a jarrah frame with a steel bottom during the “whites” run (November to January) both in the shallows and deep water.

Following a return to the shallows and the mid-water grounds in January an increasing number of skippers commenced using beehive pots in the belief that this type of pot was a more efficient catching unit during the “reds” fishery (February to June).

In the northern sector batten pots were used universally throughout the entire season. These pots were constructed of pine battens on a steel frame with steel bottoms. Small numbers of karri and jarrah battens on steel frames also were used.

Fishers also used batten pots constructed with a jarrah frame on a steel bottom utilising battens chiefly of pine and to a lesser extent karri and jarrah.

	PRICE OF POTS (\$)			
	1997/98		1998/99	
	North 30° S	South 30° S	North 30° S	South 30° S
Batten ¹				
Steel Bottom	130.00	135.00	131.00	135.00
Wood Bottom	128.00	130.00	129.00	130.00
Steel Framed Batten ²				
Steel Bottom	141.00	-	146.00	-
Stick and Cane Beehive ³	-	88.00	-	90.00

1. Batten pots are either constructed with a steel or wooden bottom and come complete with two built-in bait baskets, plastic or wood finger neck, escape gaps, ballast and an anode in steel bottom pots.
2. Steel framed batten pots are constructed with a removable top and side panels comprised of pine, karri or jarrah battens, depending on personal preference.
3. The price quoted for stick and cane beehive pots does not include ballast or a skid board, which was approximately \$6.50 per pot for the skid board.

The above prices were supplied by selected pot manufacturers, however, pot prices vary between manufacturers.

Listed below are the prices charged by a major distributor of commercial fishing gear in the southern sector of the fishery for 11 mm and 12 mm pot rope and 200 mm pot floats. Once again prices varied depending on the distributor and in the case of rope, the country of origin.

Season	Pot rope (\$) (220 m coil)	Country of origin	Pot float (\$) (each)
1997/98	65.00-78.00	Thailand	2.98
1998/99	63.00-75.00	Thailand	2.60

3.9 Bait

Data from research log books showed that of those skippers who filled in a research log book, the following usage of bullock hocks and pieces of cattle hide as a holding and/or catching bait north and south of 30° S took place:

Season	Area	Hocks	Hide
1997/98	North 30°S	2%	59%
	South 30°S	1%	50%
1998/99	North 30°S	1%	51%
	South 30°S	2%	48%

Fishermen were able to choose from a wide range of both local and imported fish baits. These fish baits generally were used in combination with either pieces of cattle hide or, to a lesser extent, cattle hocks. During the 1997/98 and 1998/99 seasons the following baits were the most commonly used and are listed in order of popularity:

Common names	1997/98		1998/99	
	North 30° S	South 30° S	North 30° S	South 30° S
North Sea herring (<i>Clupea</i> sp.)	1	3	1	4
Imported mackerel (<i>Scomber</i> sp.)	2	1	2	1
Australian salmon (<i>Arripis truttaceus</i>) and New Zealand Kahawai (<i>Arripis trutta</i>)	3	2	3	2
Australian herring (<i>Arripis georgianus</i>)	4	7	4	-
Orange roughy heads (<i>Hoplostethus atlanticus</i>)	5	4	6	3
Tuna heads (<i>Thunnus</i> sp.)	6	-	8	-
Scaly mackerel (<i>Sardinella lemura</i>)	7	6	-	9
Mullet (<i>Mugil cephalus</i>)	8	8	-	6
Bony herring (<i>Nematalosa</i> sp.)	9	-	9	-
Kangaroo (<i>Macropus</i> sp.)	10	-	7	-
Pilchards (<i>Sardinops neopilchardus</i>)	-	5	-	5
Sardinella (<i>Clupea</i> sp.)	-	-	5	7
Hoki heads (<i>Macruronus novaezelandiae</i>)	-	-	-	8

Listed below are the retail prices paid by fishermen both north and south of 30° S for a variety of rock lobster baits. Prices quoted here are from selected processing establishments and do vary between suppliers:

Type of Bait	1997/98 Retail price (\$)		1998/99 Retail price (\$)	
	North 30° S	South 30° S	North 30° S	South 30° S
Hocks per bag	-	10.66	-	14.00
Hides per bag	18.00	18.78	18.00	16.50
Australian salmon per kg	1.10-1.20	1.47	1.00-1.20	1.32
New Zealand salmon per kg	1.15	1.18	1.15	1.17-1.59
Australian herring per kg	1.10	1.06	1.10	-
Yelloweye mullet per kg	1.05	1.12	1.00	-
Mullet per kg	-	-	-	-
Scaly mackerel per kg	0.95	1.24	-	1.07
Bonito per kg	-	-	-	-
Perth or bony herring per kg	1.05	-	-	-
Imported mackerel per kg	1.05-1.30	1.25	1.00-1.25	1.35
Tuna heads per kg	0.95	1.09	0.95	1.07
Kangaroo per kg	0.80	0.97	0.80	0.85
Pilchards per kg	-	0.95	-	1.07
North Sea herring per kg	1.10	1.14	1.05	1.10

3.10 Distribution of fishing

The distribution of fishing, indicated by catch and effort records in fishermen's returns, is shown in Tables 1 and 2. The pattern of fishing does not vary greatly from season to season and is dependent on the density of rock lobsters in the various depths. Throughout a season, the usual pattern is concentrated fishing in the shallows during November and early December; followed by a move to deeper water fishing during the latter part of December and early January as the "whites" migration is followed; then back to the shallows, with some fishing in the middle grounds, during February, March and April; and finally fishing in mixed depths (mainly shallower), depending on weather and density of rock lobsters, throughout the remainder of the season.

During the period covered by this report, vessels fished for rock lobsters in the extreme northern and southern areas of the fishery, viz. in the area around South Passage in Shark Bay in the north and Augusta in the south. Most of the rock lobsters caught in the Augusta area (statistical blocks 3414, 3415, 3416 and 3517) were outside the West Coast Rock Lobster Managed Fishery concession area. However, because of the boundary at 34°24' S, blocks 3414 and 3415 include catches from both the West Coast Rock Lobster and Windy Harbour-Augusta Rock Lobster Managed fisheries. The catch from the latter fishery was minimal in the two years covered by this report.

Prior to the 1986/87 season, a small number of vessels fished for rock lobsters in deep water north-west of Kalbarri in an area known as Big Bank (Figure 2c). From 1986/87 through to 1998/99 up to 119 vessels fished in the above area during January and February of each season, taking large numbers of migratory rock lobsters in very deep water (70 to 100 fathoms) (Chubb, Barker and Dibden 1994). Regulations controlling the timing of the commencement of fishing there have been in force since 1991.

3.11 Average number of days worked per boat per month

Listed below are the average total number of days worked per boat each month for both north and south of 30° S latitude and a total for the combined areas:

Month	North* 30° S		South 30° S		Total	
	1997/98	1998/99	1997/98	1998/99	1997/98	1998/99
November	15.5	14.6	14.7	14.3	15.0	14.4
December	28.8	28.6	28.2	27.6	28.5	28.1
January	14.7	15.0	23.0	25.1	19.0	20.1
February	25.1	23.7	26.6	27.1	25.9	25.4
March	25.2	25.5	30.2	30.0	27.7	27.8
April	29.3	29.1	26.3	26.0	27.8	27.5
May	27.8	26.1	23.8	23.5	25.8	24.8
June	21.9	22.0	20.1	21.0	21.0	21.5

*Note: North includes the Abrolhos Islands.

3.12 Price of rock lobsters (per kg)

The prices gained by exporters for the sale of rock lobsters are governed by a complex set of factors, eg. demand, size of lobster, product type, exchange rate, etc. Thus this section deals only with the average price paid to fishermen (the "beach price") selling their catch directly to licensed rock lobster processors.

1997/98

The prices that fishermen received for their catches varied considerably throughout the season but using the average price per kg for catches in each zone, the ex-vessel value of the landed catch was approximately \$213 million.

In the northern sector of the fishery the average price that fishermen received for their catches was approximately \$20.50 per kg.

In the southern sector of the fishery the average price that fishermen received for their catches was approximately \$20.00 per kg.

1998/99

In both the northern and southern sectors of the fishery the price that fishermen received for their catches was approximately \$20.00 to \$20.50 per kg. The ex-vessel value of the landed catch was approximately \$263 million.

3.13 Marketing

Each season, depending on market demand, rock lobsters were processed into various product types; frozen tails, frozen whole cooked (boiled), frozen whole raw and live. The processed rock lobsters, with the exception of a small quantity destined for the local market, were exported chiefly to Japan, Taiwan, USA and China with a very small quantity marketed in France. Whole cooked, whole raw and live were marketed in Japan and Taiwan, live in China, whilst the frozen tails were exported to the USA.

Average wholesale New York price for Australian rock lobster tails. (*NA not available):

Grade	\$US per Kg	
	1997/98	1998/99
5-6 oz (113-170 gm)	NA	NA
6-8 oz (170-226 gm)	NA	NA
8-10 oz (226-283 gm)	NA	NA
12-16 oz (300-453 gm)	NA	NA

* The average wholesale New York price for Australian Rock Lobster tails was not published in FAO Info Fish Trade News for the above period. Info Fish was contacted but the data was not available.

Listed below are the percentages of each product type for the seasons 1997/98 to 1998/99 converted to landed live weight equivalents.

The production figures have been separated into three fishing/processing sectors, Augusta to Wedge Island, Green Islets to Green Head, Leeman to Denham, together with a total for the whole coast. It must be noted however, that due to transportation of some product between centres for processing, the figures are a combination of what was caught and what was processed in each area:

Area	Season	PRODUCT TYPE (%)			
		Tails	Cooked	Raw	Live
South	1997/98	16.52	21.92	3.39	58.18
(Augusta to Wedge Island)	1998/99	17.12	22.02	3.72	57.14
Central	1997/98	32.87	39.21	13.47	14.44
(Green Islets to Green Head)	1998/99	34.26	42.06	5.15	18.53
North	1997/98	20.11	44.19	10.88	24.82
(Leeman to Denham)*	1998/99	22.83	46.34	6.00	24.84
Total	1997/98	20.54	35.84	8.63	34.99
	1998/99	21.83	36.17	4.99	37.01

*Note: Leeman to Denham includes the Abrolhos Islands.

3.14 Value per pot on pot redistribution

(i.e. market price paid for a licensed pot)

1997/98

Zones A and B from approximately \$29,250 to approximately \$30,000.

Zone C from approximately \$21,500 to approximately \$25,000.

1998/99

Zones A and B approximately \$18,000.

Zone C from approximately \$18,000 to approximately \$19,000.

3.15 Sea water temperatures and salinities

These environmental variables have relevance to the behaviour and catch rates of rock lobsters (Morgan 1974). The average sea water temperatures (°C) and salinities (parts per thousand) together with maximum and minimum sea water temperatures and salinities during the following rock lobster seasons (i.e. 1997/98 to 1998/99, 15 November to 30 June) at the Western Australian Marine Research Laboratories (aquarium header tank) were:

Season	Max. temp (°C)	Week ending	Min temp (°C)	Week ending	Avg temp (°C) (season)	Max salinity	Week ending	Min salinity	Week ending	Avg salinity (season)
1997/98	23.4	12,19/01/98	16.5	29/06/98	21.1	36.11	09/03/98	35.03	15/12/97	35.54
1998/99	24.0	01/03/99	18.4	14,21/06/99	21.6	36.28	05/04/99	33.70	21/12/98	35.30

Bottom temperatures and surface salinities in waters of various depths in the Fremantle, Lancelin, Jurien and Dongara areas were collected as part of the monitoring of rock lobster catches (see section 2.0) and are shown in Tables 7 and 8. Limited information is available for the Abrolhos Islands in March.

3.16 Spawning rock lobsters

Monitoring on board commercial vessels provides a detailed description of the lobsters caught in commercial pots, particularly with respect to the breeding stock and undersize animals that are returned to the sea. The sex ratios between males and females in different depth categories are given in Tables 9 and 10.

Most of the breeding females are found in the 20-50 fathom (37-92 m) range with no variation in the size of first breeding observed from one depth category to another. Hence the data for December, January and February from all depths may be pooled to indicate the size frequency of breeding (*i.e.* “berried” and/or mated) females (Figures 4a and b). The mean sizes of breeding females from monitoring data collected during the period 1997/98 to 1998/99 were as follows:

Season	CARAPACE LENGTH (mm)			
	Fremantle	Lancelin	Jurien	Dongara
1997/98	103.1	105.5	89.1	90.7
1998/99	102.0	103.3	92.6	92.0

By comparison the mean sizes at first breeding (*i.e.* the smallest carapace length at which 50% are “berried” and/or mated) were found to be:

Season	CARAPACE LENGTH (mm)			
	Fremantle	Lancelin	Jurien	Dongara
1997/98	95.4	94.8	90.8	90.6
1998/99	94.5	90.6	88.0	86.4

4.0 Discussion

Following the two previous seasons where low catches were recorded, landings in 1997/98 returned to average then to a record level in 1998/99. The 13,000 tonnes landed in the latter season approached the largest single-season catch of rock lobsters recorded by any single jurisdiction anywhere in the world. The highest was 13,600 tonnes landed by Cuba in 1985. Record catches for A and C zones of 1,970 and 6870 tonnes respectively were taken, beating the previous highest of 1,900 tonnes in 1995/96 in A zone and 6,670 tonnes in C zone in 1982/83.

Through both seasons, downturns in the Asian economies, changes in consumption patterns and large inventories of stored product brought at high prices served to reduce demand for Western Australian product, with preference shown for cheaper lines from other countries. The result saw beach prices fall to averages of \$20 - \$20.50 per kg in the north and south during both the 1997/98 and 1998/99 seasons. This compares with the \$27.50 and \$26 per kg in the north and south respectively on offer during 1996/97. The value of the landed catch totalled \$213 million in 1997/98 and \$263 million in 1998/99. While the cost of gear (pots, ropes and floats) increased in these two seasons, the price of fuel was considerably less than during 1996/97 and even 1995/96.

Interestingly, the forecast very high catch in 1998/99 and the economic situation and stored inventories in Asia suggested a very low beach price of \$13 - \$15 prior to the season. When the season commenced, buyers appeared content to wait for selling prices to fall in the wake of large catches. Fortunately, two things led to a better beach price. A weakening Australian dollar against the US dollar led to a beach price of around \$16 when the season started. More importantly though, the Western Rock Lobster Development Association (processors)

and WestFish promoted a “Lobsters for Christmas” campaign that was extremely successful, with lobsters on offer to the public for as little as \$8 – \$9 per piece. As a result of this promotion, an estimated 600-700 tonnes of whole boiled lobster were sold to Australian domestic consumers through the supermarket trade. This reduced the volume to be sold in traditional overseas markets, so when buyers’ demand improved, Australian processors were able to seek and were paid higher prices with a consequent improvement in the beach price.

During the two seasons covered by this report, the fleet continued to restructure. Eight vessels left the industry in 1997/98 (3 from B zone and 8 from C zone) and a further 7 retired in 1998/99 (1 in each of A and B zones and 5 from C zone) bringing to 596 the total number of boats fishing in the latter season. Numbers of new vessels entering the fleet continued to fall through 1997/98 (18) and 1998/99 (11), however, the replacement vessels were considerably larger presumably reflecting the removal of the “7 and 10 rule” and allowing fishers the choice of vessels that best suited their operations. Total levels of fishing effort were comparable to the previous two seasons at around 10.75 million pot lifts. The ratio of pots in A and B zones virtually had been 50:50 over the four seasons 1995/96 to 1998/99, however, in 1997/98 and 1998/99, the slightly greater number of pots (0.8-1.0%) in B zone shifted to A zone.

The impact of the 1993/94 management arrangements that were still in force was a dramatic and very visible improvement in the size of the breeding stock. Evidence for this came from the fishery and fishery-independent breeding stock indices, the voluntary research log books and fishers’ verbal reports of very large numbers of setose and berried females in both seasons. Perhaps as a result of the success of the management package, containing an 18% temporary pot reduction which introduced further economic efficiency into the fishing operation, the level of participation in the log book programme rose to a record 38.5% in 1997/98. Whilst it declined a little to 37.6% in 1998/99, it appeared that the fleet was happy with record catches and the prospect of even higher catches in 1999/2000 and content to ensure that research advice to the fishery managers had the best possible basis.

5.0 Acknowledgments

Measurements on board fishing vessels were performed by S. O’Connor, M. Byrne, T. Paust, J. Christianopoulos, D. Murphy, R. Edwards, K. Brooks, D. Ashby, D. McVeigh, M. Rossbach, P. Verelst, M. Killick, D. Wilkins, J. Norriss, M. Painter, M. Kleeman, W. Norton, L. Farrington, G. Boshoff, G. Meinema, J. Mutter and R. Frater. Summary data were provided by Wilf Lehre and Eva Lai of the Department of Fisheries. The report was produced by Sandy Clarke, Publications Officer, Department of Fisheries.

6.0 References

- Anonymous. 1993. Rock Lobster Industry Advisory Committee. Chairman's report to the Minister for Fisheries on management recommendations for 1993/94 and 1994/95 western rock lobster seasons. Fisheries Dept. Western Australia, Fisheries management Paper. No. 55, 22pp.
- Bowen, B.K. 1963. Preliminary report on effectiveness of escape gaps in crayfish pots. *Fish Dept. West Australia. Rep.* No 2.
- Bowen, B.K. 1971. Management of the western rock lobster (*Panulirus longipes cygnus*, George). *Proc. 14th Sess. Indo-Pacif. Fish. Coun.*, Bangkok, pp. 139-154.
- Bowen, B.K. and Hancock, D.A. 1989. Effort limitation in the Australian rock lobster fisheries. In: J.F. Caddy (ed), *Marine Invertebrate Fisheries: Their Assessment and Management*. John Wiley and Sons, New York, pp. 375-393.
- Brown, R.S. and Barker, E.H. 1990. The Western Rock Lobster Fishery (1985/86). *Res. Rep. Dept. West. Aust.* No. 83, 17pp.
- Brown, R.S. and Caputi, N. 1986. Conservation of recruitment of the western rock lobster (*Panulirus cygnus*) by improving survival and growth of undersize rock lobsters captured and returned by fishermen to the sea. *Can. J. Fish. Aquat. Sci.*, **43**(11): 2236-2242.
- Brown, R.S., Caputi, N. and Barker, E.H. 1995. A preliminary assessment of increases in fishing power in the Western rock lobster (*Panulirus cygnus* George 1962) fishery in Western Australia. *Crustaceana*, **68**: 227-257.
- Caputi, N., Brown, R.S. and Chubb, C.F. 1995. Regional prediction of the Western rock lobster, *Panulirus cygnus*, commercial catch in Western Australia. *Crustaceana*, **68**: 245-256.
- Chubb C.F., Barker, E.H. and Brown, R.S. 1996. The Western rock lobster fishery 1986/87 to 1990/91. *Fish. Res. Rep. Fish. Dept. West. Aust.*, No. 105, 51pp.
- Chubb C.F., Barker, E.H. and Dibden, C.J.D. 1994. The big bank region of the limited entry fishery for the Western rock lobster, *Panulirus cygnus*. *Fish. Res. Rep. Fish. Dept. West. Aust.* No. 191, 20pp.
- Chubb C.F. and Barker, E.H. 1998. The western rock lobster fishery 1991/92 to 1992/93. *Fish. Res. Rep. Fish. West. Aust.*, No. 109, 35pp.
- George, R.W. 1958. The status of the "white" crayfish in Western Australia. *Aust. J. Mar. Freshw. Res.*, **9**: 537-545.
- Gulland, J.A. 1969. Manuals of methods for fish stock assessment. Part 1. Fish population analysis. *FAO Manuals in Fisheries Science* No. 4, 154pp.
- Hancock, D.A. 1981. Research for management of the Rock Lobster Fishery of Western Australia. *Proc. Gulf Carib. Insti.*, **33**: 207-229.
- Morgan, G.R. 1974. Aspects of the population dynamics of the western rock lobster, *Panulirus cygnus* George, II: Seasonal changes in the catchability coefficient. *Aust. J. Mar. Freshw. Res.*, **25**: 249-259.
- Phillips, B.F and Brown, R.S. 1989. The western rock lobster fishery: Research for Management. In: Caddy, J.F. (ed), *Marine Invertebrate Fisheries: Their assessment and management*. John Wiley and Sons, New York, pp. 159-181.

7.0 Tables

Table 1. Catch (in kg weight) and fishing effort (in pot lifts) for the 1997/98 rock lobster season in various statistical blocks.

Block		9711	9712	9801	9802	Date 9803	9804	9805	9806	Total
25120	Catch	-	-	-	-	-	3,134	-	-	3,134
	Effort	-	-	-	-	-	1,845	-	-	1,845
26120	Catch	-	-	-	24,951	-	-	3,565	500	29,016
	Effort	-	-	-	13,921	-	-	2,448	400	16,769
26131	Catch	-	-	-	9,541	1,617	16,362	24,817	1,192	53,529
	Effort	-	-	-	6,265	776	7,650	16,190	744	31,625
27120	Catch	-	-	-	2,513	-	-	-	-	2,513
	Effort	-	-	-	1,620	-	-	-	-	1,620
27132	Catch	1,843	22,384	6,485	115,496	37,680	57,167	44,393	16,759	302,207
	Effort	1,979	16,418	12,931	93,484	33,010	33,793	36,467	19,481	247,563
27140	Catch	17,110	94,787	14,367	24,332	44,955	37,769	25,906	16,040	275,266
	Effort	18,114	67,726	25,881	35,957	33,836	25,128	24,709	19,903	251,254
28131	Catch	-	-	-	-	-	-	1,528	903	2,431
	Effort	-	-	-	-	-	-	1,800	1,800	3,600
28132	Catch	836	5,002	1,712	1,701	-	1,843	-	-	11,094
	Effort	1,185	4,732	3,320	3,012	-	1,000	-	-	13,249
28142	Catch	102,715	276,590	35,387	103,665	152,831	122,597	83,866	84,514	962,165
	Effort	130,210	205,117	127,930	232,461	137,103	102,966	101,910	104,821	1,142,518
29132	Catch	-	3,994	349	-	632	8,035	4,302	3,335	20,647
	Effort	-	2,896	760	-	900	3,567	2,706	3,480	14,309
29142	Catch	228,117	647,884	83,190	133,036	255,914	271,276	178,211	138,317	1,935,945
	Effort	268,736	489,568	224,015	296,678	258,912	216,270	198,414	189,332	2,141,925
30140	Catch	85,595	365,497	105,368	82,296	174,058	228,112	118,333	90,242	1,253,501
	Effort	107,563	216,397	159,872	161,436	202,457	216,618	162,230	140,497	1,367,070
30150	Catch	36,678	141,780	35,728	28,083	77,643	75,219	35,245	28,511	458,887
	Effort	45,045	81,202	58,197	52,134	85,557	79,569	51,272	46,248	499,224
31140	Catch	1,714	23,610	3,277	3,033	10,785	10,393	4,201	2,769	59,782
	Effort	1,845	11,718	4,579	5,851	12,821	11,049	5,910	5,494	59,267
31150	Catch	238,357	672,275	253,747	298,398	428,943	328,238	262,514	178,727	2,661,199
	Effort	230,381	410,827	350,809	446,899	470,805	369,593	369,371	302,971	2,951,656
32140	Catch	900	3,675	1,115	1,290	2,535	2,948	-	-	12,463
	Effort	1,246	2,464	2,200	2,376	4,054	3,560	-	-	15,900
32150	Catch	48,190	158,971	47,690	68,882	82,041	67,003	89,052	66,930	628,759
	Effort	45,025	102,500	86,509	100,792	107,684	85,402	100,486	90,303	718,701
33140	Catch	-	-	1,428	2,220	1,605	1,439	3,858	-	10,550
	Effort	-	-	3,567	5,636	3,567	1,378	5,123	-	19,271
33150	Catch	-	-	4,834	4,729	-	3,283	5,229	3,120	21,195
	Effort	-	-	6,278	6,056	-	2,902	4,220	5,601	25,057
34141	Catch	-	-	-	-	-	2,454	-	-	2,454
	Effort	-	-	-	-	-	3,321	-	-	3,321
34152	Catch	-	-	19	-	-	-	-	-	19
	Effort	-	-	364	-	-	-	-	-	364
35150	Catch	-	-	-	-	-	-	21	4	25
	Effort	-	-	-	-	-	-	123	222	345
97011	Catch	-	-	-	-	27,521	29,388	25,915	934	83,758
	Effort	-	-	-	-	10,276	18,120	18,334	1,680	48,410
97012	Catch	-	-	-	-	256,546	237,817	132,461	62,343	689,167
	Effort	-	-	-	-	90,126	164,834	159,105	115,444	529,509
97013	Catch	-	-	-	-	212,830	161,208	81,006	39,464	494,508
	Effort	-	-	-	-	79,583	105,648	96,327	72,639	354,197
97014	Catch	-	-	-	-	120,981	176,216	71,379	25,137	393,713
	Effort	-	-	-	-	40,114	87,793	73,908	37,266	239,081
97015	Catch	-	-	-	-	23,708	68,911	27,925	6,871	127,415
	Effort	-	-	-	-	9,828	32,039	22,718	10,038	74,623
Total	Catch	766,055	2,416,449	594,696	904,166	1,912,825	1,910,812	1,223,727	766,612	10,495,342
	Effort	851,329	1,611,565	1,067,212	1,464,578	1,581,409	1,574,045	1,453,771	1,168,364	10,772,273

Table 2. Catch (in kg weight) and fishing effort (in pot lifts) for the 1998/99 rock lobster season in various statistical blocks.

Block		9811	9812	9901	9902	Date 9903	9904	9905	9906	Total
24131	Catch	-	-	-	429	-	231	-	-	660
	Effort	-	-	-	350	-	450	-	-	800
25120	Catch	-	-	541	-	-	251	-	-	792
	Effort	-	-	783	-	-	450	-	-	1,233
25130	Catch	-	-	674	110	898	-	-	-	1,682
	Effort	-	-	522	210	1,050	-	-	-	1,782
26120	Catch	-	-	-	9,296	5,858	4,776	2,433	-	22,363
	Effort	-	-	-	6,658	3,000	2,800	2,700	-	15,158
26131	Catch	-	-	1,385	4,276	1,369	9,377	5,931	-	22,337
	Effort	-	-	2,835	3,390	1,209	4,883	4,806	-	17,123
27120	Catch	-	-	-	2,245	-	298	-	-	2,543
	Effort	-	-	-	1,760	-	330	-	-	2,090
27132	Catch	3,321	10,003	12,576	189,526	47,520	66,353	44,539	10,128	383,966
	Effort	4,371	6,688	15,852	114,837	32,096	37,287	38,674	10,547	260,352
27140	Catch	11,055	56,714	17,246	26,302	48,597	46,878	19,266	13,933	239,991
	Effort	16,262	42,215	30,541	36,504	35,707	33,443	24,182	25,536	244,390
28132	Catch	712	3,221	1,343	1,226	-	4,664	-	-	11,166
	Effort	1,185	2,450	1,770	2,410	-	2,576	-	-	10,391
28142	Catch	55,356	330,283	57,290	119,348	227,008	134,608	83,178	88,041	1,095,111
	Effort	122,427	215,968	130,533	205,948	153,443	101,142	99,527	111,494	1,140,482
29132	Catch	618	200	289	294	955	3,858	-	-	6,215
	Effort	1,504	452	1,210	990	1,230	2,610	-	-	7,996
29142	Catch	120,931	966,680	89,264	161,612	385,493	301,181	185,120	172,830	2,383,112
	Effort	247,864	518,909	215,237	270,631	251,282	206,270	192,727	207,698	2,110,618
30140	Catch	25,758	440,929	107,057	93,890	271,080	212,178	111,887	97,272	1,360,051
	Effort	68,710	162,241	118,366	133,324	187,736	157,062	132,527	125,848	1,085,814
30150	Catch	17,550	223,248	65,819	42,294	123,349	102,619	39,000	26,042	639,921
	Effort	42,210	89,700	75,249	54,969	86,879	81,632	50,740	36,588	517,967
31140	Catch	2,928	48,136	15,804	8,198	10,384	14,760	5,390	6,234	111,834
	Effort	3,495	18,267	13,272	9,858	7,223	11,663	6,364	8,197	78,339
31150	Catch	204,825	973,875	373,198	421,102	672,745	458,010	308,541	288,483	3,700,780
	Effort	263,453	420,725	417,842	481,667	478,358	397,543	369,514	339,654	3,168,756
32140	Catch	75	18,467	4,764	3,921	7,054	4,377	4,564	-	43,222
	Effort	476	7,425	4,733	3,444	6,887	3,321	5,810	-	32,096
32150	Catch	14,752	248,856	100,183	88,849	146,102	117,237	110,283	115,321	941,582
	Effort	38,771	103,525	96,962	100,398	116,604	96,621	116,919	95,898	765,698
33140	Catch	-	-	-	3,006	-	5,232	-	-	8,238
	Effort	-	-	-	4,591	-	2,756	-	-	7,347
33150	Catch	183	6,339	3,762	5,164	2,798	14,328	7,248	8,830	48,652
	Effort	680	2,550	3,995	6,400	2,666	10,144	7,650	6,226	40,311
34141	Catch	-	-	-	-	6,361	2,242	1,423	3,848	13,874
	Effort	-	-	-	-	5,505	1,666	1,785	3,213	12,169
34151	Catch	-	-	1,298	-	1,481	2,241	1,423	-	6,443
	Effort	-	-	1,785	-	1,666	1,547	1,666	-	6,664
34152	Catch	-	21	112	148	199	140	-	-	621
	Effort	-	720	1,500	175	100	375	-	-	2,870
97011	Catch	-	-	-	-	23,281	31,078	26,880	1,997	83,236
	Effort	-	-	-	-	6,048	16,572	22,301	5,364	50,285
97012	Catch	-	-	-	-	308,029	244,494	106,822	43,650	702,994
	Effort	-	-	-	-	91,580	156,365	143,045	95,080	486,070
97013	Catch	-	-	-	-	266,578	180,057	85,260	32,052	563,947
	Effort	-	-	-	-	75,028	111,015	102,479	74,632	363,154
97014	Catch	-	-	-	-	166,725	169,165	49,978	14,030	399,898
	Effort	-	-	-	-	45,560	83,931	54,841	29,089	213,421
97015	Catch	-	-	-	-	77,210	101,525	27,165	7,572	213,472
	Effort	-	-	-	-	19,919	43,763	25,774	12,381	101,837
Total	Catch	458,064	3,326,971	852,607	1,181,236	2,801,073	2,232,160	1,226,331	930,263	13,008,705
	Effort	811,408	1,591,835	1,132,987	1,438,514	1,610,776	1,568,217	1,404,031	1,187,445	10,745,213

Table 3. Catch (kg) per unit of fishing effort (*i.e.* kilograms of rock lobster per pot lift) data for the 1997/98 season in various statistical blocks (see figures 2a, b).

Block	Date								Total
	9711	9712	9801	9802	9803	9804	9805	9806	
25120	-	-	-	-	-	1.699	-	-	1.699
26120	-	-	-	1.792	-	-	1.456	1.250	1.730
26131	-	-	-	1.523	2.084	2.139	1.533	1.602	1.693
27120	-	-	-	1.551	-	-	-	-	1.551
27132	0.931	1.363	0.502	1.235	1.141	1.692	1.217	0.860	1.221
27140	0.945	1.400	0.555	0.677	1.329	1.503	1.048	0.806	1.096
28131	-	-	-	-	-	-	0.849	0.502	0.675
28132	0.705	1.057	0.516	0.565	-	1.843	-	-	0.837
28142	0.789	1.348	0.277	0.446	1.115	1.191	0.823	0.806	0.842
29132	-	1.379	0.459	-	0.702	2.253	1.590	0.958	1.443
29142	0.849	1.323	0.371	0.448	0.988	1.254	0.898	0.731	0.904
30140	0.833	1.689	0.659	0.510	0.860	1.053	0.729	0.642	0.917
30150	0.814	1.746	0.614	0.539	0.908	0.945	0.687	0.616	0.919
31140	0.929	2.015	0.716	0.518	0.841	0.941	0.711	0.504	1.009
31150	1.035	1.636	0.723	0.668	0.911	0.888	0.711	0.590	0.902
32140	0.722	1.491	0.507	0.543	0.625	0.828	-	-	0.784
32150	1.070	1.551	0.551	0.683	0.762	0.785	0.886	0.741	0.875
33140	-	-	0.400	0.394	0.450	1.044	0.753	-	0.547
33150	-	-	0.770	0.781	-	1.131	1.239	0.557	0.846
34141	-	-	-	-	-	0.739	-	-	0.739
34152	-	-	0.052	-	-	-	-	-	0.052
35150	-	-	-	-	-	-	0.171	0.018	0.072
97011	-	-	-	-	2.678	1.622	1.413	0.556	1.730
97012	-	-	-	-	2.847	1.443	0.833	0.540	1.302
97013	-	-	-	-	2.674	1.526	0.841	0.543	1.396
97014	-	-	-	-	3.016	2.007	0.966	0.675	1.647
97015	-	-	-	-	2.412	2.151	1.229	0.684	1.707
Total	0.900	1.499	0.557	0.617	1.210	1.214	0.842	0.656	0.974

Total catch = 10,495,342 kg

Total effort = 10,772,273 pot lifts

Table 4. Catch (kg) per unit of fishing effort (i.e. kilograms of rock lobster per pot lift) data for the 1998/99 season in various statistical blocks (see figures 2a, b).

Block	Date								Total
	9811	9812	9901	9902	9903	9904	9905	9906	
24131	-	-	-	1.225	-	0.514	-	-	0.825
25120	-	-	0.691	-	-	0.559	-	-	0.642
25130	-	-	1.291	0.525	0.855	-	-	-	0.944
26120	-	-	-	1.396	1.953	1.706	0.901	-	1.475
26131	-	-	0.488	1.261	1.132	1.920	1.234	-	1.305
27120	-	-	-	1.276	-	0.904	-	-	1.217
27132	0.760	1.496	0.793	1.650	1.481	1.780	1.152	0.960	1.475
27140	0.680	1.343	0.565	0.721	1.361	1.402	0.797	0.546	0.982
28132	0.601	1.315	0.759	0.509	-	1.811	-	-	1.075
28142	0.452	1.529	0.439	0.580	1.479	1.331	0.836	0.790	0.960
29132	0.411	0.443	0.239	0.297	0.777	1.478	-	-	0.777
29142	0.488	1.863	0.415	0.597	1.534	1.460	0.961	0.832	1.129
30140	0.375	2.718	0.904	0.704	1.444	1.351	0.844	0.773	1.253
30150	0.416	2.489	0.875	0.769	1.420	1.257	0.769	0.712	1.235
31140	0.838	2.635	1.191	0.832	1.438	1.266	0.847	0.761	1.428
31150	0.777	2.315	0.893	0.874	1.406	1.152	0.835	0.849	1.168
32140	0.158	2.487	1.007	1.139	1.024	1.318	0.786	-	1.347
32150	0.380	2.404	1.033	0.885	1.253	1.213	0.943	1.203	1.230
33140	-	-	-	0.655	-	1.898	-	-	1.121
33150	0.269	2.486	0.942	0.807	1.049	1.412	0.947	1.418	1.207
34141	-	-	-	-	1.155	1.346	0.797	1.198	1.140
34151	-	-	0.727	-	0.889	1.449	0.854	-	0.967
34152	-	0.029	0.075	0.847	1.993	0.374	-	-	0.216
97011	-	-	-	-	3.849	1.875	1.205	0.372	1.655
97012	-	-	-	-	3.363	1.564	0.747	0.459	1.446
97013	-	-	-	-	3.553	1.622	0.832	0.429	1.553
97014	-	-	-	-	3.659	2.016	0.911	0.482	1.874
97015	-	-	-	-	3.876	2.320	1.054	0.612	2.096
Total	0.565	2.090	0.753	0.821	1.739	1.423	0.873	0.783	1.211

Total catch = 13,008,705 kg

Total effort = 10,745,213 pot lifts

Table 5. Mean carapace lengths (mm) of male and female rock lobsters in various depth categories at Fremantle, Lancelin, Jurien, Dongara and Abrolhos Islands throughout the 1997/98 fishing season.

Location	Month	0-10 Fathoms		10-20 Fathoms		20-30 Fathoms		30+ Fathoms	
		Male	Female	Male	Female	Male	Female	Male	Female
Abrolhos	Mar	79	75	79	76	79	75	80	76
Dongara	Nov	75	74	78	76	-	-	-	-
	Dec	74	72	78	76	81	78	-	-
	Jan	75	74	76	74	79	80	74	73
	Feb	74	73	75	74	80	78	-	-
	Mar	75	73	76	74	85	87	-	-
	Apr	75	73	77	75	84	82	81	81
	May	74	72	76	75	85	83	85	81
Jurien Bay	Nov	77	73	79	76	78	75	-	-
	Dec	78	76	78	75	79	77	82	78
	Jan	75	73	76	75	79	78	78	75
	Feb	74	70	75	74	81	80	-	-
	Mar	76	74	77	75	81	81	82	81
	Apr	76	74	78	76	81	79	83	81
	May	75	73	76	74	83	78	-	-
Lancelin	Nov	77	76	78	76	-	-	-	-
	Dec	-	-	83	81	91	92	89	82
	Jan	75	73	79	76	80	83	-	-
	Feb	74	73	79	79	-	-	-	-
	Mar	75	73	83	89	84	85	-	-
	Apr	75	74	81	83	81	81	85	83
	May	74	73	89	83	84	77	-	-
Fremantle	Nov	80	78	82	79	-	-	-	-
	Dec	81	77	86	83	86	82	91	84
	Jan	79	77	87	85	95	91	93	88
	Feb	78	75	79	76	-	-	-	-
	Mar	80	76	84	87	89	95	-	-
	Apr	76	75	82	80	89	90	-	-
	May	77	75	-	-	92	83	-	-
Jun	77	76	89	81	107	82	-	-	

Table 6. Mean carapace lengths (mm) of male and female rock lobsters in various depth categories at Fremantle, Lancelin, Jurien, Dongara and Abrolhos Islands throughout the 1998/99 fishing season.

Location	Month	0-10 Fathoms		10-20 Fathoms		20-30 Fathoms		30+ Fathoms	
		Male	Female	Male	Female	Male	Female	Male	Female
Abrolhos	Mar	79	75	79	76	81	77	83	79
Dongara	Nov	76	74	73	72				
	Dec	76	74	77	75	81	78	81	77
	Jan	75	74	75	75	87	85	76	74
	Feb	75	74	75	74	84	87	86	81
	Mar	77	75	77	75	81	82		
	Apr	75	74	76	75	86	87	83	82
	May	75	74	80	77	85	80		
	Jun	74	73	75	74	89	80		
Jurien Bay	Nov	75	73	76	74				
	Dec	76	72	76	74	78	74	76	74
	Jan	74	73	76	75	79	80	77	75
	Feb	76	73			83	81		
	Mar	77	75	77	76	79	78		
	Apr	75	73	78	76	79	76	81	78
	May	77	74	76	74	83	79		
	Jun	75	72	79	75	89	78		
Lancelin	Nov	77	75	78	75				
	Dec	77	74	77	75	77	75	92	86
	Jan	75	73	81	88	85	90		
	Feb	75	74	81	77	85	82		
	Mar	76	74	79	77	84	87		
	Apr	76	74	80	81	92	89	90	88
	May	76	74	95	90	93	86		
	Jun	76	75	91	83	80	76		
Fremantle	Nov	78	77	80	78				
	Dec	83	79	83	79	81	78	86	82
	Jan	76	74	83	82	81	83	92	82
	Feb	77	75						
	Mar	80	77	89	90	91	98		
	Apr	78	76	84	81	88	87		
	May	78	77	85	86	87	82		
	Jun	79	74	89	81				

Table 7. Bottom temperature (°C) and surface salinity (in parts per thousand) in various depth categories in waters out from Fremantle, Lancelin, Jurien and Dongara throughout the 1997/98 fishing season, and from the Abrolhos Islands in March.

Location	Depth (fathoms)	November		December		January		February		March		April		May		June	
		Temp	Sal	Temp	Sal	Temp	Sal	Temp	Sal	Temp	Sal	Temp	Sal	Temp	Sal	Temp	Sal
Abrolhos	0-10	-	-	-	-	-	-	-	-	23.00	-	-	-	-	-	-	-
	10-20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	20-30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	30+	-	-	-	-	-	-	-	-	22.70	-	-	-	-	-	-	-
Dongara	0-10	21.60	36.06	20.90	36.09	20.50	35.89	21.75	35.89	21.60	35.73	-	36.22	22.30	-	20.50	35.32
	10-20	21.40	36.08	20.90	36.10	21.60	35.89	21.00	35.91	23.40	36.04	21.90	36.19	22.30	-	22.10	35.31
	20-30	-	-	20.60	35.80	-	-	20.80	35.97	21.40	35.96	22.50	35.67	-	-	20.20	35.41
	30+	-	-	-	-	21.40	35.81	-	-	-	-	23.80	35.50	22.30	-	-	-
Jurien Bay	0-10	20.60	36.08	-	-	21.20	36.03	23.10	36.44	-	36.08	22.60	36.15	23.00	-	18.50	-
	10-20	-	-	20.65	35.87	-	-	20.30	35.95	-	35.94	22.30	35.78	23.10	-	-	-
	20-30	19.30	35.97	20.10	35.97	18.60	35.85	18.40	35.90	-	35.78	21.90	36.00	22.10	-	20.20	35.43
	30+	-	-	20.50	35.70	21.80	35.79	20.60	35.89	-	35.79	22.80	35.68	-	-	-	-
Lancelin	0-10	20.65	35.94	-	-	21.90	36.18	21.50	36.22	21.70	36.07	21.60	35.90	22.20	35.55	18.40	35.38
	10-20	20.50	35.90	20.40	35.80	21.40	36.02	20.47	35.94	21.15	36.02	-	-	21.30	35.61	20.20	35.42
	20-30	-	-	19.40	35.78	19.10	36.01	-	-	21.50	35.93	22.90	35.51	21.50	35.35	20.40	35.43
	30+	-	-	-	-	-	-	-	-	-	-	22.70	36.08	-	-	-	-
Fremantle	0-10	19.40	35.86	21.50	35.83	21.00	-	20.10	-	22.10	-	-	-	21.05	35.79	20.20	35.55
	10-20	19.70	35.83	19.80	-	22.00	-	20.90	-	21.10	-	21.40	35.90	-	-	21.00	35.57
	20-30	-	-	20.40	-	19.30	-	-	-	21.80	-	21.90	35.97	21.00	35.71	-	35.68
	30+	-	-	20.00	-	22.00	-	-	-	-	-	-	-	-	-	-	-

Temperatures were taken using a protected reversing thermometer and surface water samples were taken and later analysed to determine salinity.

Table 8. Bottom temperature (°C) and surface salinity (in parts per thousand) in various depth categories in waters out from Fremantle, Lancelin, Jurien and Dongara throughout the 1998/99 fishing season, and from the Abrolhos Islands in March.

Location	Depth (fathoms)	November		December		January		February		March		April		May		June	
		Temp	Sal	Temp	Sal	Temp	Sal	Temp	Sal	Temp	Sal	Temp	Sal	Temp	Sal	Temp	Sal
Abrolhos	0-10	-	-	-	-	-	-	-	-	24.55	35.47	-	-	-	-	-	-
	10-20	-	-	-	-	-	-	-	-	-	35.30	-	-	-	-	-	-
	20-30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	30+	-	-	-	-	-	-	-	-	23.80	35.50	-	-	-	-	-	-
Dongara	0-10	21.50	-	21.20	35.95	22.60	36.08	22.90	36.02	-	36.10	24.90	35.40	20.20	36.10	20.40	35.00
	10-20	22.60	36.11	21.70	35.85	21.80	35.80	23.10	36.02	24.10	35.70	24.70	36.80	22.60	35.80	20.40	35.03
	20-30	-	-	21.30	35.58	21.20	35.54	22.40	35.51	24.00	-	24.60	35.40	26.00	35.30	21.20	34.99
	30+	-	-	21.00	35.60	21.80	35.55	22.90	35.55	-	-	25.80	35.30	-	-	-	-
Jurien Bay	0-10	22.20	35.95	20.50	-	22.10	36.30	22.80	36.23	24.10	36.00	23.50	-	20.80	35.70	22.00	35.05
	10-20	-	-	19.70	35.85	21.20	35.72	-	-	23.30	35.60	24.30	35.60	22.60	35.50	20.40	35.01
	20-30	-	-	21.40	35.75	-	35.58	22.10	35.54	23.40	35.60	24.30	35.30	24.20	35.20	-	35.07
	30+	-	-	20.50	35.70	22.10	35.57	-	-	-	-	-	-	-	-	-	-
Lancelin	0-10	-	35.75	20.40	35.80	22.60	36.42	23.10	36.50	23.30	36.69	22.30	35.59	23.75	35.70	-	34.80
	10-20	21.20	35.85	20.40	35.80	20.70	35.97	22.30	36.20	23.20	36.49	23.80	35.31	25.00	35.30	21.60	34.80
	20-30	-	-	22.20	35.74	-	-	20.00	36.00	23.20	35.47	22.90	35.50	-	-	22.60	34.80
	30+	-	-	21.20	35.35	-	-	-	-	-	-	23.90	34.50	-	-	-	-
Fremantle	0-10	20.25	35.55	21.00	35.75	21.80	36.19	22.45	36.35	22.80	36.00	22.50	35.90	-	-	21.90	35.00
	10-20	19.85	35.67	-	-	19.80	36.11	-	-	23.10	36.20	22.50	35.50	22.70	35.60	21.40	34.50
	20-30	-	-	20.80	-	19.40	35.98	-	-	22.80	35.70	23.30	35.30	23.30	36.00	-	-
	30+	-	-	21.10	35.60	-	-	-	-	-	-	-	-	-	-	-	-

Temperatures were taken using a protected reversing thermometer and surface water samples were taken and later analysed to determine salinity.

Table 9. 1997/98 sex ratio by location, depth category and month. Figures are the percentage of female rock lobster in the total sampled catch.

Location	Depth (fathoms)	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Abrolhos	0-10	-	-	-	-	46	-	-	-
	10-20	-	-	-	-	46	-	-	-
	20-30	-	-	-	-	51	-	-	-
	30+	-	-	-	-	41	-	-	-
Dongara	0-10	60	62	54	56	61	59	62	67
	10-20	63	64	56	61	60	61	67	66
	20-30	-	62	73	54	77	75	72	45
	30+	-	-	75	-	-	79	72	-
Jurien Bay	0-10	52	62	44	52	56	56	63	53
	10-20	53	60	43	55	58	57	63	-
	20-30	57	67	56	60	68	68	62	50
	30+	-	74	73	-	67	64	-	-
Lancelin	0-10	53	-	61	58	59	69	61	70
	10-20	62	69	59	67	79	74	62	55
	20-30	-	76	60	-	66	64	50	55
	30+	-	75	-	-	-	65	-	-
Fremantle	0-10	60	56	55	51	50	56	56	53
	10-20	62	60	52	63	67	62	-	56
	20-30	-	58	56	-	67	67	58	35
	30+	-	69	69	-	-	-	-	-

Table 10. 1998/99 sex ratio by location, depth category and month. Figures are the percentage of female rock lobsters in the total sampled catch.

Location	Depth (fathoms)	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Abrolhos	0-10	-	-	-	-	47	-	-	-
	10-20	-	-	-	-	52	-	-	-
	20-30	-	-	-	-	51	-	-	-
	30+	-	-	-	-	67	-	-	-
Dongara	0-10	52	58	58	49	58	58	58	60
	10-20	56	69	61	54	59	66	50	58
	20-30	-	64	75	77	71	70	72	49
	30+	-	74	74	83	-	77	-	-
Jurien Bay	0-10	52	55	44	46	46	52	58	50
	10-20	55	54	51	-	59	57	60	54
	20-30	-	53	60	61	57	70	75	46
	30+	-	76	71	-	-	72	-	-
Lancelin	0-10	58	59	54	58	60	61	59	65
	10-20	66	60	72	56	61	61	57	36
	20-30	-	57	72	66	61	69	45	50
	30+	-	52	-	-	-	82	-	-
Fremantle	0-10	50	59	54	50	53	59	48	59
	10-20	58	58	52	-	62	64	58	49
	20-30	-	58	50	-	77	68	55	-
	30+	-	62	56	-	-	-	-	-

8.0 Figures

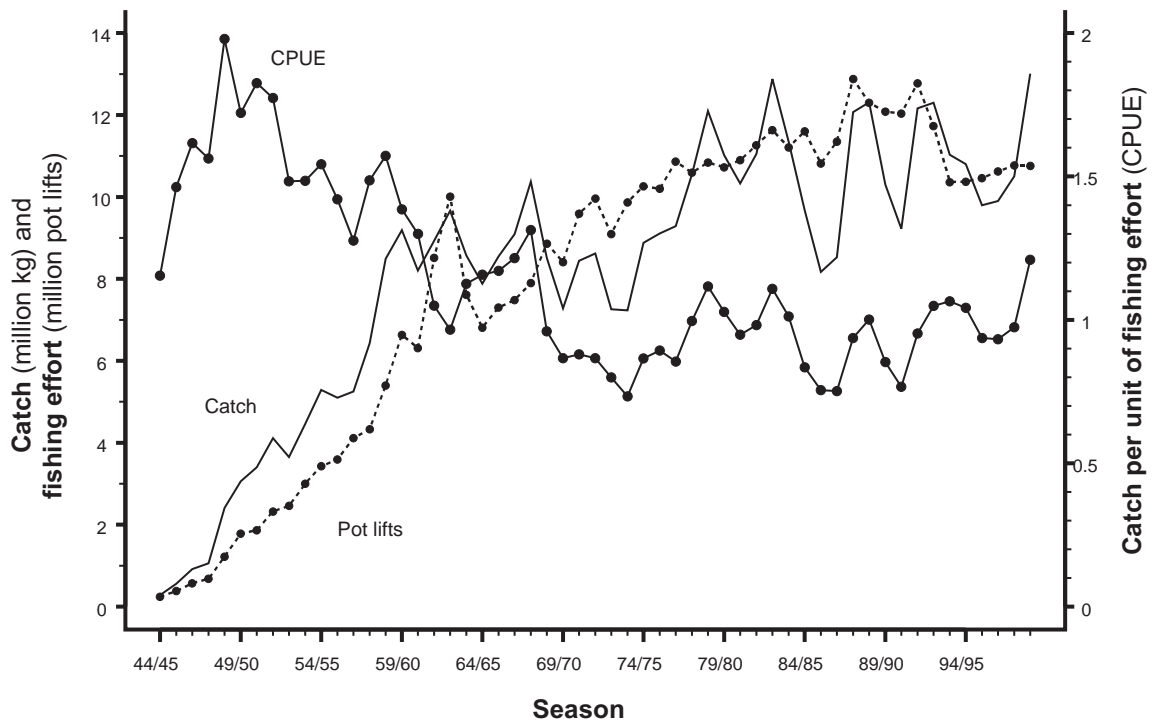


Figure 1. Rock lobster catch (kg), fishing effort (pot lifts) and catch per unit of fishing effort (kg/pot lift) data.

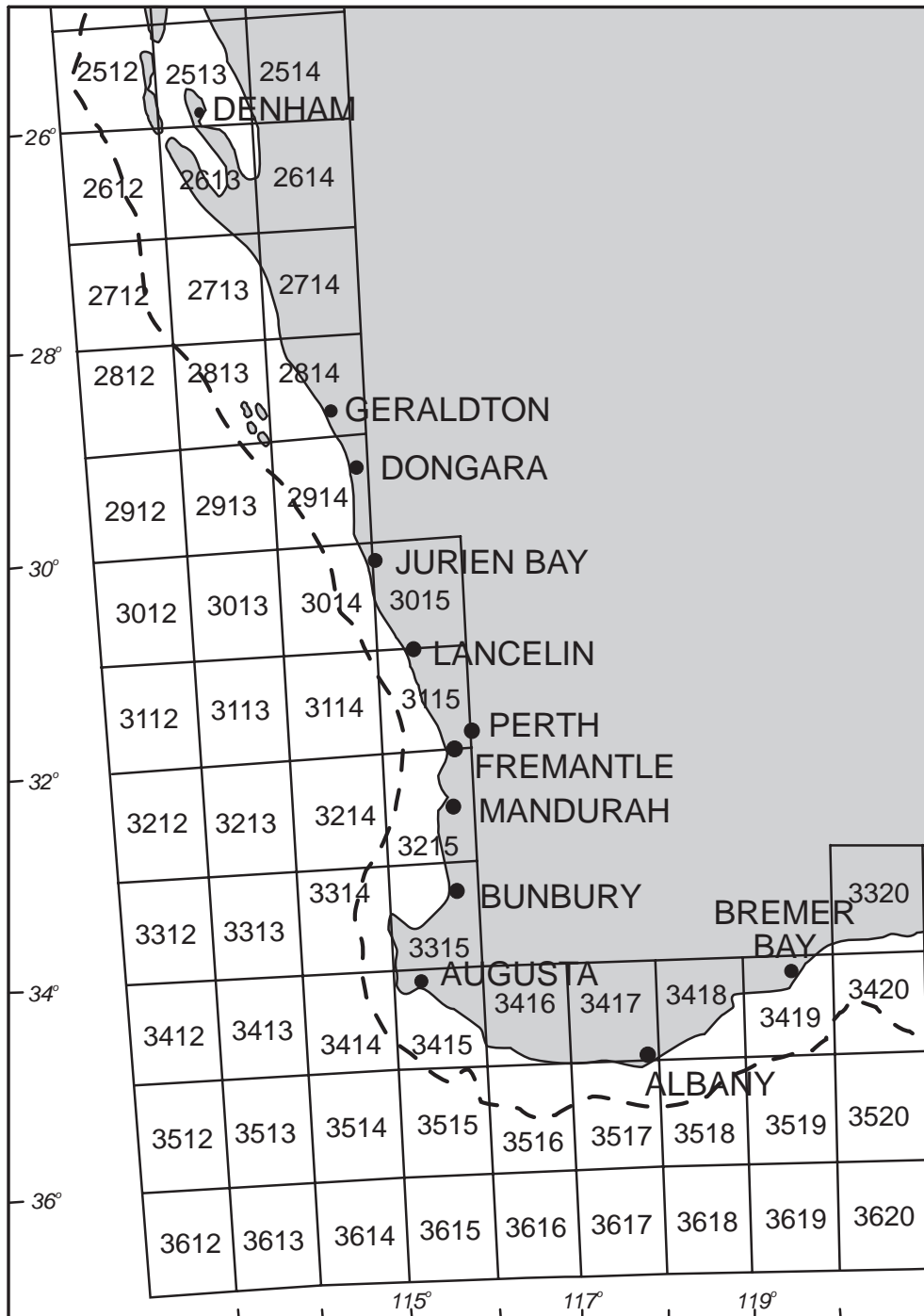


Figure 2a. Rock lobster fishing areas.

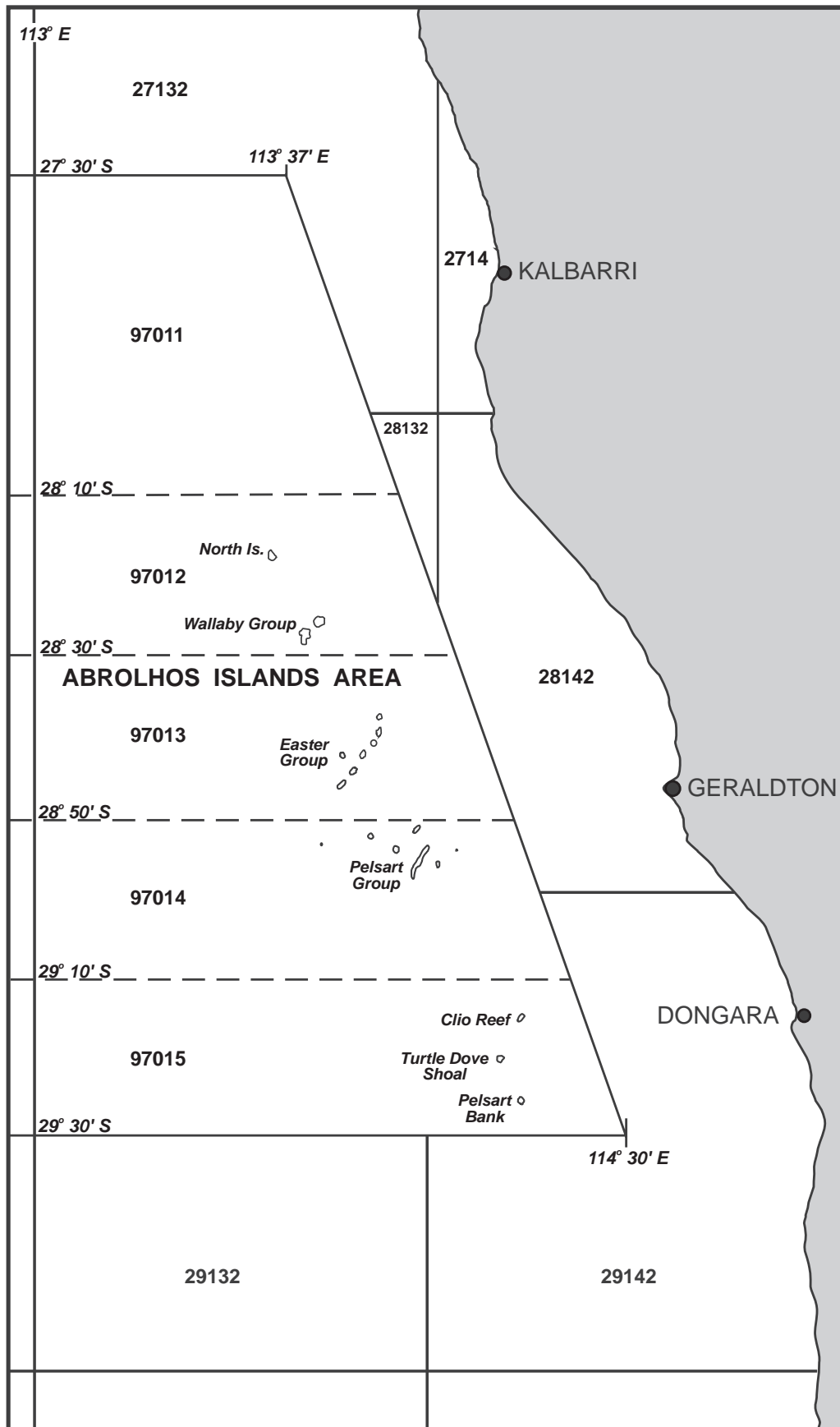


Figure 2b. Rock lobster fishing areas. (The new series of Abrolhos Island statistical blocks were introduced at the commencement of the 1989/90 season).

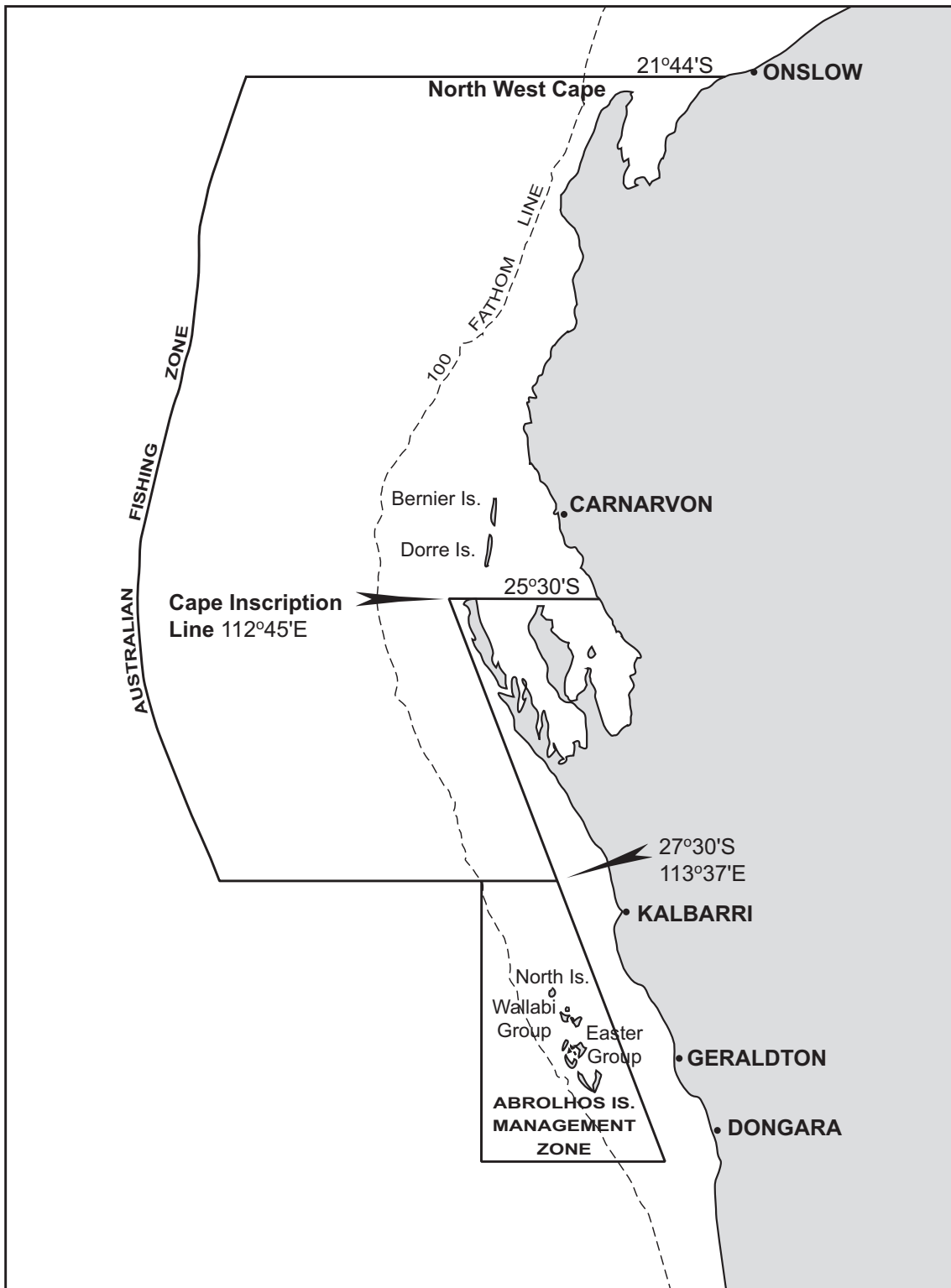


Figure 2c. Big Bank fishing area (adapted from Chubb *et al.* 1994).

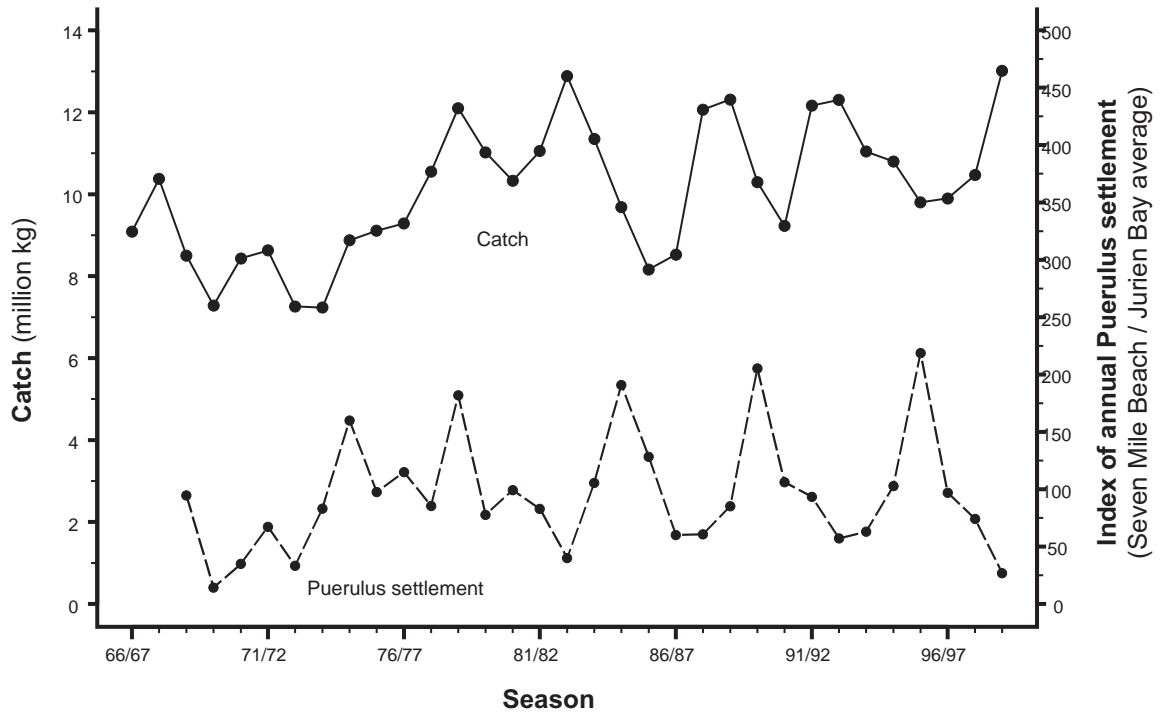


Figure 3. Rock lobster catch and index of annual puerulus settlement (puerulus take three to four years to grow to legal size).

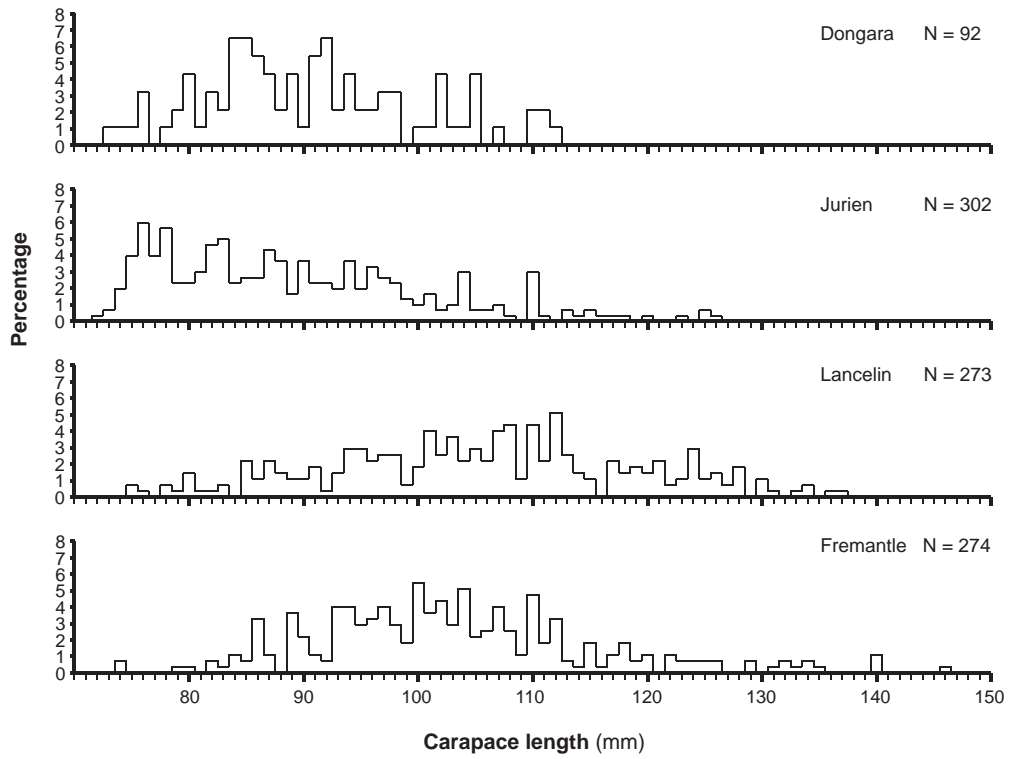


Figure 4a. Length frequency of breeding female rock lobsters (berried and/or mated) taken from December 1997 to February 1998.

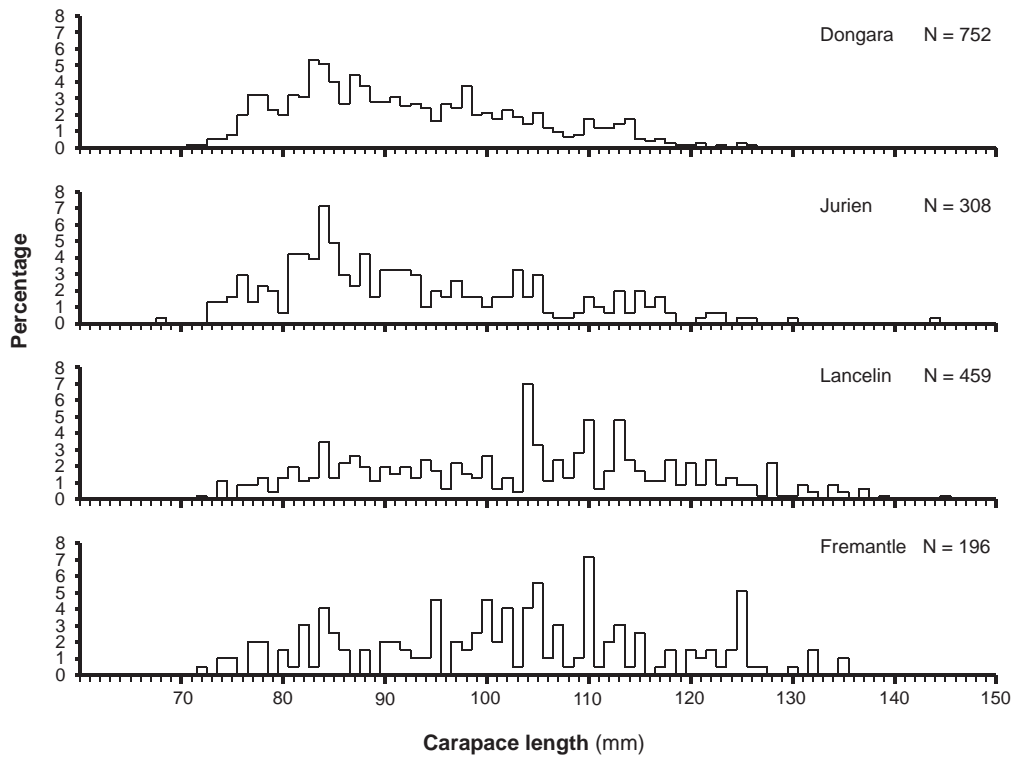


Figure 4b. Length frequency of breeding female rock lobsters (berried and/or mated) taken from December 1998 to February 1999.

9.0 Appendices



Commercial Fisheries Production Bulletin

WESTERN ROCK LOBSTER FISHERY

1997/98 SEASON

THE COASTAL FISHERY TO DATE

The 603 commercial vessels licensed to operate in the Western Rock Lobster Fishery landed 3 169 tonnes of lobster during the "whites" segment of the 1997/98 rock lobster season. This is approximately 11.2% higher than the 2 851 tonnes caught over the same period last season.

Table 1. Rock lobster production figures.

Production (t) to end of Dec 1997			
Fremantle	Jurien	Geraldton	Total
1 219	522	1 429	3 170
Production (t) to end of Dec 1996			
Fremantle	Jurien	Geraldton	Total
914	553	1 385	2 852
Difference (t) and percentage difference			
Fremantle	Jurien	Geraldton	Total
+305	-31	+44	+318
+33.4%	-5.6%	+3.2%	+11.2%
10 yr. cumulative avg. to end Dec 1996 = 3 577 t			
Production to end of Dec 1997 = 3 170 t			
Difference = 407 t			
% Difference = -11.4%			

Whites were present in the catches from the start of the season and subsequently comprised the bulk of the catches from approximately 22 to 24 November in all areas.

The high levels of puerulus settlement in past years started to reflect in the whites catches in the inshore and middle grounds with good catches being taken in both areas, particularly the inshore grounds. These slightly higher densities of legal sized lobsters resulted in the fleet remaining in the inshore to middle grounds well into December. From approximately the middle to the third week of December the fleet moved into deep water, however, low densities of legal size lobsters resulted in typically patchy and scattered catches along the entire coast. In short, a rather lack lustre deep water run and by the middle of January deep water fishing was effectively over. Towards the end of December, beginning of January, much of the northern fleet had given fishing away and brought their gear ashore.

Fishermen reported extremely high numbers of undersize lobsters from the shallows all the way through to deep water. These animals, resulting from past high levels of puerulus settlement will comprise a large part of the high catches expected in the next two seasons. Setose females were also reported to be in very high numbers from the mid grounds to deep water, further demonstrating that the current management package is working.

Individual monthly catches for November and December were up on the same months in the previous season. The monthly differences (%) in catch by the three regional centres were as follows:

	Fremantle	Jurien	Geraldton	Total
November	69.0% up	0.3% down	8.4% down	13.8% up
December	24.7% up	6.9% down	7.6% up	10.4% up

PREDICTION FOR THE 1997/98 SEASON

The catch for the 1996/97 season of approximately 9 900 tonnes was slightly above the 9 600 tonnes predicted, but was below the 10 year average catch of 10 850 tonnes. This decline in catch was the direct result of low puerulus settlement three and four years previously.

The 1997/98 season catch is anticipated to be close to the long term average catch of 10 850 tonnes. The 1998/99 and 1999/2000 seasons catches are predicted to be very good as a result of exceptional puerulus settlements 3 and 4 years previous.

PUERULUS SETTLEMENT

The 1997/98 puerulus season is well under way and so far settlement, with the exception of Port Gregory (north of Geraldton) and Alkimos (near Two Rocks) has been below average at all sites. Preliminary settlement at Jurien & Seven-Mile Beach can be seen in Figure 1 and early indications are that settlement will be well below that of the two excellent preceding collection years and below the long term average.

Last year saw the commencement of an El Nino-Southern Oscillation (ENSO) event. The El Nino generally results in weaker Leeuwin currents flowing down the coast of Western Australia. This event not only affects the strength of the current and water temperature off the coast, but also plays an important role in the distribution and settlement of puerulus.

The final annual index of puerulus settlement figures will become available after the April puerulus collection run.

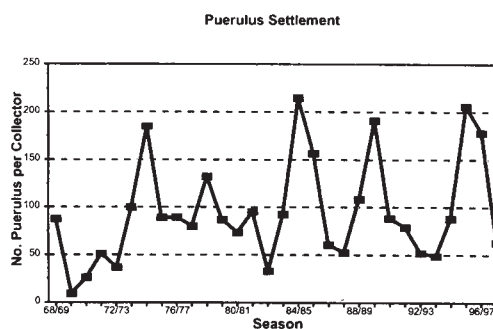


Figure 1. Average of Jurien & Seven-Mile Beach puerulus settlement. Figure for 97/98 is preliminary.

This Bulletin is produced by the Research Division of Fisheries W.A.

1997 INDEPENDENT BREEDING STOCK SURVEY

This year a total of approximately 12000 rock lobsters were tagged offshore from Kalbarri, Abrolhos Islands, Dongara, Jurien, Lancelin and Fremantle.

To date a total of 23159 (26%) tagged rock lobsters have been returned by both commercial and recreational fishers out of a total of approximately 89000 tagged rock lobsters originally released prior to and during the past season.

Next season the I.B.S.S. will be scaled down to three coastal locations, Lancelin, Dongara and the Abrolhos Islands to reduce overall programme costs while continuing to gather data on the spawning stocks in the three fishing zones.

Researchers at the Watermans Laboratories would again like to thank all those fishers who either returned tagged rock lobsters and/or recapture information. Final reward payments, together with a personal summary showing tagging details will be forwarded in the near future.

1997 "WHITES" TAGGING

The Rock Lobster Research Unit conducted tagging of undersized "white" rock lobsters to investigate their movement during the migratory phase of the fishery in response to earlier industry requests. This was conducted using commercial vessels in conjunction with live holding facilities, in December to early January from Lancelin, Cervantes and Jurien. A total of approximately 9000 rock lobsters were tagged during this programme.

THANKS

The Rock Lobster Unit would like to thank all those skippers, crews and factory personnel who assisted in the Independent Breeding Stock Survey and "whites" rock lobster tagging programme.

MARKETING*

Overview

The Japanese boiled market deserves some comment due to a dramatic situation which was evident at the commencement of the new season. There were stocks of boiled lobster in Japanese cold stores of approximately 500 metric tonnes on the 15th November. This has never been witnessed before!

This stock was purchased at extremely high prices by Japanese buyers and had to compete with Cuban and Indian product available at US\$9.50 and US\$8.00 per kg respectively. This stock position, combined with the changing consumption patterns particularly for celebrations (weddings etc) did not paint a very rosy picture to commence the season.

It has been estimated that consumption of boiled Western rock lobster in Japan so far this season is down by in excess of 50%.

What has happened?

The young people about to be married in Japan now don't believe it is necessary to have our lobster available on the wedding tables. There is an increasing trend towards substituting cheaper lobster and it is becoming increasingly the norm for guests at weddings to pay to attend. Parents are being asked for an overseas trip or money in lieu of the traditional wedding, which in many cases parents borrowed large sums of money for, only to be faced with years of repayments. Japanese buyers of boiled lobster have not made any money for a number of years and unless the price is kept well below the US\$20/kg and maintained at this sort of level we may well never re-create the boiled market we knew for many years in Japan.

Live Lobster Japan

Early demand has been strong and will probably remain at that level until the end of the Chinese New Year when there will be some drop off until mid-March. In reality the prices achieved thus far are not greatly different to those of the comparable period last season. The difference has been primarily currency related.

USA/Lobster Tails

Early production levels are well above those of last season and already we have witnessed about a 20% fall-off in the prices on offer.

Taiwan

Overall thus far the Taiwanese market demand has been reasonable and we have managed to live with the import duty situation and can take some credit in hopefully achieving some reduction in the overall duty applied by the Taiwanese customs. We anticipate some further reduction in the rates in February which will enhance our position.

China/Hong Kong

Indications so far are that these markets can be best viewed with cautious optimism however only time will tell.

Whilst the live demand has been improving, the requirement for larger grades has and will continue to be a stumbling block.

A further note of caution concerning the Chinese market is that we would hope that there is no currency scare similar to that witnessed by other economies in the Asean region.

RESEARCH LOG BOOK PROGRAM

A record number (38%) of skippers/deckies completed and forwarded research records to the Laboratories at Waterman during the 1996/97 season. Once again the rock lobster research team would like to pass on sincere thanks to all those fishermen who participated and urge those who are not part of the team to join this current season.

*This information was provided by the Western Rock Lobster Development Association (Inc), Suite 6, 41 Walters Drive, Osborne Park WA 6017. Chairman Tony Gibson pH: (08) 9244 2933 fax: (08) 9244 2934.

Except where acknowledged, the information in this bulletin has been supplied by the FISHERIES RESEARCH DIVISION of FISHERIES W.A. Contact Mr Barker or Mr Mark Rossbach pH: (08) 9246 8444 fax: (08) 9447 3062.



Commercial Fisheries Production Bulletin

WESTERN ROCK LOBSTER FISHERY

1997/98 SEASON

THE COASTAL FISHERY TO DATE

The 603 commercial vessels licensed to operate in the western rock lobster fishery landed 6490 tonnes of lobster from 15 November 1997 to 31 March 1998. This is approximately 0.7% lower than the 6538 tonnes caught over the same period last season.

Table 1. Rock lobster production figures.

Production (t) to end of Mar 1998

Fremantle	Jurien	Geraldton	Total
2496	880	3114	6490

Production (t) to end of Mar 1997

Fremantle	Jurien	Geraldton	Total
2102	1088	3348	6538

Difference (t) and percentage difference

Fremantle	Jurien	Geraldton	Total
+394	-208	-234	-48
18.7% up	19.1% down	7.0% down	0.7% down

<i>10 yr. cumulative avg. to end of March 1997</i>	= 7746 t
<i>Production to end of March 1998</i>	= 6490 t
<i>Difference</i>	= 1256 t
<i>% Difference</i>	= 16.2% down

During January, most of the fleet returned to the shallows with some vessels operating in the mid-water grounds. A few boats working multiple day pulls remained in deep water until approximately mid January. Catches in January, February and the early part of March were patchy and generally poor throughout the fishery (Table 2).

Table 2. Monthly catches by region for 1997/98 compared to 1996/97.

	Fremantle	Jurien	Geraldton	Total
Jan	9.3%	16.3%	27.4%	15.8%
	down	down	down	down
Feb	4.2%	49.4%	17.1%	13.9%
	up	down	down	down
Mar	23.1%	31.7%	11.0%	5.9%
	up	down	down	down

As a direct result of low catches, many skippers in the northern part of the fishery (A and B zone concessions) ceased fishing and brought their gear ashore for part of January. Poor catches in the central region, pushed much of the fleet further south (Two Rocks south) where better catches were taken (Table 2).

The low catches of the central region were the result of below average settlement three to four years previous. Good settlement in the Alkimos region has led to improved catches in the southern sector. However, whilst landings in the Fremantle region appear to be significantly better than last season, the difference is probably inflated due to the large number of vessels operating in this area. Conversely the difference in the central region may also be exaggerated due to the absence of catch from boats that moved south.

By mid March, following a late moult, catches had improved considerably throughout the fishery with boats distributed from inshore through the mid-water grounds and deeper. These good catches have continued into April.

During the season, fishers commonly have reported large numbers of under-size lobsters in all depths, their presence indicating the good seasons to follow in the next couple of years.

THE BIG BANK SEASON

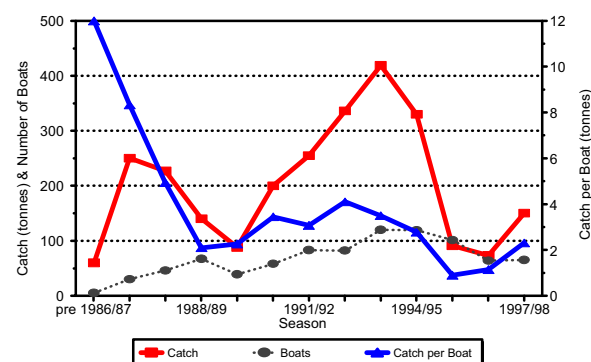


Figure 1. Big Bank catch, fishing effort and catch rates.

The total catch for the Big Bank region was 158 tonnes, an increase of 117% on the previous season's catch of 73 tonnes. A total of 65 vessels nominated and fished the region in 1998 compared to 64 in 1997. The average catch per boat of 2.3 tonnes was double that of the 1.1 tonnes caught the previous season (Fig. 1). Improved settlement three years previous may have contributed to the higher catch.

Initial catches of migratory animals were taken in deep water, with rock lobsters distributed over a wide area from east to west in depths of 80-100 fathoms. Following a brief catching period of 1-2 weeks in deep water, much of the fleet moved to the shallower bank area (40-70 fathoms) and continued fishing until the end of February.

THE ABROLHOS ISLANDS SEASON

The Abrolhos Islands season commenced with preliminary processors-production figures indicating that catches in the opening week were approximately 17% down. The occurrence of the full moon, coinciding with clear, calm sea-conditions and a late moult were responsible for the relatively lower catches than normal at the start of the season. By mid April, catches had improved with landings estimated to be down on the previous season by approximately five percent.

Initially, catches comprised grades A to G, with a predominance of red and pink A and B lobsters. However, since the beginning of April, moderate numbers of large males and non-setose females have been received at the factories as fishers redirected some of their fishing effort to deeper waters. In general though, Abrolhos deep water catches this season have not been particularly good compared to the very good catches in recent seasons.

PUERULUS SETTLEMENT

The 1997/98 puerulus season has resulted in well below average settlement at all sites except Alkimos (near Two Rocks) which yielded above average puerulus numbers. This year's settlement will contribute first to the reds catch in the 2000/2001 season which coupled with a relatively good whites catch should produce an average season.

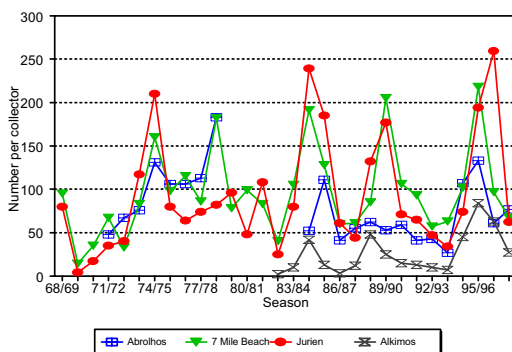


Figure 2. Trends in puerulus settlement at selected coastal sites and the Abrolhos Islands.

A dominant El Niño-Southern Oscillation (ENSO) event in 1997 continued this year and has resulted in a weaker Leeuwin Current off the Western Australian coast. The Leeuwin Current plays an important role in the distribution and settlement of puerulus and the weak Leeuwin Current is responsible for the below average settlement experienced this season.

How long the current ENSO event will continue is yet to be determined, however, oceanographers believe that this event will weaken later in 1998 with indications of a return to normal conditions.

WRLDA MARKETING NEWS*

Japan

The Japanese market for boiled and frozen product is the worst witnessed for the past fifteen years! Due to the economic crisis in Japan, there is virtually no demand for western rock lobster there. Export volumes to Japan are down by about 39% and prices are down by about 35%. Stocks in Japan are not moving. The majority of the Japanese population are concerned with saving their money and job security and consequently they are not spending on luxury goods and foods. In addition, importers are extremely reluctant to purchase, having sustained losses on western rock lobsters for the past three to four years. Some marketeers have indicated that the Japanese buyers simply are not in the market, therefore, even offering product at reduced selling prices will not achieve any results.

Hopefully, the Japanese economic crisis will ease in the not too distant future and the yen will remain relative stable. Certainly any devaluation of the yen against our currency will have negative impacts on imports into Japan of western rock lobster.

Taiwan

Until the first week in April demand had been good, however, prices have dropped quite sharply in recent weeks. There are high stock levels in Taiwan particularly of A sized lobster. Concern still exists about the high level of import duty on lobsters imported into the country and diplomatic channels are being explored in an attempt to reduce it. In addition, very high quality product from other countries offered at much lower prices is providing stiff competition for WA product.

Hong Kong/China

Demand is good, particularly for large lobsters, however, the buyers have shown a reluctance to meet the price levels being asked for WA product.

USA

Despite a fairly dramatic increase in the volume of tails exported to the USA market, demand still is very high. Nevertheless, the demand primarily is for the larger sizes which in the overall catch composition are the smallest component.

* This information was provided by the Western Rock Lobster Development Association (Inc.), Suite 6, 41 Walters Drive, Osborne Park WA 6017. Chairman Mr Tony Gibson ph: (08) 9244 2933 fax: (08) 9244 2934.

Except where acknowledged, the information in this bulletin has been supplied by the FISHERIES RESEARCH DIVISION of FISHERIES W.A. Contact Dr Chris Chubb or Mr Eric Barker ph: (08) 9246 8444 fax: (08) 9447 3062.



Commercial Fisheries Production Bulletin

WESTERN ROCK LOBSTER FISHERY

1997/98 SEASON

THE COASTAL FISHERY TO DATE

The 603 commercial vessels licensed to operate in the western rock lobster fishery landed 10,373 tonnes (preliminary) of lobster from 15 November 1997 to 30 June 1998. This is approximately 4.2% higher than the 9,953 tonnes caught in the 1996/97 season (Table 1). Following mediocre catches during the early part of the year, catches improved in mid March in all coastal areas of the fishery in all depths except really deep water (greater than 60 fathoms). These good catches (Table 2) continued until the end of the season with variations due to moon phase and swell. The lasting good catches probably were a result of the late moult in March extending the catch a little later than usual and the early recruitment of some of the very large number of under-sized rock lobsters that will form the whites catch in the 1998/99 season.

Table 1. Rock lobster production figures.

Production (t) to end of June 1998			
Fremantle	Jurien	Geraldton	Total
3586	1362	5425	10373
Production (t) to end of June 1997			
Fremantle	Jurien	Geraldton	Total
3097	1474	5382	9953
Difference (t) and percentage difference			
Fremantle	Jurien	Geraldton	Total
+489	-112	+43	+420
15.8% up	7.6% down	0.8% up	4.2% up
10 yr. cumulative ave. to end of June 1997			= 10987 t
Production to end of June 1998			= 10373 t
Difference			= 614 t
% Difference			= 5.6% down

Table 2. Percentage differences in monthly catches by region for 1997/98 compared to 1996/97.

	Fremantle	Jurien	Geraldton	Total
Apr	6.7% up	54.9% up	18.3% up	19.0% up
May	12.8% up	9.7% up	12.5% up	12.3% up
Jun	18.5% up	0.1% up	11.2% up	12.0% up

THE ABROLHOS ISLANDS SEASON

Final figures for the Abrolhos Islands will not be available until all the compulsory monthly returns are submitted. However,

preliminary indications from processors are that the catch will be similar to the 1,790 tonnes caught in 1996/97.

The late moult also was felt at the Islands and together with the full moon and calm conditions a "late" start to the season was experienced. The A zone deep water fishery was sporadic with some very good catches for a short period of time but in general it was not as good as in previous seasons. Good catches were produced throughout April and May.

PUERULUS SETTLEMENT

The 1997/98 puerulus season resulted in settlement that was well below average at all sites except at Alkimos (near Two Rocks) where although puerulus numbers declined significantly, settlement still was 3% above average (Table 3). This year's settlement will contribute first to the reds catch in the 2000/01 season and produce the whites of 2001/02.

The 1997/98 El Nino-Southern Oscillation (ENSO) event resulted in a weaker Leeuwin Current off the Western Australian coast and generally was responsible for the below average puerulus settlement experienced this season.

Based upon several different sets of environmental data Research Division suggested that puerulus numbers over the 1998/99 settlement period would be about average. This "prediction" was tentative at the very least due to the uncertainty of predicting ENSO/La Nina (opposite of ENSO) events. Recent data shows the 1997/98 ENSO event has ended. This is evidenced by the positive southern oscillation index and the cooling of the surface waters of the central and eastern Pacific. The suggestion is for a La Nina event to occur later in the year leading to a stronger Leeuwin Current. If this occurs, puerulus settlement probably will be above average. Anecdotal information from fishers suggests a good current flow already is occurring.

Table 3. Percentage difference between puerulus settlement in 1997/98 compared to the long term average (number of years given for each location in brackets).

Abrolhos	Shark Bay	Dongara	Jurien
-54% (21)	-30% (13)	-26% (29)	-35% (29)
Lancelin	Alkimos	Warnbro	Margaret R.
-51% (7)	+3% (15)	-76% (13)	-63% (13)

Erratum: In CFPB No 15 the puerulus settlement graph wrongly showed settlement at the Abrolhos Islands as increasing from 1996/97 to 1997/98. It, in fact, decreased from 77 to 37 in line with all other sites.

This Bulletin is produced by the Research Division of Fisheries Western Australia

ROCK LOBSTER TAGGING

Tagging of western rock lobsters was carried out during the breeding stock survey in October 1997 and during the whites at Lancelin, Cervantes and Jurien. To date information on only 9.8% of those tagged lobsters has been provided to Rock Lobster Research. Recapture information from between 7 and 13% of lobsters tagged at most centres was provided during season 1997/98, but data from only 2.5% of lobsters tagged at Fremantle was returned (Table 4). For centres where tagging has been carried out on a "regular" basis since 1988, overall returns from all tagging exercises run at between about 20 and 40% (Table 5). Rock Lobster Research wishes to sincerely thank all those commercial and recreational fishers who have provided tag recapture information. The data will provide a better understanding of the movement and growth of western rock lobsters.

Table 4. Percentage recapture of rock lobsters tagged at various centres during the 1997/98 season.

Fremantle	Lancelin	Cervantes	Jurien
2.5%	11.6%	5.5%	7.3%
Dongara	Kalbarri	Abrolhos	Total
12.6%	10.8%	8.8%	9.8%

Table 5. Overall percentage recapture of rock lobsters tagged at selected centres from all seasons since 1988.

Fremantle	Lancelin	Jurien	Dongara
18.7%	43.3%	30.9%	38.7%
Kalbarri	Abrolhos	Total	
26.0%	22.6%	30.1%	

VOLUNTARY RESEARCH LOG-BOOK PROGRAMME

The participation rate in the log book programme reached an all time record of over 38% during season 1997/98. Both skippers and deckies effectively became part of the research team and provided data vital to accurate stock assessment of the fishery. Sincere thanks to all of those fishers who filled in log books and we look forward to your continued involvement next season. To those readers who would like to become part of the log-book programme please contact Eric Barker at the Western Australian Marine Laboratories on 9246 8444

WRLDA MARKETING NEWS*

The average price paid to fishers in 1997/98 was about \$20 per kg, some 25% less than the \$26.50 per kg in 1996/97. The decline doesn't look like stopping there. Industry is faced with a market outlook for 1998/99 the like of which it never before has seen.

At the commencement of the 1997/98 season, the inventories of whole boiled lobster in cold stores in Japan totalled an estimated 300 tonnes. This lobster had been purchased by importers at very high prices. In the past all stocks of whole cooked lobster in Japan would have been consumed by the start of the new fishing season, so the surplus immediately put downward pressure on the price of new season's product.

A dramatic change in currency rates of around 20% over the season exacerbated the situation. The outlook for the Japanese market does not appear all that promising.

The Japanese economy officially is in recession and a very real change in the consumption patterns of whole cooked lobster is being seen. Traditionally, the wedding halls in Japan have served small western rock lobsters at premium prices. Trends now apparent are indicating that the recession is hitting the Japanese public hard and lower cost Cuban lobster is replacing western rock lobster at wedding banquets. The old traditional demands are being replaced by more immediate economic ones.

The shift in market demand to larger sized lobsters in the Asian region is fact. In previous years our small sizes were prized and highly sought after but economic considerations are rationalising the markets. Larger lobsters now are being sought, particularly in the emerging Chinese market, centred solely around live lobster. It also is a fact that the Chinese prefer the southern rock lobster. The United States market also is preferring larger grades. The problem is that there still is unsold product in Australia from last season; that is we have not sold all of last season's average catch. Next season it's predicted that around another 3,000 tonnes of product will be caught (compared to 1997/98), the majority of which will be the now non-preferred A and B grades. The question is what to do with them?

It is true that the Asian live market probably will not be affected but that is almost at capacity. With reduced demand for whole cooked from the Asian region, it is highly likely that the bulk of the 1998/99 catch will be exported as tails to the United States.

The market in the USA has been relatively strong. However, if we produce a greater volume of tails than last season (in which we produced 100% more than 1996/97) it remains to be seen how much product the market will absorb before we experience a significant downturn in the prices on offer. The indications are that it won't take a great deal more. Post February production is reaching the market now and the US market is weakening as a result.

While the situation does not look bright we must remember we are competing in the international arena at the top end of the luxury food item market and accordingly there will be times when our product will not be preferred. Also there will be times when foreign exchange movements will adversely impact on our revenue. And there will be times when competing suppliers will make inroads into markets "traditionally" (and perhaps arrogantly) regarded as our own.

We are entering such a situation and if ever there was a time for a united industry approach to meet the marketing challenges that are ahead of us all, that time is now. We will have to put aside personal issues and operate collectively as an industry, pooling our resources to meet the magnitude and variety of the new challenges. Promotion of Western Australia's western rock lobster on an industry-wide basis (generic promotion) is essential if we are to compete effectively in the "new" international arena against stronger opposition. To do otherwise would not be in our better interests.

* This information was provided by the Western Rock Lobster Development Association (Inc.), Suite 6, 41 Walters Drive, Osborne Park WA 6017. Chairman Mr Tony Gibson ph: (08) 9244 2933 fax: (08) 9244 2934.

Except where acknowledged, the information in this bulletin has been supplied by the FISHERIES RESEARCH DIVISION of FISHERIES W.A. Contact Dr Chris Chubb or Mr Eric Barker ph: (08) 9246 8444 fax: (08) 9447 3062.



Commercial Fisheries Production Bulletin

WESTERN ROCK LOBSTER FISHERY

1998/99 SEASON

THE COASTAL FISHERY TO DATE

The number of commercial vessels licensed to operate in the western rock lobster fishery has dropped below 600 and now stands at 596. These vessels landed 3,782 tonnes of lobster (preliminary total) from 15 November 1998 to 31 December 1998. This is approximately 19.3% higher than the 3,170 tonnes caught in the previous season (Table 1) and 8.2% greater than the average over the past 10 years of 3,496 tonnes. Whites were present in good numbers in the catches from opening day but it would be fair to say that the fishery got off to a slow start (rather than a late start) so by the end of November the overall catch was 41.9% below the figure for November 1997 (Fremantle, Jurien and Geraldton were down 28.0%, 69.9% and 45.8% respectively).

Table 1 Rock lobster production figures.

Production (t) to end of December 1998			
Fremantle	Jurien	Geraldton	Total
1595	631	1556	3782
Production (t) to end of December 1997			
Fremantle	Jurien	Geraldton	Total
1219	521	1429	3169
Difference (t) and percentage difference			
Fremantle	Jurien	Geraldton	Total
+376	+110	+127	+613
30.9% up	21.0% up	8.9% up	19.3% up
10 yr. cumulative ave. to end of December 1997			= 3496 t
Production to end of December 1998			= 3782 t
Difference			= 286 t
% Difference			= 8.2% up

During the early part of the season, catches in the mid-coastal region (Jurien/Cervantes) were particularly poor, whereas from Lancelin south, especially around Mindarie, catches were quite good. This led to the usual movement of mid-coastal boats into the southern area of C zone (Fremantle to Two Rocks) during the early part of the season. At one stage Two Rocks was harbouring 75 boats.

By approximately the end of the first week of December the catches, composed entirely of "whites" really started to pick up in both B and C zones. The mobile fleet from the mid-coastal region moved back home during the early part of December to take advantage of the greatly improved catches in that area. By the middle of December, much of the fleet was in the mid-grounds throughout the fishery, however, good catches were still being taken from the inshore grounds.

From approximately mid December, much of the fleet shifted into deep water and remained there until the end of December when catches (taken by multiple-day pulls) started to drop. As a result many boats returned to the mid and inshore grounds and by the end of the first week in January, deep water fishing was almost over.

As in previous seasons, due to low catch rates in January, many fishers in Zone B brought their gear ashore and tied up their vessels. Anecdotal information suggests that Kalbarri has experienced below average catch rates for the season to date. In January in other parts of B zone, reasonable catches were being landed from 1, 2 and 3 day pulls over most depths. Overall, January 1999 catches have been good throughout the western rock lobster fishery and it appears that the prediction for the whites (Nov-Jan) is on target.

PUERULUS SETTLEMENT

Contrary to expectations of an approximately average level of puerulus settlement in 1998/99, numbers settling to December 1998 have been very poor, 30% below average at Margaret River and at least 50% below average at all other sites (Table 3). By the end of December most (over 80%) of the pueruli have settled and so there does not appear to be scope for much improvement at coastal sites. Settlement occurs a little later at the Abrolhos but it's questionable whether numbers will improve over the next few months.

Table 2 Percentage difference between puerulus settlement in 1998/99 compared to the long term average.

Abrolhos	Shark Bay	Dongara	Jurien
-81%	-74%	-79%	-52%
Lancelin	Alkimos	Warnbro	Margaret R.
-64%	-62%	-94%	-31%

The April 1998 Fremantle sea level, usually an indication of settlement to come, was about average suggesting an average settlement for 1998/99. However, the late swing from El Nino to La Nina conditions in 1998 may indicate that the timing of such changes might be an important factor influencing western rock lobster puerulus settlement. Nevertheless, the poor settlement recorded this season will be reflected first in the reds catch of 2001/02, with the whites catch in 2002/03 being below average.

Some scientists are suggesting a return to El Nino conditions later in 1999. This, is not surprising given the trends in El Nino events since the mid 1970s, shown by the Multivariate ENSO Index (Figure 1), seem to indicate that El Nino events now are the rule rather than the exception. A return to El Nino conditions later in 1999 would suggest the possibility of poor puerulus settlement, through a weakening of the Leeuwin Current, over 1999/2000 and perhaps longer.

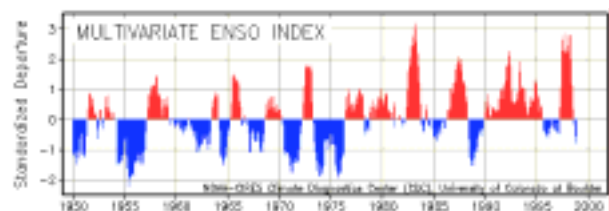


Figure 1 Index showing El Nino (above the zero line) and La Nina (below the zero line) events since 1950. (By permission of NOAA-CIRES Climate Diagnostics Center, Colorado, USA; web site: www.cdc.noaa.gov/ENSO).

THE PREDICTIONS FOR 1998/99 AND BEYOND

The predictions of catch are based on puerulus settlements three and four years prior to the season of catch. Forecasts are made for the whites period and the reds. The whites catch is taken as the landings for November, December and January, with the remainder of the season treated as the reds. Long enough time-series of data now allow predictions of white and reds catches by zone (Table 2).

Although a long time series of data is available for Jurien in the northern part of C zone, by itself, it is not representative of settlement in the whole of C zone and has not been used to predict catches for that zone. In the past C zone predictions have been based upon the results

This Bulletin is produced by the Research Division of Fisheries Western Australia

of 17 years of settlement data from the Alkimos site. Those have been relatively accurate (generally within about 5%)

Data now available for Lancelin and Warnbro can be combined with the Jurien and Alkimos data to forecast C zone catches. Providing the trends in settlement across C zone are similar (e.g. settlement at all sites average or above average), the catches predicted by the Alkimos site alone will be very close to those predicted by the grouped puerulus settlement index. Where trends in numbers settling vary in different locations within C zone, the combined settlement index is expected to provide a better estimate of catch, since it takes into account the within-zone variability in puerulus settlement.

Table 3 Forecast whites and reds catches by zone and using Alkimos alone for C zone predictions.

** predictions for C zone using combined C zone puerulus index.

Season	A	B		C		Total
		Whites	Reds	Whites	Reds	
98/99	1950	1900	2650	3900	3750	14150
**				3300	3400	13200
99/00	1900	2000	2250	4400	3800	14350
**				4350	3450	13950
00/01	1850	1650	2100	3800	3300	12700
**				2950	2450	11000

WRLDA MARKETING NEWS*

JAPAN / TAIWAN

At the commencement of the season, both Japan and Taiwan held fairly small inventories of lobster. Nonetheless, the effects of the "Asian crisis" were apparent along with an element of general uncertainty which resulted in lower-than-normal forward sales being negotiated prior to the season commencing. The exchange rates at the time combined with the inventory position and general uncertainty indicated a beach price in the order of \$13 to \$15 per kg. However, a favourable exchange rate at the season's start, retrieved the situation somewhat and beach prices of \$16 per kg were on offer.

When the season began, unexpectedly low levels of "A" sized lobsters were landed. At the same time we saw an increased demand from Japan and a modest increase from Taiwan for this product. The higher volumes of "B" and "C" sized lobsters landed and the lower prices achieved for them countered any gains made from the increased demand for smaller product.

The live situation started slowly, however, now it has firmed up and is generally expected to be maintained through to February. There is an improved interest in Japan for live lobsters which some suggest may be linked to a view that the Japanese economy may be improving. Whilst this renewed interest is encouraging, any improvement in prices received for lives will be directly linked to volumes offered for sale at any one time. There is a widely accepted view that Japanese buyers will not take quantities of live above their established levels of supply.

CHINA

The situation in China is interesting. Readers should be aware that the Chinese authorities have tightened up the regulations surrounding the quotas of imported luxury items (including rock lobster). New quotas have been issued and a return to the dramatically increased levels of imports taken by China in recent seasons is unlikely. The expectation is for Chinese/Hong Kong price levels to remain steady, with some firming of prices (hopefully) as the season progresses.

USA

The USA tail market remained steady throughout the Christmas period, however, a note of caution always is sounded as new season stocks

arrive in America. The production of tails so far this season has been greater than in recent years particularly of "B" and "C" sizes. It will be interesting to watch the effect of the current political situation in the USA on currency fluctuations which may in turn impact upon prices achieved for our exports.

EUROPE

There have been increased levels of product destined for the European market which is related almost certainly to the promotion efforts of WRLDA, on behalf of the industry, in Brussels last year. Product has been exported to three new markets in the early part of this season; countries that never before have purchased our lobster. WRLDA are continuing to mount pressure against the levels of import duty into the European Union. This situation will not be resolved in the short term and so will require an ongoing commitment of funding and political pressure to achieve a favourable outcome for industry.

LOCAL PROMOTION

The local promotion of the "Lobster For Christmas" campaign appears to have been a resounding success. Lobsters were offered to local consumers at very acceptable prices and total sales were estimated at around 1,000 tonnes. Advice from Westfish indicated that some larger retail outlets increased sales by 300%. The success of local sales meant the availability of some product types was reduced and export demand remained relatively high as a result. WRLDA and Westfish each contributed \$20,000 to this campaign and it is a good example of the success in market development that can be achieved by properly targeted promotional spending.

GENERAL

Overall, the prognosis for the next few months would appear to be a little brighter than that in the lead up to the 1998/99 season. Barring any major unforeseen circumstances, a steady situation is anticipated with perhaps some modest gains for the remainder of the season.

ROCK LOBSTER TAGGING

Just a reminder to all fishers that Rock Lobster Research still encourages the return of information from any tagged lobster recaptured by fishers. Of particular interest is any information we receive from the whites tagging carried out last season (1997/98) in Lancelin, Cervantes and Jurien.

Remember that tagged lobsters can go back in the water or be consigned *if* Rock Lobster Research is given the tag number, date, location (lat. and long.), depth, sex, and an accurate carapace length. **NO estimates of size should be given, so if you have to guess, just return the whole lobster to the research team.**

Remember also to include your name and boat details to ensure reward for this information. Recapture information labels are available from your local receival depot and Fisheries Office, or details can be called through directly to Rock Lobster Research on (08) 9246 8481.

The research team sincerely thanks all those who participate in the return of tag recapture information. We really appreciate your commitment to your industry and urge you to continue to provide the data! The information helps to ensure that the best possible research advice is provided to the industry and fishery managers.

VOLUNTARY RESEARCH LOG-BOOK PROGRAMME

The participation rate in the log book programme reached an all time record of 38.5% during season 1997/98. Both skippers and deckies effectively became part of the research team and provided data vital to accurate stock assessment of the fishery. Sincere thanks to all of those fishers who filled in log books and we look forward to your continued involvement this season. To those readers who would like to become part of the log-book programme please contact Eric Barker at the Western Australian Marine Laboratories on 9246 8444.

* This information was provided by the Western Rock Lobster Development Association (Inc.), Suite 6, 41 Walters Drive, Osborne Park WA 6017. Chairman Mr Tony Gibson ph: (08) 9244 2933 fax: (08) 9244 2934.

Except where acknowledged, the information in this bulletin has been supplied by the FISHERIES RESEARCH DIVISION of FISHERIES W.A. Contact Dr Chris Chubb or Mr Eric Barker ph: (08) 9246 8444 fax: (08) 9447 3062.



Commercial Fisheries Production Bulletin

WESTERN ROCK LOBSTER FISHERY

1998/99 SEASONS

THE COASTAL FISHERY 1998/99

The 596 commercial vessels licenced to operate in the western rock lobster fishery caught a total of 10,855 tonnes of lobster (preliminary total from processors returns) from 15 November 1998 to 31 April 1999. This is approximately 29% higher than the 8,408 tonnes caught the previous season (Table 1) and 18.1% greater than the past 10 year average of 9,189 tonnes.

While the whites catches commenced slowly, they soon improved and good catches were landed throughout the fishery. Towards the end of January, deep-water fishing had ended with only a few boats remaining offshore. All along the coast most of the fleet had returned to the mid-water and inshore grounds. In some areas, such as Kalbarri, many fishermen had brought their gear ashore in mid-January, preferring to wait for the February 1 change in the size limit and anticipated better catches. Catches throughout the fishery were generally poor in late January and early February. This period is the time for a major moult in the western rock lobster population. By the end of January catches for the whites period were just over 5% better than the average over the previous 10 years, but compared to the whites catch the previous season, catches were 38.8% up at Fremantle, 21.2% up at Jurien, 10.8% up at Geraldton and overall up 24.1%. These increases were in line with the forecasts for the whites (see Predictions below).

In early February most vessels were inshore but with the first flush of newly moulted lobsters in mid-February catches improved. By early March a number of boats had moved into the middle grounds while landings continued to increase. During this time it was reported that catches in C zone were good from Lancelin south and poorer to the north. As a result, the mid-coastal fleet moved south and led to large numbers of vessels operating from Two Rocks, Mindarie and Hillarys. As the landings improved, after about the first week of March, vessels again became re-distributed throughout the fishery and throughout all depths except very deep water.

Catches through March and April were consistently very good with large numbers of lobsters being caught all along the coast. In late April very calm sea conditions combined with the presence of the full moon to lower lobster catchability and reduce catches.

Table 1. Rock lobster production figures.

Production (t) to end of June 1999

Fremantle	Jurien	Geraldton	Total
4235	1516	5104	10855

Production (t) to end of June 1998

Fremantle	Jurien	Geraldton	Total
2953	1140	4314	8407

Difference (t) and percentage difference

Fremantle	Jurien	Geraldton	Total
+1282	+376	+790	+2448
43.4% up	33.0% up	18.3% up	29.1% up

10 yr. cumulative ave. to end of April 1998	=	9189 t
Production to end of April 1999	=	10855 t
Difference	=	1666 t
% Difference	=	18.1% up

In short, the reds fishery to date has yielded very good catches and has been described as "brilliant". There is no doubt the high catches (as forecast) result from the high densities of lobsters recruiting to the fishery from the excellent puerulus settlement over 1994/95 and 1995/96.

Environmental influences may have acted to increase catches, particularly in the reds. Reports from fishermen indicate the presence of a very strong southward-setting current (the Leeuwin Current). At the same time water temperatures, from fishermen's and researcher's measurements, are 1-2°C higher than average. This is evidenced by reports of the best ever season for marlin and dolphin fish at the Rottnest trench. The higher temperatures obviously have had an effect on the biological processes of the rock lobster. Increased temperature would increase activity and hence the catchability of all lobsters leading to more being caught. The larger numbers of larger lobsters being caught, *ie* large males, over-size females and setose, probably also can be attributed to the higher catchability. In addition, the higher water temperature may be resulting in a greater degree of moulting in the population so that many large females that perhaps normally would appear setose, now are appearing as non-setose, and will moult again prior to breeding. Male lobsters that grow faster than females, particularly in the southern sector of the fishery, may well be growing faster still. These changes in biology may be the answer to the "where did all these come from?" questions currently posed by many fishermen.

THE ABROLHOS ISLANDS SEASON

Preliminary processors figures to mid-April indicate that catches from the Abrolhos Islands area are approximately 30% up on the same period last season. However, it is anticipated that this will fall over the next two months as the season progresses.

The Islands season this year started on a new moon in comparison to the 1998 season which started on a full moon. Good catches were taken from day one, however, big swells for the first two days prevented fishermen from fishing the shallow inshore reef areas. Soon after, conditions moderated allowing the shallows to be fished in earnest. In an interesting development exceptionally good catches were taken by a number of vessels over a two week period on the eastern side of Southern Group.

In similar fashion to last season, big numbers of very large animals were present in the landed catch. Fishermen also reported good numbers of oversize females and that catches were being taken in areas previously regarded as non-productive. This is probably as a result of the higher sea water temperatures (catchability) and an increase in the overall survival rate of lobsters due to the current management arrangements. Growth may be quicker also.

Given the extremely good catches throughout the season, it is likely that fishing may begin to wind down around about the May full moon.

This Bulletin is produced by the Research Division of Fisheries Western Australia

THE BIG BANK SEASON

A total of 83 boats, compared to 65 the previous season, nominated to fish in the Big Bank area of the fishery during February of this year. These vessels caught 214 tonnes (processors figures), an increase of 55 tonnes (34.8%) on the 1998 catch of 158 tonnes (Figure 1). The average catch per boat was 2.6 tonnes compared to the 2.4 tonnes the previous season. According to industry reports, the majority of the catch was taken in the southern part of the area, essentially on the Abrolhos Islands line. With the exception of isolated good daily catches, those vessels that fished north did not fare particularly well. The landed catch was in excellent condition and comprised mostly grades A and B with some Cs and Ds.

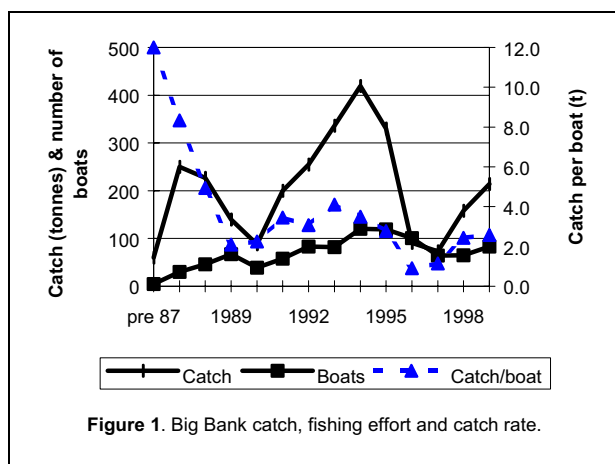


Figure 1. Big Bank catch, fishing effort and catch rate.

PREDICTIONS

Over the years, the prediction of catches has developed from a forecast of the catch for the whole fishery from the Seven Mile Beach (Dongara) puerulus settlement four years prior to the catch, to the sophisticated breakdown of predictions for whites and reds landings for the coastal fishery, and total catch projections for A, B and C zones. The modern day forecasts are based on settlement of puerulus three and four years previous. The predictions have proved accurate (usually within 5%) and have become widely sought after as the basis for advanced planning in the fishery from management, financial, marketing and investment perspectives.

Because of the vagaries of the environment and their effects on catchability, forecasts have always been a little less precise for shorter periods in the fishery, such as the whites and reds, than for the whole fishery. Nonetheless, they provide a solid basis for planning. The catch predictions for C zone, in the past, have been based on settlement at the Alkimos site alone. Now there is a suitable time series of data from other sites established in the mid 1980s in C zone, comparisons are being made between predictions based on Alkimos and forecasts based on a combination of C zone puerulus settlement sites to identify which index will provide the best catch estimate. The predictions apparently vary only if the Alkimos settlement is out of phase relative to the other C zones sites. An example would be average settlement at all C zone sites except Alkimos which had very good settlement. In this case, using Alkimos alone might overestimate the catch that could be expected from C zone.

In the comparison of the 1998/99 whites catch with the forecasts (Table 2) we have included predictions for C zone from both the Alkimos alone and from all sites combined. While the 1998/99 actual whites catches are about 10% lower than predicted, the whites run did commence a little later than usual. The excellent reds and Abrolhos catches should ensure the total landings for the fishery for 1998/99 will fall within the predicted range of catch of 13,000 to 14,000 tonnes. If this is achieved it will be the highest catch ever recorded in the history of the fishery.

Table 2. Predicted and actual whites catches for the 1998/99 season.

	B zone	C zone
Predicted	1900t	3900t (Alkimos)
		3300t (all sites)
Actual (preliminary)	1740t	2900t

PUERULUS SETTLEMENT

This season provides a prime example of the effects of differing environmental conditions on the fishery, and in particular the stock - recruitment relationship. Even with the very high level of spawning stock, puerulus settlement is the lowest seen for many years. Table 3 indicates the level of reduction compared to the average over the past ten years or so, and indicates that the settlement pattern along the coast this season was not consistent. In general terms the Abrolhos was about 44% below average; South Passage (Shark Bay) to and including Seven Mile Beach was 70-75% below average; Jurien and Lancelin were less affected at around 30% below average; Warnbro 94% below average and Alkimos and Cape Mentelle were 55-60% below average. These low settlements will be felt first in the reds of 2001/02 and then as a very poor whites in 2002/03.

Table 3. Percentage difference between puerulus settlement in 1998/99 compared to the long term average.

Abrolhos	Shark Bay	Dongara	Jurien
-44%	-70%	-75%	-28%
Lancelin	Alkimos	Warnbro	Margaret R.
-30%	-56%	-94%	-59%

A possible reason to account for this low settlement may have been the later than average transition, by about 3 months, from El Nino to La Nina conditions in 1998. This timing could be important in some way, perhaps in a critical period, that assists lobster phyllosoma (larvae) survival in the open ocean and/or transport back to the coast. This however, is only hypothesis at this time. The presence of a strong Leeuwin Current and recent indications that the La Nina situation will persist for a while yet, suggest a return to much better puerulus numbers during the next settlement period commencing around August.

WRLDA MARKETING NEWS

The increase of over 30% in product volume this season was foreseen to be a problem for the markets given the financial situation in Asia. Fortunately the promotion by Westfish over Christmas, targeting Australian domestic consumers through the supermarket trade, including recipes, colourful posters and competitive prices saw between 600 and 700 tonnes of whole boiled lobster placed on this market. This effectively reduced the volume that normally would have had to be sold on the traditional overseas markets, which reduced the anticipated over-supply of lobsters to those markets. The results have been encouraging.

TAIWAN

We have seen continued growth in this market for frozen whole cooked and whole raw product. To date this has been achieved from a pricing structure offered by WA processors that is more competitive in the international marketing arena.

JAPAN

Continuing exchange rates ranging up to 125 Yen to the US\$, together with a slow economic recovery in Japan has restricted increased sales to this market. As at 31 March this year, competitive prices ensured that similar volumes, in comparison to the same period last year, were sold into this market.

CHINA

Sales into China have been very restricted due to the imposition of import duty and tariffs.

USA

As a result of demand for more product from American importers, Western Australian suppliers responded by forwarding greater volumes of frozen tails to this market. However, it is noticeable that prices are starting to slide downward with the increased volumes forwarded.

EUROPE

A great deal of hard work by many processors has seen this currently small market grow in excess of 100% in the form of chilled and frozen whole boiled lobsters and frozen lobster tails. Concentrated efforts in this market, by marketing people and government bodies, to reduce import duties are gathering momentum. Western Australian processors have just attended the Seafood Trade Fair in Brussels to further extend and generate new markets in Europe. The results are pleasing.

GENERAL

The competitive prices sought by WA processors overseas have been brought about by the need to be more competitive in the international market place. Simply put, this means that if the prices asked by processors for WA lobster are too high, importers will substitute cheaper lines sourced from elsewhere in place of WA product. The current strength of the Australian dollar (AUD) against both the US dollar and the Yen also is not good for WA exporters, since product is sold in overseas currency and to maintain Australian profit margins, buyers have to pay more. Nevertheless, providing the marketing section of the WA rock lobster fishery continues to expand into new markets, whilst at the same time nurturing existing markets with a quality product at reasonable prices, the long term picture of the industry is bright.

VOLUNTARY RESEARCH LOG-BOOK PROGRAMME

The participation rate by skippers and deckies during the 1997/98 season reached an all time high of 38.5%. Sadly, however, this season the level has fallen by several percent. The research team would like to maintain the participation rate at the higher level and therefore urge those fishers who may have records for the season to date or have personal records (in an exercise book), that they are prepared to transfer into the research log book, to send those research records to the laboratories at Waterman. We offer our sincere thanks to those fishers who have maintained their part in the log book programme this season, your efforts are greatly appreciated. If you would like to become part of the research team by filling in a research log book, please contact Eric Barker at the Western Australian Marine Research Laboratories on (08) 9246 8444.

THE QUESTION OF LARGE FEMALES, LARGE MALES AND EGG PRODUCTION

The Fishing industry consistently raises the issue of whether there is enough large male rock lobsters to successfully mate with the large females protected under the current regulations. Some large non-setose females also are being caught this season which, on the face of it at least, seems to add fuel to the concerns of fishermen. The Research team's assessment, however, is that there does not appear to be any cause for concern at the moment.

The raw data and observations from Fisheries WA staff undertaking the monitoring programme on board commercial vessels strongly indicate that all females that should have been mated during the last breeding season were in fact mated and carrying eggs. Furthermore, there is no suggestion that the number of eggs, nor the level of infertility (of which there is some always), is any greater than it should be.

The presence in the fishery of large non-setose females at this time of year probably is due to breeding females moulting into a non-setose state, due to higher water temperatures (see The Coastal Fishery To Date above). It is very likely these females will moult into setose condition closer to the breeding season which extends from about September through the February. Some larger females will be tar-spotted (mated) in June and appear in the catches then.

The higher number of larger males being caught this season may point to another explanation for the conclusion that egg production is not being affected. Catchability plays an important role in whether lobsters get caught or not. For example, everyone knows the effect of swell on catches. Temperature has a similar effect. So that it is very likely that

numbers of large males do live on the sea bed, but generally are caught only in numbers when their catchability is increased, such as during this season. This group of "largely unseen" big males would mate the large females.

Two other factors are relevant. The first is that males grow faster than females particularly after females become sexually mature. This means that under the current management arrangements where the survival of lobsters has been enhanced, more males can grow through to the large size groups. The growth rate of these lobsters is faster when water temperatures are higher, as is the case this season. The second fact is that one large male will mate with a number of females, thus reducing the need for equal numbers of large males and females.

The Research team is constantly monitoring the breeding stock to ensure that egg production is not adversely impacted from the maximum size rule and has a contingency plan in place for quantitatively assessing the full biological implications should the need arise. Research staff thank those concerned fishermen for their comments and hope they continue to liaise with them to pass on vital observations to ensure that any changes in spawning are reported.

ASSESSMENT OF THE FIVE YEARS OF MANAGEMENT 1993/94 TO 1997/98

In early February this year a Rock Lobster Industry Advisory Committee mini-tour was conducted as part of the consultation process with industry. During that tour, a preliminary assessment of the status of the fishery and the effects of five seasons of stable management were reported to industry. Researchers gave a verbal presentation to augment the published Commercial Fisheries Research Bulletin dealing with this issue sent to all licence holders in January. The bulletin entitled "The Effects of Five Years (1993/94 to 1997/98) of Stable Management in the Western Rock Lobster Fishery" provided an assessment of the **combined** effects of the elements of the management package. It was mentioned in that Research bulletin that a model to assess the effects of the **individual** elements of the package would be operational in February and the results available soon after. The March/April 1999 issue of "Pro West" reported on the February coastal tour and again mentioned that the model results would be available in late February.

Unfortunately, Fisheries WA population dynamics/modelling resources were diverted to other issues, eg pilchard kills and stock assessment, considered to be of a higher priority, and so the results of individual effects of the management package on the rock lobster fishery still are not available. Work now has recommenced on the lobster model and will be made available to industry as soon as it is finalised. Research Division apologises for this situation but it does have limited resources and priorities change from time to time. This notwithstanding, it is useful to reiterate that the lack of model results does not place the management of the fishery at risk.

As reported in the above Research Bulletin, the long term sustainability of the western rock lobster fishery is assured following the spectacular success of the package in rebuilding the depleted breeding stock to levels considered safe for this fishery. In addition, the impact of temporary pot reductions on the catch per pot achieved, and thus the relative profitability of the pots (assuming all other costs remained equal), was consistently higher than before the package was introduced. Copies of the Commercial Fisheries Research Bulletin detailing the successful outcomes of the management package and assessing the status of the western rock lobster fishery still are available from Fisheries WA (contact Helen Butler on (08) 9426 7392).

* This information was provided by the Western Rock Lobster Development Association (Inc.), Suite 6, 41 Walters Drive, Osborne Park WA 6017. Chairman Mr Tony Gibson ph: (08) 9244 2933 fax: (08) 9244 2934.

Except where acknowledged, the information in this bulletin has been supplied by the FISHERIES RESEARCH DIVISION of FISHERIES W.A. Contact Dr Chris Chubb or Mr Eric Barker ph: (08) 9246 8444 fax: (08) 9447 3062.



Commercial Fisheries Production Bulletin

WESTERN ROCK LOBSTER FISHERY

1998/99 & 1999/2000 SEASONS

THE COASTAL FISHERY 1998/99

The 596 commercial vessels licensed to operate in the western rock lobster fishery caught a total of 13,000 tonnes of lobster (preliminary total from processors returns) from 15 November 1998 to 30 June 1999. This is approximately 25% higher than the 10,373 tonnes caught the previous season and 20% greater than the past 10 year average of 10,823 tonnes (Table 1).

While the whites catches commenced slowly, they soon improved and good catches were landed throughout the fishery. Towards the end of January, deep-water fishing had ended with only a few boats remaining offshore. All along the coast most of the fleet had returned to the mid-water and inshore grounds. In some areas, such as Kalbarri, many fishermen had brought their gear ashore in mid-January, preferring to wait for the February 1 change in the size limit and anticipated better catches. Catches throughout the fishery were generally poor in late January and early February. This period is the time for a major moult in the western rock lobster population. By the end of January catches for the whites period were just over 5% better than the average over the previous 10 years, but compared to the whites catch the previous season, catches were 38.8% up at Fremantle, 21.2% up at Jurien, 10.8% up at Geraldton and overall up 24.1%. These increases were in line with the forecasts for the whites (see Predictions below).

In early February most vessels were inshore but with the first flush of newly moulted lobsters in mid-February catches improved. By early March a number of boats had moved into the middle grounds while landings continued to increase. During this time it was reported that catches in C zone were good from Lancelin south and poorer to the north. As a result, the mid-coastal fleet moved south and led to large numbers of vessels operating from Two Rocks, Mindarie and Hillarys. As the landings improved, after about the first week of March, vessels again became re-distributed throughout the fishery and throughout all depths except very deep water.

Catches through March and April were consistently very good with large numbers of lobsters being caught all along the coast. In late April very calm sea conditions combined with the presence of the full moon to lower lobster catchability and reduce catches. May and June saw good catches in mostly inshore waters along the coast with the exception of the central area (Cervantes/Jurien) and Kalbarri where landings were poor. As a result some boats moved south again to the Two Rocks to Hillarys region to take advantage of the consistently good catches from Seabird south.

In summary A and C zones had record catches of 1970t and 6870t respectively (previous highest A zone 1900t in 1995/96 and C zone 6670t in 1982/83). While B zone did not reach the

Table 1. Preliminary rock lobster production figures.

Production (t) to end of June 1999

Fremantle	Jurien	Geraldton	Total
5122	1762	6118	13002

Production (t) to end of June 1998

Fremantle	Jurien	Geraldton	Total
3586	1362	5425	10373

Difference (t) and percentage difference

Fremantle	Jurien	Geraldton	Total
+1536	+400	+693	+2629
42.8% up	29.4% up	12.8% up	25.4% up

10 yr. cumulative average to end of June 1998

= 10823 t

Production to end of June 1999

= 13002 t

Difference

= 2179 t

% Difference

=20.1% up

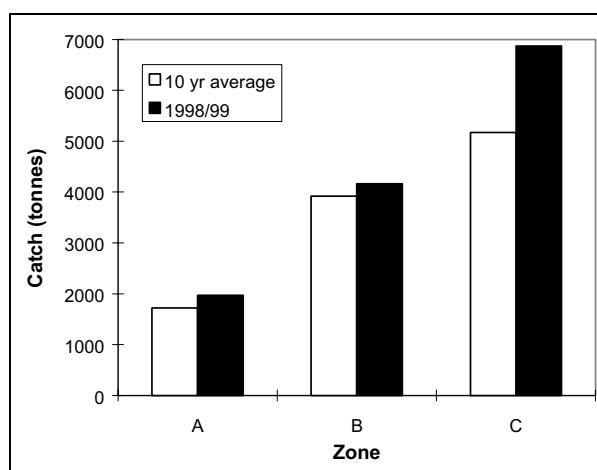


Figure 1. Catches by zone in 1998/99 compared to the average over the previous ten years (preliminary data).

highest catch of 4450t landed in 1987/88, the catch of 4160t was nevertheless the 5th highest ever landed. A, B and C zone catches were respectively 14%, 6% and 33% higher than the average landings over the previous 10 years (Figure 1).

Over the season, industry reported large numbers of setose rock lobsters throughout the fishery but particularly in the Safety Bay/Mandurah area. Of interest were the numbers of setose female lobsters seen in the inshore areas. These observations clearly show the impact of the current management package in rebuilding the breeding stock. Also reported late in the season were large numbers of under-sized lobsters which obviously augured well for season 1999/2000.

THE 1998/99 ABROLHOS ISLANDS SEASON

A preliminary catch of 1,970 tonnes from the Abrolhos Islands in season 1998/99 was a record and approximately 10% higher than the previous season's catch of 1790t.

This Islands' season was exceptional with generally good catches throughout the season until the early part of May when catches began to decline, probably in part a result of the calm sea conditions experienced then.

Deep water fishing at the Islands was good in patches. For example, good catches were taken by a number of vessels over a two week period on the eastern side of Southern Group and in late April-early May a few large boats achieved good catches between 55 and 75 fathoms north of North Island. However, such catches were not widespread or a general feature of deeper water in the Abrolhos zone. Nevertheless, fishermen reported good numbers of oversize females and catches from areas previously regarded as non-productive.

The effect of the strong Leeuwin Current was seen as sea surface temperatures and tides remained higher than normal throughout the season. The higher temperatures probably maintained a higher catchability of the lobsters, which no doubt would have contributed to the record catch reported from the Abrolhos in 1998/99.

THE COASTAL FISHERY 1999/2000

The 1999/2000 season commenced slowly with catches restricted to reds in shallow water throughout November. Many skippers pulled their gear intermittently at this time. Kalbarri had some good catches of reds right at the season's beginning, but the boats soon moved south. Cold southerly winds, low water temperatures, a full moon on the 23rd November and calm, clear water over the full moon apparently caused the whites catches to be delayed slightly. By late November the first whites were being caught and in the first two weeks in December reasonably steady catches of between 200 and 350kg for a one day pull were fairly common throughout the fishery. The fleet at this time was scattered from the nearshore grounds out to 10-12 fathoms. While catches from Lancelin south in C zone have been good whereas they have been poor to date in the northern part of C zone. In B zone catches increased in the first week of December. By mid-December the whites season was fully underway all along the coast with the fleet still scattered out to about 20 fathoms. Good catches were still being landed from the nearshore grounds. Fishers have commented on the "huge numbers" of under-sized whites in the shallows.

Preliminary estimates of the landings to the end of November indicate about 270 tonnes were caught fishery wide. This is about 40% below the catch of about 440 tonnes for November 1998.

PUERULUS SETTLEMENT

1998/99

Puerulus settlement in the 1998/99 declined to below average levels at all locations in the western rock lobster fishery (Figures 2 & 3). While the Leeuwin Current ran strongly at the time, the puerulus settlement failed to meet expectations, perhaps due to the later change over from El Nino to La Nina conditions. It is hypothesised that this timing might be important in terms of larval survival and/or transport back to the coast prior to their metamorphosis into pueruli. This has yet to be investigated.

1999/2000

Settlement for 1999/2000 is well underway and to the end of November 1999, numbers settling in the northern locations are below average while those from Jurien south are experiencing above average settlement except Cape Mentelle where settlement is about average (Figure 4). The percentages in Figure 3 indicate the proportion of settlement that occurs on average to the end of November. So in the Abrolhos, for example, the current settlement index is below 20 pueruli per collector with 50% of puerulus having settled. At Alkimos the settlement is three times the average with 13% (on average) of settlement still to occur.

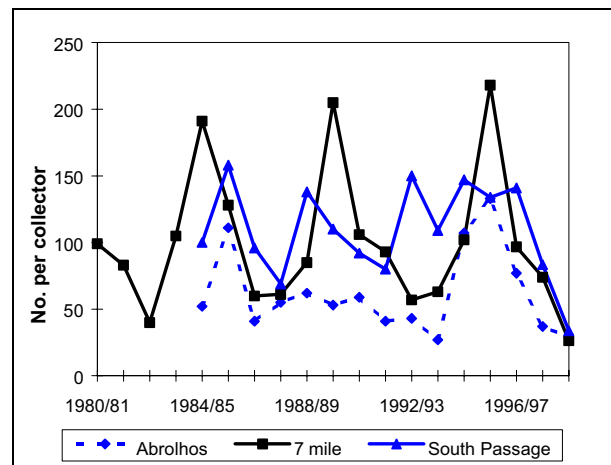


Figure 2. The annual time series of puerulus settlement for the Abrolhos (Easter Group), Seven Mile Beach (Dongara) and South Passage (Shark Bay) since 1980/81.

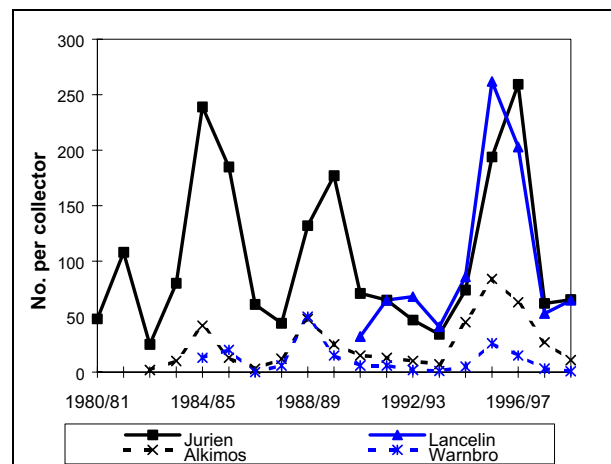


Figure 3. The annual time series of puerulus settlement for Jurien, Lancelin, Alkimos (north of Perth and Warnbro Sound (south of Fremantle) since 1980/81.

Interestingly, while puerulus settlement has improved this season, particularly in C zone, the trend of relatively poorer numbers of pueruli in the northern locations compared to the numbers settling in C zone has persisted for the second year in succession (compare the averages in Figure 4). It is true that river flow from the Irwin River deposited silt on the collectors perhaps for a time impacting puerulus settlement. What is not clear is whether the settlement on the Seven Mile Beach collectors truly reflects settlement on the reefs at these times.

Nevertheless, two pieces of evidence support the idea that the settlement probably does reflect the numbers settling on the inshore reefs. Firstly, the puerulus data in this region are continuous since 1968 and many "wet" years have been experienced before, yet the predictions of catch from the puerulus at Seven Mile Beach have been remarkably accurate throughout the period where forecasts have been made. Secondly, the low level of pueruli settling is consistent throughout the northern sectors of the fishery possibly indicating a general low availability of pueruli to settle, in spite of a strong Leeuwin Current.

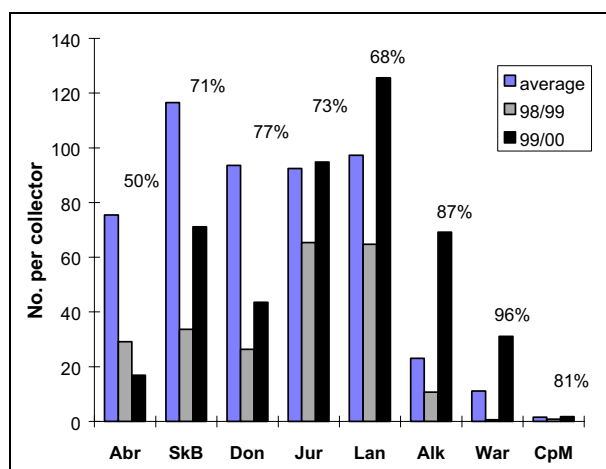


Figure 4. Puerulus settlement from May to November in 1999/2000 compared to the annual figures for both 1998/99 and the long term average for the Abrolhos (Abr), Shark Bay (SkB), Dongara (Don), Jurien (Jur), Lancelin (Lan), Alkimos (Alk), Warnbro Sound (War) and Cape Mentelle (CpM) near Margaret River. The percentages indicate the long-term average proportion of settlement that occurs to the end of November (see text for further information).

Some are suggesting that the very strong Leeuwin Current being experienced over the past year or two is actually transporting late stage phyllosoma (lobster larvae) and pueruli further south where large numbers are settling. Certainly this is consistent with the pattern of settlement but unable to be confirmed since no research is being conducted in the regions of the outer continental shelf where the current flows.

Moderately strong La Nina conditions, virtually identical to last year, persist in the Pacific (Klaus Wolter, Colorado, USA, personal communication) with model predictions suggesting little change for the next few months. This should auger well for future puerulus settlement.

PREDICTIONS

Forecasts for A, B and C zones are based on settlement of puerulus at sites in those zones three and four years previous. Because of the vagaries of the environment and their effects on catchability and the uncertainty inherent in the estimation procedure, forecasts have always been a little less precise for shorter periods in the fishery, such as the whites and reds, than for the whole fishery. Nonetheless, the forecasts have a proven track record and are valued highly by industry and managers.

The catch predictions for C zone, in the past, have been based on settlement at the Alkimos site alone. Now a suitable time series of data are available from other sites established in the mid 1980s in C zone, comparisons are being made between predictions based on Alkimos and forecasts based on a combination of C zone puerulus settlement sites. This will identify which index provides the most accurate catch estimate. The predictions from the two indices seem to vary only if the Alkimos settlement is out of phase relative to the other C zones sites. An example would be average settlement at all C zone sites except Alkimos which had very good settlement. In this case, using Alkimos alone might overestimate the catch that could be expected from C zone.

Comparison of 1998/99 predictions and actual catches

In the comparison of the 1998/99 whites and reds catches with the forecasts (Table 2), we have included predictions for C zone from both the Alkimos alone and from all sites combined. The total catch for 1998/99 was 13,000t compared to the forecast of 14,250t (using C zone Alkimos prediction) or 13,200t (from combined C zone puerulus settlement).

Table 2. Predicted and preliminary actual whites and reds catches for the 1998/99 season * based upon Alkimos settlement; ** based upon settlement from a combination of C zone sites.

Whites	B zone	C zone
Predicted	1900t	3900t *
		3300t**
Actual	1740t	2900t

Reds	A zone	B zone	C zone
Predicted	1950t	2650t	3750t *
			3400t**
Actual	1970t	2430t	3970t

Predictions for 1999/2000

Season 1999/2000 is forecast to eclipse last season's all time record catch. A total catch of around 14,000t is expected with the increase predominantly to be landed from C zone. The Abrolhos, B zone and C zone catches are predicted to be 1,900t, 4250t and around 8,000t respectively.

The B zone whites catch should be around 2,000t a slight increase on the 1998/99 actual whites catch, while the reds are expected to decline slightly to about 2,250t. In C zone, the forecast is for a very large whites catch of about 4,400t followed by an equally large reds catch of 3,450 to 3,800t. The reds catch being anticipated as being slightly below that which was actually landed last season.

As a result of declining levels of puerulus settlement, the following seasons will see reductions in forecast catches to 11,000-12,000t in 2000/01 and 9,500-10,500t in 2001/02. The outlook for season 2002/03, based upon the settlement for 1998/99 and 1999/2000, is for a poor whites for B and C zones, a poor reds for the northern sectors of the fishery and a reasonably good reds for C zone.

WRLDA MARKETING NEWS*

General

With the slow start to the 1999/2000 season and some estimates of receipts into processing plants down by 50% for November, processors are faced with the awkward position of not being able to fill early good orders on time. This situation could result in some cancellations of orders.

The predicted extra 1,000 tonnes of catch will ensure that all processors/marketers will be kept very much on their toes!!!

Japan

Due to a combination of the low commencing prices paid for our lobsters last season and the steady overall improvement in the Japanese economy during the season, Japanese importers enjoyed a profitable year and consequently found themselves trading strongly in the market. This combined with lower production from other lobster producing suppliers, low stocks in cold stores in Japan and a favourable Yen/US\$ rate have all contributed to well priced orders being received for this season's western rock lobster.

Providing we do not seek to increase prices to the extent that our lobsters become too expensive and are removed from menus in Japan, we should see steadily increasing prices received for our product. The note of caution is that whilst the Japanese economy is certainly recovering, banks are still taking a "hard-nosed" approach on lines of credit to the small to medium sized companies. Nevertheless, the overall situation in Japan is encouraging.

Taiwan

The severe earthquake in central Taiwan in September was devastating and brought considerable hardship for many people. As one might expect, it also had the effect of slowing sales of luxury items such as lobster, however, overall consumption in Taiwan now is on the rise again.

Initial sales have been good, however, again the slow start to season 1999/2000 may have some minor impact on orders. It is anticipated that the strong demand for western rock lobster will continue through until Chinese New Year on 5th February. After this event, it is possible we may see some downturn in demand due to the anticipated volume of sales into the country. However, in general the outlook is optimistic.

United States

Concern recently has been expressed that escalating asking prices in the US tail market have been pushed too high resulting in buyer resistance. A classic supply and demand situation prevails in this market where low volumes are sold at high prices and vice versa. With the forecast added production we will see an increase in the output of tails and the US tail market will be extremely fragile when large quantities of western rock lobster are pushed into it.

European Union/Domestic Sales

While there is fairly strong demand for the Christmas/Millennium celebrations, processors are finding it difficult to meet all orders due to the slow start. There simply has not been enough product caught to satisfy all buyers, noting, of course, that some of these buyers only enter the market for short periods of each season.

The favourable exchange rate currently being experienced is certainly a 'bonus'!

VOLUNTARY RESEARCH LOG-BOOK PROGRAMME

The 1999/2000 season is predicted to be the highest catch in the history of the "world's largest rock lobster fishery" and we, fishers and researchers, need to document fully the catch through the voluntary log-book programme. The participation rate in the programme during the 1998/99 season was 37.5%, slightly lower than the previous season's record of 38.5%, but still a fantastic response by industry.

We express our sincere thanks to all those skippers, deckies and wives/partners who have contributed to the knowledge base of your fishery through the log-book programme. We sincerely appreciate your contributions as part of the research team and look forward to your continued association with the log-book programme.

However, it is anticipated that, for whatever reason, some fishers will cease to provide log-book records to the Rock Lobster Research team during 1999/2000. Given we wish to maintain the participation rate at the current high level, we would like to request that if you want to become part of the research team by filling in a research log book, then please contact Eric Barker at the Western Australian Marine Research Laboratories on (08) 9246 8444.



The Rock Lobster Research Team would like to thank all who offered assistance and guidance in 1999 and wishes everybody a very Merry Christmas and a very exciting and prosperous year 2000.

L to R: Dr Chris Chubb and Eric Barker with the field staff of Tony Paust, David Murphy, James Murray, Jason Mant and Jim Christianopoulos (Zorba).
(Absent: Dr Roy Melville-Smith and Sonia Anderton).

* This information was provided by the Western Rock Lobster Development Association (Inc.), Suite 6, 41 Walters Drive, Osborne Park WA 6017. Chairman Mr Tony Gibson ph: (08) 9244 2933 fax: (08) 9244 2934.

Except where acknowledged, the information in this bulletin has been supplied by the FISHERIES RESEARCH DIVISION of FISHERIES W.A. Contact Dr Chris Chubb or Mr Eric Barker ph: (08) 9246 8444 fax: (08) 9447 3062.

List of Fisheries Research Reports

Not all have been listed here, a complete list is available online at <http://www.wa.gov.au/westfish>

- 83 The Western Rock Lobster fishery 1985/86. Brown, R.S.; Barker, E.H. (1990.)
- 84 The Marine open shelf environment: review of human influences. Hancock, D.A. (1990.)
- 85 A Description of the British United Trawlers / Southern Ocean Trawlers operation in the Great Australian Bight during the period 19.11.77 to 28.5.79. Walker, M.H.; Blight, S.J.; Clarke, D.P. (1989.)
- 86 The Demersal trawl resources of the Great Australian Bight as indicated by the fishing operations of the stern trawlers Othello, Orsino and Cassio in the period 19.11.77 to 28.5.79. Walker, M.H.; Clarke, D.P. (1990.)
- 87 The recreational marron fishery in Western Australia summarised research statistics, 1971 - 1987. Morrissy, N.M.; Fellows, C.J. (1990.)
- 88 A synopsis of the biology and the exploitation of the Australasian pilchard, *Sardinops neopilchardus* (Steindachner). Part 1: Biology. Fletcher, W.J. (1990.)
- 89 Relationships among partial and whole lengths and weights for Western Australian pink snapper *Chrysophrys auratus* (Sparidae). Moran, M.J.; Burton, C. (1990.)
- 90 A Summary of projects financed by the Fisheries Research and Development Fund 1965-1983. (1991.)
- 91 A synopsis of the biology and the exploitation of the Australasian pilchard, *Sardinops neopilchardus* (Steindachner) Part II : History of stock assessment and exploitation. Fletcher, W.J. (1991.)
- 92 Spread of the introduced yabbie *Cherax albidus* Clark, 1936 in Western Australia. Morrissy, N.M.; Cassells, G. (1992.)
- 93 Biological synopsis of the black bream, *Acanthopagrus butcheri* (Munro) (Teleostei: Sparidae). Norriss, J.V.; Tregonning, J.E.; Lenanton, R.C.J.; Sarre, G.A. (2002.)
- 94 to 98 No reports were published under these numbers.**
- 99 An Investigation of weight loss of marron (*Cherax tenuimanus*) during live transport to market. Morrissy, N.; Walker, P.; Fellows, C.; Moore, W. (1993.)
- 100 The Impact of trawling for saucer scallops and western king prawns on the benthic communities in coastal waters off south-western Australia. (FRDC final report 90/019) Laurenson, L.B.J.; Unsworth, P.; Penn, J.W.; Lenanton, R.C.J.; Fisheries Research and Development Corporation (1993.)
- 101 The Big Bank region of the limited entry fishery for the western rock lobster *Panulirus cygnus*. Chubb, C.F.; Barker, E.H.; Dibden, C.J. (1994.)
- 102 A Review of international aquaculture development and selected species in environments relevant to Western Australia. Lawrence, C. S. (1995.)
- 103 Identifying the developmental stages for eggs of the Australian pilchard, *Sardinops sagax*. White, K.V.; Fletcher, W.J. (Warrick Jeffrey) (1998.)
- 104 Assessment of the effects of a trial period of unattended recreational netting in selected estuaries of temperate Western Australia. Lenanton, R.C.; Allison, R.; Ayvazian, S.G. (1996.)
- 105 The western rock lobster fishery 1986/7 to 1990/91. Chubb, C.F.; Barker, E.H.; Brown, R.S.; Western Australia. Fisheries Dep. (1996.)
- 106 Environmental and biological aspects of the mass mortality of pilchards (Autumn 1995) in Western Australia. Fletcher, W.J.; Jones, B; Pearce, A.F.; Hosja, W.; Western Australia. Fisheries Dept. (1997.)
- 107 Chemical composition of yabbies, *Cherax albidus* Clark 1936 from Western Australian farm dams. Francesconi, K.A.; Morrissy, N.M. (1996.)
- 108 Aspects of the biology and stock assessment of the whitebait, *Hyperlophus vittatus*, in south western Australia. Gaughan, D.J.; Fletcher, W.J.; Tregonning, R.J.; Goh, J. (1996.)
- 109 The western rock lobster fishery 1991/92 to 1992/93. Chubb, C.F.; Barker, E.H.; Fisheries Western Australia (1998.)
- 110 A Research vessel survey of bottom types in the area of the Abrolhos Islands and mid-west trawl fishery. Dibden, C.J.; Joll, L.M. (1998.)
- 111 Sea temperature variability off Western Australia 1990 to 1994. Pearce, A.; Rossbach, M.; Tait, M.; Brown, R. (1999.)
- 112 Final report, FRDC project 94/075: enhancement of yabbie production from Western Australian farm dams. Lawrence, C.; Morrissy, N.; Bellanger, J.; Cheng, Y. W.; Fisheries Research and Development Corporation (1998.)
- 113 Catch, effort and the conversion from gill nets to traps in the Peel-Harvey and Cockburn Sound blue swimmer crab (*Portunus pelagicus*) fisheries. Melville-Smith, R.; Cliff, M.; Anderton, S.M. (1999.)
- 114 The Western Australian scallop industry. Harris, D.C.; Joll, L.M.; Watson, R.A. (1999.)
- 115 Statistical analysis of Gascoyne region recreational fishing study July 1996. Sumner, N.R.; Steckis, R.A. (1999.)
- 116 The western rock lobster fishery 1993/94 to 1994/95 Chubb, C.F.; Barker, E.H.; Fisheries Western Australia (2000.)
- 117 A 12-month survey of coastal recreational boat fishing between Augusta and Kalbarri on the west coast of Western Australia during 1996-97. Sumner, N.R.; Williamson, P.C. (1999.)
- 118 A study into Western Australia's open access and wetline fisheries. Crowe, F.; Lehre, W.; Lenanton, R.J.C. (1999.)
- 119 Final report : FRDC project 95/037 : The biology and stock assessment of the tropical sardine, *Sardinella lemuru*, off the mid-west coast of Western Australia. Gaughan, D.J.; Mitchell, R.W.D.; Fisheries Research And Development Corporation (Australia); Western Australian Marine Research Laboratories. (2000.)
- 120 A 12 month survey of recreational fishing in the Leschenault Estuary of Western Australia during 1998 Malseed, B. E.; Sumner, N.R.; Williamson, P.C. (2000.)
- 121 Synopsis of the biology and exploitation of the blue swimmer crab, *Portunus pelagicus* Linnaeus, in Western Australia Kangas, M.I. (2000.)
- 122 Western rock lobster mail surveys of licensed recreational fishers 1986/87 to 1998/99 Melville-Smith, R.; Anderton, S.M. (2000.)
- 123 Review of productivity levels of Western Australian coastal and estuarine waters for mariculture planning purposes. CDRom in back pocket has title "Chlorophyll-a concentration in Western Australian coastal waters - a source document. by S. Hellenen and A. Pearce" (document in PDF format) Pearce, A.; Hellenen, S.; Marinelli, M. (2000.)

Fisheries Research Reports cont'd.

- 124 The Evaluation of a recreational fishing stock enhancement trial of black bream (*Acanthopagrus butcheri*) in the Swan River, Western Australia Dibden, C.J.; Jenkins, G.; Sarre, G.A.; Lenanton, R.C.J.; Ayvazian, S.G. (2000.)
- 125 A history of foreign fishing activities and fishery-independent surveys of the demersal finfish resources in the Kimberley region of Western Australia. [Part funded by Fisheries Research and Development Corporation Project 94/026] Nowara, G.B.; Newman, S.J. (2001.)
- 126 A 12 month survey of recreational fishing in the Swan-Canning Estuary Basin of Western Australia during 1998-99 Malseed, B.E.; Sumner, N.R. (2001.)
- 127 A 12 month survey of recreational fishing in the Peel-Harvey Estuary of Western Australia during 1998-99. Malseed, B.E.; Sumner, N.R. (2001.)
- 128 Aquaculture and related biological attributes of abalone species in Australia - a review Freeman, K.A. (2001.)
- 129 Morphology and incidence of yabby (*Cherax albidus*) burrows in Western Australia. Lawrence, C.S.; Brown, J.I.; Bellanger, J.E. (2001.)
- 130 Environmental requirements and tolerances of rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*) with special reference to Western Australia : a review. Molony, B. (2001.)
- 131 Pilchard (*Sardinops sagax*) nursery areas and recruitment process assessment between different regions in southern Western Australia. Gaughan, D.J.; Baudains, G.A.; Mitchell, R.W.D.; Leary, T.I. (2002.)
- 132 A review of food availability, sea water characteristics and bivalve growth performance occurring at coastal culture sites in temperate and warm temperate regions of the world. Saxby, S.A. (2002.)
- 133 Preliminary assessment and seasonal fluctuations in the fish biota inhabiting the concentrator ponds of Dampier Salt, Port Hedland, with options for the potential application of results. Molony, B.; Parry, G. (2002.)
- 134 Towards an assessment of the natural and human use impacts on the marine environment of the Abrolhos Islands. Volume 1, Summary of existing information and current levels of human use. CD Rom in back pocket has title "Abrolhos Habitat Survey". Webster, F.J.; Dibden, C.J.; Weir, K.E.; Chubb, C.F. (2002.) Volume 2, Strategic research and development plan. Chubb, C.F.; Webster, F.J.; Dibden, C.J.; Weir, K.E. (2002.)
- 135 The western rock lobster fishery 1995/96 to 1996/97. Chubb, C.F.; Barker, E.H. (2002.)
- 136 Assessment of gonad staging systems and other methods used in the study of the reproductive biology of narrow-barred Spanish mackerel, *Scomberomorus commerson*, in Western Australia. Mackie, M.; Lewis, P. (2001.)
- 137 Annual report on the monitoring of the recreational marron fishery in 2000, with an analysis of long-term data and changes within this fishery. Molony, B.; Bird, C. (2002.)
- 138 Historical diving profiles for pearl oyster divers in Western Australia. Lulofs, H.M.A.; Sumner, N.R. (2002.)
- 139 A 12-month survey of recreational fishing in the Gascoyne bioregion of Western Australia during 1998-99. Sumner, N.R.; Williamson, P.C.; Malseed, B.E. (2002.)
- 141 A guide to good otolith cutting. Jenke, J. (2002.)
- 142 Identifying the developmental stages of preserved eggs of snapper, *Pagrus auratus*, from Shark Bay, Western Australia, Norriss, J. V. and Jackson G. (2002.)
- 143 Methods used in the collection, preparation and interpretation of narrow-barred Spanish mackerel (*Scomberomorus commerson*) otoliths for a study of age and growth in Western Australia, Lewis P. D. and Mackie, M. (2003.)
- 144 FRDC Project 1998/302 – Rock Lobster Enhancement and Aquaculture Subprogram: Towards establishing techniques for large scale harvesting of pueruli and obtaining a better understanding of mortality rates, Phillips B. F. (2003.)

