Ministry for Primary Industries
Manatū Ahu Matua

Operational management procedures for New Zealand rock lobster stocks (*Jasus edwardsii*) in 2015

New Zealand Government

Growing and Protecting New Zealand

Requests for further copies should be directed to:

Publications Logistics Officer
Ministry for Primary Industries
PO Box 2526
WELLINGTON 6140

Email: brand@mpi.govt.nz
Telephone: 0800 00 83 33
Facsimile: 04-894 0300

This publication is also available on the Ministry for Primary Industries websites at:
http://www.mpi.govt.nz/news-resources/publications.aspx
http://fs.fish.govt.nz go to Document library/Research reports

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Breen, P.A. (2015). Operational management procedures for New Zealand rock lobster stocks (*Jasus edwardsii*) in 2015.

New Zealand Fisheries Assessment Report 2015/51. 27 p.

This document describes operational management procedures used for the 2015–16 fishing year to manage New Zealand stocks of red rock lobsters (*Jasus edwardsii*). Management procedures are extensively simulated-tested decision rules; they specify what data will be used as input (CPUE for all stocks managed in 2015) and for every valid value of the input they return an output value (Total Allowable Commercial Catch, TACC). They consist of a harvest control rule, which defines the relation between CPUE and TACC, and other rules such as minimum change thresholds that modify the output.

There are now eight rock lobster stocks with management procedures: only CRA 6 is managed without one.

This document is intended as a central reference resource that contains all the equations and specifications for the current management procedures, for use in updating or describing rules. The original material is scattered among FARs, consultation documents and other sources, so this should be a living document that is updated every year.

1. INTRODUCTION

The red rock lobster (*Jasus edwardsii*) supports the most valuable inshore commercial fishery in New Zealand, with exports worth about NZ$200 million (New Zealand Ministry for Primary Industries (MPI) unpublished data) and is also valuable to customary Maori and recreational fishers. The commercial trap or pot fisheries have been managed since 1991 with individual transferable quotas in nine arbitrary stocks (Figure 1).

This document describes the current – as of 1 April 2015 – operational management procedures (MPs) used to manage New Zealand stocks of red rock lobsters. Management procedures (Butterworth & Punt 1999) are extensively simulated-tested decision rules: see Johnston & Butterworth (2005) and Johnston et al. (2014) for discussion of MPs used to manage rock lobsters in South Africa. The potential shift in management thinking that MPs can support is discussed by Bentley & Stokes (2009). MPs are now a major part of New Zealand rock lobster management (Bentley et al. 2003a; Breen et al. 2009a; Breen et al. in press).

MPs specify what data will be used as input, and for every valid value of the input they return an output value. For New Zealand rock lobster MPs, the input is standardised CPUE and the output is a catch limit: either a Total Allowable Commercial Catch or a Total Allowable Catch (TACC or TAC). Currently all MPs produce TACC.

Some work has investigated the use of MPs with additional inputs (e.g. settlement indices, Bentley et al. 2005 and Bentley unpublished) but so far other inputs have not been used. Before 2007, the input CPUE was from the preceding fishing year, which runs from April through March and is named by the first year, thus "2011–12" is called "2011". This approach created a one-year lag between observed CPUE and resulting catch limit: the fishing year ended on the 31st of March and any new catch limit from the MP was applied in April of the next year. To shorten the lag to six months, "offset-year" CPUE is calculated using the October through September year.

MPs consist of a harvest control rule, which defines the relation between input CPUE and output TACC, and other rules such as minimum change thresholds that modify the output.

The first New Zealand MP and its successors were used to rebuild the depleted CRA 8 stock in New Zealand and to manage the volatile CRA 7 stock (Starr et al. 1997; Bentley et al. 2003b; Breen et al. 2008; Haist et al. 2013). In the CRA 4 fishery described below, industry adopted an MP, before any formal adoption by MPI, to reduce their catches voluntarily (quota "shelving"; Breen et al. 2009b) and a voluntary MP for CRA 5 was designed to maintain high abundance (Breen 2009a).
There are now eight rock lobster stocks with MPs, all described below. Only CRA 6 is managed without an MP, although management procedure evaluations (MPEs) have been conducted for CRA 6 (Breen 2009b).

Much of the evolution of MPs for rock lobsters has occurred as each stock has been assessed and MPEs have been made, but some generalised work has also been done (e.g. Breen et al. 2003). Advances were made by Nokome Bentley in the way that MPE results are interpreted (Bentley et al. 2003a). The industry-inspired "plateau" rules described below impart great stability if they are designed appropriately.

The impetus for adoption of MPs for rock lobsters in New Zealand has largely come from the need to rebuild depleted stocks. This has been largely successful: Breen et al. (in press) show that fishing effort (potlifts) has been steady in stocks where MPs are only recent, but has declined strongly since 2000 in stocks with established MPs. Catch and CPUE, also steady in stocks without MPs, have increased since 2008 in stocks with established MPs. In CRA 7 and CRA 8 the CPUE increase has been two- or three-fold.

Success of these MPs is partly in rebuilding depleted stocks and maintaining healthy stocks, but also in making stakeholders think about management goals. There has been a shift in thinking towards the

strategic (Bentley & Stokes 2009). A series of Ministers, in whose hands the catch limit decisions always lie, have chosen to accept MP results throughout their short New Zealand history.

This document is intended as a central reference containing all the specifications for the current MPs, for use in updating or describing rules. The original material is scattered among FARs, consultation documents and other sources, so this should be a living document that is updated every year (the Plenary Report is not a suitable repository because changes made for April of the new fishing year are not captured there).The most definitive documents for each rule are the relevant FAR describing the stock assessment and MPEs, the National Rock Lobster Management Group (NRLMG) Final Advice Paper or consultation document containing the basis on which the Minister of Fisheries or Minister for Primary Industries (MPI) signed off the MP, and the Minister's decision letter.

The document does not attempt to describe the historical MPs before the current MP for each stock (see Breen et al. 2009a).

Catch limits and allowances are all in tonnes; CPUE is in kg/potlift.

NEW ZEALAND RED ROCK LOBSTER
FISHERY MANAGEMENT AND STATISTICAL AREAS
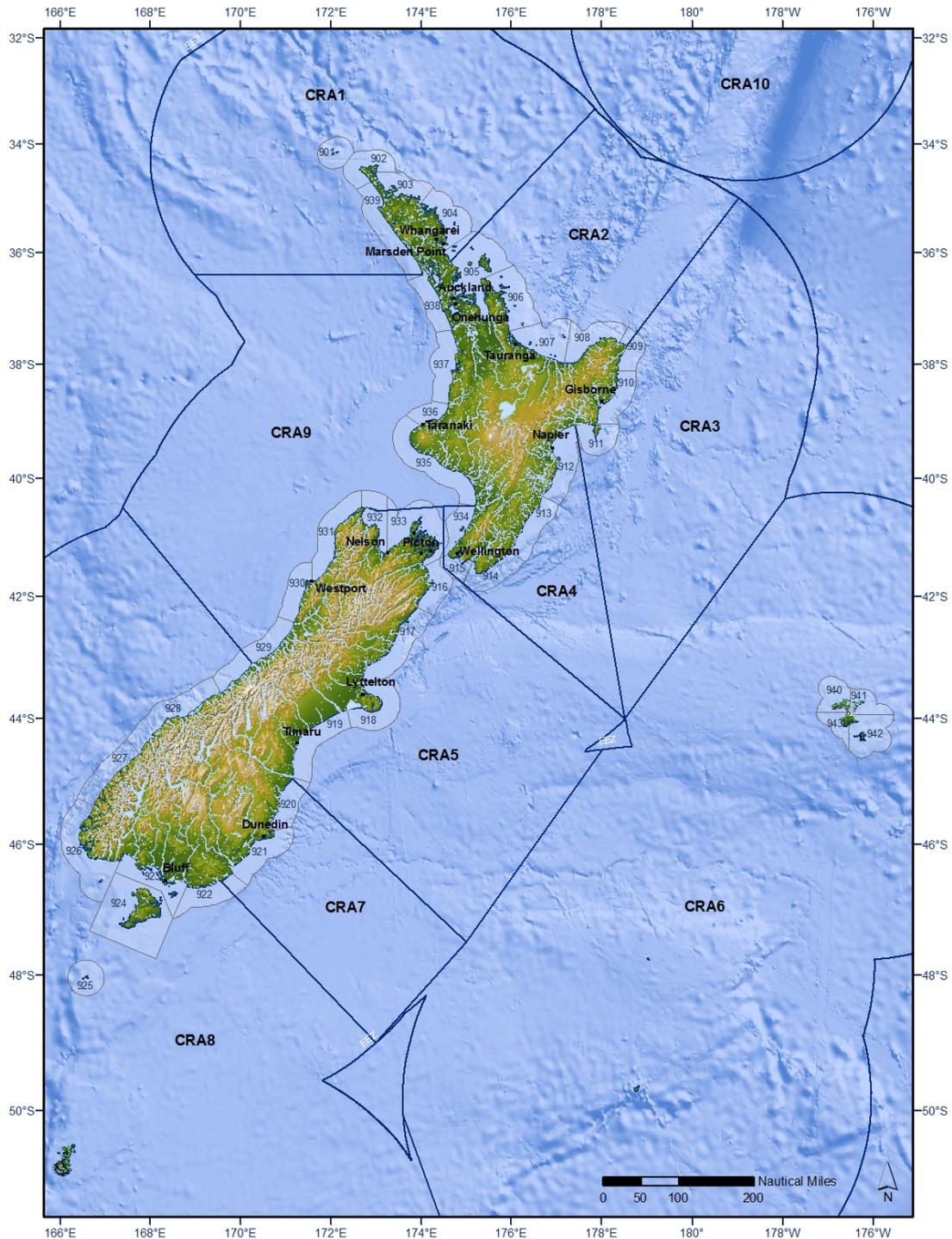
Figure 1: Rock lobster quota management areas; lighter lines and numbers indicate statistical reporting areas.

2.   GENERALISED PLATEAU RULES

2.1   Step and slope harvest control rules

The eight current MPs have either a "plateau step" harvest control rule or a "plateau slope" rule, illustrated in Figure 2 and Figure 3. CRA 3 has a modified plateau slope rule (described in the CRA 3 section below). These rules have:

- a straight-line segment from zero TACC at some value of CPUE (not necessarily zero CPUE) up to a plateau
- a plateau over which TACC stays the same as CPUE changes (the plateau could be of zero width, but all current rules have a plateau)
- and either
    - a series of steps to the right of the plateau (step rules) or
    - an ascending function at CPUE values to the right of the plateau (slope rules).

The previous version of this document attempted to define parameters in a consistent way, but for some reason the model coding was inconsistent with this. For a given stock, the parameters defined here may differ from those defined in the relevant MPE document, or in previous descriptions, but MPs have not changed and now the description here and the model code are the same.

The description in this section assumes that the MP determines the TACC, as all current MPs do. A TAC-determining MP was developed in 2010, at MPI's request, for CRA 5 (Haist et al. 2011). This had a TACC component plus components for non-commercial catch sectors; it was rejected by the Minister and a TACC-determining rule was developed and approved the following year. There is concern that rules controlling only the commercial catch will pump catch away from the commercial sector and into the non-commercial sectors, who can increase their catch share as stocks increase. This idea was confirmed by simulation modelling (Breen et al. 2003).
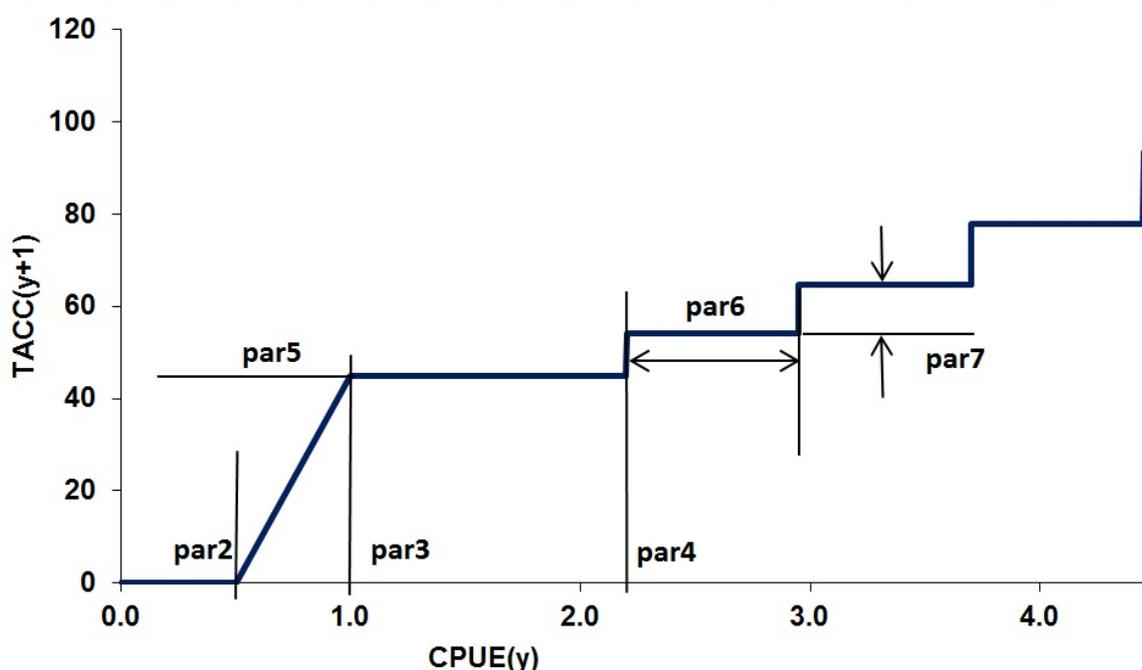

Figure 2: A generalised step rule; see Table 1 for parameter definitions.
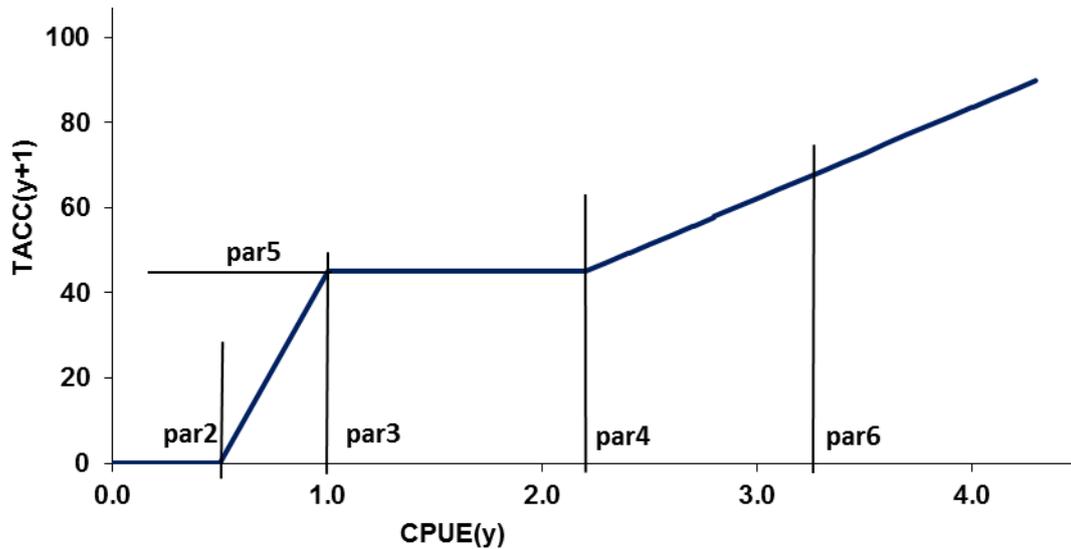
Figure 3: A generalised plateau slope rule; see Table 1 for parameter definitions.

2.2   Rule parameters

The generalised rule parameters are defined in Table 1.

Table 1: Parameters for the generalised plateau rules.

Parameter	Applies to	Function
*par*1	all	rule type
*par*2	all except CRA 3	CPUE at TACC = 0
*par*2	CRA 3 rule	CPUE at first inflection
*par*3	all	CPUE at plateau left
*par*4	all	CPUE at plateau right
*par*5	all	plateau height
*par*6	step rules	step width
*par*6	slope rules	slope
*par*6	CRA 3 rule	slope
*par*7	step rules	step height
*par*8	all	minimum change
*par*9	all	maximum change
*par*10	all	latent year switch

Rule type, *par*1, is 3 for plateau slope rules, 4 for plateau step rules and 6 for the modified CRA 3 rule form. The CRA 3 rule form will be described in the CRA 3 section below; the description here is for rule types 3 and 4 only.

The point at which TACC becomes zero, *par*2, can be zero or non-zero but must be less than the left edge of the plateau, *par*3. *Par*3 must be less than or equal to the right edge, par4. In plateau slope rules, *par*6 must be greater than *par*4. Thus for an acceptable rule:

$$par2 < par3 \le par4 < par6$$

Step height for step rules, *par*7, is defined as a proportion of the TACC on the previous step; thus 0.1 would indicate that the TACC on the first step is 10% higher than TACC on the plateau, and that each step increases by 10% of the previous step.

The slope parameter for slope rules, *par*6, is defined as the CPUE at which TACC is 1.5 times the plateau height, *par*5.

The minimum change parameter, *par*8, defines the minimum proportional change in TACC. When CPUE changes only slightly and the rule specifies a new TACC differing from the existing TACC by an amount less than *par*8, there is no change to the TACC.

The maximum change parameter, *par*9, specifies the maximum allowable proportion of TACC change. When CPUE changes so much that the rule specifies a TACC change greater than *par*9, the TACC is changed only by the *par*9 proportion. For some stocks, this parameter is modified by other rules: for instance, in CRA 9 the maximum applies to an increase but not to a decrease. A value of zero for *par*9 indicates that there is no maximum change threshold and that any TACC change is allowed.

A latent year component to the rule (not used in any current rule) means that TACC cannot be changed if it was changed in the previous year. An "asymmetric latent year" means that TACC can be decreased but not increased when it was changed in the previous year. The switch *par*10 operates as follows:

Par10	Effect
0	no latent year
1	latent year
2	asymmetric latent year

2.3   Rule operation

For both rule forms and for CPUE at or less than the right edge of the plateau, *par*4, the provisional TACC (before operation of thresholds) is given by:

$$TACC_{y+1} = 0 \qquad\qquad\qquad \text{for } I_y \leq par2$$

$$TACC_{y+1} = par5\left(\frac{I_y - par2}{par3 - par2}\right) \qquad \text{for } par2 < I_y \leq par3$$

$$TACC_{y+1} = par5 \qquad\qquad\qquad \text{for } par3 < I_y \leq par4$$

where $TACC_{y+1}$ is the provisional TACC (before thresholds operate) and I_y is the standardised offset-year CPUE in the preceding year. When CPUE is above the right edge of the plateau, TACC for the plateau step rules is given by:

$$TACC_{y+1} = par5\left((1 + par7)^{\text{floor}\left((I_y - par4)/par6\right)+1}\right) \qquad \text{for } I_y > par4$$

and for the plateau slope rules by:

$$TACC_{y+1} = par5\left(1 + \frac{0.5(I_y - par4)}{par6 - par4}\right) \qquad\qquad \text{for } I_y > par4$$

The provisional TACC that results from these equations may be modified by the operation of the minimum and maximum change thresholds, or by the latent year, to give the rule's recommended TACC.

In the rule information given below for each stock, some definitions are:
- fishing years (April through the following March) are named by the April–December portion; *viz.* 2010–11 is labelled "2010"
- offset years (October through the following September) are named by the January–September portion; *viz.* 2010–11 is labelled "2011"
- "review scheduled" is simply the year five years after development of the current rule; whether the review occurs is a matter for the NRLMG

- input CPUE is standardised offset year for all stocks; "B4-L" and "F2-LFX" define the data extraction algorithm, which must be the same as was used when the rule was developed (see Starr 2014)
- managers vary in the precision they use in recommending catch limits; the tables report at the precision used by managers

3. CRA 1 MANAGEMENT PROCEDURE

3.1 Summary

	CRA 1
First year with MP	2015
First year of current MP	2015
Review scheduled	2019
Input CPUE	offset year F2-LFX
Output	TACC
Type of rule	generalised plateau step rule
Latent year?	No
Minimum change	5%
Maximum change	none
2015–16 TAC	273.062
2015–16 customary allowance	20
2015–16 recreational allowance	50
2015–16 other mortality allowance	72
Total non-commercial allowance	142
2015–16 TACC	131.062

The rule is based on work conducted in 2014 by Webber & Starr (2015), using an operating model based on the CRA 1 stock assessment model.

Rules evaluated were generalised plateau step rules as described above. From the options recommended (NRLMG 2015), the Minister adopted rule 9d, for which the specific parameter values are shown in Table 2.

Table 2: Parameters for the CRA 1 generalised plateau step rule.

Par	Function	CRA 1 rule 9d value
par1	rule type	4
par2	CPUE at TACC = 0	0.1
par3	CPUE at plateau left	1.1
par4	CPUE at plateau right	1.7
par5	plateau height	131.062
par6	step width	0.25
par7	step height	0.05
par8	minimum change	0.05
par9	maximum change	0
par10	latent year switch	0

A TAC was set for the first time for CRA 1 in 2015; before that there had been only a TACC and in 2015 the Minister had to set allowances for non-commercial catches.

The Final Advice Paper (NRLMG 2015) for the 2015–16 fishing year described the rule as follows:
> *Some important elements of the CRA 1 management procedures are:*
> *The output variable is TACC (tonnes);*
> *Offset-year standardised CPUE is used as an input to the rule to determine the TACC for the fishing year that begins in the following April;*
> *CPUE is calculated using the 2012 F2_LFX procedure which uses landings to a licensed fisher receiver, along with recreational landings from a commercial vessel and the amount of rock*

lobsters returned to the water in accordance with Schedule 6 of the Act (i.e. highgraded rock lobsters), estimates, by vessel, of the ratio of annual landed catch divided by annual estimated catch to correct every landing record in a quota management area for the vessel;

The management procedure is to be evaluated every year (no "latent year"), based on offset-year CPUE;

The minimum change threshold for the TACC is 5%. There is no maximum change threshold for the TACC.

For Rule 9d: between CPUEs of 0 to 0.1 kg/potlift the TACC is zero, the TACC then increases linearly with CPUE to 1.1 kg/potlift, and between CPUEs of 1.1 to 1.7 kg/potlift the TACC is 131.062 tonnes. As CPUE increases above 1.7 kg/potlift, the TACC increases in steps with a width of 0.25 kg/potlift and a height of 5% of the preceding TACC.

3.2   History

This is the first MP for this stock. In November 2014, standardised offset-year CPUE was 1.5803 kg/potlift, which gave a suggested TACC of 131.062 t. The Minister accepted this rule and assigned the current allowances (customary 20 t, recreational 50 t and other mortality 72 t) to give the results in Table 3 and Figure 4.

Table 3: History of the CRA 1 management procedure. "Rule result" is the result of the management procedure after operation of all its components including thresholds.

Year	Applied to fishing year	Offset CPUE (kg/potlift)	Rule result: TACC (t)	Applied TACC (t)	Applied TAC (t)
2014	2015–16	1.5803	131.062	131.062	273.062
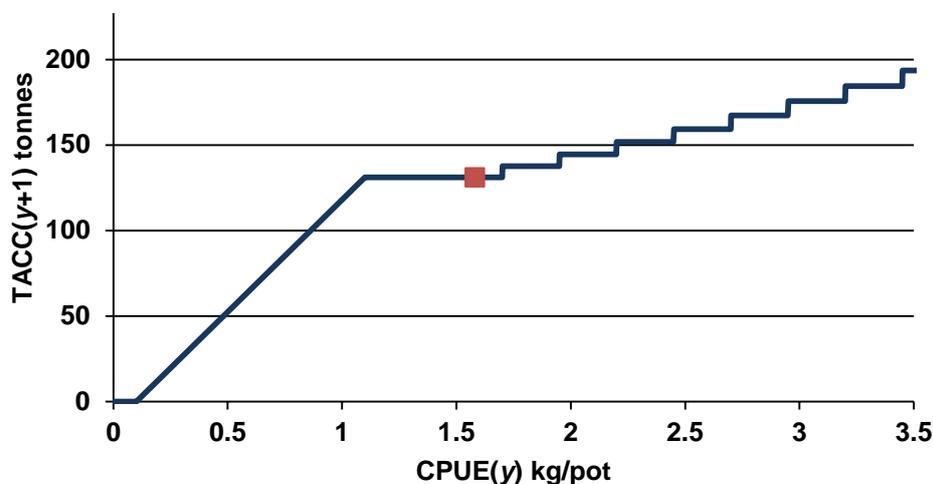
Figure 4: The current CRA 1 harvest control rule. The red square shows the 2014 offset-year CPUE.

4. CRA 2 MANAGEMENT PROCEDURE

4.1 Summary:

	CRA 2
First year with MP	2014
First year of current MP	2014
Review scheduled	2018
Input CPUE	offset year F2-LFX
Output	TACC
Type of rule	generalised plateau step rule
Latent year?	no
Minimum change	5%
Maximum change	none
2015–16 TAC	416.5
2015–16 customary allowance	16.5
2015–16 recreational allowance	140
2015–16 other mortality allowance	60
Total non-commercial allowance	216.5
2015–16 TACC	200

The rule is based on work conducted in 2013 by Starr et al. (2014), using an operating model based on the CRA 2 stock assessment model.

Rules evaluated were generalised plateau step rules as described above. From the options recommended (NRLMG 2014), the Minister adopted rule 4, for which the specific parameter values are shown in Table 4.

Table 4: Parameters for the CRA 2 generalised plateau step rule.

		CRA 2 rule 4
Par	Function	value
par1	rule type	4
par2	CPUE at TACC = 0	0
par3	CPUE at plateau left	0.3
par4	CPUE at plateau right	0.5
par5	plateau height	200
par6	step width	0.1
par7	step height	0.1
par8	minimum change	0.05
par9	maximum change	0
par10	latent year switch	0

The 2014 decision was the first time that a TAC was set for CRA 2; before 2014 there had been only a TACC and in 2014 the Minister had to set allowances for non-commercial catches.

The Final Advice Paper (NRLMG 2014) for the 2014–15 fishing year described the rule as follows:
> *Some important elements of the CRA 2 management procedures are:*
> *a) The output variable is TACC (tonnes);*
> *b) Offset-year standardised CPUE is used as an input to the rule to determine the TACC for the fishing year that begins in the following April;*
> *c) CPUE is calculated using the 2012 F2_LFX procedure which uses landings to a licensed fisher receiver, along with recreational landings from a commercial vessel and the amount of rock lobsters returned to the water in accordance with Schedule 6 of the Act (i.e. highgraded rock lobsters) and*
> *estimates, by vessel, of the ratio of annual landed catch divided by annual estimated catch to correct every landing record in a quota management area for the vessel;*
> *d) The management procedure is to be evaluated every year (no "latent year"), based on offset-year CPUE;*
> *e) The minimum change threshold for the TACC is 5%.*

The CRA 2 management procedures are based on a generalised 'step' rule.
For Rule 4: between a CPUE of zero and 0.3 kg/potlift, the TACC increases linearly with CPUE to a plateau of 200 tonnes, which extends to a CPUE of 0.5 kg/potlift. As CPUE increases above 0.5 kg/potlift, the TACC increases in steps with a width of 0.1 kg/potlift and a height of 10% of the preceding TACC.
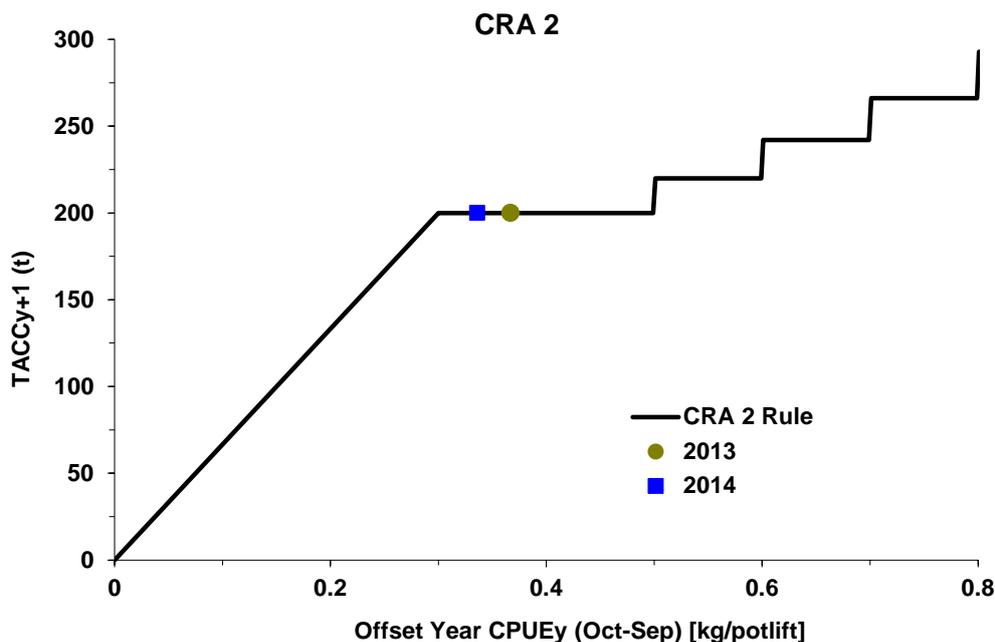

4.2   History

First used for the 2014–15 fishing year, this was the first MP for this stock. In November 2013, standardised offset-year CPUE was 0.367 kg/potlift, which gave a suggested TACC of 200 t. The Minister accepted this rule and assigned the current allowances (customary 16.5 t, recreational 140 t and other mortality 60 t) to give the results in Table 5 and Figure 5.

In November 2014, CPUE was 0.3361, which gave a TACC that remained on the plateau. The Minister accepted this result and retained the current allowances to give the results in Table 5.

Table 5: History of the CRA 2 management procedure. "Rule result" is the result of the management procedure after operation of all its components including thresholds.

Year	Applied to fishing year	Offset CPUE (kg/potlift)	Rule result: TACC (t)	Applied TACC (t)	Applied TAC (t)
2013	2014–15	0.3668	200.0	200.0	416.5
2014	2015–16	0.3361	200.0	200.0	416.5

Figure 5: History of the current CRA 2 management procedure. The coloured points show the 2013 and 2014 offset-year CPUE.

5.   CRA 3 MANAGEMENT PROCEDURE

5.1   Summary:

	CRA 3
First year with MP	2010
First year of current MP	2015
Review scheduled	2019
Input CPUE	offset year F2-LFX
Output	TACC
Type of rule	modified plateau slope rule
Latent year?	no
Minimum change	5%
Maximum change	none
2015–16 TAC	389.95
2015–16 customary allowance	20
2015–16 recreational allowance	20
2015–16 other mortality allowance	89
Total non-commercial allowance	129
2015–16 TACC	260.95

The rule is based on work conducted in 2014 by Haist et al. (2015), using an operating model based on the 2014 CRA 3 stock assessment model.

The new harvest control rule is a modified plateau slope rule. The modification involves a) fixing the intercept to zero, b) having two straight-line segments between zero and the left of the plateau (Figure 6) and c) having an inexplicably different slope equation from the generalised rule.   Rule parameters (Table 6) are defined differently from those in the other rules.

The equations below define this harvest control rule. The Minister adopted rule 4, for which the specific parameter values are shown in Table 6.

Table 6: Parameters for the CRA 3 plateau slope rule evaluated in 2014, and values for the rule agreed by the Minister in 2015.

Par	Function	CRA 3 rule 4 value
par1	rule type	6
fixed	CPUE at TACC = 0	0.0
par2	CPUE at first inflection	1.0
par3	left plateau	2.0
par4	right plateau	3.0
par5	plateau height	260
par6	slope	50
par7	TACC at first inflection	180
par8	minimum change	0.05
par9	maximum change	0.10
par10	latent year	0

The 2015 CRA 3 rule is described by:

$$TAC_{y+1} = par7\left(\frac{I_y}{par2}\right) \qquad \text{for } I_y \leq par2$$

$$TAC_{y+1} = par7 + \left(par5 - par7\right)\left(\frac{I_y - par2}{par3 - par2}\right) \qquad \text{for } par2 < I_y \leq par3$$

$$TAC_{y+1} = par5 \qquad \text{for } par3 < I_y \leq par4$$

$$TAC_{y+1} = par5 + par6\left(\frac{\left(I_y - par4\right)}{0.5}\right) \qquad \text{for } I_y > par4$$

where TAC_{y+1} is the provisional TAC (before thresholds operate) and I_y is the CPUE (kg/potlift) in the preceding year.

The Final Advice Paper (NRLMG 2015) for the 2015–16 fishing year described the rule as follows:

> *Some important elements of the proposed CRA 3 management procedures are:*
> *The output variable is TACC (tonnes);*
> *Offset-year standardised CPUE is used as an input to the rule to determine the TACC for the fishing year that begins in the following April;*
> *CPUE is calculated using the 2012 F2_LFX procedure which uses landings to a licensed fisher receiver, along with recreational landings from a commercial vessel and the amount of rock lobsters returned to the water in accordance with Schedule 6 of the Act (i.e. highgraded rock lobsters), estimates, by vessel, of the ratio of annual landed catch divided by annual estimated catch to correct every landing record in a quota management area for the vessel;*
> *The management procedure is to be evaluated every year (no "latent year"), based on offset-year CPUE;*
> *The minimum change threshold for the TACC is 5%. There is no maximum change threshold for the TACC.*
>
> *The proposed new Rule 4 CRA 3 management procedure is a non-standard rule, illustrated in [Figure 6]. For Rule 4: the TACC is zero at a CPUE of zero, the TACC increases linearly with CPUE, reaching 180 tonnes at a CPUE of 1.0 kg/potlift. The TACC then increases linearly to reach 260 tonnes at a CPUE of 2.0 kg/potlift. The TACC remains at 260 tonnes until CPUE reaches 3.0 kg/potlift, after which the TACC increases linearly again with a slope of 100 tonnes per 1 kg/potlift.*

5.2 History

The current rule is the second MP for this stock. Of the rules recommended (NRLMG 2015), the Minister chose rule 4 for the 2015–16 fishing year.

In November 2014, standardised offset-year CPUE was 2.2139 kg/potlift, which gave a TACC on the main plateau (Table 7). The Minister accepted this result and retained the previous non-commercial allowances (customary 20 t, recreational 20 t and illegal 89 t).

Table 7: History of the current CRA 3 management procedure. "Rule result" is the result of the management procedure after operation of all its components including thresholds.

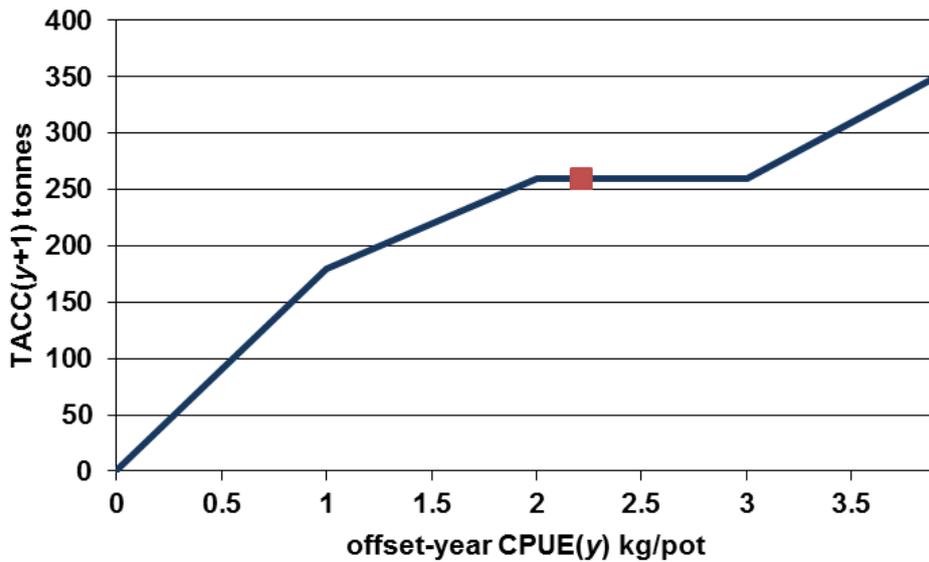| Year	Applied to fishing year	Offset CPUE (kg/potlift)	Rule result: TACC (t)	Applied TACC (t)	Applied TAC (t)
2014	2015–16	2.2139	260.95	260.95	389.95

Figure 6: The current CRA 3 harvest control rule; the coloured dot shows the 2014 CPUE.

6. CRA 4 MANAGEMENT PROCEDURE

6.1 Summary:

	CRA 4
First year with MP	2010
First year of current MP	2012
Review scheduled	2016
Input CPUE	offset year B4-L
Output	TACC
Type of rule	generalised plateau step rule
Latent year?	no
Minimum change	none
Maximum change	25%*
2015–16 TAC	662
2015–16 customary allowance	35
2015–16 recreational allowance	85
2015–16 other mortality allowance	75
Total non-commercial allowance	195
2015–16 TACC	467

*maximum change threshold applies only to increases when TACC is to the left of the plateau

The CRA 4 MP is based on work conducted in 2011 by Breen et al. (2012), who used an operating model based on the CRA 4 stock assessment done in that same year. Rules evaluated were generalised plateau step rules as described above. From the options recommended (NRLMG 2012), the Minister adopted rule 28a, for which the specific parameter values are shown in Table 8.

Table 8: Parameters for the CRA 4 generalised plateau step rule.

Par	Function	CRA 4 rule 28a value
par1	rule type	4
par2	CPUE at TACC = 0	0.5
par3	left plateau	0.9
par4	right plateau	1.3
par5	plateau height	467
par6	step width	0.1
par7	step height	0.07
par8	minimum change	0
par9	maximum change	0.25*
par10	latent year switch	0

*applies only to increases when TACC is below the plateau, i.e. when CPUE is less than *par3*

The Final Advice Paper (NRLMG 2012) for the 2012–13 fishing year described the rule as follows:

1) *It is proposed that the expired CRA 4 Management Procedure is replaced by a recommended new Management Procedure from the 2012–13 fishing year onwards. A new 2011 stock assessment was used to set the operating model for evaluating the new CRA 4 Management Procedure.*

2) *Some important elements of the new CRA 4 Management Procedure are:*

   a. *The output variable is TACC (tonnes) and that standardised CPUE (kg/potlift) is to be used as the input variable;*

   b. *Standardised CPUE is to be based on the offset year from 1 October;*

   c. *CPUE is to be standardised according to the recent usage described in annual Fishery Assessment Reports (FARs), using a data extract obtained in November to ensure that sufficient data from the most recent autumn-winter season have been entered;*

   d. *The management procedure is to be evaluated every year (no "latent year"), based on offset-year CPUE; and*

   e. *It has no thresholds for minimum and maximum change, except a maximum 25% increase limit below the first plateau.*

   Below a CPUE of 0.5 kg/potlift, the TACC is zero; between a CPUE of 0.5 and 0.9 kg/potlift, the TACC increases linearly with CPUE to a plateau of 467 tonnes, which extends to a CPUE of 1.3 kg/potlift. As CPUE increases above 1.3 kg/potlift, TACC increases in steps with a width of 0.1 kg/potlift and a height of 7% of the preceding TACC.

6.2 History

The first MP for CRA 4 was voluntary (Breen et al. 2009a), based on the work of Breen & Kim (2006), and was used to guide ACE (Annual Catch Entitlement, related to quota) shelving for 2007 and 2008. The Minister adopted the current MP in March 2012 for the 2012–13 fishing year. The input standardised offset-year CPUE for 2011 was 1.194, giving a TACC of 466.9 t and a TAC of 661.9 t (Figure 7) when the non-commercial allowances of 195 t were added (Table 9); these were customary 35 t, recreational 85 t and other mortality 75 t.

In November 2012, CPUE was 1.374, giving a TACC of 499.69 t. The Minister accepted this result, rounding the TACC to 499.7 t, and retained the current allowances to give a TAC of 694.7 t.

In November 2013, CPUE was 1.293, giving a TACC of 467 t. The Minister accepted this result and retained the current allowances to give a TAC of 662 t.

In November 2014, CPUE was 1.168 giving a TACC on the plateau of 467 t. The Minister accepted this result and retained the current allowances to give a TAC of 662 t.

Table 9: History of the CRA 4 management procedure. "Rule result" is the result of the management procedure after operation of all its components including thresholds.

Year	Applied to fishing year	Offset CPUE (kg/potlift)	Rule result: TACC (t)	Applied TACC (t)	Applied TAC (t)
2011	2012–13	1.194	466.9	466.9	661.9
2012	2013–14	1.374	499.69	499.7	694.7
2013	2014–15	1.293	467	467	662
2014	2015–16	1.168	467	467	662
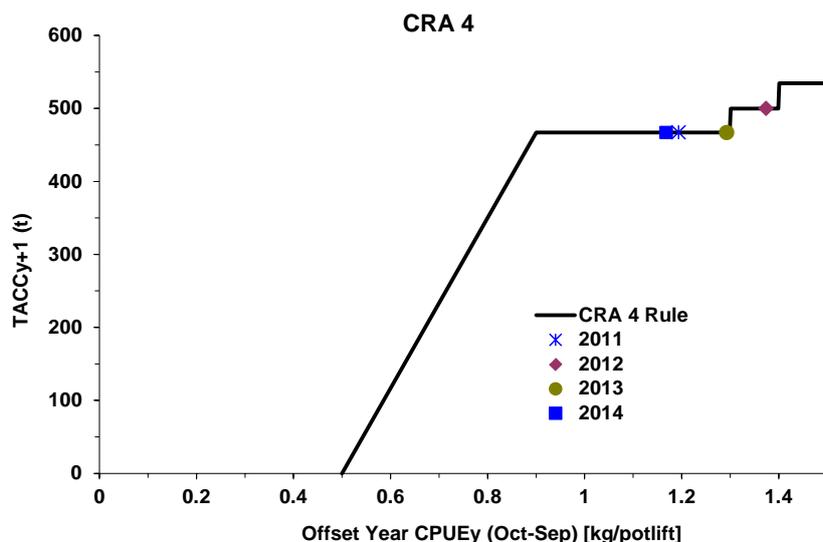
Figure 7: History of the current CRA 4 management procedure.

7.   CRA 5 MANAGEMENT PROCEDURE

7.1   Summary:

	CRA 5
First year with MP	2009
First year of current MP	2012
Review scheduled	2016
Input CPUE	offset year B4-L
Output	TACC
Type of rule	generalised plateau step rule
Latent year?	no
Minimum change	none
Maximum change	none
2015–16 TAC	467
2015–16 customary allowance	40
2015–16 recreational allowance	40
2015–16 other mortality allowance	37
Total non-commercial allowance	117
2015–16 TACC	350

The current CRA 5 MP is based on MPEs made in 2010 (Haist et al. 2011), using an operating model that was based on a stock assessment in the same year, and on further evaluations made later with the same operating model (Breen 2011). The later evaluations used TACC-generating rules.

Rules evaluated were generalised plateau step rules as described above. From the options recommended (NRLMG 2012), the Minister chose the rule 2011-01, for which the specific parameter values are shown in Table 10.

Table 10: Parameters for the CRA 5 generalised plateau step rule.

Par	Function	CRA 5 2011-01 rule value
par1	rule type	4
par2	CPUE at TACC = 0	0.3
par3	left plateau	1.4
par4	right plateau	2.0
par5	plateau height	350
par6	step width	0.2
par7	step height	0.05
par8	minimum change	0
par9	maximum change	0
par10	latent year switch	0

The Final Advice Paper (NRLMG 2012) for the 2012–13 fishing year described the rule as follows:

1) *A recommended new management procedure was developed for CRA 5 in 2011. The new management procedure was based on a 2010 stock assessment and incorporates elements of the voluntary annual catch entitlement shelving rule the CRA 5 industry has used since 2009*

2) *Some important elements of the new CRA 5 Management Procedure are:*
   a. *The output variable is TACC (tonnes) and that standardised CPUE (kg/potlift) is to be used as the input variable;*
   b. *Standardised CPUE is to be based on the offset year from 1 October;*
   c. *CPUE is to be standardised according to the recent usage described in annual Fishery Assessment Reports (FARs), using a data extract obtained in November to ensure that sufficient data from the most recent autumn-winter season have been entered;*
   d. *The management procedure is to be evaluated every year (no "latent year"), based on offset-year CPUE; and*
   e. *The management procedure has no thresholds for minimum and maximum change.*

3) *Below a CPUE of 0.3 kg/potlift, the TACC is zero; between a CPUE of 0.3 and 1.4 kg/potlift, TACC increases linearly with CPUE to a plateau of 350 tonnes, which extends to a CPUE of 2.0 kg/potlift. As CPUE increases above 2.0 kg/potlift, TACC increases in steps with a width of 0.2 kg/potlift and a height of 5% of the preceding TACC.*

7.2   History

The first MP used in CRA 5 was a voluntary rule that would guide shelving if CPUE fell to low values (Breen 2009a). It was adopted for the 2009 year but did not result in any change. The 2010–11 CPUE of 1.740 kg/potlift gave a TACC of 350 t, on the plateau (Table 11, Figure 8), and no shelving was required.

The current rule was adopted by the Minister for the 2012–13 fishing year. The Minister retained the non-commercial allowances, which were customary 40 t, recreational 40 t and illegal 37 t, giving a TAC of 467 t.

In November 2012, the standardised offset-year CPUE was 1.636 kg/potlift, which gave a TACC of 350 t, indicating no change to the catch limits. The Minister accepted this result and made no changes to allowances.

In November 2013, the standardised offset-year CPUE was 1.587 kg/potlift, which gave a TACC of 350 t, indicating no change to the catch limits. The Minister accepted this result and made no changes to allowances.

In November 2014, the standardised offset-year CPUE was 1.3554 kg/potlift, which gave a TACC of 335.81 t, a 4% decrease. The NRLMG advised the Minister that management procedures in some other stocks have a 5% minimum change threshold, which would have resulted in no change had this threshold been adopted, and they advised that a review of the MP was planned in 2015. The Minister accepted the advice to let TAC and TACC remain at their 2014 levels.

Table 11: History of the CRA 5 management procedure. "Rule result" is the result of the management procedure after operation of all its components including thresholds.

Year	Applied to fishing year	Offset CPUE (kg/potlift)	Rule result: TACC (t)	Applied TACC (t)	Applied TAC (t)
2011	2012–13	1.740	350	350	467
2012	2013–14	1.636	350	350	467
2013	2014–15	1.587	350	350	467
2014	2015–16	1.355	335.81	350	467
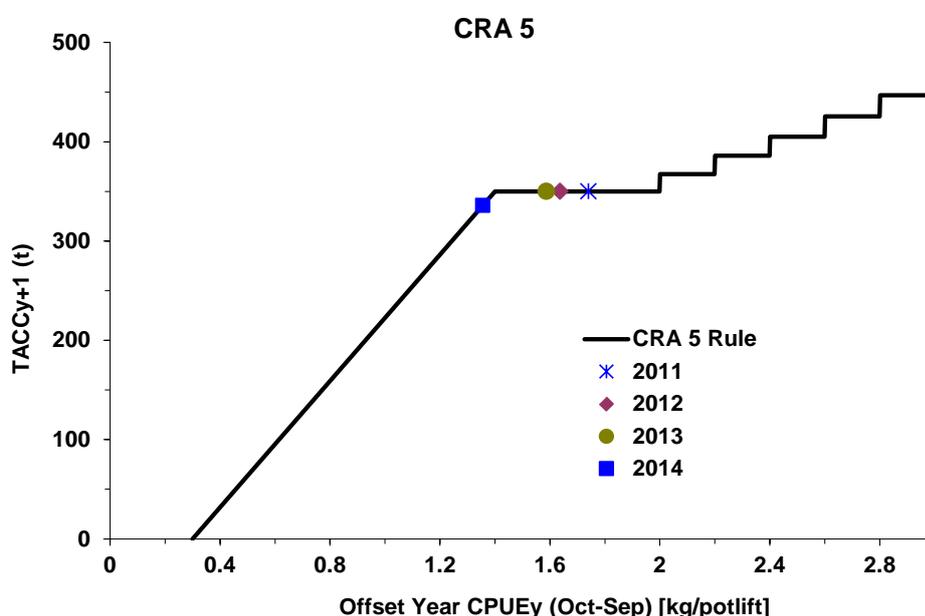
Figure 8: History of the current CRA 5 management procedure.

8. CRA 7 MANAGEMENT PROCEDURE

8.1 Summary

	CRA 7
First year with MP	1996
First year of current MP	2013
Review scheduled	2017
Input CPUE	offset year F2-LFX
Output	TACC
Type of rule	generalised plateau slope rule
Latent year?	no
Minimum change	10%
Maximum change	50%
2015–16 TAC	117.72
2015–16 customary allowance	10.0
2015–16 recreational allowance	5.0
2015–16 other mortality	5.0
Total non-commercial allowance	20.0
2015–16 TACC	97.72

The CRA 7 MP is based on MPEs made in 2012 (Haist et al. 2013), which used an operating model based on the 2012 joint stock assessment for CRA 7 and CRA 8 (Haist et al. 2013).

Rules evaluated in 2012 were generalised slope rules. From the options recommended (NRLMG 2013) the Minister adopted rule 39, for which specific parameter values are shown in Table 12. This rule replaced an earlier rule and is the latest in a series (Starr et al. 1997; Bentley et al. 2003b; Breen et al. 2008).

Table 12: Parameters for the CRA 7 generalised plateau slope rule.

Par	Function	CRA 7 rule 39 value
par1	rule type	3
par2	CPUE at TACC = 0	0.17
par3	left plateau	1.00
par4	right plateau	1.75
par5	plateau height	80
par6	slope	3.0
par7	step height	n.a.
par8	minimum change	0.1
par9	maximum change	0.5
par10	latent year switch	0

The Final Advice Paper (NRLMG 2013) for the 2013–14 fishing year described the rule as follows:
> *Some important elements of the new Rule 39 CRA 7 Management Procedure are:*
>
> - *the output variable is TACC (tonnes) (non-commercial catch assumptions are made from the operating model).*
> - *offset-year standardised CPUE is used as an input to the rule to determine the TACC for the fishing year that begins in the following April.*
> - *CPUE is calculated using the new "F2-LFX" procedure which uses:*
>   - *landings to a licensed fisher receiver, along with recreational landings from a commercial vessel and the amount of rock lobsters returned to the water in accordance with Schedule 6 of the Act (i.e. highgraded rock lobsters),*
>   - *estimates, by vessel, of the ratio of annual landed catch divided by annual estimated catch to correct every landing record in a quota management area for the vessel.*

- *the management procedure is to be evaluated every year (no "latent year"), based on offset-year CPUE.*
- *the new CRA 7 Management Procedure is based on a generalised plateau rule. Below a CPUE of 0.17 kg/potlift, the TACC is zero; between a CPUE of [0.17] and 1.0 kg/potlift, the TACC increases linearly with CPUE to a plateau of 80 tonnes, which extends to a CPUE of 1.75 kg/potlift. As CPUE increases above 1.75 kg/potlift, TACC increases linearly. The minimum change threshold for the TACC is 10% and the maximum change threshold is 50%.*
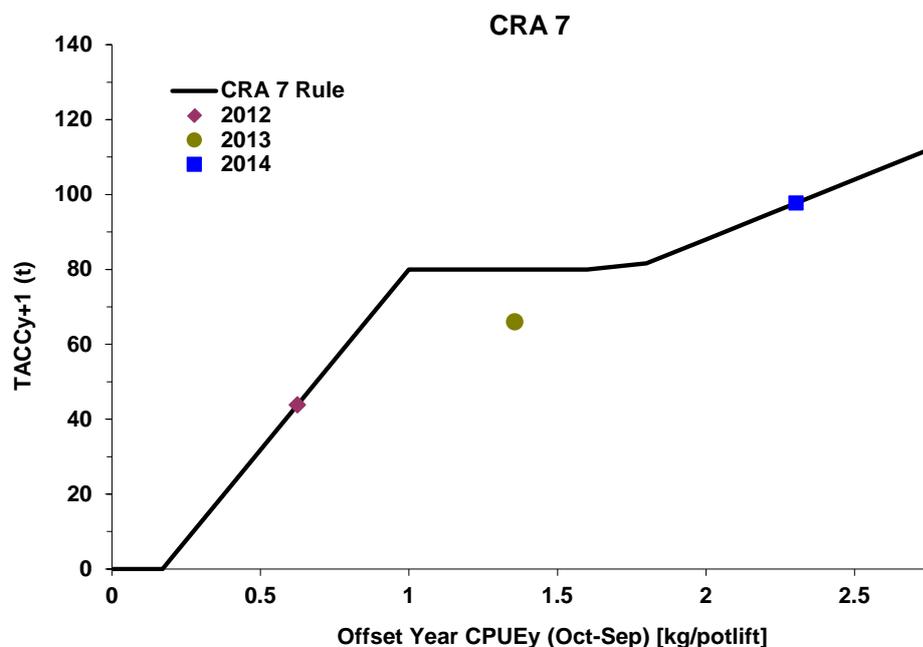
8.2   History

The Minister adopted this rule in 2013 for the 2013–14 fishing year. The standardised offset-year CPUE in November 2012 was 0.625, giving a TACC of 44.96 t. The Minister accepted this result and used the same allowances as for previous years (customary 10 t, recreational 5 t, other mortality 5 t) to set a TAC of 64 t (Table 13, Figure 9).

In November 2013 the offset-year CPUE had more than doubled to 1.356, which suggested a TACC of 80 t. The increase was greater than the maximum allowed increase of 50%, so the TACC was increased by 50% to 66 t. The Minister accepted this result and used the same allowances to set a TAC of 86 t.

In November 2014 the offset-year CPUE had increased to 2.3036, giving a TACC of 97.72 t. The Minister accepted this result and retained the same allowances as before, giving a TAC of 117.72 t.

Table 13: History of the CRA 7 management procedure. "Rule result" is the result of the management procedure after operation of all its components including thresholds.

Year	Applied to fishing year	Offset CPUE (kg/potlift)	Rule result: TACC (t)	Applied TACC (t)	Applied TAC (t)
2012	2013–14	0.625	43.96	44.0	64.0
2013	2014–15	1.356	66.0	66.0	86.0
2014	2015–16	2.3036	97.72	97.72	117.72

Figure 9: History of the current CRA 7 management procedure.

9. CRA 8 MANAGEMENT PROCEDURE

9.1 Summary

	CRA 8
First year with MP	1996
First year of current MP	2013
Review scheduled	2017
Input CPUE	offset year F2-LFX
Output	TACC
Type of rule	generalised plateau slope rule
Latent year?	no
Minimum change	5%
Maximum change	no
2015–16 TAC	1053
2015–16 customary allowance	30
2015–16 recreational allowance	33
2015–16 other mortality allowance	28
Total non-commercial allowance	91
2015–16 TACC	962

The CRA 8 MP is based on MPEs made in 2012 (Haist et al. 2013), using an operating model that was based on the combined CRA 7 / CRA 8 stock assessment conducted in 2012 (Haist et al. 2013). From the options recommended (NRLMG 2013) the Minister adopted rule 13, for which the parameters are shown in Table 14. This rule replaced a similar rule and is the third in a series that began in 1996 (Starr et al. 1997; Bentley et al. 2003b; Breen et al. 2008).

Except for an extended plateau, the adopted rule is the same as the previous CRA 8 MP when the allowances are the same (the previous rule generated a TAC; this rule generates a TACC).

Table 14: Parameters for the CRA 8 generalised plateau slope rule.

Par	Function	CRA 8 rule 13 value
par1	rule type	3
par2	CPUE at TACC = 0	0.4535
par3	left plateau	1.9
par4	right plateau	3.7
par5	plateau height	962
par6	Slope	8.6244
par7	step height	n.a.
par8	minimum change	0.05
par9	maximum change	0
par10	latent year switch	0

The Final Advice Paper (NRLMG 2013) for the 2013–14 fishing year described the rule as follows:
> *Some important elements of the new Rule 13 CRA 8 Management Procedure are:*
> - *the output variable is TACC (tonnes) (non-commercial catch assumptions are made from the operating model).*
> - *offset-year standardised CPUE is used as an input to the rule to determine the TACC for the fishing year that begins in the following April.*
> - *CPUE is calculated using the new "F2-LFX" procedure which uses:*
>   - *landings to a licensed fisher receiver, along with recreational landings from a commercial vessel and the amount of rock lobsters returned to the water in accordance with Schedule 6 of the Act (i.e. highgraded rock lobsters),*
>   - *estimates, by vessel, of the ratio of annual landed catch divided by annual estimated catch to correct every landing record in a quota management area for the vessel.*

- *the management procedure is to be evaluated every year (no "latent year"), based on offset-year CPUE.*

- *the new CRA 8 Management Procedure is based on a generalised plateau rule. Below a CPUE of 0.4535 kg/potlift, the TACC is zero; between a CPUE of 0.4535 and 1.9 kg/potlift, the TACC increases linearly with CPUE to a plateau of 962 tonnes, which extends to a CPUE of 3.7 kg/potlift. As CPUE increases above 3.7 kg/potlift, the TACC increases linearly. The minimum change threshold for the TACC is 5%; there is no maximum change threshold.*

9.2   History

History of the new and previous CRA 8 MP (both are shown because they are so closely related) is shown in Table 15. The previous rule was first used to determine the TAC for the 2008–09 fishing year, and the new rule was adopted by the Minister and used to determine the TACC for 2013–14.

In November 2012, the standardised offset-year CPUE was 3.346 kg/potlift, which led to an unchanged TACC of 962 t. The Minister accepted this result. The non-commercial allowances of customary 30 t, recreational 33 t and illegal 28 t combined to give a TACC of 1053 t (Table 15, Figure 10).

In November 2013, the standardised offset-year CPUE was 3.377 kg/potlift, which led to an unchanged TACC of 962 t. The Minister accepted this result and made no changes.

In November 2014, CPUE was 3.562, again leading to an unchanged TACC of 962 t. The Minister accepted this result and made no changes.

Table 15: History of the CRA 8 management procedure. "Rule result" is the result of the management procedure after operation of all its components including thresholds. Note that CPUE before 2013–14 was estimated with a different algorithm from the current method.

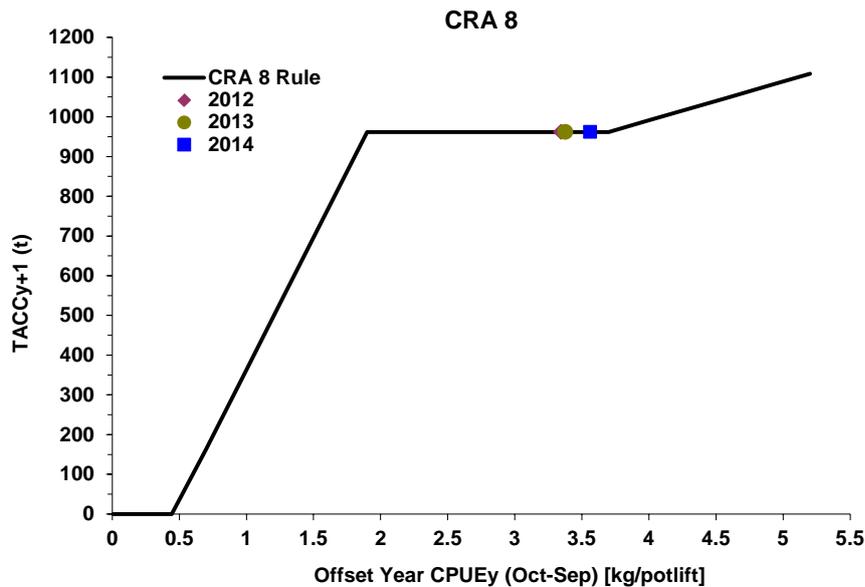| Year	Applied to fishing year	Offset CPUE (kg/potlift)	Rule result: TAC (t)	Rule result: TACC (t)	Applied TACC (t)	Applied TAC (t)
2007	2008–09	2.960	1053		966	1053
2008	2009–10	3.844	1110		1019	1110
2009	2010–11	3.781	1110		1019	1110
2010	2011–12	3.107	1053		962	1053
2011	2012–13	2.947	1053		962	1053
2012	2013–14	3.346		962	962	1053
2013	2014–15	3.377		962	962	1053
2014	2015–16	3.562		962	962	1053

Figure 10: History of the current CRA 8 management procedure; the 2012 point lies under the 2013 point.

10. CRA 9 MANAGEMENT PROCEDURE

10.1 Summary

	CRA 9
First year with MP	2014
First year of current MP	2014
Review scheduled	2018
Input CPUE	offset year F2-LFX
Output	TACC
Type of rule	generalised plateau step rule
Latent year?	no
Minimum change	5%
Maximum change	15%*
2015–16 TAC	115.8
2015–16 customary allowance	20
2015–16 recreational allowance	30
2015–16 other mortality allowance	5
Total non-commercial allowance	55
2015–16 TACC	60.8

*maximum change applies to increases only

The CRA 9 MP is based on MPEs made in 2013 (Breen 2014), using an operating model based on a simple surplus-production model. From the options recommended (NRLMG 2014) the Minister adopted rule 4041, for which the parameters are shown in Table 16.

When first used in 2014, it was the first MP for this stock, and for the first time in 2014 the Minister set TAC and non-commercial allowances.

Table 16: Parameters for the CRA 9 generalised step rule.

		CRA 9 rule 4041
Par	Function	value
par1	rule type	4
par2	CPUE at TACC = 0	0.5
par3	left plateau	1.0
par4	right plateau	1.4
par5	plateau height	40
par6	step width	0.75
par7	step height	0.15
par8	minimum change	0.05
par9	maximum change	*0.15
par10	latent year switch	0

*maximum change applies to increases only

The Final Advice Paper (NRLMG 2014) for the 2014–15 fishing year described the rule as follows:

In 2013 a surplus-production model was developed for CRA 9. This model was used to set the operating model for evaluating new CRA 9 management procedures.

Five different CRA 9 management procedure options were considered by the NRLMG in November 2013. The NRLMG have put forward one of these 'final' rules for your consideration which when operated it is recommended that the TAC increases for the 2014–15 fishing year. This rule is called Rule 4041 and is based on a generalised 'step' rule.

Some important elements of the CRA 9 management procedure are:
a) *The output variable is TACC (tonnes);*
b) *Offset-year standardised CPUE is used as an input to the rule to determine the TACC for the fishing year that begins in the following April;*
c) *CPUE is calculated using the 2012 F2_LFX procedure which uses:*
- *landings to a licensed fisher receiver, along with recreational landings from a commercial vessel and the amount of rock lobsters returned to the water in accordance with Schedule 6 of the Act (i.e. highgraded rock lobsters),*
- *estimates, by vessel, of the ratio of annual landed catch divided by annual estimated catch to correct every landing record in a quota management area for the vessel;*
d) *The management procedure is to be evaluated every year (no "latent year"), based on offset-year CPUE;*
e) *The minimum change threshold for the TACC is 5%.*

For Rule 4041: below a CPUE of 0.5 kg/potlift the TACC is zero. Between a CPUE of 0.5 kg/potlift and 1.0 kg/potlift, the TACC increases linearly with CPUE to a plateau of 40 tonnes, which extends to a CPUE of 1.4 kg/potlift. As CPUE increases above 1.4 kg/potlift, the TACC increases in steps with a width of 0.75 kg/potlift and a height of 15% of the preceding TACC.

As proposed, there is a maximum allowable increase of 15% in TACC; there is no maximum allowable decrease.

10.2 History

The current rule is the first MP to be used in CRA 9, and was first used to determine the TACC for the 2014–15 fishing year. In November 2013, the standardised offset-year CPUE was 3.141 kg/potlift, which led to a TACC of 60.84 t. The Minister rounded this to 60.8, allowed 20 t for customary, 30 t for recreational and 5 t for illegal catch, giving a TAC of 115.8 t (Table 17, Figure 11).

In November 2014, the standardised offset-year CPUE was 2.095 kg/potlift, which suggested a TACC of 46.0 t. Industry complained vigorously that the decline in TACC did not reflect a decline in the stock, but was a mistake or possibly an artefact of the small number of fishing vessels. The NRLMG advised the Minister not to change the TACC or TAC in 2015 and promised a CPUE review for this stock in 2015. The Minister made no changes.

Apart from the decision not to make a 4% decrease in the CRA 5 TACC in 2015, this was the first instance where the NRLMG and the Minister did not follow a MP.

Table 17: History of the CRA 9 management procedure. "Rule result" is the result of the management procedure after operation of all its components including thresholds.

Year	Applied to fishing year	Offset CPUE (kg/potlift)	Rule result: TACC (t)	Applied TACC (t)	Applied TAC (t)
2013	2014–15	3.141	60.8	60.8	115.8
2014	2015–16	2.095	46.0	60.8	115.8
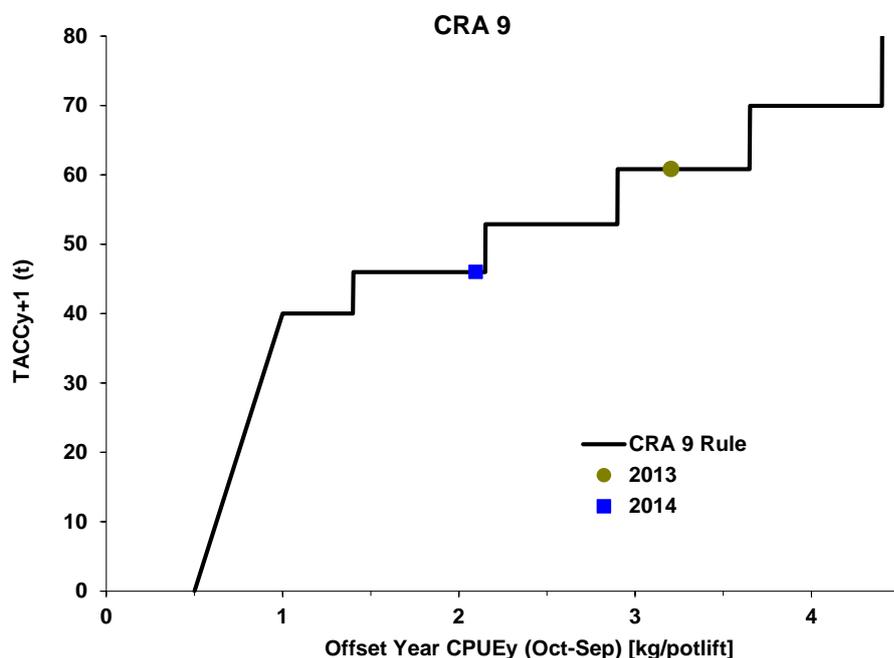
Figure 11: History of the current CRA 9 management procedure: the coloured dots indicate the CPUE in 2013 and 2014.

11. ACKNOWLEDGEMENTS

12. REFERENCES

Bentley, N.; Breen, P.A.; Kim, S.W.; Starr, P.J. (2005). Can additional abundance indices improve harvest control rules for New Zealand rock lobster fisheries (*Jasus edwardsii*)? *New Zealand Journal of Marine and Freshwater Research 39(3):* 629–644.

Bentley, N.; Breen, P.A.; Starr, P.J. (2003b). Design and evaluation of a revised management decision rule for red rock lobster fisheries (*Jasus edwardsii*) in CRA 7 and CRA 8. *New Zealand Fisheries Assessment Report 2003/30.* 44 p.

Bentley, N.; Breen, P.A.; Starr, P.J.; Sykes, D.R. (2003a). Development and evaluation of decision rules for management of New Zealand rock lobster stocks. *New Zealand Fisheries Assessment Report 2003/29.* 14 p.

Bentley, N.; Stokes, K. (2009). Contrasting paradigms for fisheries management decision making: how well do they serve data-poor fisheries? *Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science 1(1)*: 391–401.

Breen, P.A. (2009a). A voluntary harvest control rule for a New Zealand rock lobster (*Jasus edwardsii*) stock. *New Zealand Journal of Marine and Freshwater Research 43(3)*: 941–951.

Breen, P.A. (2009b). CRA 6 Management procedure evaluations. *New Zealand Fisheries Assessment Report 2009/60.* 56 p.

Breen, P.A. (2011). Further operational management procedure evaluations for CRA 5. Final Research Report for Ministry of Fisheries Research project CRA2009-01, Objective 5. NZ RLIC Ltd. 12 December 2011. 23 p. (Unpublished report held by Ministry for Primary Industries, Wellington.)

Breen, P.A. (2014). CRA 9 Management procedure evaluations. *New Zealand Fisheries Assessment Report 2014/20.* 72 p.

Breen, P.A.; Bentley, N.; Haist, V.; Starr, P.J.; Sykes, D.R. (in press). Management procedures for New Zealand lobster stocks. pp. xx-xx *In* C.T.T. Edwards & D.J. Dankel (Eds.) Management science in fisheries: a practical introduction to simulation-based methods. Routledge.

Breen, P.A.; Haist, V.; Smith, A.N.H.; Starr, P.J. (2008). Review of the NSS decision rule for stocks CRA 7 and CRA 8 and development of new operational management procedures. *New Zealand Fisheries Assessment Report 2008/55.* 71 p.

Breen, P.A.; Haist, V.; Starr, P.J.; Pomarede, P.J.M. (2012). The 2011 stock assessment and management procedure development for red rock lobsters (*Jasus edwardsii*) in CRA 4. *New Zealand Fisheries Assessment Report 2012/09.* 98 p.

Breen, P.A.; Kim, S.W. (2006). Development of an operational management procedure (decision rule) for CRA 4. *New Zealand Fisheries Assessment Report 2006/53.* 46 p.

Breen, P.A.; Kim, S.W.; Bentley, N.; Starr, P.J. (2003). Preliminary evaluation of maintenance management procedures for New Zealand rock lobster (*Jasus edwardsii*) fisheries. *New Zealand Fisheries Assessment Report 2003/20.* 65 p.

Breen, P.A.; Starr, P.J.; Haist, V. (2009a). New Zealand decision rules and management procedures for rock lobsters. *New Zealand Fisheries Assessment Report 2009/43.* 18 p.

Breen, P.A.; Sykes, D.; Starr, P.J.; Haist, V.; Kim, S.W. (2009b). A voluntary reduction in the commercial catch of rock lobster (*Jasus edwardsii*) in a New Zealand fishery. *New Zealand Journal of Marine and Freshwater Research 43(1)*: 511–523.

Butterworth, D.S.; Punt, A.E. (1999). Experiences in the evaluation and implementation of management procedures. *ICES Journal of Marine Science 56*: 985–998.

Haist, V.; Breen, P.A.; Edwards, C.T.T. (2015). The 2014 stock assessment of red rock lobsters (*Jasus edwardsii*) in CRA 3 and development of new management procedures. *New Zealand Fisheries Assessment Report 2015/28*. 73 p.

Haist, V.; Breen, P.A.; Starr, P.J.; Kendrick, T.H. (2011). The 2010 stock assessment of red rock lobsters (*Jasus edwardsii*) in CRA 5, and development of an operational management procedure. *New Zealand Fisheries Assessment Report 2011/12*. 68 p.

Haist, V.; Starr, P.J.; Breen, P.A. (2013). The 2012 stock assessment of red rock lobsters (*Jasus edwardsii*) in CRA 7 and CRA 8, and review of management procedures. *New Zealand Fisheries Assessment Report 2013/60*. 90 p.

Johnston, S.J.; Butterworth, D.S. (2005). Evolution of operational management procedures for the South African West Coast rock lobster (*Jasus lalandii*) fishery. *New Zealand Journal of Marine and Freshwater Research 39*: 687–702.

Johnston, S.J.; Butterworth, D.S.; Glazer, J.P. (2014). South coast rock lobster OMP 2014: initial specifications. Unpublished Report to the South African Department of Fisheries. Fisheries/2014/SEP/SWG_SCRL/07. 14 pp. available at: *http://www.mth.uct.ac.za/maram/pub/2014/FISHERIES_2014_SEP_SWG-SCRL_07.pdf*

National Rock Lobster Management Group (2012). Review of Rock Lobster Sustainability Measures for 1 April 2012. Final Advice Paper – March 2012. Unpublished document for the Minister of Fisheries, April 2012. 41 p. plus appended submissions.

National Rock Lobster Management Group (2013). Review of rock lobster sustainability measures for 1 April 2013. Unpublished document for the Minister for Primary Industries, February 2013. 47 p. plus appended submissions.

National Rock Lobster Management Group (2014). Review of rock lobster sustainability measures for 1 April 2014. Final Advice Paper. *MPI Information Paper No: 2014/01* March 2014. 59 pp. plus appended submissions. Available at: *http://www.mpi.govt.nz/Default.aspx?TabId=126&id=2131*

National Rock Lobster Management Group (2015). Review of rock lobster sustainability measures for 1 April 2015. Final Advice Paper. *MPI Information Paper No: 2015/03*. 57 pp. plus appended submissions. Available at: *http://www.mpi.govt.nz/news-and-resources/consultations/fisheries-sustainability-measures-1-april-2015/*

Starr, P.J. (2014). Rock lobster catch and effort data: summaries and CPUE standardisations, 1979–80 to 2012–13. *New Zealand Fisheries Assessment Report 2014/28*. 106 p.

Starr, P.J.; Breen, P.A.; Hilborn, R.; Kendrick, T.H. (1997). Evaluation of a management decision rule for a New Zealand rock lobster substock. *Marine and Freshwater Research 48(8):* 1093–1101.

Starr, P.J.; Haist, V.; Breen, P.A.; Edwards, C.T.T. (2014). The 2013 stock assessment of red rock lobsters (*Jasus edwardsii*) in CRA 2 and development of management procedures. *New Zealand Fisheries Assessment Report 2014/19*. 76 p.

Webber, D.N.; Starr, P.J. (2015). The 2014 stock assessment of red rock lobsters (*Jasus edwardsii*) in CRA 1 and development of management procedures. *New Zealand Fisheries Assessment Report 2015/38*. 103 p.