



ISSN 1175-1584

MINISTRY OF FISHERIES

Te Tautiaki i nga tini a Tangaroa

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Chatham Islands rock lobster fishery (CRA 6)**

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P O Box 60
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**Published by Ministry of Fisheries
Wellington
2002**

ISSN 1175-1584

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**Ministry of Fisheries
2002**

Citation:

Walker, N.A.; Bentley, N. (2002).
A compilation of commercial weight-grade data from the
Chatham Islands rock lobster fishery (CRA 6).
New Zealand Fisheries Assessment Report 2002/45. 14 p.

This series continues the informal
New Zealand Fisheries Assessment Research Document series
which ceased at the end of 1999.

EXECUTIVE SUMMARY

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Information on the size and sex composition of the catch is an important component of the monitoring and assessment of rock lobster stocks in New Zealand. In most areas, observer catch sampling and logbooks provide this information, but observer catch sampling in the Chatham Islands (CRA 6) ceased in 1997–98 because of logistic difficulties and a logbook programme has only recently begun. We assessed factory weight grade data for their accuracy and suitability in lieu of more detailed sampling programmes in CRA 6.

Data of weight of catch by grade were provided from factories processing and exporting rock lobsters from the Chatham Islands. The data compiled represent 37.7% of the total catch taken in CRA 6 between April 1991 and June 2001. The grading system used by these factories has changed often over the history of the fishery and compatible grading regimes were condensed into common grades to provide more continuity. These condensed regimes provide various resolutions, with the longest running regimes providing only two grades; less than, and greater than, 0.8 kg (grading regime H). The most recent regime included seven grades and was used from 1997–98 to 2001–02 (grading regime A). These regimes showed some changes in the proportion of catch in each grade over time. A time series based on three grades (grading regime D) provides a compromise, trading off continuity for resolution.

Previous analysis of catch sampling data from the Chatham Islands (CRA 6) suggested that the average size of lobster caught had remained high despite apparently high rates of exploitation. This had led to suggestions that lobsters from outside the fished area may be replenishing the fishery. Analysis of the factory data suggests that the composition of the catch landed by CRA 6 fishers has continued to remain relatively constant over time with small lobsters (weighing less than 0.8 kg) representing less than 30.5 % of the total catch except in 1996–97 and 1997–98, when this grade provided close to 38 % of the catch.

We discuss the issues with the resolution of the data and the extent to which it is likely to be representative of the fishery. Although earlier grading systems had low resolution, the current grading system has seven grades and should be continued if possible. We suggest that given the high proportion of the catch, these data are representative of the fishery as a whole. However, it is recommended that the logbook programme that has recently been established in CRA 6 be continued to gather more detailed catch composition data. The current regime of factory grading provides a relatively long-term data set during a period where little other catch sampling data was available.

1. INTRODUCTION

The Chatham Islands rock lobster (*Jasus edwardsii*) fishery began in the late 1960s. Catches increased rapidly to a peak of about 6000 t in 1968. Over the next decade, catches declined as fast as they had risen, and between 1974 and 1989 fluctuated between 293 t and 604 t. On 1 April 1990 the rock lobster fishery was brought into the Quota Management System and the total allowable commercial catch (TACC) for the Chatham Islands (CRA 6) was set at 503 t. Through appeals, the TACC increased to 530.6 t at the beginning of the 1993–94 fishing year, but was reduced to 400 t in 1997–98 and 360 t in 1998–99 because of concerns about continuing declines in catch and CPUE.

CRA 6 was last assessed in 1996 using a simple production model that assumed a constant production independent of biomass, which was fitted to a series of annual catch per unit effort indices. The reductions in catch and CPUE since 1979 suggested a high exploitation rate. However, catch sampling data from the fishery, which could not be incorporated in the simple production model in 1996, showed high proportions of large lobsters, indicating a lower exploitation rate (Breen & Kendrick 1998). Hypotheses proposed for the apparent contradiction between catch and CPUE trends and size frequency data include:

- that the fishery might be sequentially depleting a large, unproductive stock;
- that the growth in CRA 6 might be rapid, meaning that the large lobsters are young;
- that the CPUE data and catch data, or alternatively the catch composition data, might be incorrect and misleading;
- that lobsters may be entering the fishery from an area outside the fished area.

Of these hypotheses, Breen & Kendrick (1998) considered the latter to be the most plausible, but noted that the dynamics of the stock were highly uncertain.

The stock assessment model currently used in New Zealand rock lobster stock assessments incorporates data on both size distribution and sex ratio of the catch. In other Quota Management Areas, this information is gathered by observer catch sampling or the rock lobster logbook (completed by fishers). In CRA 6, the observer catch sampling programme starting in 1989–90 and sampled 184 fishing days. However, due to this fishery's remoteness and vulnerability to poor weather, observer catch sampling became prohibitively expensive and finished in 1997–98. A logbook programme was established in CRA 6 during August and September 2001. Any stock assessment of CRA 6 in the near future will depend on the availability of additional catch composition data to augment the small amounts of existing observer and logbook catch sampling data.

Rock lobster processing factories record various data about their product, including the total weight of lobster processed within certain weight classes or grades. This study examines the potential of the time-series of weight-grade data collected by the rock lobster processing factories on the Chatham Islands as a source of size frequency information in lieu of catch sampling or logbook data, and to confirm the observation that the average size of lobsters remains relatively unchanged over time.

Although this type of data provides lower resolution than size frequency distributions from catch sampling, it is available for a long period of time. Length frequency data obtained from processing factories are examined for resolution and representation. The number of weight grades used to record the catch determines the resolution of the data: more grades provide greater resolution. The proportion of the catch that the data represents is summarised as a measure of the extent to which it represents the catch from the fishery.

2. METHODS

Weight-grade data were requested from the four factories that currently process rock lobster from CRA 6. Factories were asked to provide the weight of rock lobster received by grade and by month for

as far back in time as possible. Data were received from two factories, which between them processed a large portion of the total catch from CRA 6 from 1991-92 to 2000-01. The weight by grade data provided represent at least 13 % and up to 100 % of the Quota Management Return (QMR) in each month during this period (Table 1). For the entire period, the data represent 37.7 % of the total QMR recorded catch.

Table 1: Percentage of CRA 6 catch represented in the available factory data (total CRA 6 catch based on QMR data); -, no fishing; *, either QMR or factory data not available.

Month	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Jan	*	57	41	48	47	40	16	23	22	37	48
Feb	*	66	57	26	46	29	13	23	20	23	49
Mar	*	72	58	2	-	0	0	0	0	31	26
Apr	0	-	-	-	-	-	-	-	-	-	-
May	52	66	48	43	33	41	17	24	20	35	13
Jun	52	55	41	43	38	32	18	19	28	39	40
Jul	50	46	55	37	39	25	18	18	34	42	*
Aug	69	42	47	50	59	32	13	17	38	50	*
Sept	100	38	42	59	39	31	19	15	40	45	*
Oct	57	49	42	39	22	20	18	21	43	60	*
Nov	42	52	42	39	29	16	29	23	44	63	*
Dec	45	39	49	47	38	19	26	22	38	62	*

The data obtained from each factory included the total weight of lobsters in each weight grade by month. The factories used many different grading regimes (Table 2), ranging from the modern system (regime A), where the lobsters are recorded in seven different weight bins, to regime K, where no grading took place. 6 of the 12 regimes included breaks at 0.8 kg, and 6 also used 2.5 kg as the maximum break point (Table 2).

Table 2: Grading regimes used by the factories sampled. Codes are those of the authors.

Code	Grades used within the regimes (kg)						
A	0.4-0.6	0.6-0.8	0.8-1.0	1.0-1.5	1.5-2.0	2.0-2.5	2.5+
B	0-0.7	0.7-1.0	1.0-2.5	2.5+			
C	0-0.7	0.7-1.5	1.5+				
D	0-0.8	0.8-1.5	1.5+				
E	0-1.0	1.0-2.5	2.5+				
F	0-0.8	0.8-2.5	2.5+				
G	0-0.8	0.8-2.0	2.0+				
H	0-1.0	1.0+					
I	0-0.8	0.8-1.0	1.0-2.5	2.5+			
J	0-0.8	0.8+					
K	0+						
L	0-2.5	2.5+					

The grading regime changed among years, and within years, until the current regime was introduced in May 1998 (Table 3). The changes in grading system were dictated by changes in the market price for different sized lobsters. The factories recorded grades only if there was a difference in market price between them.

Table 3: Schedule showing the use of the grading regimes used by the factories sampled. -, no data recorded by factories.

Month	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Jan	-	C	D	D	J	H	E	F	A	A	A
Feb	-	C	D	D	J, K	H	E	F	A	A	A
Mar	-	C	D	D	J	-	-	-	A	A	A
Apr	-	-	-	-	-	-	-	-	-	-	-
May	B	I	I	J	J	H, F, E	G	A	A	A	A
Jun	B	I	I	J	J	F	G, F	A	A	A	A
Jul	B	I	I, D	J	J, K, L	F	F	A	A	A	A
Aug	B	I	D	J	J, K	F	F	A	A	A	A
Sept	B	I	D	J	J	F	F	A	A	A	A
Oct	B, C	I, D	D	J	J, K, H	F	F	A	A	A	-
Nov	C, D	D	D	J	H	F	F	A	A	A	-
Dec	B, C, D	D	D	J	H	F, E	F	A	A	A	-

To estimate the tail width of lobsters represented in each weight grade, we converted the boundary weights used in the grading regimes to tail widths using a size to weight relationship (Equation 1). Coefficients for the relationship (a , b) were calculated for each sex from market sampling data using a geometric regression. The weights and corresponding tail widths are given in Table 4.

$$\text{Equation 1. } \text{TailWidth} = \exp\left(\frac{\ln(\text{Weight}) - \ln(a)}{b}\right)$$

Table 4: Tail width equivalents for weights used in grading regimes.

Weight (kg)	Female (mm TW)	Male (mm TW)
0.4		57.8
0.6		67.2
0.7		71.1
0.8		74.7
1.0		81.2
1.5		94.4
2.0		105.1
2.5		114.2

3. RESULTS

Total annual catch per grade was examined for changes in the size structure of the catch with time. Since the grading system changed often, we provide summaries of the data using alternative grading regimes.

3.1 Grading regime J

Data from the grading regimes A, D, F, G, and I were condensed into the J grading system, with two grades, 0–0.8 kg (females, 0–74.7 mm TW; males, 0–64.2 mm TW) and over 0.8 kg (females, over 74.7 mm TW; males, over 64.2 mm TW) (Table 2). The percentage of the sampled catch below 0.8 kg,

increased from 13.1 % in the 1991–92 fishing year to a peak of 39.0 % in the 1996–97 fishing year and then declined to 25.1 % by the 2001–02 fishing year (Figure 1).

The catch sampled under A, D, F, G, and I grading regimes accounted for less than 10 % of the annual catch in 1991 and 1995 and over 30 % in 1992–94 and 1999–2001 (Table 5).

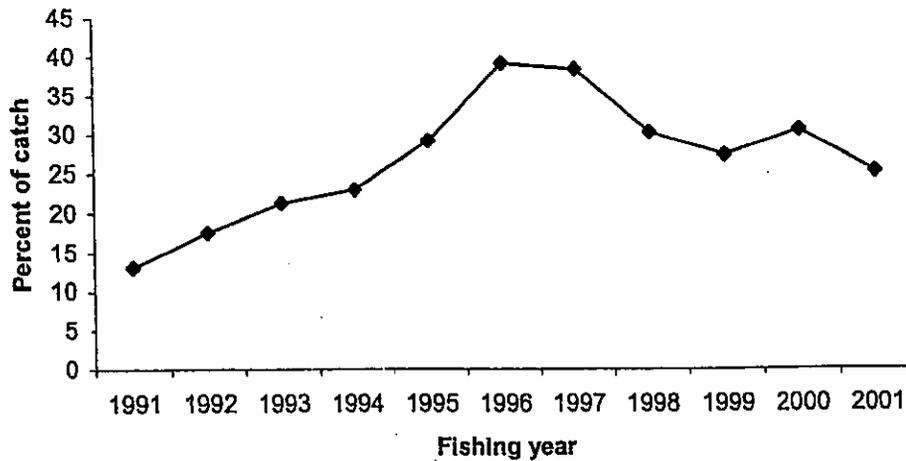


Figure 1: Percentage by weight of CRA 6 lobster below 0.8 kg (females 74.7 mm TW; males 64.2 mm TW) from grading regimes, A, D, F, G, I, and J.

Table 5: Percentage of annual catch (from QMR) sampled and condensed into the grading regime J.

Fishing year	% QMR sampled
1991	7.6
1992	46.0
1993	37.3
1994	34.8
1995	6.5
1996	16.6
1997	21.2
1998	15.4
1999	32.3
2000	44.7
2001	60.7

3.2 Grading regime F

Grading regimes A and I were condensed to the same three grades as grading regime F (Table 2). The percentage of annual catch (QMR) that was less than 0.8 kg (females, 74.7 mm TW; males, 64.2 mm TW) was at a minimum of 8.3 % in the 1993–94 fishing year and at a maximum of 73.8 % in the 1997–98 fishing year. After 1997–98 the percentage of annual catch below 0.8 kilograms varied between 30.5 % and 25 %.

The percentage of the annual catch (QMR) between 0.8 and 2.5 kg (females, 74.7–114.2 mm TW; males, 64.2–89.7 mm TW) increased overall from 42.0 % in 1992–93 to 65.9 % in 2001–02, with an exception in 1997–98, when it was just 13.1 %.

The catch sampled under A, F and I grading regimes accounted for 5.9 % of the annual catch in 1993–94 and 10.2 % in 1997–98 (Table 6).

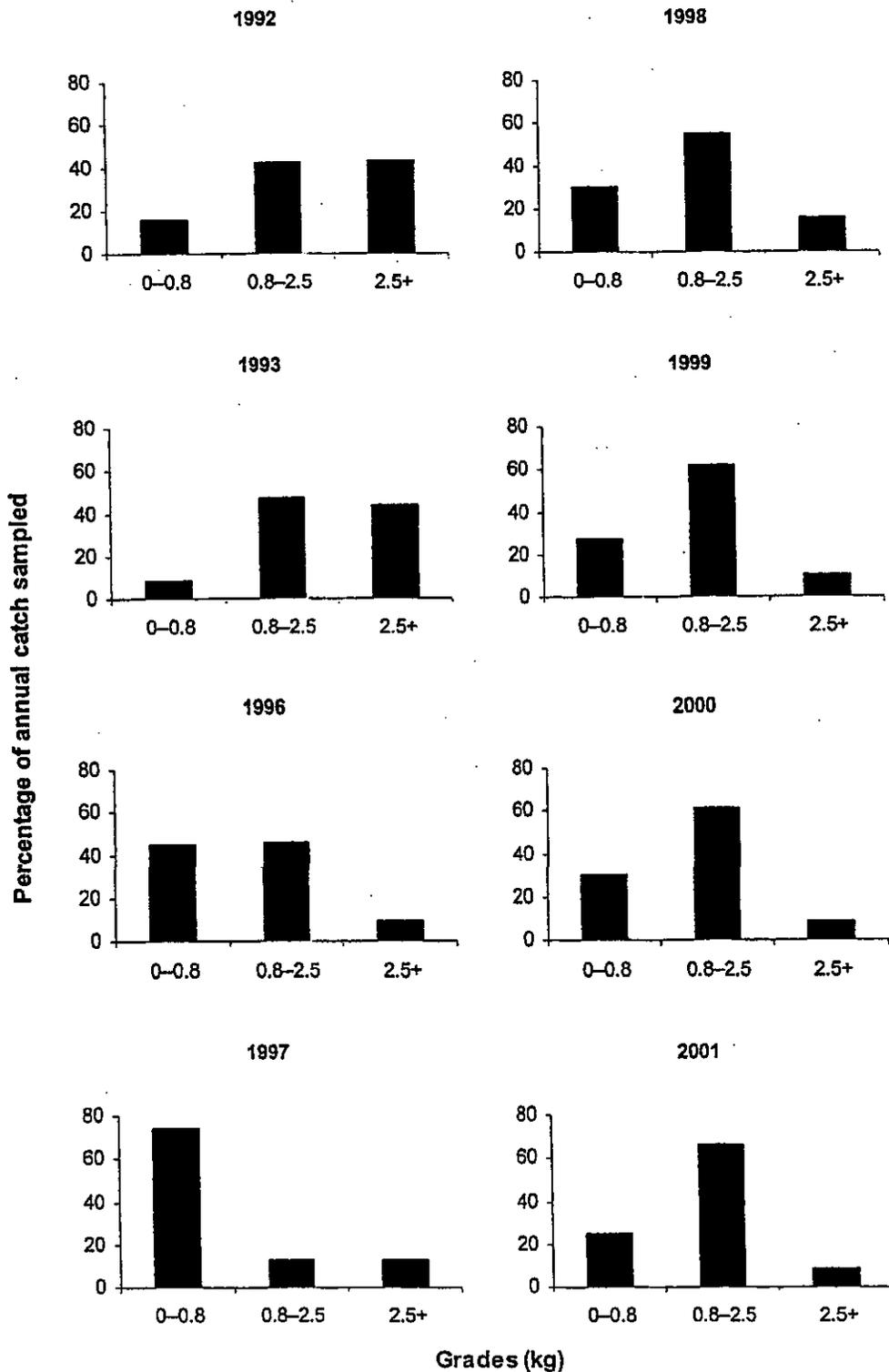


Figure 2: Percentage (by weight) of CRA6 lobsters by grade from grading regimes, A, F, and I.

Table 6: Percentage of annual catch (from QMR) sampled and condensed into the grading regime F.

Fishing year	% QMR sampled
1992	10.6
1993	5.9
1996	13.0
1997	10.2
1998	15.4
1999	32.3
2000	44.7
2001	60.7

3.3 Grading regime A

This comparison is based on regime A, as the most recent regime, with seven grades providing the greatest resolution. Data for 1989 and 1993–97 are from catch sampling, converted to weight by grade (Figure 3).

There is a similar distribution of the proportion in each weight grade from 1989–90 through to 1995–96, with most of the catch in two grades between 1.0 and 2.0 kg

In 1996–97, there was a sudden increase in the proportion of 0–0.6 (27.3 %) and 0.6–0.8 (15.1 %) kg lobsters (Figure 3). Since 1998–99, there has been a more even distribution of the proportion by grade (Figure 3).

The catch sampling data for 1989–90 and for 1993–94 to 1997–98 represented a small proportion of the annual catch, but the factory data (grading regime A) represent high proportions of the annual catch from 1998–99 to 2001–02 (Table 7).

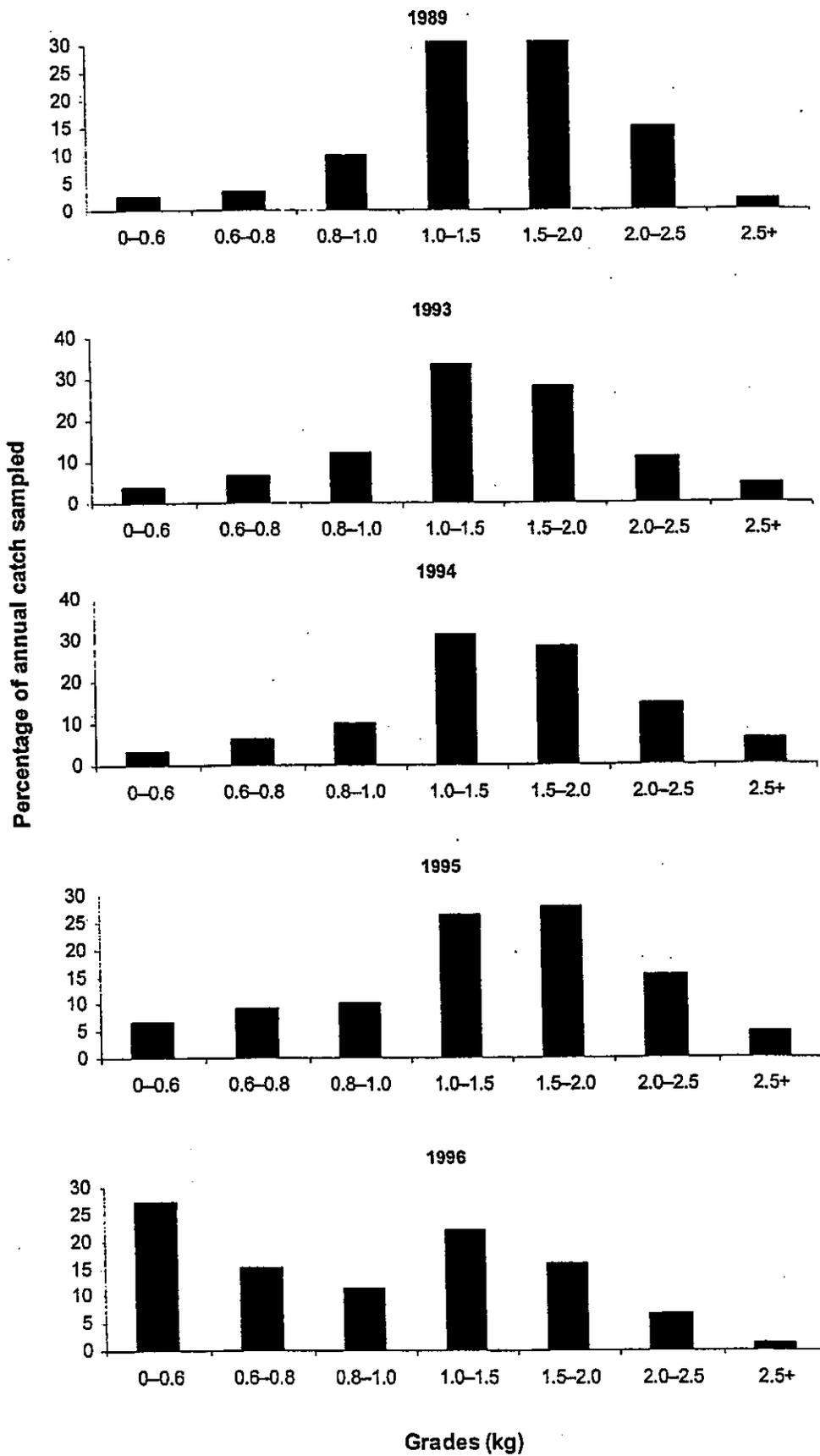


Figure 3: Percentages (by weight) of CRA 6 lobster by grade from grading regime A, data for 1989 and 1993-96 are from catch sampling.

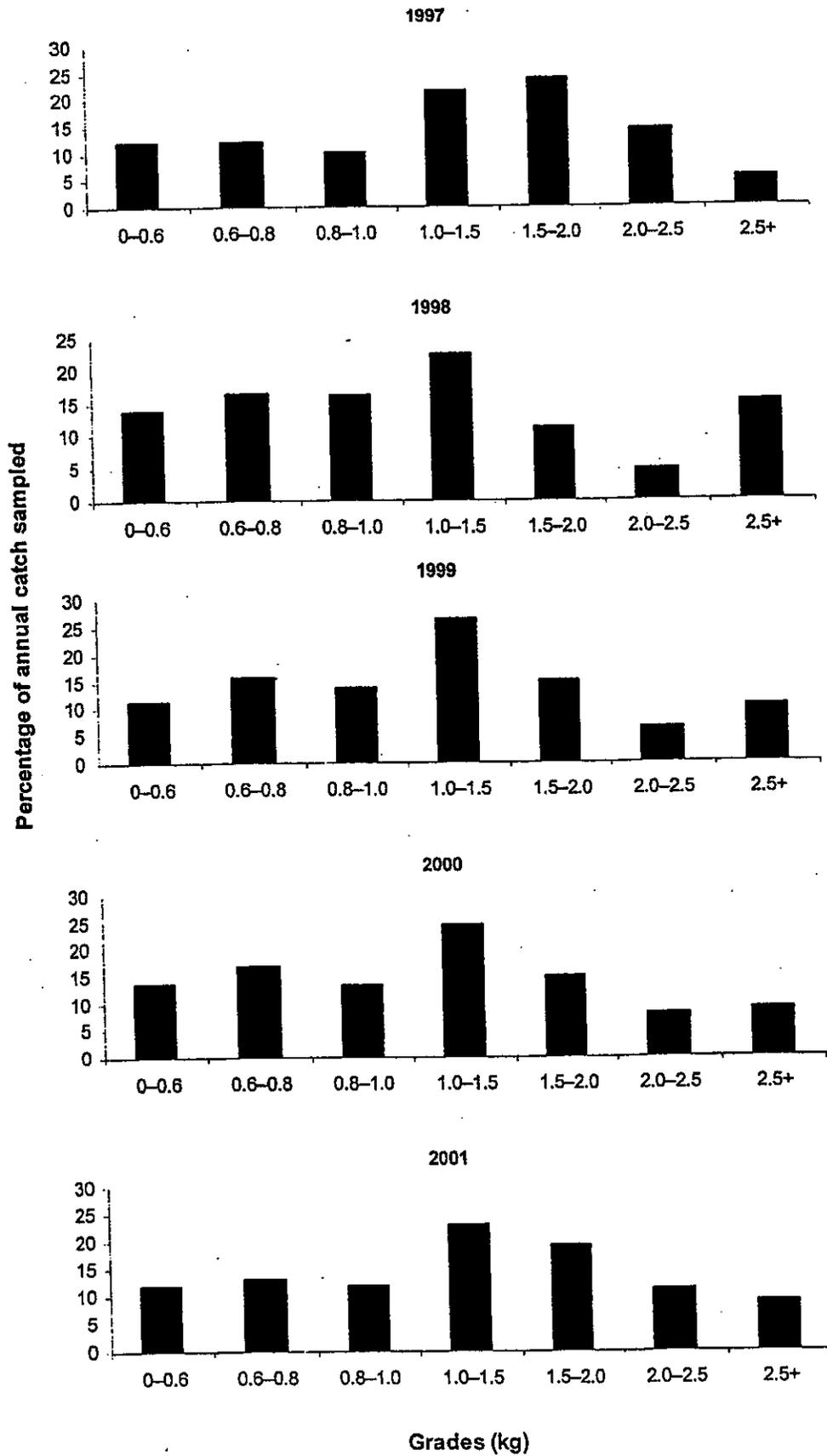


Figure 3 (Cont.): 1997 data are from catch sampling.

Table 7: Percentage of annual catch (from QMR) sampled and condensed into the grading regime A.

Fishing year	% QMR sampled
1989	0.5
1993	0.2
1994	0.3
1995	0.9
1996	1.6
1997	0.8
1998	15.4
1999	32.3
2000	44.7
2001	60.7

4. DISCUSSION

Information on the size and sex composition of the catch are essential for the monitoring and assessment of rock lobster stocks in New Zealand. Catch sampling data could also form an input into a management decision rule that incorporates information on the size of the catch.

The current stock assessment model estimates the number of lobsters in the population in each sex and size category. Allowing for the selectivity of the fishery, these estimates are converted into relative proportions of lobsters in size and sex categories. In the 2001 assessment of CRA 3, size frequency data from factory sampling by scientific technicians during the 1970s was used (Breen et al. 2002). These data provided information from a period in the fishery for which no other catch composition data were available. If such an assessment model were used for CRA 6 these data could just as readily be fitted to the relative proportions of catch by weight grade.

Below we discuss the utility of the CRA 6 factory weight grade data for use in monitoring and assessment of the fishery in terms of its information content and how representative it is of the fishery. We also comment on the need for improvements in data collection.

4.1 Information content of factory weight-grade data

For several reasons, factory weight-grade data provide less information than data from catch sampling at sea:

1. No information on undersized lobsters and berried females

Factory data (sampled by technicians or recorded in weight grades) contains no information on changes in the proportion of lobsters that are smaller than the minimum legal size limit or that are berried females (and thus cannot be retained). In fisheries that have high recruitment variation, information on changes in the relative abundance of animals below the size limit can be important for interpreting apparent changes in the recruited biomass.

2. No information on the proportions of males, immature females, and mature females

Factory weight-grade data contain no information on the sex or stage of maturity of lobsters. This is a significant disadvantage since due to regulations, the populations of males, immature females, and mature females can have quite different dynamics.

3. Low resolution of sizes

The numerous changes in the grading regimes used in CRA 6 do not by themselves reduce the utility of the data (although they do make their analysis and the technicalities of fitting a stock assessment

model more complex). However, the information content contained in grading systems with few grades may be so low that it is not worth using. The resolution of a grading system should be assessed against the length of time that it is available: a grading regime with a low resolution may be useful if it is available over a long time series.

4. Variation in relation between weight and tail width

The relation between tail width and the weight of a lobster is variable. Depending on its magnitude, this variability will further reduce the information contained in the factory weight grade data.

4.2 Degree to which factory weight-grade data are representative of the fishery

Another concern in using catch sampling data is the degree to which they are representative of the fishery as a whole. Variations in the proportion of lobsters in each weight grade will result not only from changes in the size distribution of the population, but also changes in the selectivity of fishing. For instance, fishers may target small lobsters when the relative price of small grades increases. This does not reduce the utility of the factory weight grade data. In current rock lobster assessments, catch sampling data was assumed to represent the composition of the catch taken, not the composition of the population.

The factory weight-grade data compiled in this study represent a large proportion of the catch. For example, when collapsed to grading regime D, the data represented at least 10 % of the catch in all but one year and reached 60.7 % in 2001. Given these high proportions we expect the factory weight-grade data to be representative of the fishery as a whole. We have no information to suggest that the catch processed by the two factories is dissimilar to that processed by the other factories.

4.3 Recommendations

- The logbook programme recently established in CRA 6 should be continued. For reasons described above, at sea catch sampling provides more information than factory weight grade data. Logbooks provide a more cost effective and representative way of collecting these data than using scientific observers. The auxiliary information collected by the logbook programme on area, depth, and high grading also allows better account to be taken of changes in the selectivity of the fishery.
- Given that there is a lack of size frequency data for CRA 6, factory weight-grade data should be used in any assessments of CRA6.
- Although the current grading system A provides the greatest resolution, that a time series based on grading system D (section 3.2) should be used in assessments as a trade-off between continuity and resolution. Alternatively, assessments could be fitted to data from both systems D and A, although this would involve greater complexity in fitting.
- As far as possible, CRA 6 factories should continue recording weight grades using current regime.

5. ACKNOWLEDGMENTS

This work would not have been possible without the cooperation of processing factory management personnel in Waitangi and Wellington in providing the data. This report was performed under contract to the New Zealand Rock Lobster Industry Council Ltd as part of the Ministry of Fisheries contract CRA2000/01. The authors also thank Paul Breen, Anthony Hart, Terese Kendrick, and Daryl Sykes for their input on draft versions of this document.

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