

NSW Total Allowable Fishing Committee

Report and Determination 2019–20

ROCK LOBSTER FISHERY

17 June 2019

EXECUTIVE SUMMARY

Preamble

The NSW Total Allowable Fishing Committee (the Committee) has responsibility under the NSW Fisheries Act (1994, No. 38) to determine the total allowable commercial catch of rock lobster by NSW commercial fishers. This determination is for the period 1 August 2019 to 31 July 2020. The determination is based on a scientific assessment of the rock lobster stocks, reports from fishery managers and compliance officers, comment from fishers, and input at a public forum on May 22nd 2019.

Determination

The Committee has determined that the total allowable catch of rock lobster by NSW commercial fishers during the 2019–20 fishing period should not exceed **170 tonnes** (t).

This allocation is the same as that set for the 2018–19 fishing period. The determination is set given expected catches of rock lobster by non-commercial fishers of approximately 18.5 t and illegal and unreported commercial catches of approximately 15.8 t.

Primary Recommendations

The Committee again provides the following recommendations to the NSW Department of Primary Industries (the Department) and the Lobster Industry Working Group in the interests of improving fishery performance. The Committee appreciates the Department's reporting against previous recommendations in its fishery management report this year.

Recommendation 1: The Department and industry continue their work to develop a harvest strategy with specific fishery objectives linked to target reference points.

Recommendation 2: The Department continue redevelopment of the stock assessment model to improve predictions for TACC setting and support strategic analyses of longer-term harvest strategies. Specifically:

- The stock-recruitment assumptions in the population model should be re-examined using the empirical and model-based measurements of spawning stock and recruitment to the fishery to ensure that the base-case assumptions and sensitivity ranges are appropriate;
- The analysis of alternative scenarios for minimum and maximum legal lengths be extended to examine the effects on spawning stock and exploitable stock depletions;
- A more comprehensive and realistic treatment of the inter-related issues of catchability and spatial structure of the fishery be developed.

Recommendation 3: The Department and Industry develop a strategy for gathering economic information for the fishery, including quota and share transfer prices and fishing operating costs, to facilitate robust economic analyses and development of a robust bioeconomic model for the fishery.

Recommendation 4: The Department obtains more robust estimates of recreational catch.

Stock Status

The rock lobster stock is considered to be robust to current levels of harvest. Management and allowable catch limits since 2004 have been targeted at stock rebuilding. Evidence from scientific assessments, fishery-independent monitoring, and increasing catch rates over that period indicates that rebuilding of spawning stock and stocks of lobster available to the fishery has progressed through most of the period and might be continuing.

The scientific assessment provided this year contains significant improvements over previous versions and gives a best estimate of current spawning biomass of 34% of unfished levels. Evidence is convincing that spawning biomass is above the 25% legislated trigger point. The Committee considers this assessment to be the most appropriate and robust to date.

Analysis provides good support for a limit reference point of 20% of the unfished spawning biomass and for a target reference point of 30% of the unfished spawning biomass to achieve

Maximum Economic Yield. The stock has now rebuilt to that target reference point and current catches are close to the estimated Maximum Economic Yield. The potential for future increase in allowable catches substantially depends on resolving better the relationship between spawning stock size and recruitment to the fishery, through careful management and monitoring to determine the likely level of maximum recruitment to the fishery.

Uncertainty about historically unreported catch and current recreational catch continue to be important risks in setting allowable commercial catches from the common stock. The former might not be resolvable other than by modelling alternative scenarios but the latter can be addressed by implementing a robust monitoring program to estimate recreational harvests.

Economic Considerations

Economic performance of the NSW lobster fishery has further improved in 2018–19, mostly due to improvements in market prices. The main export market for Australian lobsters has been relatively weak, though there are indications that export prices will increase over 2019 and subsequent years. A relatively small portion of NSW lobsters is exported but weaker export prices can adversely affect domestic prices if declines in export prices result in more product being sold through the domestic markets.

Share trading prices have increased substantially over recent years indicating a positive perception by industry about the future for the fishery. This has been fuelled in part by increased catch rates arising from apparent stock increases.

Development of a more spatially explicit bio-economic assessment model incorporating economic parameters such as operating costs and market prices would allow economic targets to be set and potential future economic benefits to the industry and broader NSW economy to be estimated. Such a model also would allow costs and benefits of alternative quota settings to be analysed and included in Committee deliberations. Lack of detailed economic data about fishery operations and quota and share transactions remains a major impediment to development of such a model.

Management Considerations

The lobster industry is reporting positive stock and economic conditions across much of the fishery. These positive conditions are verified by data coming from the fishery and the stock assessment, which suggests that the stock is nearing levels approximating Maximum Economic Yield (MEY). The TACC was increased by 10 t in 2018–19 as a result of the ongoing recovery of the stock and it appears that that TACC will be fully harvested this season. Licensing and management arrangements in the commercial fishery remain stable and effective, and compliance rates remain high.

The robust state of the fishery means that the focus of management is moving away from stock rebuilding toward optimising outcomes. The Committee therefore strongly supports the continued development of a harvest strategy for the lobster fishery to clarify the outcomes being sought. This should be supported by continued refinements to the stock assessment model, with augmentation to enable bio-economic modelling for the fishery.

Industry cooperation with the Department and the Committee continues to be effective. Industry generally appear to support maintaining a precautionary approach to setting the TACC in the interests of a consistent and predictable return from a robust stock.

Useful data and analyses are available for the commercial fishery but uncertainty about the levels of non-commercial (recreational and Aboriginal) harvest of lobster remains a key risk to long term management of the lobster fishery. Continued improvement of the stock will lead to greater lobster availability and probably greater interest from recreational fishers. There is insufficient information to understand the current levels of non-commercial harvest, let alone identify any increase or shift in harvest, which represents a material risk for management of both the recreational and commercial sectors of the fishery. Harvest by Aboriginal fishers under permits for cultural purposes is less than permitted limits and few permits have been sought or issued, suggesting that Aboriginal harvest remains low. The Committee recommends that the Department investigate cost effective mechanisms to obtain improved regular estimates of non-commercial lobster harvest, sufficient to understand the scale and location of recreational catch and any changes in those metrics over time.

Conclusions

The NSW eastern rock lobster stock has rebuilt to a robust state apparently capable of supporting current levels of harvest. Some uncertainty remains, however, about the degree to which the stock has stabilised or has further rebuilding ahead, though it appears likely that any further increases in total allowable catches will be small.

Improvements in the current assessment model over the last year have provided for more informative forecasts of consequences of alternative harvests and that work is commended by the Committee. Support by the Department for further development of the assessment framework is strongly encouraged.

Absence of specific biological or economic targets for the fishery preclude conclusions about whether the stock, and harvest, are at preferred levels. Unavailability of solid economic information about fishery and market operations also hinder such conclusions. The Committee has used current biological analyses to set target and limit reference points for the stock pending formal statement of those metrics in a harvest strategy. The Committee commends the Department and Industry for recent progress toward an agreed harvest strategy. These factors together nevertheless indicate the need for prudence in setting future harvest levels to minimise the risk of again overfishing the stock. The Committee therefore has maintained the current TACC of 170 tonnes for the 2019–20 fishing period.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	I
Preamble.....	i
Determination.....	i
Primary Recommendations.....	i
Stock Status	i
Economic Considerations.....	ii
Management Considerations.....	ii
Conclusions.....	iii
TABLE OF CONTENTS	IV
1.INTRODUCTION	1
2.PROCEDURES	2
2.1 Public Consultation.....	2
2.2 Matters considered.....	2
3.STATE OF THE STOCKS.....	3
3.1 Introduction.....	3
3.2 Stock rebuilding.....	3
3.3 Catch rates.....	3
3.4 Unreported commercial catch	4
3.5 Non-commercial catch	4
3.6 Stock assessment model.....	4
3.7 The future	4
4.ECONOMIC CONSIDERATIONS.....	5
4.1 Introduction.....	5
4.2 Changes in Fishery Gross Value, Lobster Prices, and Market Destinations.....	5
4.3 Fishery Profits and Quota Trading Prices	5
4.4 Economic Targets for the Fishery.....	6
4.5 Future Economic Information Needs	6
5. MANAGEMENT CONSIDERATIONS.....	7
5.1 Management implications of stock status	7
5.2 Non-commercial components of the fishery	7
5.3 Compliance.....	7
5.4 Management decision-making framework.....	8
5.5 Engagement.....	9
6. CONCLUSION	10
6.1 Summary	10
6.2 Total Allowable Commercial Catch for 2019–20.....	10
6.3 The Determination.....	11
Acknowledgements.....	11
APPENDICES	12
APPENDIX 1. PUBLIC CONSULTATION.....	12
APPENDIX 2*. SUMMARY OF SUBMISSIONS.....	13
APPENDIX 3. STOCK STATUS AND ASSESSMENT	14
A3.1 Introduction.....	14
A3.2 Fishery reference points	14
A3.3 Data	15
A3.4 Analysis.....	21
A3.5 Conclusions.....	23
APPENDIX 4.ECONOMIC ANALYSIS	25
A4.1 Introduction.....	25
A4.2 Volume and Value of Production	25
A4.3 Catch Per Unit Effort and Productivity	26

A4.4 Rock Lobster Markets and Prices.....	27
A4.5 Costs and fishery profitability	28
A4.6 Shareholders and Business Structures	31
A4.7 Quota Transfers and Values.....	32
A4.8 Economic Data and Future Analyses	34
A4.9 Community Contribution.....	35
A4.10 Conclusion	35
APPENDIX 5. MANAGEMENT EVALUATION	36
A5.1 Introduction.....	36
A5.2 Compliance.....	36
A5.3 Management framework.....	38

1. INTRODUCTION

The Total Allowable Catch Setting and Review Committee was established by Division 4 (S26-34) of the *Fisheries Management Act 1994* and renamed the Total Allowable Fishing Committee (the Committee) and given a broader responsibilities in a 2018 amendment to the Act (Part 2A S40) following structural reform of management arrangements for most NSW commercial fisheries. The Committee in 2019 was:

- Dr Bruce Mapstone – Chair
- Dr Keith Sainsbury – fisheries science
- Dr Sean Pascoe – natural resources economics
- Ms Alice McDonald – fisheries management

The Committee is required to determine the Total Allowable Commercial Catch (TACC) for the commercial sector of the rock lobster fishery and, in doing so, give effect to the objectives of the *Fisheries Management Act 1994*, as amended (*Fisheries Management Amendment Acts 1997, 2004, 2006, 2010, 2015, 2018*). The Committee is not subject to control or direction of the Minister but in reaching its decision is required to have regards to:

- All relevant scientific, industry, community, social and economic factors;
- The need to ensure that the rock lobster resources are exploited in a manner that will conserve stocks in the long term;
- The impact of fishing on other species and the environment; and
- The precautionary principle as set out in Section 30(2)(c) of the Act.

The Committee also may be consulted out of session on a range of management issues.

The Committee produces a stand-alone report each year in support of the TACC determination. The report also sometimes includes recommendations for management of the fishery related to setting TACCs, based on the experience and background of the Committee members and reports received by the committee. Regular and constructive dialogue between the Committee and the Department and Industry on a range of issues related to the fishery, including recommendations from the Committee, is an important and valuable part of the Committee's deliberations in reaching a TACC determination. It is important to note, however, that the Committee makes a determination on the TACC and, potentially, matters it is required to regard that affect the TACC directly. The degree to which Committee recommendations beyond that scope are accepted is up to the Minister and Department.

The Committee must consider the full extent of rock lobster exploitation to meet its statutory obligations. Total removals from the rock lobster stock are made up of:

- The commercial catch, up to the quota allocated to commercial fishers;
- The total legal catch by recreational and Aboriginal fishers; and
- Catches by commercial, recreational, or Aboriginal fishers not sanctioned by the Regulations controlling the fishery and not recorded in catch statistics.

The legal and illegal catches by the non-commercial fishery are estimated as a single figure expressed as a percentage of the total commercial catch and the unreported commercial catch is estimated separately, also as a percentage of the total commercial catch.

The Act defines, in Section 30(2)(c), how the Committee should apply the precautionary principle, specifically:

'... if there are threats of serious irreversible damage to fish stocks, lack of scientific certainty should not be used as a reason for postponing measures to prevent that damage.'

The Committee interprets 'threat' in this context to mean an 'indication of probable harm to come'. The Committee therefore must respond to evidence before it that indicates probable future harm to the fishery or the stocks and not postpone action to prevent that harm occurring even if there is uncertainty surrounding that evidence.

2. PROCEDURES

2.1 Public Consultation

The Committee, through the Department, called for public submission on the appropriate total allowable commercial catch under the requirements of Section 40F of the *Fisheries Management Act* 1994 No. 38. Lobster fishers, relevant industry and community bodies, and the community generally were invited to make submissions on the total allowable commercial catch. The details of the consultative process are set out in Appendix 1 and main points from submissions are summarised in Appendix 2.

The Committee obtained input from participants in the Total Allowable Fishing Committee Open Forum meeting in Sydney on May 22nd 2019 and received written reports from:

- NSW Department Primary Industries (DPI), Fisheries Research;
- NSW Department Primary Industries, Commercial Fisheries Management;
- NSW Department Primary Industries, Fisheries Compliance; and
- Participants in the commercial rock lobster fishery.

Public submissions and presentations to the Committee were invited in the Open Forum meeting but confidential submissions were not discussed publicly. The Committee also was able to call for *in-camera* discussions, where appropriate, during its meeting of May 22nd 2019. No in-camera discussions were requested by the Committee.

2.2 Matters considered

The Committee considered the following matters before reaching its determination:

- Documentation available on the fishery and submissions received for this year;
- Management objectives set out in the management plan;
- The current state of the fishery;
- Advice on the status of management of the fishery provided by the Department;
- Advice on the economic status of the fishery as assessed by the Department and industry representatives;
- Advice about compliance with fishery regulations as assessed by the Department and industry representatives.
- The stock assessment for rock lobster provided by the Department;
- The spatial nature of the fishery, particularly in relation to the spawning biomass; and
- Submissions and commentary provided at the Open Forum.

This report covers the three key areas affecting management of the fishery and, in particular, the TACC setting process:

- Status of the rock lobster stocks;
- Economic considerations; and
- Management considerations.

The key considerations for each of these areas are presented in the following sections 3, 4, and 5, followed by a concluding section 6. More detailed and technical analyses for each area are presented in Appendix 3 (Stock), Appendix 4 (Economics), and Appendix 5 (Management) for interested readers.

The Determination of the Committee is to be published by the Minister. The Minister is required to review the regulations and any other instruments under the Act in the light of the Determination. The Determination is to be implemented in accordance with the Management Plan.

3. STATE OF THE STOCKS

3.1 Introduction

Data from the fishery and research and monitoring programs were reviewed, including fishery catch and effort, fishery independent surveys and monitoring, and estimates of illegal, unreported, recreational and Aboriginal catches. An assessment of current stock status from a length-based population model based on these data, and stock predictions for various future catches, also were reviewed.

3.2 Stock rebuilding

Management decisions in the past several years have been aimed at stock rebuilding. There is now clear evidence that significant rebuilding of the spawning biomass has been achieved since about 2000.

Analyses of long-term yield at various catches and population depletions were provided this year. The Committee accepts that these analyses provide sensible interim values for the limit¹ and target² reference points for stock depletion. The interim limit reference point is a spawning stock depletion to 20% of the unfished level. The target reference point relates to achieving the Maximum Economic Yield and is a spawning stock depletion of 30% of the unfished level. The target reference point may need future revision as the relationship between spawning stock size and maximum recruitment is better understood.

The median estimate from the current assessment is that spawning stock biomass is at 34% of the most likely unfished level. There is very little chance that the spawning biomass is depleted below the limit reference point of 20% of the unfished level. There is high probability that spawning biomass is at or above the target reference point of 30% of the unfished level. Expectations of increased catches in future are limited given this assessment, though this interpretation will be updated as additional observations are obtained about the relationship between recruitment to the fishery and spawning biomass. Rebuilding of the spawning stock is predicted to continue or stabilise at a moderate rate under recent catch levels, but the exploitable biomass is predicted to reduce slightly in the near term.

3.3 Catch rates

Commercial catch rates have increased substantially since 2000 and have increased rapidly each year since about 2011. Catch rates in the last few years have been broadly stable or increasing across all the depths and regions of the fishery, implying stable or increasing abundance of lobsters of all sizes and maturity groups. There has been substantial increase in catch rates in the far north of the fishery, implying expansion of the breeding stock back into this area after many years of severe depletion. The catch rate of sub-legal lobsters is among the highest on record, indicating strong recruitment to the fishery in the coming season, and high catch rates of migrating lobsters indicate that substantial numbers are surviving to join the breeding stock.

The catch rates indicate a substantial increase in the exploitable biomass and the spawning biomass of lobsters, but there also is an unknown contribution due to increased fishing efficiency. The current method of catch rate standardisation³ accounts for some effects of recent shifts from shallow (less than 30m depth) to deeper pot sets, and the associated use of larger pots set for longer periods. That standardisation, however, is unlikely to account for all the expected gear effects or for increases in efficiency related to investment in equipment or increased ability to avoid marginal weather on fishing grounds whilst still landing allocated quota at high catch rates.

Catch rates have increased over the last 4-5 fishing periods whilst model predictions were for a small decrease under recently increased TACCs. This slight pessimism in the model is interpreted as being due to assumptions about the relationship between spawning stock and recruitment, the course method of catch rate standardisation, and the lack of spatial structure in the model to represent the very distinct selectivity and efficiency characteristics of fishing operations in different areas.

¹ A limit reference point (LRP) indicates a stock status that is undesirable and that should be avoided with high probability. The Committee previously has interpreted the legislated management trigger of 25% of unfished biomass to be the *de facto* LRP for the lobster fishery, but now accepts advice based on the current assessment that an appropriate LRP in this fishery is 20% of unfished biomass, pending resolution of a formal harvest strategy.

² A Target Reference Point (TRP) stipulates the level of biomass that is considered to produce specific desirable outcomes given allowed fishing practices. TRPs often are set to deliver either Maximum Sustainable Yield or Maximum Economic Yield and fishery management is put in place to ensure stocks are maintained close to the TRP and safely above the Limit Reference Point (Footnote 1).

³ 'Standardised' catch rates take account of changes in fishery gear and practice to provide improved measures of stock density. Standardised catch rates generally are considered to be more realistic indicators of stock abundance than are raw (un-standardised) catch rates.

3.4 Unreported commercial catch

The scale of unreported commercial catch in the fishery is uncertain. Estimates of unreported commercial catch prior to 1969 are recognised to be very uncertain, whereas there is a better basis for estimation post-1969 and particularly post-1994. The current base-case stock assessment uses the currently most credible scenario for unreported commercial catch, following sensitivity tests on a range of alternative historical scenarios of under-reporting. This is an important source of uncertainty in the stock assessment. It is recommended that a suite of scenarios likely to encompass the catch history under credible time-varying under-reporting scenarios continue to be developed and applied in future stock assessments.

The level of discards, and likelihood of high-grading of retained lobsters, have increased in recent years as the TACC has become increasingly limiting, and this is expected to continue. Discards were about 8.3t in 2017–18, which is about 5.3% of the reported landed catch and it is assumed that 10% of these did not survive. It is necessary to both monitor discards and include mortality associated with discarding in future stock assessments.

3.5 Non-commercial catch

There is considerable uncertainty about the level of non-commercial (recreational and Indigenous) catch and unreported commercial catch. The Committee this year again has supported the approach adopted since 2013–14 of using lower estimates of unreported catch and non-commercial catch than in earlier assessments. There is broad agreement that the non-commercial catch has decreased in recent years and the catch of 18.5 t that has been assumed this year seems reasonable, allowing for slight annual increases above the the midpoint of the very imprecise Recreational Fishing Survey from 2013–14. It is again recommended that more accurate measures of the amount of recreational catch be established. There is a variety of mechanisms being considered by the Department for better measurement of the recreational catch, including implementing a system for fishers to indicate their intention to take lobster that facilitates an improved sampling frame for surveys.

3.6 Stock assessment model

The assessment model has been redeveloped and refined in recent years and it is now fitting the available data well. The revised model confirms recent concern that the spawning stock was more depleted in the mid-1990s than estimated previously. It now is thought that depletion then reached about 4% of the unfished level, representing significant recruitment overfishing and consistent with the considerable increases in recruitment observed as the spawning stock has rebuilt.

3.7 The future

The dual challenges in coming years are to continue steady rebuilding of the spawning stock to secure the target level and to avoid catches ‘overshooting’ the desired sustainable level, which would have negative impacts on the stock and require subsequent TACC reductions. The challenge of not ‘overshooting’ is complicated because the stock status giving MSY or MEY will be known accurately only when recruitment to the fishery can be seen to plateau on average as spawning biomass continues to increase. There is a several year delay between a given estimate of spawning biomass and observation of the recruitment generated from that biomass. There thus is a risk that catches could be increased above the sustainable level during that delay period, before the plateau level is recognised, resulting in a several-year delay before the oversetting of TACC is detected. Determining and achieving such targets in this fishery will be adaptive by necessity, guided by the (prospective) stock assessments and monitoring results following TACC settings. The Committee therefore supports constant catches for intervals of two or more fishing periods following moderate catch increases, so that the relationship between increasing spawning stock and recruitment can be evaluated as the target of a sustainable catch level is approached. This strategy minimises the risk of ‘overshoot’ of target catches and consequent damage to the stock, or catch corrections that would be disruptive to the fishery. Maintaining this strategy is important particularly in the next few years as the predicted maximum sustainable catch is approached.

The fishery data, scientific monitoring data, and stock assessment provide consistent evidence in support of the above interpretations. The range of different information and its consistency is a significant source of confidence in the assessment and management of this fishery. The scientific monitoring program is particularly valuable as it provides direct measurement of some key indicators for the fishery that are independent of industry reporting and model assumptions.

4. ECONOMIC CONSIDERATIONS

4.1 Introduction

Economic information available for considering economic implications of alternative TACCs included estimates of gross value of production from the fishery, market prices from the Sydney fish market (SFM), share trading prices and quota leasing prices from a subset of trades where information was provided voluntarily. Average catch rates provided indirect productivity measures for the fishery.

The absence of primary data on fishing costs means that it is not possible to make a complete analysis of the economic performance of the NSW rock lobster industry, although trends in profitability can be inferred using some simplifying assumptions around profit decomposition. Economic implications of different TACC scenarios cannot be assessed fully, however, from gross returns alone. The constraints of limited economic information have been highlighted in several previous determination reports.

4.2 Changes in Fishery Gross Value, Lobster Prices, and Market Destinations

The gross value of production (GVP) of the fishery in 2018–19 is estimated to be \$13.75 m, based on Sydney Fish Market (SFM) prices and assuming the whole quota (170 t) is taken. Prices received on the SFM increased in nominal terms⁴ from \$ 75.13/kg in 2017–18 to \$80.90/kg up to May 2019. Around 44% of the product was consigned to the SFM in 2018–19 (up to 3 May 2019), higher than in 2017–18 (41%).

Around half of the remaining product was exported, mainly to China. Export prices have fallen in recent years, believed to be due to falls in demand flowing from a slowdown in the Chinese economy, as well as expansion of sales of US lobsters into the Chinese market.⁵ The current trade war between the US and China, and subsequent increase in tariffs on US imports in China, may result in more favourable prices for Australian producers over 2019. The reduction in tariffs on Australian imports as part of the Australia–China free trade agreement and the relative devaluation of the Australian dollar (AUD) against the Chinese Yuan (CNY) also are likely to result in improved prices in 2018–19 and coming years.

GVP often is used as an indicator of the gross value of the fishery to the community but better information on actual prices is required to derive a more detailed and accurate picture of the fishery's economic performance. Information on how prices change with landings, either as a result of changing market allocations or due to a price–quantity relationship on the main domestic markets, also is needed to help assess the effects of changes in TACCs, and size composition of catches, on prices and fishery revenue.

The price–quantity relationship for NSW lobster is complicated. There appears to be a negative relationship between quantity on the SFM and the monthly price received by fishers, although there also appears to be a strong seasonal influence on price. Large quantities supplied to the SFM in short periods are believed to have substantial negative impacts on prices. Export prices are believed to be less affected by domestic supply, and so are more stable. NSW product is highly substitutable with lobster from other Australian States or other nations, so the export price received will be more dependent on total Australian (and international) production than on NSW production alone. US supplies to China are believed to have increased over 2018, for example, contributing to the decline in price on the Chinese market, but are expected to decline in 2019. Any future increase in NSW catch is likely to be diverted to the export market provided the Australian dollar does not strengthen substantially. The 12 month forecast for the AUD against the CNY is for it to again depreciate slightly⁶, which may provide some additional benefits to the NSW exporters over the coming year.

4.3 Fishery Profits and Quota Trading Prices

Higher quota trading prices are a good indicator of industry expectations of profits, as there generally is a direct relationship between expectations of profits and quota and share prices. Reported quota trading prices increased by 20% between 2017–18 and 2018–19, suggesting that fishery profits increased over the last year.

⁴ Nominal values are the actual or 'raw' transaction values recorded at given times, without adjustment for inflation from previous or later times. Real values are the transactions values at each time adjusted for inflation between the time of transactions and some reference period. Comparison of real values over time are more sensible because effects of inflation have been removed. The Consumer Price Index (CPI) often is used for the adjustment since it reflects changes in the costs of living, and inflation, over time.

⁵ <http://www.abc.net.au/news/2017-04-07/rock-lobster-price-falls-with-demand-lessening-from-china/8426944>

⁶ <http://www.nab.com.au/business/international-and-foreign-exchange/financial-markets/exchange-rate-forecast>

4.4 Economic Targets for the Fishery

The Committee again noted that there is no formal (or informal) economic objective for the fishery, nor an economically-based target level of biomass and catch. Recent good fishing periods have demonstrated to the industry that the fishery has the potential to generate substantial profits, although neither how large is that potential nor what is an economic optimum for the fishery can be established.

It is important that industry, managers, and policy makers determine what they want to achieve in the fishery, especially now that the stock is considered confidently to be well above the limit reference point implicit in the legislated management trigger (25% of pre-exploitation biomass). Failure to set specific objectives and targets for the fishery exposes the fishery to risks of not achieving its full potential, operating less efficiently than possible, or returning to stock sizes closer to the limit reference point if future stock increase immediately are consumed through short term increases in allowable catch.

4.5 Future Economic Information Needs

The outcomes of this year's assessment reaffirm the need for robust economic information to support future deliberations and ensure that TACCs are set that maximise returns from the fishery to both industry and NSW coastal communities. Key economic analyses should include:

- Bioeconomic modelling, building on the current stock assessment models, to estimate Maximum Economic Yield from the fishery;
- Productivity analysis to estimate effects on performance of heterogeneity in fishing behaviour and operational characteristics;
- Analyses of price dynamics to verify how prices on the SFM change with supply and interactions between supplies to the export and domestic markets, including costs of supply to alternative markets; and
- Fishing cost analysis to document how fishing costs vary among different sectors in the fishery (e.g. inshore vs offshore) and quantify cost–production relationships.

The apparent importance of prices in driving profitability in the fishery means a better understanding of the impact of changes in TACCs on prices will be important for future assessments. The limited information available suggests that marginal costs are increasing with the TACC. Confirming this through a more detailed analysis of costs, therefore, also will be important when assessing the likely implications of different TACCs for fishery profit. Such information also could be incorporated into a bioeconomic model of the fishery to provide greater assistance in assessing TACCs and their effect on fishery profitability as well as identifying potential target reference points for the fishery. Development of economic objectives for the fishery also are essential to enable strategic analyses of TACCs appropriate to legislative and industry aspirations for the fishery.

Analyses of likely dynamics of recreational fishing demand also will be important for future TACC determinations, especially to estimate how recreational catch might change with changing stock levels and greater ease of capture by recreational fishers.

5. MANAGEMENT CONSIDERATIONS

5.1 Management implications of stock status

The stock assessment indicates that the lobster stocks are significantly higher than the trigger point in the FMS and the basic economics of the fishery are sound. The stock assessment continues to be refined, and the analysis presented to the Committee is a useful basis for decisions regarding the TACC. The Committee is confident, therefore, that it can make informed and low-risk decisions in the short term. Uncertainties remain in the stock assessment, however, so improvements should continue to be pursued, including to the data underpinning the stock assessment and management processes. That work, plus additional economic data and analysis, will be necessary to detect reliably any downturn in the stocks and to make medium to long term decisions that optimise fishery benefits. The primary gap at present however, is the poor information available to estimate harvest by recreational and Aboriginal fishers. Better understanding that component of harvest, and in particular any increases in non-legal 'commercial' harvest, is important to further minimising management risks in this fishery.

5.2 Non-commercial components of the fishery

Estimating recreational participation rate and catch has been problematic in the past and there is no quantitative evidence to support the varied views on these issues. The most recent estimate of recreational lobster harvest was provided in the NSW/ACT recreational fishing survey (West et al. 2015), where the estimated harvest was 23,200 lobsters, with a 95% confidence limit of +/- 24,500. The uncertainty in this estimate is so high that there can be no confidence in its use for management purposes. The results of an updated recreational fishing survey are expected in mid-2019, though estimates of lobster harvest from that survey also are likely to contain significant uncertainty. The option to notify an intention to fish for rock lobster when making a recreational fishing licence application is a positive step that may help future assessments by providing a targeted sampling frame, although the utility of that device would be improved materially if nomination of intent to take lobster was obligatory rather than optional. There is no current plan to use that sampling frame for a targeted survey of lobster fishers to improve harvest estimates.

It is reasonable in the meantime to assume recreational fishers will target rock lobster more as lobsters become more abundant and easier to catch, or will be more likely to take lobster while targeting other species. Some anecdotal information from industry at the public forum suggested that recreational effort may be increasing in some areas, due to the increased availability of lobster. The paucity of data, however, means that change in the recreational harvest cannot be inferred with confidence. The Committee therefore continues to assume that any increase in recreational catch as a result of higher abundances reflects the existing share of the sector. The Committee cautions against any consideration of increases to recreational catch or effort limits until there is greater certainty in estimates of recreational catch and robust procedures in-place to monitor recreational catch.

Aboriginal cultural fishing has been recognised formally under a 2010 amendment to the *Fisheries Management Act 1994*, the relevant elements of which will provide regulation-making powers that allow limits (including bag and possession limits) or other management options to be applied to special cultural fishing provisions. These provisions have not commenced yet but an interim policy is in place to implement the intent of the amendments through permits. A number of cultural fishing permits were issued in 2017–18 and 2018–19 that allow for lobster harvest. These permits are issued for a basket of species, not just lobster, and advice from fishery compliance officers is that actual take is often significantly less than the amounts formally permitted. The catch under Aboriginal cultural fishing permits remains unlikely to have a detectable impact on the resource.

5.3 Compliance

Overall (recreational and commercial) compliance rates in the lobster fishery for 2017–18 was 89% and for 2018–19 (YTD) is 82.5%. These represent high levels of overall compliance in comparison to recent years, potentially as a result of sustained compliance efforts and appropriate intelligence-led and risk-based compliance approaches. The compliance rates over the past six years are set out below.

	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19 (YTD)
Overall	74%	81%	79%	66%	89%	82.5%
Commercial	58%	73%	74%	46%	61%	68%
Recreational	91%	88%	83%	89%	93%	87%

The information provided on compliance effort suggests that the level of targeted compliance effort has remained reasonably stable over recent years. This suggests that the structure of the compliance program has stayed roughly the same, with a balance between routine patrols focussed on compliance in general and intelligence-led, targeted effort focussing on specific (likely) rock lobster offenders. The observed trends in compliance rate, therefore, are probably reliable, noting that compliance rate is an inherently broad and simplistic measure that requires some qualitative analysis for interpretation.

Compliance with the TACC goes to the integrity of the quota system and uncertainties in the reported catch, which in turn can affect future TACC determinations. The figures, plus the qualitative analysis provided by the Department, support the conclusion that the majority of the licensed fishers continue to be compliant with regulations and are committed to the rebuilding and strengthening of the lobster stock. Strong penalties recently achieved through successful prosecutions represent important disincentives to more serious offences, including systemic and targeted illegal operations. The types of offences detected demonstrates that the mechanics of the quota system continue to be monitored and breaches continue to be detected at low levels. This is to be expected, especially with the introduction of new reporting systems, and provides confidence that the integrity of the quota system is being addressed actively.

Licence holders expressed to the Committee their continued strong support for the compliance program and for strong penalties, including forfeiture of quota, for serious offences.

5.4 Management decision-making framework

Both the Lobster Share Management Plan (SMP) and the Fisheries Management Strategy (FMS) specify objectives, performance indicators and trigger points that provide a framework to measure the performance of the fishery against the objectives. Both current CPUE and estimated stock biomass far exceed their triggers in the SMP and FMS respectively.

The Department and Industry are conscious that the existing frameworks are out of date, and that more appropriate performance indicators and targets need to be developed, particular as the fishery continues to improve biologically and move away from its trigger points. The Department has commenced the development of a harvest strategy for the fishery which will specify limit and target reference points for the lobster fishery, and is closely consulting with Industry as part of the process.

The Committee has been implicitly using its own targets and objectives, in the absence of formally specified targets, to guide decisions on appropriate stock levels to support a sustainable and profitable fishery. The stock has recovered substantially over the past 15 years as a result of TACC amendments and management actions and is now well above the interim limit reference point of 0.2 of the unfished spawning biomass. The stock assessment presented to the Committee now estimates stock deletion level of 0.34, which is close to levels that would represent the proxy target reference point of a Maximum Economic Yield (MEY) equivalent to 1.2 time the estimated Maximum Sustainable Yield (MSY). The economic conditions in the fishery are largely positive, and industry present at the public forum have indicated that they are broadly comfortable with the catch rates and economic returns currently being generated in the fishery. All of these indicators suggest that the stock levels are now providing conditions consistent with (implicit) biological and economic objectives for this fishery, and therefore the stock conditions that would likely be sought as targets in a well-considered harvest strategy.

It is necessary, however, to develop an agreed harvest strategy that formalises the objectives and reference points for the fishery in order to ensure that economic returns are being optimised and strategic long term decisions on harvest can be made appropriately. This will enable more informed and strategic TACC setting and ensure that appropriate and timely management responses can be made to future changes in the stock. The Committee recommends that the Department continue to progress development of the lobster harvest strategy, using a considered and consultative process. The Committee supports continuing to refine the stock assessment model to enhance medium and long-term forecasts, and to develop a bio-economic model to inform strategic decision making and the development of appropriate harvest control rules, to inform this process.

Cost recovery is relevant to making long term investments in management of the fishery. The contribution of management charges to total costs as a share of fishery GVP has contracted over the last decade from around 15% to below 5%. The Committee continues to support a transparent system of cost recovery where services received by industry against management and other charges are fully justified and delivered efficiently. The totality of fees applying to the fishery should be considered, however, and thought be given to developing an overall, risk-based, management package (including science and compliance) that has costs appropriate to the scale of the fishery.

5.5 Engagement

The Committee continues to be confident that the open forum process that has been in place for several years is working effectively and appears to have the ongoing support of commercial fishers. The Committee finds the level of discussions at the open forum to be positive and constructive. It would benefit the fishery if other non-commercial fishing sectors became more engaged with this process, in particular to provide some qualitative information on the levels and locations of non-commercial fishing of lobster, given the absence of reliable quantitative estimates.

The Lobster Industry Working Group is established and is engaged actively in managing the fishery. The Committee strongly supports this group, especially in taking a strategic long-term focus. There are challenges ahead for the industry if the fishery is to reach its full potential and a cohesive and planned approach will be important. The fishery still requires investment in management (research, management, compliance) and would benefit greatly from a framework for assessing how and when to invest in specific elements. Developing a harvest strategy should be a core component of such a framework and industry is urged engage fully in that process.

Industry observations reported to the Committee were largely very positive about the status of the fishery. This was balanced by a measured low-risk approach to the long term management of the fishery and a desire not to increase the TACC too quickly and risk the current favourable conditions. Most industry members present at the forum expressed a preference to hold the TACC constant at current levels.

Some industry participants suggested that a review of the maximum size limit, or some ability to harvest larger lobsters (>230mm), could be considered. The Department has undertaken some preliminary analyses of the implications of changing size limits but the potential effect of targeting specific size classes on the biomass more broadly is not yet clear. The Committee encourages the Department to continue to refine their analyses to enable robust assessment of the potential effects of changes to size restrictions. The Committee recommends that the current size limits should be retained until such robust and detailed analyses are available.

6. CONCLUSION

6.1 Summary

The Committee continues to be impressed by the high level of co-operation between the Department and the commercial sector for both the research and compliance programs. The Committee acknowledges the consideration and feedback provided on its recommendations.

The Committee notes industry's advice that shareholders favour a cautious approach to stock rebuilding but are very confident in their observations that the stock is in a very strong position.

The Committee notes that uncertainty remains about the amount of recreational catch. Accounting for recreational catch is important for the management of the fishery as TACCs are set at levels close to those thought to be near maximum sustainable levels and so any changes in recreational harvest become more influential on future stock status. The likely long lead-times to implement methods for regularly collecting recreational fishery data also mean this uncertainty should be addressed sooner rather than later.

There also are basic economic data that should be collected to inform future TACC setting in the interests of setting economically and biologically optimal TACCs. The Committee has been highlighting this for several years and it is time now to collect that information.

The Committee again emphasises the need for a change in management approach to the fishery. A revised management plan with newly-defined fishery objectives and a formal harvest strategy are needed to facilitate further development of this fishery. We acknowledge, however, that the Department and Industry appear to have made material progress over the last year toward resolving an agreed harvest strategy. A key part of that harvest strategy will be articulation of what is most valued in the lobster fishery, such as stability of catches, maximising catches, or maximising profits. Having clearly defined objectives is essential for a useful harvest strategy and an investment framework for the fishery. It also is key to recognise the need for formal limits and targets that incorporate economic as well as biological considerations. The absence of that framework continues to affect materially TACC Determinations.

The Committee also acknowledges the continued improvement of the stock assessment model over the last year. That model now is providing rudimentary forecast information that is necessary to refine TACC-setting to meet fishery targets, once the latter are resolved.

6.2 Total Allowable Commercial Catch for 2019–20

The Committee was presented with a detailed Resource Assessment based on available fishery-dependant catch and effort information as well as data from fishery-independent surveys. Management and compliance reports also were provided.

The key factors in arriving at the Total Allowable Commercial Catch for 2019–20 were:

- The spawning biomass is estimated with considerable confidence to be significantly above the management trigger point of 25% of pre-exploitation levels;
- All measures of recruitment (puerulus settlement, catch rate of undersize lobster, and fishery-independent catch data) indicate continuing healthy recruitment to the fishery;
- There are reasonable levels of consistency among the fishery data, scientific survey, and model-based indicators for the fishery;
- There is agreement that current recreational and unreported catch can be regarded as 'low' for current assessments;
- Compliance rates for the fishery are stable in the long term with improvements over recent years;
- Catch rates of lobsters across the legal size range and discard rates of lobsters above the maximum legal size have continued to increase, indicating sustained rebuilding of the harvestable and spawning stock; and
- Industry opinion favours a cautious approach whilst the lobster stock continues to rebuild and generally favour a small or zero increase in TACC accordingly.

The Committee therefore has resolved to maintain the TACC unchanged for the 2019–20 quota year. The Committee has reached this conclusion after taking into account the positive stock assessment and improvements in model prognoses about stock performance under alternative harvest regimes, but with reasonable caution about the unknowns about the stock, its limits, and at what stage of rebuilding it stands. Uncertainty about the relationship between the now well-established spawning stock and recruitment at current catch levels warrants caution in setting the TACC to minimise the risk that over-optimism results in setting a higher TACC that subsequently proves to be 'over-shoot' and requires

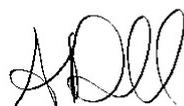
reduction. The Committee's determination for 2019–20 again strikes a balance between allowing for further rebuilding of the spawning biomass and a conservative approach to exploring the sustainable biological and economic potential of the fishery under slightly increased harvest.

6.3 The Determination

The Total Allowable Fishing Committee, pursuant to Divisions 1 and 2 of Part 2a of the Fisheries Management Act 1994 (as amended), determines that the Total Allowable Commercial Catch of rock lobster that may be taken in the NSW Rock Lobster Fishery during the period 1 August 2019 to 31 July 2020 should be **170 tonnes**.



Bruce Mapstone,
Chair



Alice McDonald
Fisheries Management



Sean Pascoe,
Natural Resource Economist



Keith Sainsbury,
Fisheries Scientist

Acknowledgements

The Committee thanks the authors of submissions for consideration in this determination and those fishers who attended and provided valuable discussion in the open forum on May 22nd. We also thank the Departmental officers who prepared comprehensive reports on management, compliance, and the stock assessment on which we drew heavily in preparing this report. The figures and tables in this report are taken from those Departmental reports.

APPENDICES

APPENDIX 1. PUBLIC CONSULTATION

Public consultation steps taken by the Committee, with support from the Department, are summarised in the table below. These steps effected the consultation requirements stipulated, *inter alia*, in the *Fisheries Management Act 1994, Part 2a, Division 2, S40*.

Date	Fisheries Management Act Reference	Consultation Stages
11.04.2019	Section 40F(1)	Call for public submissions on the appropriate level of the annual TACC for Lobster for 2019–20.
11.04.2019	Section 284 (1b)	Advertisement inviting submissions placed under ‘Open for Comment’ on the DPI website.
11.04.2019	Section 284 (1b)	<p>Individual calls for submissions sent to particular interest groups who the Committee considered might wish to provide collective submissions either due to their direct involvement in the lobster fishery or their interest in related issues. These groups included:</p> <ul style="list-style-type: none"> ■ All NSW Lobster Shareholders; ■ All Members of the NSW Lobster Fishery Working Group; ■ NSW DPI Fisheries Offices; ■ NSW DPI Head Office.
13.05.2019	Section 284 (1b)	Public consultation closing date, after at least 30 days.
	Section 40F (1)	<p>The Committee received the following collated submissions:</p> <ul style="list-style-type: none"> ■ NSW DPI Commercial Fisheries Management Report; ■ NSW DPI Research and Resource Assessment Report; ■ NSW DPI Fishery Compliance Report; ■ 2 Shareholder submissions.*
22.05.2019	Section 40F (2)	<p>The Committee considered submissions and heard formal presentations and opinions at the Total Allowable Catch Committee Open Forum meeting in Sydney on 22 May 2019. The following attended the meeting:</p> <ul style="list-style-type: none"> ■ Steve Burt, commercial fisher; ■ Mark Cranstone, commercial fisher; ■ Steve Drake, commercial fisher; ■ Daniel Gogerly, commercial fisher; ■ Mark Horne, commercial fisher; ■ Brad Horne, commercial fisher; ■ Lee Monin, Rock Lobster Working Group; ■ Les Muller, commercial fisher; ■ Peter Offner, Rock Lobster Working Group; ■ Daniel Stewart, Rock Lobster Working Group; ■ Scott Westley, Rock Lobster Working Group. ■ Nicholas Giles, Commercial Management, DPI; ■ Matt Cartwright, Compliance, DPI; ■ Joseph Wright, Compliance, DPI; ■ Geoff Liggins, Scientific Services, DPI; ■ Giles Ballinger, Science & Research, DPI; ■ Marcus Miller, Science & Research, DPI; ■ Julian Hughes, Science & Research, DPI <p>An apology was received from Noel Gogerly.</p>

* *These submissions were either marked ‘Confidential’ or contained commercial information that was considered confidential. Identification of the authors has been withheld from the Report and Determination. One submission was received in advance of the public forum and the other was submitted in-person at the forum.*

APPENDIX 2*. SUMMARY OF SUBMISSIONS

Submission provided by	Issue(s)
Shareholders A	<p>Very good year in 2018–19, landing 95% of quota in first 3 months & then leasing quota for rest of year. Employed more crew than usual to handle very large catches.</p> <p>Very good prices for product but economics limited by quota availability. Would like to see fisher-only web site for quota trading.</p> <p>Selected premium-grade (best priced sizes) at sea for first time, releasing lower-valued sizes.</p> <p>Some variation among depth-grounds, with mid-depths most productive and deepest grounds disappointing.</p> <p>Major increased in over-sized & berried female lobsters in mid-depth grounds compared to previous years.</p> <p>Have had much lower recoveries of tagged lobster than previously, perhaps indicating very large populations.</p> <p>Have seen fair bit of upgrading by lobster fishers, indicating strong confidence in the fishery.</p> <p>Favour small increase in quota, perhaps 5%.</p>
Shareholders B	<p>Agreed that the NSW rock lobster stock "..., in the whole, is in good condition ..."</p> <p>Concerned that overall depictions of the stock obscure some local dynamics that have changed significantly over about the last 10 years. Examples presented of declining production of legal-sized lobsters in some north coast areas, seemingly accompanied by changes in the timing and quantity of immigrating mature lobsters. These changes have necessitated longer steams (usually southward) to find better grounds and sustain catch rates at what had been realised locally about 10 years previously.</p> <p>Noted that declines in harvestable (legal sized) lobsters is accompanied by regular increases in numbers of very large lobsters (above maximum legal size) but without replacement of smaller (legal sized) lobsters. Unclear about why the recruitment of legal-sized lobsters apparently is failing in these areas.</p> <p>Suggested consideration be given to allowing harvest of very large lobsters (e.g., greater than 220 mm carapace length) that might be reproductively senescent and whose removal might facilitate successful immigration of smaller animals to available habitat.</p>

** These submissions were considered confidential. Identification of the authors has been withheld from the Report and Determination.*

APPENDIX 3. STOCK STATUS AND ASSESSMENT

A3.1 Introduction

This Appendix provides more technical detail about the data and analyses used to infer the status of the rock lobster stock and upon which to make the Total Allowable Commercial Catch (TACC) Determination for 2019–20. The focus here is on key features of data and what can be inferred about current and likely future states of the rock lobster stock. The key findings and methods from a resource assessment done by DPI using a length-based population model also are reviewed as the primary basis for setting a TACC.

A3.2 Fishery reference points

Target and limit reference points for the fishery have not been set formally but the Committee has identified and used implicit target and limit reference points for several years. The current stock assessment provides analysis of reference points and justification for some specific values, with the target reference point being selected to achieve Maximum Economic Yield (MEY). The Committee considers these analyses to be well-founded and so will treat these as the interim reference points for assessment of fishery status. The Committee recognises that a more formal process is needed to adopt reference point for the fishery harvest strategy. The Committee also recognises that in recent years average recruitment to the fishery has continued to increase as the spawning biomass has rebuilt. The biomass at which the recruitment 'levels off' will affect the MEY target reference point and so this should be reviewed periodically to reflect the changes observed.

Target reference point. The Committee has treated a spawning stock depletion of 0.48 as the interim target reference point, this being the default target reference point for Maximum Economic Yield (MEY) in the Commonwealth Harvest Strategy Policy.

The current assessment estimates that at MEY the depletion of the spawning biomass (B_{MEY}) is to 0.3 of the unfished level, that depletion of the exploitable biomass is to 0.49, and that the harvest fraction is 0.16. The depletions for spawning and exploitable biomass at MEY are very different because fishery selectivity is highly constrained by the minimum and maximum size limits. These values use 1.2 times the estimated biomass at Maximum Sustainable Yield (B_{MSY}) as a proxy for B_{MEY} . Other studies suggest a value of $1.25 \times B_{MSY}$ is more appropriate but in this lobster fishery the difference would be operationally insignificant because the yield curve is very flat. It would be desirable, however, to avoid the need for use of such proxies by directly using a bioeconomic model, which could be achieved by adding economic information to the existing stock assessment model. The Committee accepts the B_{MSY} value as appropriate at this stage, however, and considers that spawning biomass depletion to be the primary target reference point.

Limit reference point. The 2007 Fishery Management Strategy identifies stock depletion to 0.25 of the unfished biomass as a level of depletion that is of biological concern and that would trigger a review of management.

The current analysis indicates that a limit reference point of 0.2 of the unfished spawning biomass is appropriate for this stock and the selectivity patterns in the fishery. The Committee accepts that a spawning stock depletion of 0.2 of the unfished level is an appropriate limit reference point.

The new analyses confirm some previously anticipated aspects of the fishery that are highly relevant to management.

1. The long-term Maximum Sustainable Yield (MSY) and Maximum Economic Yield (MEY) are both very close to current catches. Consequently, there is limited expectation for substantially increased catches in future. This interpretation will be updated as additional observations are obtained about the relationship between recruitment to the fishery and spawning biomass. The MEY catch would be expected to increase to the extent that recruitment continues to increase as spawning biomass increases, but such potential for increases must be explored with caution.
2. The limit and target reference points are quite similar — spawning stock biomass depletion of 0.2 and 0.3 respectively. There consequently is risk of breaching the limit if fishery assessment does not track changes accurately or if management does not respond adequately to changes. It has been noted previously that this is a gauntlet fishery and the amount of 'escapement' of juveniles through the fishery to join the breeding stock is a key factor in determining long-term sustainability. There is an abrupt threshold in the escapement, and consequently the harvest rate on exploitable biomass, beyond which the population would collapse despite protection provided by an upper size limit. There are two aspects of the assessment and management of the fishery that ameliorate these risks. The first is that a collapse through inadequate escapement should be slow and if

detected early could be corrected readily through catch controls. The second is that the fishery assessment has a relatively precise confidence bound and several independent aspects of the population are monitored, so the fishery assessment would be expected to quickly detect stock deterioration if that occurred. Detection of deterioration could be increased through development of an index of escapement, which should be possible from information already collected.

The analyses provided this year also examined the effects on MSY, and hence on MEY and related reference points, of varying the minimum and maximum legal lengths. There is predicted to be very little change in MSY for increase in the minimum legal length from 104mm (the current minimum legal length) to about 125mm, and for there to be decreases in MSY for larger values. MSY increases materially, however, if the maximum legal length is increased or removed. For example, the MSY would increase by almost 40 t per year if the current minimum legal length was maintained and the maximum legal length was increased from the current 180mm to 200mm. While the analysis examined the effects of changed legal lengths on the MSY, it did not report the effects on spawning stock depletion or exploitable stock depletion, which are essential to comprehensive understanding of the implications of changes in legal lengths. An addendum to the assessment report provided after the public forum detailed the latter metrics and indicated that modelled alternative regimes of minimum and maximum legal lengths likely would have little to no adverse effects on spawning stock or available stock depletions. Further analysis should be done about sensitivity of these results to potential shifts in size-selectivity or high-grading of catches with changes in size limits.

The current maximum legal length was introduced to protect the spawning stock when the spawning stock was very low, and it has succeeded in that. The risk to the spawning stock is reduced following its rebuilding, but its protection remains critical to future biological and fishery performance. Any relaxation of the maximum legal length must be accompanied by management measures to prevent excessive targeting of the spawning stock, effective monitoring to detect reduction of the spawning stock, and commitment to rapid management intervention if significant targeting or reduction of the spawning stock was detected.

A3.3 Data

A3.3.1 Illegal, Unreported and Non-commercial Catches

Large uncertainties exist about the levels of non-commercial (primarily recreational) catch and unreported (including illegal) commercial catch.

- Recreational catch of rock lobster has been estimated from research and intermittent general recreational fishing surveys over the last 2 decades but those estimates are extremely imprecise. The assumed recent non-commercial catches of 17.5 t roughly coincide with the midpoint of the very imprecise Recreational Fishing Survey done in 2013–14. Uncertainty about recreational catch nevertheless remains of significant concern. Recreational catch is considered by many to have decreased over several years but there also is a common view that it might be increasing again as continued stock recovery makes lobsters more available to recreational divers and attracts greater recreational fishing effort. The assumption of 18.5 t in this year's assessment seems a reasonable allowance for slight increases in recreational catches since the 2013–14 survey. It is very important that processes are implemented to monitor reliably the amount of recreational catch.
- Catch by Aboriginal fishers can be estimated in recent years from permitting provisions for fishing for cultural purposes and is estimated to be very low.
- Unreported commercial catch is extremely difficult to estimate and it is expected that there will be more opportunity and incentive for unreported catch as the stock recovers, especially if product prices continue to increase. Several high-profile prosecutions and the penalties imposed are considered by all stakeholders to provide serious deterrents, but illegal harvest still requires ongoing enforcement and collection of data that allows some estimation of likely quantities of lobsters harvested illegally.

The stock assessment recognises uncertainties in the non-commercial and unreported commercial (NCUC) catch. Estimates of NCUC catch prior to 1969 are recognised to be very uncertain, whereas there is a better basis for estimation post-1969 and particularly post-1994.

The most credible and 'base-case' interpretation for NCUC catch pre-1969 is that true catches from 1884–85 to 1968–69 were, on average, 30% more than the reported commercial catches each year. This conclusion is based on the goodness of fit of the model to catch data under a range of scenarios of non-reporting levels.

The most credible and 'base-case' interpretation for NCUC between 1969 and 1994 is based on occasional surveys through that period. NCUC catch is considered to have increased during the 1970s to high levels (about 50% of reported catch) during the 1980s, before abruptly decreasing as new management arrangements were introduced in the early 1990s.

The most credible and 'base-case' interpretation for NCUC post-1994 is:

- Non-commercial catch equal to 10% of the total commercial catch each year since 1994–5, equating to 10–16 t annually during that period and approximately 14 t in 2014–15, 14.9 t in 2015–18, and 15.8 t in 2018–19; and
- Unreported commercial catch linearly decreasing from 17% of the total commercial catch in 1994–5 to 8.5% in 2010–11 and subsequently, equating to approximately 12–19 t over the 23 years, approximately 16.4 t in 2014–15, 17.5 t in 2015–18, and 18.5 t in 2018–19.

The assumed amounts of recent unreported commercial catch are considered sufficient to represent recent levels of unreported retained catch from the lobster fishery (including illegal catch), unreported lobster catch in the trawl and trap fisheries targeting finfish, mortality due to ghost fishing by lost fishing gear, and predation or other mortality of commercially caught lobsters during fishing operations.

The long-term yield analysis provided in this year's assessment allows calculation of the harvest fraction that achieves the target reference point (B_{MEY} , at a spawning stock depletion of about 0.3 of the unfished level) and the harvest fraction that would reduce the spawning stock to the limit reference point (spawning stock depletion of 0.2 of the unfished level). TACC levels similar to those applied recently would be expected to achieve the target reference point with the recent levels of about 30–35 t of NCUC catch. However, for the same TAC levels the spawning stock would be reduced to the limit reference point if NCUC catch increased to about 100t. This approximate calculation indicates the sensitivity of the stock to increase in the NCUC catch and the importance of both improving confidence in estimates of those catches and continuing enforcement action to contain them.

A3.3.2 Commercial Fishery Data

Records of commercial rock lobster catch are available with few gaps since 1884 (Figure A3.1). These data provide a valuable historical perspective for the fishery and assessment, but they are open to many interpretations. Figure A3.1 shows the catch used in the 'base-case' stock assessment, including most credible estimates of NCUC catch since 1969 but excluding hypothesised unreported catch from earlier years, which was set at 30% of annual reported catch in the base-case assessment.

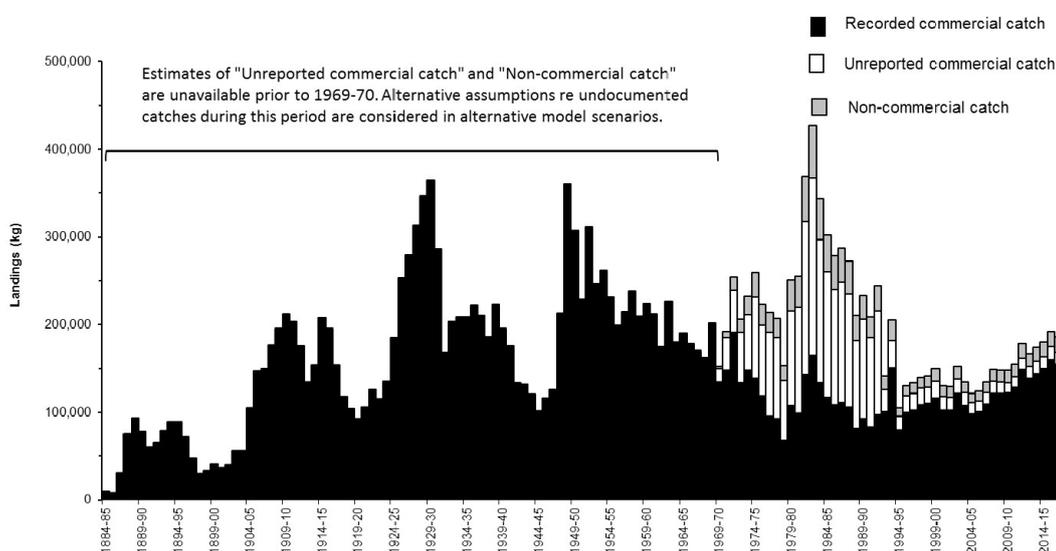


Figure A3.1. The landed catch of rock lobsters since the start of the fishery. The non-commercial and unreported commercial (NCUC) catches are shown since 1969 but the earlier NCUC scenario is not shown in the figure.

The level of discards and likelihood of high-grading of retained lobsters have increased in recent years as the stock biomass has rebuilt and the TACC has become increasingly constraining of catches. Discards were about 8.3 t in 2017–18, which is an increase of about 1.3 t compared to the previous reporting year, about 5.3% of the reported landed catch. It is assumed that 10% of discards do not survive. High discard rates are expected to continue in the fishery and it is necessary to both monitor and include them, and estimates of resulting mortality, in stock assessments.

Total catch, effort, and catch per unit effort (CPUE) since 1969–70 are shown in Figure A3.2, including standardised and unstandardised CPUE since 1997. The standardisation accounts for the gross effects of recent shifts in fishing effort from shallower grounds (less than 30 m) to deeper grounds where larger pots are set for longer periods. The applied standardisation does not account for all the expected effects of these changes, however, nor for increases in efficiency expected from improved equipment and ability to avoid marginal weather or fishing grounds because of improved catch rates. The 2018–19 data are incomplete but account for approximately 84% of the TACC and CPUE is likely to be a close to that for the quota year.

Both un-standardised and standardised catch rates (Figure A3.2) have increased substantially since 2000–01. This indicates a substantial increase in the exploitable biomass of lobsters, but there is also an unknown contribution to these increases likely due to increased fishing efficiency.

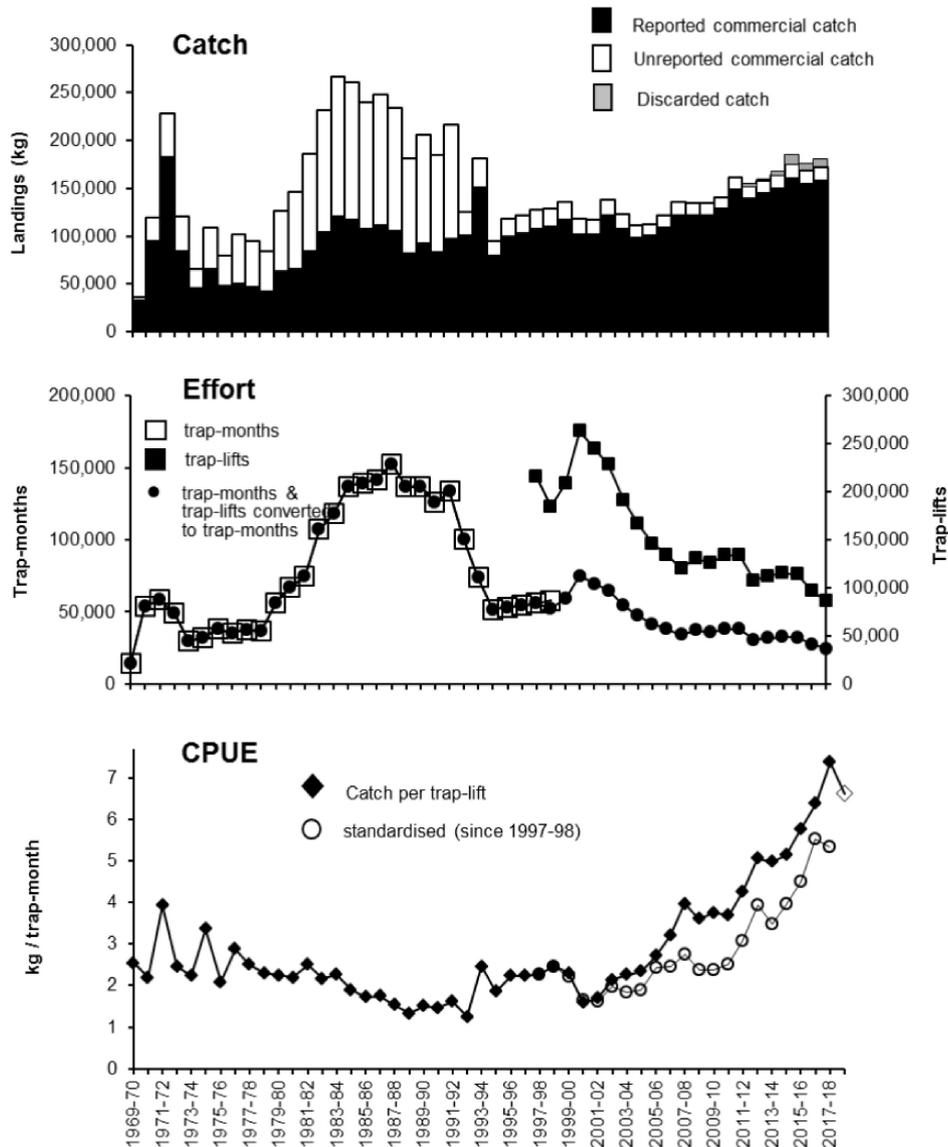


Figure A3.2. Commercial catch, effort, and catch rate since 1969–70 when more reliable effort is available. Data for the 2018–19 represent about 84% of the TACC.

Catch rates in the last few years have been broadly stable or increasing across all the depths and regions where significant fishing effort has occurred (Fig A3.3). High catch rates have been recorded in the 10–30m depth areas in the far-north coast in the last 8–9 years, which implies expansion of the breeding stock back to this area after many years of severe depletion. Catch rates in deep water (>30m) on the central and north coast remain high. Those catches will include maturing lobsters from southern regions recruiting to the spawning stock, indicating a significant and continued contribution to the spawning stock from lobsters surviving the gauntlet of the more southern fisheries. Catch rates of small legal-sized lobsters in shallow water (<10m) also remain high in the central, mid-north, and far-north coasts,

indicating that increased numbers of young lobsters continue to enter the fishery in most regions. The catch rate of undersized lobsters in the most recent year (2018–19), which mostly recruit to the fishery about a year later, was high, consistent with those from recent years. These observations indicate that: (i) good recruitment to the fishery is expected next year; (ii) recent recruitment to the fishery is stable despite inter-annual fluctuations in puerulus settlement; and (iii) there continues to be an overall increase in average recruitment to the fishery as average puerulus settlement increases.

The catch and catch rate data overall support interpretations that the stock has been increasing in recent years and is now well above the low levels of the late 1990s and early 2000s. Catch rates of maturing lobsters from deeper, offshore grounds indicate substantial numbers are reaching the size and age at which they join the spawning stock.

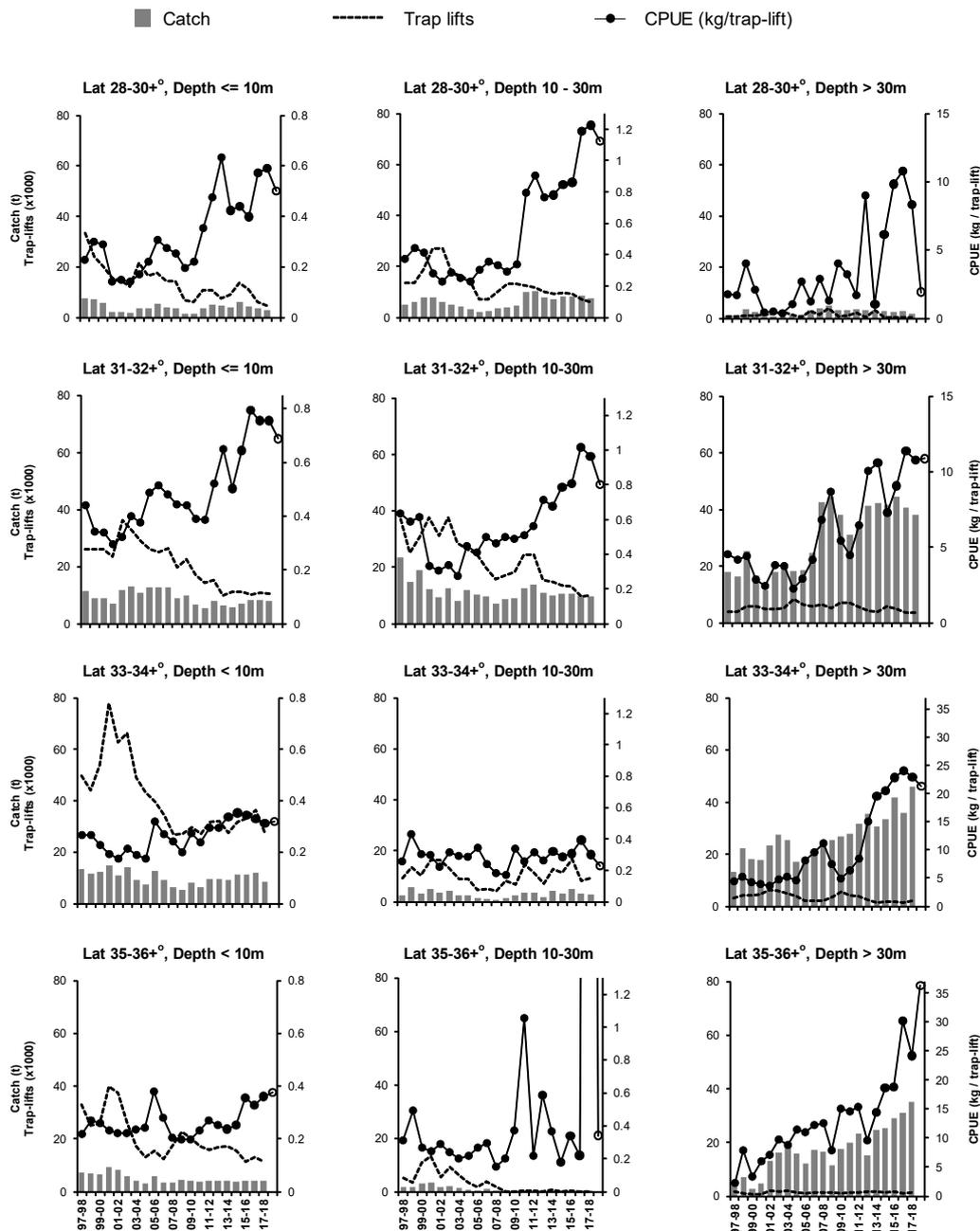


Figure A3.3. Commercial catch, effort, and catch rate by area and depth since 1997–98 when detailed reporting became mandatory. The spawning stock is found mostly in the far north coast (28–30+°) and mid-north coast (31–32°) at depths greater than 10m and especially depths 10–30m. Data for the 2018–19 fishing period are incomplete but include about 84% of the TACC and are expected to be good pro-rata (catch, effort) or average (CPUE) indications of the full year information.

A3.3.3 Fishery independent surveys and monitoring

Independent measures of spawning stock are particularly important in this fishery because a maximum legal size is used to protect the older, mature animals. Commercial catches and catch rates consequently do not fully reflect the spawning stock.

Two fishery independent monitoring programs have been established to monitor the settlement of post-larval lobster (puerulus) from the plankton to inshore reef habitats and the abundance of spawning stock, including that above the maximum legal size. The puerulus surveys started in 1995–96. The spawning stock surveys started in 1998–99 and use standardised pot sets in the northern areas where eastern rock lobster spawn. Puerulus grow and recruit to the fishery about 2–3 years after settlement.

The combination of spawning stock surveys, puerulus monitoring, and fishery data is beginning to allow direct examination of the relationships among spawning stock, settlement of puerulus, and recruitment to the exploitable stock. These data also provide an independent check on the results of the population modelling and so greatly increase confidence in fishery interpretations and management. The value of these data will increase greatly during the next few years. These direct observations will help to define the asymptote beyond which further increase in spawning biomass does not result in increased average recruitment.

Puerulus settlement has been increasing on average since about the mid-2000s, coincident with the increasing spawning biomass. Recent average settlement is more than double the settlement in the late 1990s and early 2000s. Settlement in the past 3 years has been variable but relatively high, and the increasing trend appears to be continuing. The increase in settlement on average has been accompanied by an increase in recruitment to the fishery. The undersize catch monitoring indicates that recent recruitment to the fishery is about double the levels in the late 1990s and early 2000s. The undersize catch rate for the most recent complete year (2017–18) and the current partial year (2018–19) are among the highest on record. The risk of reduced recruitment to the fishery in the next 1–2 years is very low.

Size compositions of the catches from standardised trap surveys on the mid-north and far-north coast are shown in Figure A3.4. These are the areas where mature lobsters are found. Size composition is monitored every second year and was updated in 2018–19. These surveys indicate that the mature female population has recovered substantially from the low abundance and truncated size distribution in the early 2000s. The recovery was very slow until about 2007–08 but has been rapid since then and there are now high catch rates for a wide size-range of mature lobsters.

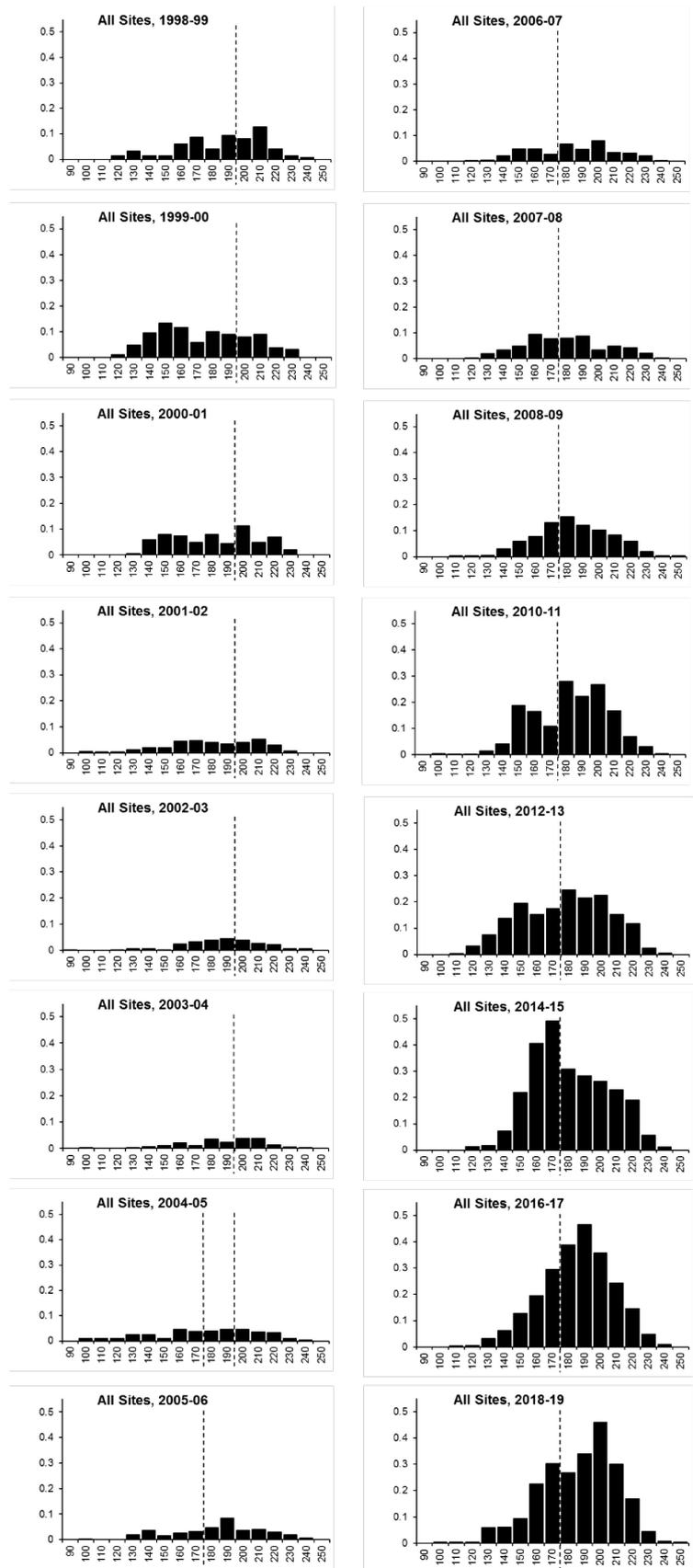


Figure A3.4. Size compositions of lobsters in the commercial catch of the mid- and far-northern areas combined from logbook data augmented by observers. The dashed lines indicate the maximum legal sizes applied in each year, which changed from 200mm to 180mm in 2004–5, and the vertical axis is number of lobsters per pot-lift. Monitoring is done every second year and was updated in 2018–19.

A composite index of the spawning stock from fishery dependent and fishery independent observations is shown in Figure A3.5. It indicates a slow rebuild of the spawning stock through the mid-2000s and then a rapid increase since the late 2000s.

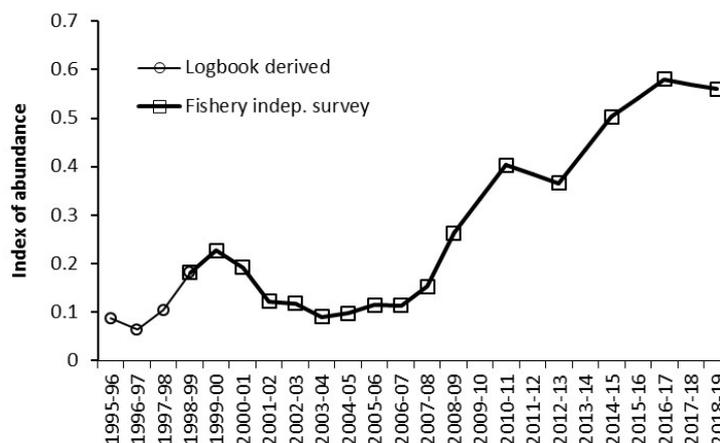


Figure A3.5. Spawning stock index (lobsters per pot-lift) from direct observations. The index is based on commercial catches of berried female lobsters up to 1997–98 and on fishery-independent surveys since 1998. Surveys have been done biennially recently, most recently in 2018–19.

Results from direct monitoring of the spawning stock are very encouraging with respect to the strength of rebuilding. They greatly increase confidence in assessing the status of the stock and clearly and directly demonstrate that management measures applied since the mid to late-2000s have allowed rebuilding of the spawning biomass. The increased spawning stock has been associated with increased puerulus settlement and recruitment to the fishery, albeit with inter-annual variation, which appears to be continuing. The 2018–19 spawning stock index is similar to that from the last survey in 2016–17, which is consistent with model predictions that recent TACCs are close to maximum sustainable levels and that relatively little further increase in spawning biomass is expected. The biennial fishery independent sampling of the spawning stock is considered adequate in the current situation.

A3.4 Analysis

A3.4.1 Stock assessment

The status of the lobster population is assessed annually using a length-based model that explicitly represents the length and associated age structure in the population, as well as sexual differences in some key parameters such as growth, and hence availability to the fishery. It allows calculation of the size of the mature stock, can represent effects of strong or weak year-classes passing through the population, and accounts for changes in gear size-selectivity. The model also incorporates a great deal of other information, including detailed biological information about growth rate, maturity schedule, percentage berried females, natural mortality rate, relationship between mature stock and recruitment, and fishery information including selectivity of the fishing gear, discarding of lobsters near the legal size limits, and mortality of discarded lobsters.

The model is fitted to the catch data (including hypothesised un-reported catch prior to 1969) throughout the history of the fishery, the standardised catch rate data since 1969, and the size composition of 160–200mm lobsters between 1999–02 and 2008–10. The limited size range (160–200mm) is used because it is expected to be less subject to changing fishery practices and the limited range of years with size information is used because the size compositions of catches in those years were collected by observers. A wide range of sensitivity scenarios were conducted to examine the consequences of uncertainties arising from poor knowledge of historical catch under-reporting, alternative rates of natural mortality, the stock-recruitment relationship, fishery size selectivity, discard mortality, and several biological life-history parameters. A 'base-case' model that reflects the most credible parameter values across these uncertainties and that best fit available data was used for the core assessment.

The model was fitted to the observed length frequency, spawning stock index, and standardised fishery catch rate data.

- The fit to the length frequency data was good, including both to the 1999–2002 period of high fishing mortality with a steep gradient in the length frequency distribution and to the later 2012–13 period of lower fishing mortality with a shallow gradient.

- The model fit to the spawning stock index is reasonable, though it underestimates the index since 2013 and cannot reproduce the prolonged period of low spawning biomass during 2001–2007.
- The model fit to the median catch rates is good but the frequency distribution of CPUE appears to have become increasingly skewed since about 2014, with the median and means becoming increasingly different. The cause of this is not clear but it suggests that catchability has been changing recently in at least some parts of the fishery. Operational changes and efficiency gains are to be expected as the fishery approaches the MSY or MEY targets and stabilizes there. It would be appropriate to further examine catchability and its standardisation.

The model estimates that the spawning stock was very depleted in the mid-1990s, with the estimate being that depletion was to about 4% of the unfished level. This depletion represents serious recruitment overfishing and is consistent with the substantially increased recruitment observed as the spawning stock has rebuilt. The extent to which recruitment might further increase is uncertain. Recruitment is predicted to have already reached its maximum (on average) in recent years under the stock-recruitment relationships assumed in the stock assessment model, including the range examined in sensitivity scenarios. Observed recruitment, however, appears still to be increasing as the spawning biomass increases. The stock-recruitment assumptions in the population model should be re-examined to ensure that the base-case assumptions and sensitivity ranges are appropriate.

A3.4.2 Present stock levels

Key population and depletion estimates are provided in Table A3.1 for the base-case assessment. The 95% confidence bounds reflect statistical uncertainty in fit of the base-case model. Sensitivity scenarios contain additional uncertainty due to structural assumptions about the model and input data, but these give broadly similar overall interpretations of current stock status and near-future harvest options.

Table A3.1. Estimates of total and spawning biomass prior to exploitation and in 2018–19 from the base-case assessment model.

Metric	Median	5% limit	95% limit
Unexploited total biomass (K) (t)	7,473	7,409	7,918
2018-19 total biomass (t)	3,113	2,788	4,177
2018-19 total biomass/K	0.417	0.375	0.529
Unexploited spawning biomass (USB) (t)	2,864	2,840	3,035
2018-19 spawning biomass (SB) (t)	974	846	1,421
2018-19 SB / USB	0.341	0.297	0.469

These results indicate that the management measures of the past several years have had the desired effect of rebuilding the stock. The median spawning stock is well above the legislated trigger point of 0.25 of the unfished level and the revised interim limit reference point of 0.2 of unfished spawning biomass. There is also a high probability that the spawning stock is at or above the interim target reference point of 0.3 of unfished biomass.

A3.4.3 Predictions of future stock levels

Predictions under the base-case assumptions were made of the change in biomass that would occur after 5 years of total catch⁷ at various levels, starting from the most recent biomass estimate in 2018–19 (i.e. total catch at various constant levels in years 2019–20 to 2023–24). Changes of spawning biomass are given in Table A3.2 and of exploitable biomass in Table A3.3.

⁷ Conversion between TAC and TACC uses the same method and unreported catch assumptions as last year. The TACC is expected to equal the reported commercial catch (RCC) assuming that the complete quota is landed, and the TAC is equal to the reported commercial catch plus the estimates of unreported commercial catch (UCC) and the non-commercial catch (NCC). The NCC (mainly recreational) catch is assumed to be 0.1 of the total commercial catch (RCC+UCC) and the unreported commercial catch (UCC) since 2010–11 is assumed to be 0.085 of the total commercial catch (RCC+UCC). That is:

$$\begin{aligned}
 \text{UCC} &= 0.085 (\text{RCC} + \text{UCC}) = 0.085 \text{RCC} / (1 - 0.085); \text{ and} \\
 \text{TAC} &= \text{RCC} + \text{UCC} + \text{NCC} \\
 &= \text{RCC} + \text{UCC} + 0.1 (\text{RCC} + \text{UCC}) \\
 &= \text{RCC} + 0.085 \text{RCC} / (1 - 0.085) + 0.1 [\text{RCC} + 0.085 \text{RCC} / (1 - 0.085)] \\
 &= 1.202 \text{RCC};
 \end{aligned}$$

and hence

$$\begin{aligned}
 \text{TACC} &= \text{RCC} = \text{TAC} / 1.202 \\
 &= 0.832 \text{TAC}, \text{ and} \\
 \text{NCC} + \text{UCC} &= 0.168 \text{TAC}.
 \end{aligned}$$

Table A3.2. Predicted spawning biomass in 2024–25 relative to spawning biomass in 2018–19 ($SB_{2024-25}/SB_{2018-19}$) after 5 years of different future constant total catches (including prospective TACCs, estimated non-commercial catches, and unreported catches). All projections use the base-case stock assessment.

Total Catch (t)	Median relative spawning biomass [95% confidence interval]
175	1.07 [1.00–1.11]
200	1.02 [0.96–1.06]
225	0.97 [0.92–1.00]

Table A3.3. Predicted exploitable biomass of 104–180mm lobsters in 2024–25 relative to that in 2018–19 ($EB_{2024-25}/EB_{2018-19}$) after 5 years of different future constant total catches (including prospective TACCs, estimated non-commercial catches, and unreported catches). All projections use the base-case stock assessment.

Total Catch (t)	Median relative exploitable biomass [95% confidence interval]
175	1.04 [1.00–1.08]
200	0.95 [0.92–0.97]
225	0.85 [0.83–0.87]

It is predicted that for catches at recent levels [TACC = 170 t, total catch (TAC) = 204 t] the spawning biomass would remain at about recent levels and the exploitable biomass would decrease slightly. The 5y stock projections in recent years have been pessimistic compared to actual outcomes, probably because of uncertainty about the stock-recruitment relationship. The model assumption is that recruitment should not, on average, increase further, but if recruitment continues to increase then the current model predictions will continue to be pessimistic. This situation needs to be explored with caution.

A3.5 Conclusions

Management decisions in the past several years have been aimed at stock rebuilding. There is now clear measurable evidence that significant rebuilding of the spawning biomass has been achieved since about 2000. There is now little chance that the spawning biomass is depleted below the current interim limit reference point of 0.2 of the unfished level. The median estimate of spawning stock depletion is 0.34, and there is a high probability that the stock is at or above the interim MEY target reference point of 0.3 of the unfished spawning stock biomass.

There are uncertainties in the model interpretations about the extent of stock rebuilding and the potential for further rebuilding, but all model interpretations indicate that significant rebuilding has occurred in the past about 10 years and that it is being maintained or is continuing. This inference is supported by all the empirical observations from the fishery and fishery independent monitoring. The commercial catch rates continue to increase or be maintained in all the components of the fishery that target different sized lobsters. The fishery independent spawning stock index was not updated this year but the commercial catch rates in the areas occupied by the spawning stock have remained high or increased, indicating continued high spawning stock levels. Puerulus settlement, an indicator of recruitment to the fishery 2–3 years later, has increased on average during the past about 10 years as the spawning stock has increased and has been generally high in the past 2–3 years. The undersize catch rate for the most recent complete year (2017–18) and for the current partial year (2018–19) are among the highest on record. The risk of reduced recruitment to the fishery in the next 1–2 years is very low.

In summary, all indicators of stock status trends are positive. The wide range of both model-based and empirical indicators available give a high degree of confidence in the robustness to these conclusions.

The analyses of long-term sustainable catch provide a very sound basis to set stock target and limit reference points, and the Committee has adopted them as interim. The stock is currently at or above the target reference point, and the recent catches are consistent with achieving and maintain the fishery at the target reference point. Consequently, there is limited expectation for substantially increased Total Allowable Catches in future if maintenance of the stock near the interim target reference point remains desirable. This interpretation will be updated as additional observations are obtained about the relationship between recruitment to the fishery and spawning biomass, and to the extent that recruitment continues to increase as spawning biomass increases, but any changes must be explored with caution. It is recommended the stock-recruitment assumptions in the population model be re-examined using the

empirical and model-based measurements of spawning stock and recruitment to the fishery, and that this be used to test whether the base-case assumptions and sensitivity ranges are appropriate.

The analyses of long-term sustainable catch provide a very good basis for development of a formal harvest strategy for the fishery. The harvest strategy should also consider the minimum and maximum legal lengths applied in the fishery. The current analyses examined the effects of changed legal lengths on the MSY and, in supplementary material provided to the Committee, implications for relative depletions of spawning and exploitable biomass under alternative length limit scenarios. These effects are critical to comprehensive understanding of changed legal lengths and it is recommended that the analysis be extended to explore sensitivity of these estimates to potential changes in size-specific targeting or high-grading of catches if size limits were changed.

The Committee has noted in previous years concerns that the current analyses do not represent adequately the catchability and spatial structure of the fishery. This is expected to become more important as the fishery continues to develop and optimise. It is recommended that a more comprehensive and realistic treatment of these inter-related issues be developed.

Management of the fishery through the current circumstance is a balance between the rate of continued recovery of the spawning stock, obtaining observations to recognise the relationship between the size of the spawning stock and recruitment at higher stock levels, and catch forgone in the short term. A low catch, for example, would give the fastest increase in spawning stock and fastest determination of the maximum recruitment but would forego catch in the short-term. A rapidly increased catch, conversely, could prevent further spawning stock recovery, prevent observation of recruitment at higher stock levels, and potentially lock the fishery into a sub-optimal harvest situation, and risk over-shooting the catch associated with maximum productivity. An important aspect of this challenge is the time lag associated with interpretation of different monitored indicators. There is an about 1-year lag between when lobsters spawn and when the measurement of puerulus settlement gives the first indication of breeding success. There is an about 3-year lag between lobsters spawning and when the under-size catch rates in the fishery give the first indication of the strength of the resulting recruitment to the fishery. It is a further year until the recruiting lobsters from that spawning join the exploitable biomass and are more fully reflected in catch rates from the inshore fishery. There hence is a multi-year time lag between the setting of a TACC and being able to observe the effects of that TACC on spawning stock and recruitment. Incremental catch increases need to be monitored for long enough to observe their consequences before the next increment is applied. This approach has been applied in recent years, with a TACC of 150 t applied for 2 years and a TACC of 160 t applied for the following 3 years before the increase to 170 t last year. This approach is applied again here.

The available data and recent resource assessment indicate that it is appropriate to maintain the Total Allowable Commercial Catch (TACC) at 170 t, which corresponds to a Total Catch of 204.3 t including non-commercial and unreported catch. This is expected to at least maintain the current spawning stock and fishery production, based on the recovery already achieved.

APPENDIX 4. ECONOMIC ANALYSIS

A4.1 Introduction

The Fisheries Management Act (1994) requires that the Committee have regard to economic and social issues in making its determination. Absence of specific information on fishing operating costs means that estimates of economic performance are based on quota leasing, share transfer and market prices. Summaries of quota and share market prices are presented as indicators of both short and long run industry profitability. Analyses of other data affecting the economic performance of the fishery, such as export prices, exchange rate movements, and catch per unit effort, also are presented. The analysis is for the rock lobster fishery only and does not consider returns to individual enterprises (fishing businesses) from other types of fishing, which can be quite significant especially in the far north of the fishery.

The absence of any formal economic objective for the fishery also means that performance cannot be assessed relative to any target. Maximum Economic Yield (MEY) therefore cannot be determined empirically for the fishery at the moment but indications are that the fishery is currently *likely* to be close to MEY.

A4.2 Volume and Value of Production

The volume of reported catch of rock lobster from August 1 2018 to 3 May 2019 was 140.5t, representing 82.6% of the TACC of 170 t allowed for the 2018–19 fishing period (Figure A4.1). This is a similar proportion of the TACC as taken in previous years at this stage of the fishing season, noting that only 98.4% of the TACC (160 t) was taken over the full fishing period in 2017–18.

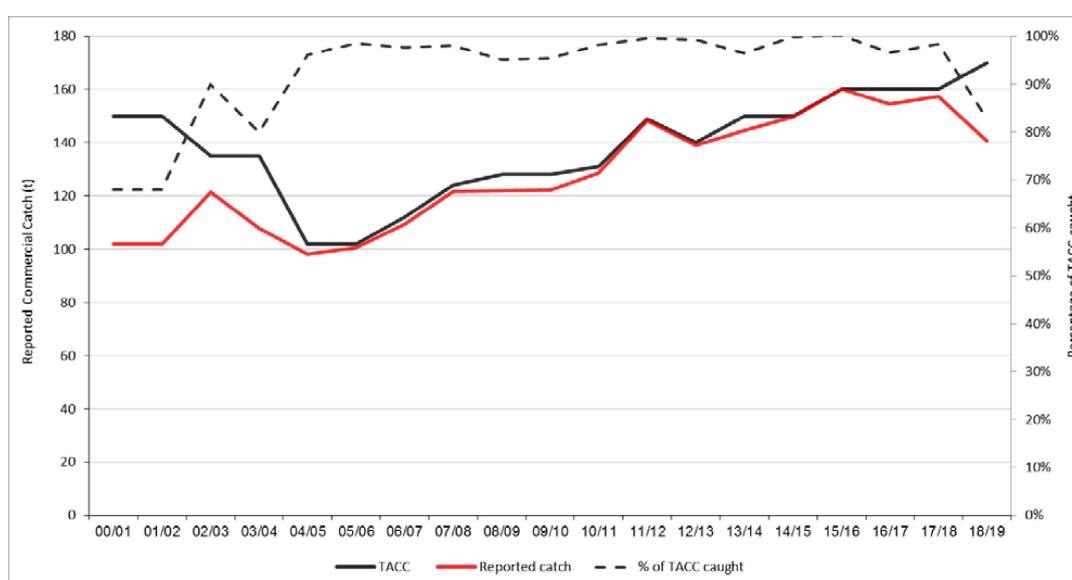


Figure A4.1: Catch, TACC, and per cent of TACC caught 2000–01 to 3 May 2019.

The nominal estimated gross value of production (GVP) for the fishery over 2018–19 is \$13.75m, based on Sydney Fish Market (SFM) prices and assuming the whole quota (170 t) is taken (Figure A4.2). GVP in the fishery generally has increased in both real and nominal terms⁸ since 2012–13, a result of increases in both catches and prices (see next section).

⁸ Consumer Price Index (CPI) adjusted values are calculated using ABS “all groups” CPI data. Real price adjustments are taken from the December quarter of the appropriate year, or the March quarter for the fiscal management charge. CPI adjusted data is identified as “real” price or value figures in graphs.



Figure A4.2: Value of production 2000–01 to 2018–19 (Data to 3 May 2019 with predicted return to 31 July assuming full 170 t TACC is landed).

A4.3 Catch Per Unit Effort and Productivity

Catch per unit of effort (CPUE) has increased markedly over the period since 2001–02. Catch rates during 2017–18 were the highest for the last 50 years, noting greater uncertainty of the data in earlier years (Figure A4.3). Catch rates apparently have declined in 2018–19 (up to 3 May 2019), although higher production often is experienced over winter months. CPUE for the 2018–19 overall therefore is expected to be similar to that achieved in 2017–18.

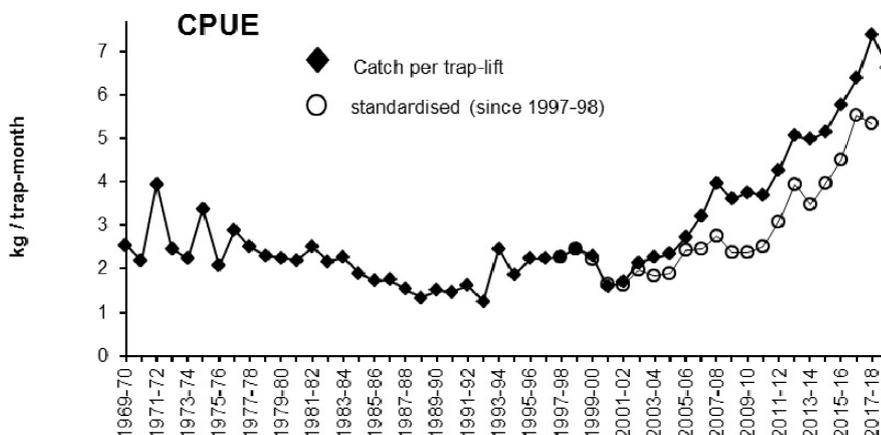


Figure A4.3: Estimated catch per unit effort, 1969–70 to 2018–19.

Much of this increase likely is due to changes in stock levels but fishers also have been able to increase their productivity through changing gear. Lobster fishers have been able to invest in larger traps and larger, more efficient boats as a result of improvements in the profitability of lobster fishing. The Committee notes that changes in fishing power are rudimentary in the stock assessments, effected through a basic CPUE standardisation. The standardised CPUE is still high historically, even allowing for these productivity changes (Figure A4.3). There may be merit in a further study of productivity to assess how different fleet segments (spatially and technologically) have changed over time. This will be relevant particularly if a spatially explicit bioeconomic model of the fishery is to be developed, as suggested earlier.

A4.4 Rock Lobster Markets and Prices

NSW is a minor contributor to the total production of lobster in Australia, with the bulk of production coming from Western Australia, South Australia, and Tasmania. Total Australian production of rock lobster in 2015–16 (the latest year for which production data are available) was 10,516 t, of which NSW contributed 146 t (1.4%). The price received by NSW lobster fishers on both the international and domestic markets therefore is driven largely by total Australian and global supply and demand conditions.

Over 82% of the total 2015–16 production of lobsters in Australia was exported, with over 96% of this by weight (98% by value) exported fresh, most as live animals⁹. The largest markets for Australian exports of rock lobster by weight in 2015–16 were Vietnam (88%), followed by Hong Kong (10%). Vietnam has been a staging point for re-export to China rather than a consumption market itself but a free trade agreement (FTA) between Australia and China came into force in December 2015. Tariffs were reduced from 6% in 2017 to 3% in 2018 under the FTA, and were further reduced to zero in January 2019. This is expected to result in an increase in exports directly to Hong Kong and mainland China in the coming years, with potential price benefits to Australian producers.

The value of the Australian dollar (AUD) influences the price received for Australian exports overseas, including rock lobster. The fall in the value of the Australian dollar post-2014 against currencies in rock lobster export markets, for example, has increased the price received for Australian (including NSW) rock lobster on those markets. The AUD appreciated over 2016–17 against the Chinese Yuan (CNY), which may have impacted prices received negatively, although the AUD has depreciated again over 2017–18 and 2018–19.¹⁰ The AUD is forecast to appreciate slightly over 2019–20 relative to the CNY¹¹, so prices on export markets may decrease slightly despite the recent reduction in tariffs. ABARES forecast that export values for lobster will increase in 2019–20 and following years.¹² The current trade dispute between the US and China also may benefit Australian producers over the next year.

The influence of export markets on prices, however, may be limited. Around 75% of NSW lobster catch is sold domestically and the Sydney Fish Market (SFM) is the major single market, with 44% sold through the SFM in 2018–19 (to May 2019). Prices received on the SFM increased in 2018–19, and remains high relative to historical levels (Figure A4.4). These prices provide only a guide to price movements for lobster in NSW, however, as a significant quantity of lobster is sold through other registered fish receivers in Sydney, along the NSW coast, interstate, or exported. The Committee suggests the Department analyse price drivers to inform future economic analysis of the rock lobster fishery.

Prices for lobster sold to outlets other than the SFM are not available publicly. Anecdotal evidence, however, suggests that prices all along the coast follow the SFM price, although prices received by fishers will vary due to different transport costs. Fishers also report that prices for exported product are lower than those received from the SFM but the export market is able to take greater volumes without price effects. The Committee encourages the Department to collect data on export prices and report them to the Committee.

NSW product competes to some extent with Western Australian and South Australian product at the SFM. The Committee noted in the 2015 report that product differentiation should have been improved in the 2015–16 fishing period by using the NSW waratah logo on lobster tags, although this outcome has still not been confirmed. There is currently no information available to determine the effects of this on prices received. The Committee again urges industry to investigate improved marketing strategies, including potential benefits from third party sustainability accreditation such as that offered by the Marine Stewardship Council.

⁹ ABARES (2017). Australian fisheries and aquaculture statistics 2016. ABARES, Canberra.

¹⁰ <https://www.xe.com/currencycharts/?from=AUD&to=CNY&view=10Y>

¹¹ <http://www.nab.com.au/business/international-and-foreign-exchange/financial-markets/exchange-rate-forecast>

¹² <http://www.agriculture.gov.au/abares/research-topics/fisheries/fisheries-economics/fisheries-forecasts#rock--lobster>.

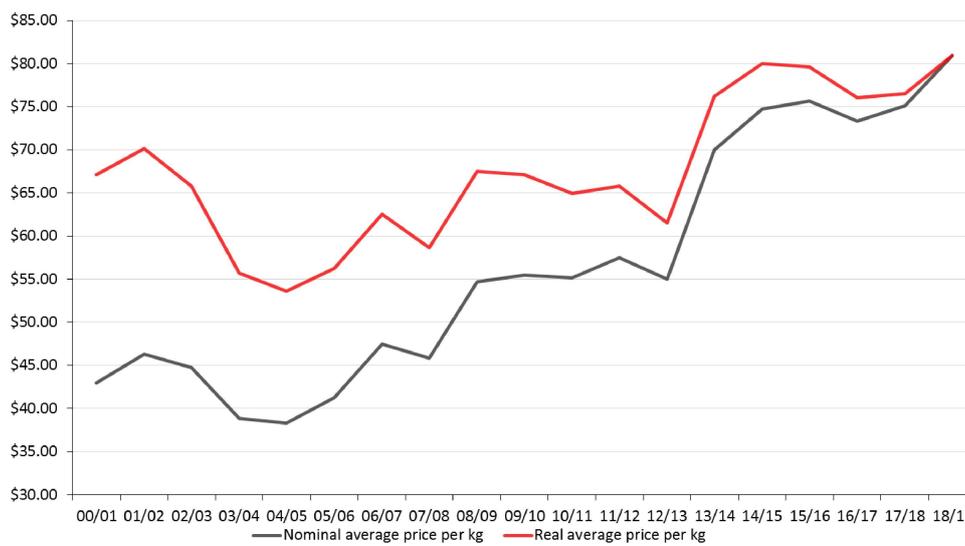


Figure A4.4: Average beach prices in real and nominal terms 2000–01 to 3 May 2019.

Data from the SFM suggests that NSW lobster generally attracts higher prices during the first quarter of the financial year (July–September), which may be due to other States either producing fewer lobsters at that time or supplying less to the NSW market. Industry also reports that there is a premium paid for larger sized lobsters at the SFM, in contrast with most other Australian rock lobster markets. This is confirmed from SFM data (Table A4.1). Nominal prices for a given grade in 2016–17 were lower than in 2015–16, consistent with the observed decline in average prices over this period (Figure A4.4). Data for 2018–19 are not yet available. The Committee suggests it is worth analysing the relationship between lobster size, market demand, and optimal economic yield, and notes that preliminary work in this regard has been undertaken recently as part of the stock assessment process.

Table A4.1: Eastern rock lobster weight and average price at Sydney Fish Markets(SFM) by grade for the 2015–16 to 2017–18 fishing periods.

SFM Grade	Weight (kg)	Carapace length (mm)	Nominal average price (\$/kg)		
			2015-16	2016-17	2017-18
Extra Large	1.7 – 2.46	158 – 179	\$78.97	\$77.75	\$83.07
Large	1.2 – 1.7	140 – 158	\$79.21	\$77.55	\$77.16
Medium	0.7 – 1.2	117 – 140	\$75.81	\$72.09	\$74.30
Small	< 0.7	104 – 117	\$72.98	\$69.64	\$70.68
Ungraded	-	-	\$75.03	\$72.49	\$75.46

A4.5 Costs and fishery profitability

The effects of changes in landings and prices on overall fishery profits remain uncertain without detailed information about fishing costs. Some general trends can be seen regarding key economic indicators based on economic first principles, however, despite economic data for the fishery being unavailable.

First, quota lease prices often reflect the level of profit earned by the least profitable fishers, who can gain more by leasing their quota to more profitable fishers rather than catching it themselves. More profitable fishers will lease quota provided that the lease price still leaves some room for profit after additional costs of fishing are deducted from the additional revenue achieved through the quota lease. Equilibrium will be reached in a well-functioning market where the quota lease price is equal to the lobster sale price less the costs of fishing, and hence is a measure of the marginal economic profit associated with an additional unit of catch. Further, the difference between the price of the catch and the lease price provides an indication of the economic cost of catching the marginal unit of catch. Costs in this case are economic costs, and include a value for owner-operator labour and other input costs (crew,

fuel, etc.). This interpretation should be interpreted with caution for the NSW lobster fishery, however, due to the relative small number of participants in the lease-transfer market.

The provided lobster price and quota leasing price data indicate that the unit cost of production generally has increased over time, and with the level of quota (Figure A4.5). The management charge, in contrast, has declined over time and with the level of quota. It should be noted, however, that time and change in quota are largely confounded effects since 2004–05, notwithstanding two short intervals of constant quota.

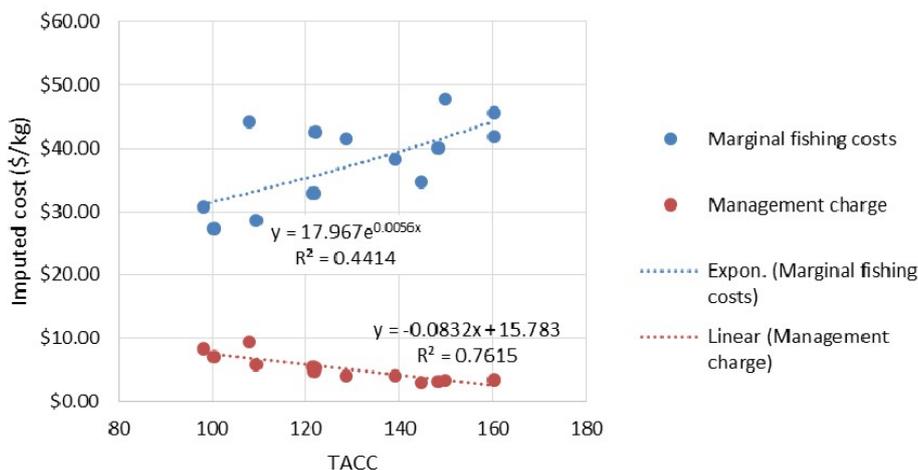


Figure A4.5: Imputed marginal cost (\$/kg) and management charges (in real terms).

Key drivers of increase in quota lease price (and hence short term profitability) can be broken down into the effects of lobster price and fishing costs (using the imputed costs). The latter also reflects any change in productivity (for example, due to stock changes), as cost per unit of catch likely decreases as stock size increases. Changes in profits can be decomposed into changes in each of these measures (see Pascoe et al. 2019¹³ for details). The key driver of lease prices over the last few years (since 2014–15) appears to have been lobster sale price (Figure A4.6). The contribution of costs of capture to profitability appears to have increased in recent years (Table A4.2).

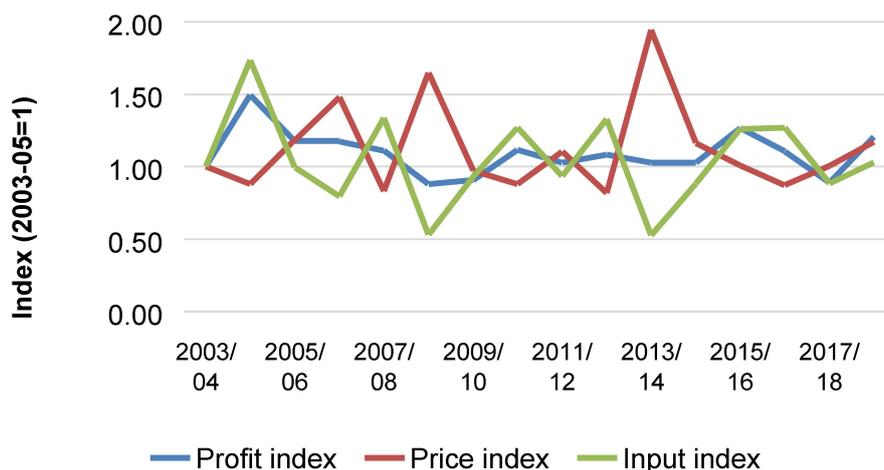


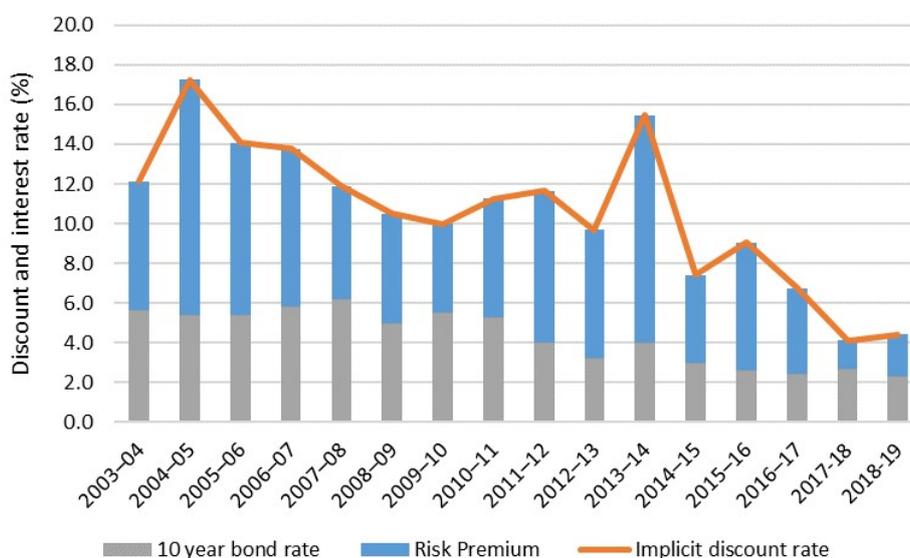
Figure A4.6: “Profit” decomposition, 2004–05 to 2018–19. The graph indicates the relative contribution of changes in prices and cost to changes in profit.

¹³ Pascoe, S., Giles, N. and Coglean, L. (2019). Extracting fishery economic performance information from quota trading data, *Marine Policy* 102, 61–67.

Table A4.2: Implicit cost and profit decomposition

Fishing period	Lease price	Lobster price	inputs	Profit index	Price index	Input index	Key driver
2003–04	\$9.60	\$51.99	\$42.39	1.00	1.00	1.00	
2004–05	\$14.36	\$50.52	\$36.15	1.50	0.88	1.74	Cost decrease
2005–06	\$16.92	\$53.15	\$36.23	1.18	1.18	1.00	Price increase
2006–07	\$19.89	\$60.37	\$40.48	1.18	1.48	0.79	Price increase
2007–08	\$22.09	\$56.53	\$34.44	1.11	0.83	1.34	Cost decrease
2008–09	\$19.43	\$66.81	\$47.38	0.88	1.65	0.53	Cost increase
2009–10	\$17.64	\$66.31	\$48.67	0.91	0.97	0.93	Cost increase
2010–11	\$19.70	\$63.95	\$44.25	1.12	0.88	1.27	Cost decrease
2011–12	\$20.27	\$65.92	\$45.65	1.03	1.10	0.93	Price increase
2012–13	\$21.96	\$61.63	\$39.67	1.08	0.82	1.33	Cost decrease
2013–14	\$22.56	\$76.39	\$53.83	1.03	1.94	0.53	Price increase
2014–15	\$23.14	\$79.84	\$56.70	1.03	1.16	0.88	Price increase
2015–16	\$29.29	\$80.05	\$50.76	1.27	1.01	1.26	Cost decrease
2016–17	\$32.35	\$75.80	\$43.45	1.10	0.87	1.27	Cost decrease
2017–18	\$28.80	\$75.96	\$47.15	0.89	1.01	0.89	Cost increase
2018–19	\$34.71	\$80.90	\$46.19	1.21	1.17	1.03	Price increase

Finally, the relationship between the annual lease price and the share sale price (in \$/kg) also provides an indication of the implicit discount rate¹⁴ used by fishers. This generally has declined over the period that the stock has been rebuilding (Figure A4.7), suggesting that fishers are having greater confidence in the industry and are prepared to take a longer term perspective on its management. The discount rate also reflects the opportunity costs of capital invested in the industry, however, and with generally lower interest rates over recent years (since the global financial crisis in 2007–08) the reduced lease to share price ratio also might reflect a lower opportunity cost. The difference between the implicit discount rate and the risk free interest rate (represented by the 10 year Treasury Bond rate) provides an indication of the risk premium in the fishery. Figure A4.7 indicates that this risk premium also has decreased over recent years, again suggesting that industry has greater confidence that longer term profits will continue to be earned.

**Figure A4.7:** Implicit discount rate, 2004–05 to 2017–18.

¹⁴ The discount rate is the rate at which fishers trade-off future benefits for current benefits. A high discount rate suggests that fishers prefer benefits now (i.e., have a relatively short time perspective) and are less concerned about future benefits, while a low discount rate suggests fishers take a longer term view about the benefits from fisheries management. Implicit in this also is the level of confidence that longer term benefits will exist.

A4.6 Shareholders and Business Structures

The number of shareholders in the lobster fishery has fallen by 44% from 174 at the commencement of the Share Management Plan (SMP) in 2000 to 98 during in 2018–19. There currently are 9,727 rock lobster fishery commercial shares held in packages of 10–350 shares per shareholder. A minimum of 55 shares is required to hold a fishing endorsement, while fishers are constrained to a maximum shareholding of 350 shares. Consolidation of shareholdings appears to have stabilised in the last 3–4 fishing periods (Figure A4.8), with around 30 fishing businesses landing 75% of the total catch in the last 3 fishing seasons (Figure A4.9). The Committee supports a proposal to increase the maximum allowable shareholding, though the level to which further consolidation should be allowed will need to be set against explicit policy objectives that have yet to be articulated. Other NSW share managed fisheries have a shareholding ceiling of 40% of the total number of shares in the fishery but lobster industry representatives seem reticent to support that value.

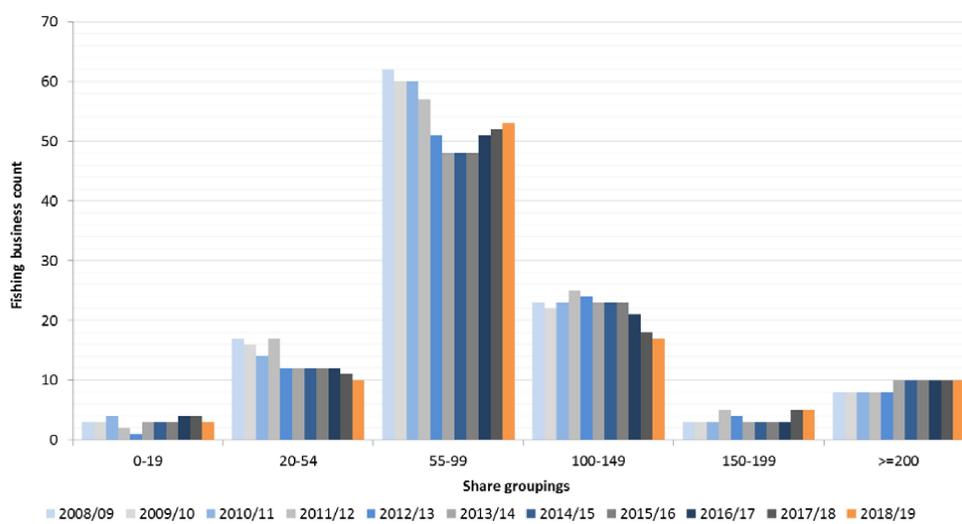


Figure A4.8: Distribution of shareholders by share grouping for the 2007–08 to 2018–19 fishing periods (2018–19 data as at 3 May 2019).

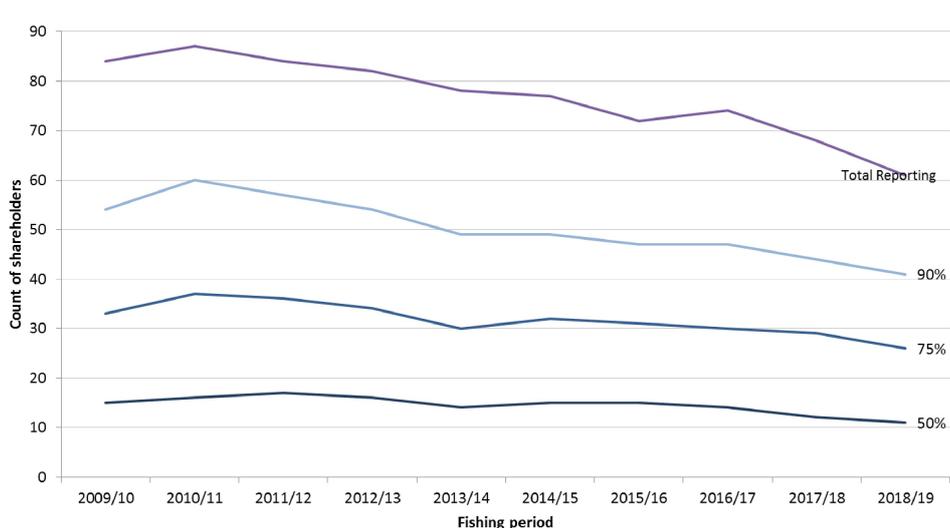


Figure A4.9: Number of shareholders catching % of TACC (2018–19 to 3 May 2019).

The structures of fishing businesses holding a lobster endorsement vary widely according to size of shareholdings, location of operations, and historical or personal fishing preferences. These differences affect numbers and types of endorsements held by a fishing business and sizes or types of vessels and traps used. Lobster fishers focussed on deep water fishing, for example, typically use larger traps and vessels and are more likely to be specialised lobster

fishers. Lobster fishers favouring shallower inshore fishing, alternatively, are more likely to have smaller boats and traps and fish other endorsements in less specialised businesses.

Many lobster fishers historically held endorsements in several fisheries, though the extent to which they gained income from each of them has varied. Reports from the lobster industry and landings data indicate a trend towards specialisation in the lobster fishery, particularly for larger shareholders. Information on business structures suggest that around half of all fishing businesses with rock lobster entitlements (49 lobster endorsement holders) hold at least one current endorsement in another fishery (Table A4.3). The implications of interactions between the lobster TACC and effort transfer to or from other fisheries should be considered in the future, especially if considerable effort is displaced into other fisheries.

Table A4.3: Endorsements in selected other fisheries held by lobster fishing businesses (2018-19 to 3 May 2019)

Other Fishery	Lobster Fishing Businesses in				
	2014-15	2015-16	2016-17	2017-18	2018-19
Ocean Trawl	4	6	7	6	6
Ocean Trap and Line	42	47	52	43	42
Ocean Haul	27	39	44	42	42
Estuary General	31	44	53	47	47
Estuary Prawn Trawl	2	2	3	2	2

Many fishers see a diversified business structure as a way to counter environmental variability, provide income after they have caught their lobster quota, or provide income should returns from lobster fishing fall. There are some endorsements held by fishing businesses in fisheries other than rock lobster that are not actively fished. The extent to which fishers will continue to hold endorsements in other fisheries without actively fishing them is likely to change as a result of the current structural review of the NSW fishing industry and planned introduction of full cost recovery to all fisheries. Preliminary recommendations from the Ministerial Fisheries Advisory Committee are that a fixed charge for each holding of a particular share class should apply irrespective of the size of the shareholding.

The Committee suggests that the Department analyse the economic structures of fishing businesses holding lobster endorsements to understand better the potential impacts on those businesses from past and future management decisions across fisheries. Economic analysis also will help the Committee to understand better the impact of its determinations on the economic viability of lobster fishing businesses and potential ramifications for effort deferral to other fisheries. Types of analysis that could be done are discussed further in Section A4.8.

A4.7 Quota Transfers and Values

The amount of quota transferred in each fishing period has been fairly consistent over the last 5 periods (2011–2016) whilst the number of shareholders trading quota has varied by up to 20% over the same time (Table A4.3). Transferability (leasing) of quota allows for flexibility in fishing operations during a fishing period but fishers contend that it often is difficult to source quota to lease and there are high transaction costs in transferring small parcels of quota, both of which could be resulting in small amounts of quota remaining unfished at the end of the season. Ceilings on the amount of quota that can be transferred also potentially impede full attainment of efficiency gains. The proposed implementation of an on-line quota transfer system should assist in lowering transaction costs and increasing access to available quota.

Quota transfer prices appear to have been increasing gradually since 2009–10 after having fallen for the previous two fishing periods (Table A4.4). Transfer prices fell slightly in 2017–18, largely as a result of decline in lobster price, but increased again in 2018-19.

Share transfer prices provide an indication of the economic health of the lobster fishery and industry's expectations about the longer-term future of the fishery, given reasonable certainty of title and a competitive market. Share prices generally have increased in real terms since 2004–05 (Figure A4.10). This can be interpreted as reflecting consistently improving economic conditions and optimism about the economic and biological health of the fishery.

The more recent large increases in share prices (Figure A4.10) indicate that economic conditions in the fishery continue to improve, as expected in response to growing stock abundance, rising prices, and (likely) lower harvesting costs. The Committee cautions, however, that high catch rates and stock rebuild may be leading to overoptimistic valuations, particularly if expectations of future TACC or market growth are unrealistic.

Table A4.4: Total quota transferred (t), number of quota transferors and transferees, amount of TACC transferred (%), and average price paid for quota (\$/kg) in each fishing period from 2000–01 to 3 May 2019.

Fishing period	Quota transferred (t)	Quota transferors (out)	Quota transferees (in)	% total TACC transferred	Nominal average transfer price (\$/kg)	Real average transfer price (\$/kg)
2000–01	17.0	31	29	11		
2001–02	30.6	40	24	20		
2002–03	44.0	77	60	33		
2003–04	29.3	56	41	22	\$7.17	\$9.60
2004–05	34.5	68	47	34	\$10.89	\$14.36
2005–06	30.1	64	45	30	\$13.15	\$16.92
2006–07	35.6	59	23	32	\$15.64	\$19.89
2007–08	42.3	60	32	34	\$17.90	\$22.09
2008–09	42.2	48	36	33	\$15.90	\$19.43
2009–10	39.3	52	43	31	\$14.76	\$17.64
2010–11	36.3	48	41	28	\$17.00	\$19.70
2011–12	48.0	51	45	32	\$17.69	\$20.27
2012–13	48.9	49	36	35	\$19.61	\$21.96
2013–14	44.8	55	34	30	\$20.68	\$22.56
2014–15	45.8	49	38	31	\$21.67	\$23.14
2015–16	45.0	45	31	28	\$27.68	\$29.29
2016/17	44.0	45	33	28	\$31.29	\$32.35
2017/18	57.1	67	37	33	\$28.49	\$28.80
2018/19	57.0	54	32	34	\$34.71	\$34.71

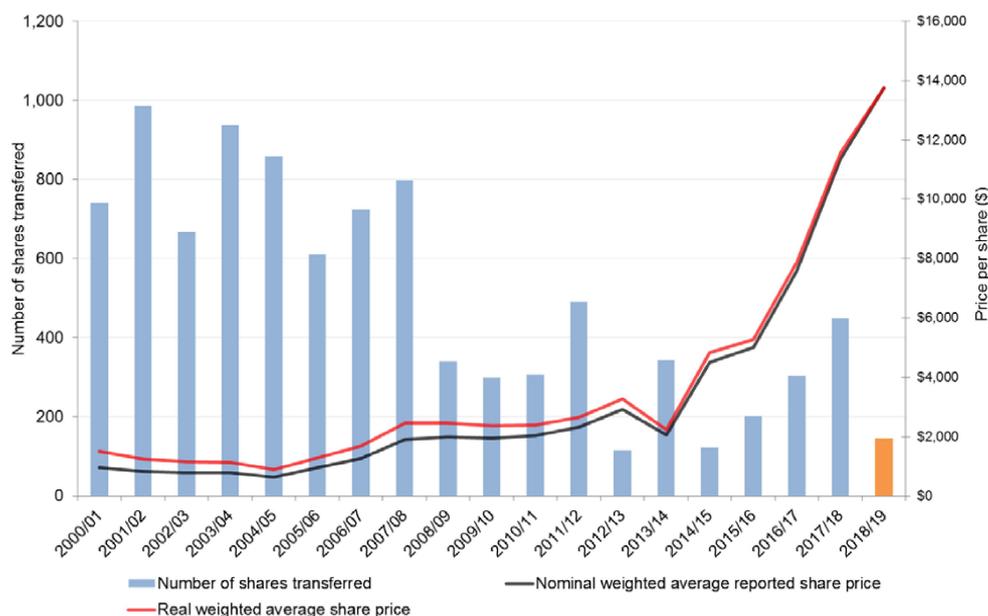


Figure A4.10: Number of shares transferred, estimated share price, and CPI adjusted (real) share price by fishing period from 2000–01 to 3 May 2019

The Committee again recommends that the Department and the Working Group encourage fishers to report all price information for quota transfers in the interests of enabling better economic analyses of the fishery and, ultimately, economically optimal TACC settings.

A4.8 Economic Data and Future Analyses

The Committee notes that industry is still cautious about the need for economic data to be collected and, instead, is focussed on building biomass and ensuring ongoing security of the resource. The question as to the level to which the stock should be rebuilt and the setting of the TACC for Maximum Economic Yield (MEY), however, remains unanswerable whilst economic data about industry operations are scant.

There are several options for economic analysis of the fishery, ranging from simple analysis of the value of shares to a more detailed analysis of net returns from fishing using costs and earnings data collected by survey of lobster fishing businesses (Box A4.1).

Box A4.1: Some options for Economic Analysis of the NSW Lobster Fishery

The following are exclusive alternatives and would be of greatest benefit done together.

Bioeconomic modelling

The development of a bioeconomic model, building on the underlying stock assessment model, would provide information on the short term and longer term economic consequences of different TACC options and provide an indication of economic target levels of catch.

Net economic returns analysis

Net economic returns can be calculated for different types of business structures, and for the fishery as a whole, using survey data on the costs and earnings of different lobster fishing businesses. An example of economic data on the South Australian Southern and Northern Zone Rock Lobster Fisheries by EconSearch can be downloaded from www.econsearch.com.au.

Share and quota prices

The price of share transactions can be used to estimate the economic value of a fishery managed by output controls. The price at which shares are traded is expected to reflect the present value of all future expected net returns from the fishery given reasonable certainty of title and a competitive market. The extent to which average share prices reflect 'true' market values in the lobster fishery is not clear, however, given the structure of the NSW lobster industry with diverse shareholders, business models, and fisher motivations.

The potential usefulness of quota prices in informing management has been illustrated in this report. Quota lease prices also can be used as an indicator of fishery profits. Quota lease prices are not reported routinely, however, with as little as 20 per cent of fishers reporting leasing prices, resulting in uncertainty about whether reported prices accurately reflect industry-wide economic values. Improving the coverage of data collection will improve the accuracy of the types of analyses undertaken in this determination report.

Technical efficiency and productivity analysis

Technical efficiency analysis is used to estimate vessel-level efficiency and is particularly useful in comparing efficiencies before and after a change in management arrangements. Examples of the use of technical efficiency and productivity analysis in the Torres Strait rock lobster fishery can be found in Pascoe et al. (2013)¹⁵.

Calculation of net return through collection of data on costs and earnings of lobster fishing businesses would be the best place to start an economic analysis. This would allow the heterogeneous nature of lobster businesses to be taken into account in economic analyses.

Developing a bioeconomic model of the fishery would provide substantial benefits to industry, both in determining appropriate biomass and TACC for specific economic objectives, and providing information on both short term and longer term biological and economic implications of different TACCs. Including economic information into current stock assessment models and analyses would be relatively straightforward provided appropriate data existed.

The Committee notes that the current version of the stock assessment models can be converted to a bioeconomic model relatively easily, and that there is interest in doing so.

Collection of information on the costs and earnings of lobster fishing businesses would place industry in a much more informed position regarding setting TACCs most likely to maximise profits for the fishery as a whole (MEY). The TACC that delivers MEY may be at a lower level of effort than would be used if it was set with reference only to stock abundance (MSY)

¹⁵ Pascoe, S., T. Hutton, I. van Putten, D. Dennis, E. Plaganyi-Lloyd and R. Deng 2013. Implications of Quota Reallocation in the Torres Strait Tropical Rock Lobster Fishery. *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie* 61(2): 335-352.

but is likely to secure a profitable fishery more resilient to changes in key variables that affect all industries, such as exchange rates and fuel prices. MSY currently implicitly drives TACC setting, largely because of the lack of fishery economic data.

The collection of costs and earnings data also would make it possible to do technical efficiency analyses of lobster fishing businesses (see Box 1), which would help inform the optimum size and structure of lobster fishing businesses to maximise returns from fishing.

A4.9 Community Contribution

The Fisheries Act requires that shareholders in category 1 share management fisheries make a periodic contribution for the right of access to the fishery (a community contribution) as prescribed in the management plan. The current community contribution charge in the lobster fishery is \$115 per shareholder. This value has not increased since 2012, despite apparent increases in profitability in the fishery.

The community contribution charge in the NSW commercial lobster fishery was based on a decision by the NSW Government to return part of the economic rent being earned by lobster fishers to society. It was designed on the basis that there is potential for economic rent¹⁶ to be earned by fishers in a well-managed fishery with a TACC set with reference to MEY. Economic rent is profit (after accounting for all costs, including the full costs of management) in excess of normal returns on capital. An estimate of economic rent in the fishery should be made to avoid too much or too little rent being appropriated from the fishery through a community contribution charge. Such an estimate, however, also requires detailed information on fishing costs and earnings. Calculation of implications of alternative TACCs for future economic rent generation requires a bioeconomic model. There is no objective basis to review the community contribution without such a model or detailed cost and earnings data.

A4.10 Conclusion

The lack of accurate information on the net return from lobster fishing means that only tentative conclusions about the economic status of the industry are possible, but evidence available to the Committee suggests that the lobster industry in NSW is economically viable. Both quota and share prices have tended to increase in recent years, indicating positive perceptions by industry about the future of the fishery. The decline in quota trading price in 2017–18 largely was driven by a decline in market prices, and increase in 2018–19 due to increase in market prices. Increasing share trading prices and the declining implicit discount rate suggest that industry has strong confidence in future economic performance of the fishery. Confidence is a result of a number of factors, including increased stock abundance and CPUE, the latter probably influenced partly by efficiency and practice improvements.

Basic analysis of available data also suggests that increased profits, with the exception of 2017–18, largely have been influenced by increased real prices over the last decade. There are some indications that this year-on-year price increase may be slowing if not reversed as a result of a slowdown in the Chinese economy, as seen in 2017–18. Future improvements in exchange rate conditions and reduced tariffs may ease that downward pressure. The Committee again suggests, however, that fishers remain cautious about over-investment, and take into account potential impacts of future events such as changes in market demand.

The Committee again emphasises that improvements in the economic viability of the lobster fishery, and especially as determined by future TACCs, hinges on robust economic analyses of the industry. Better economic data and bioeconomic models will allow future TACCs to be set that maximise economic returns and facilitate better management decisions by allowing the Department to understand better the financial impacts of alternative management options.

¹⁶ Economic rent is comprised of three types of rent: entrepreneurial rent, quasi-rent, and resource rent. Some operators in any business are more skilful than others and will earn more profit. Rents attributable to fisher skill are entrepreneurial rents. Entrepreneurial rents can be up to 36% of total economic rent in a fishery and should be left with fishers. Fishers may earn large surpluses over costs in the short-term, which provide *prima facie* evidence of substantial resource rents. There are some circumstances, however, where surpluses can occur but are not true rents. These are quasi-rents and might arise, for example, when there is under-investment in a recovering fishery or short-term but unsustainable increases in prices from exchange rate fluctuations. Some profits will be obtained, however, because the natural resource being used (i.e. the fishery) has a value. These profits are resource rents.

APPENDIX 5. MANAGEMENT EVALUATION

A5.1 Introduction

The lobster fishery is regulated by annual TACCs, individual transferable quotas, and minimum and maximum size limits, supported by verification and compliance mechanisms including catch and disposal records and compulsory tagging of all commercially caught lobsters. The TACC has been increasing for since 2004–06, and has been fully caught (over 95% TACC) during that time. The TACC for 2018–19 was 170 t, an increase of 10 t on the previous season, and is again on track to be fully harvested by the end of the season.

A5.2 Compliance

Objective 6 of the Lobster Share Management Plan (SMP) is to minimise the number of offences committed in the fishery. The SMP specifies that a response would be triggered if overall compliance (across recreational and commercial sectors) fell below 70%.

Reporting on compliance rates and detection rates is notoriously difficult as improvements in the targeting of compliance effort can lead to more offences being detected, which can appear as higher levels of non-compliance when reported statistically. The use of an intelligence-led enforcement program targeted at the group of fishers suspected of infringing would be expected, if successful, to result in very high rates of infringement (low compliance) for that group. It would be inappropriate, however, to infer that those metrics alone reflected the behaviour of the general population, making it difficult to draw conclusions about general compliance rates from 'crude' compliance rate information without the support of further analysis and qualitative explanations about enforcement strategies. The Committee accordingly finds the discussions with Fisheries Officers at the annual TAFC public forum very useful.

The overall compliance rate in the fishery in 2017–18 was 89% and so far in 2018–19 is 82.5%, both of which remain above the trigger level of 70% in the SMP. Advice from the Department is that the majority of offending in the commercial sector over the past two seasons has been relatively minor in nature and has related to commercial fishers failing to complete electronic post landing reports. Recreational compliance rates remain relatively steady, as they have for the past 10 years, with the most common offence continuing to be the possession of prohibited size fish.

The Committee welcomes the inclusion of the category of "Targeted Illegal" in the compliance effort reporting, which identifies compliance efforts targeted at expected illegal operations. While these targeted efforts have been isolated in the reporting of compliance hours and compliance rates on page 5 of the Compliance Report, it is unclear if they have been included in the "overall compliance rate" figure of 89%. The Committee asks that in future reports the metrics for targeted and 'routine inspection' compliance be reported strictly separately and that Figure 4 (showing compliance rates in the commercial and recreational fisheries) also include the targeted illegal compliance rates. The overall compliance rates that would relate to the trigger point in the SMP should include only compliance rates from 'routine' inspections of recreational and commercial fishers. It also will be important to track (and report) those targeted compliance actions that do not discover non-compliant behaviour.

Table A5.1: Breakdown of compliance effort for the commercial and recreational sectors

Year	Compliance effort (hours)			Total
	Commercial	Recreational	Targeted	
2012–13	1722	2959	30%*	4681
2013–14	2269	3160	57%*	5429
2014–15	1811	3340	38%*	5151
2015–16	939	3150	36%*	4089
2016–17	877	3227	35%*	4104
2017–18	529	1713	1463	3705
2018–19**	446	870	1314	2630

* The proportion of compliance effort hours that were targeted.

** To May 2019

The information available on the different types of sanctions in the commercial and recreational sectors for recent years is set out in Figures A5.1 and A5.2 below.

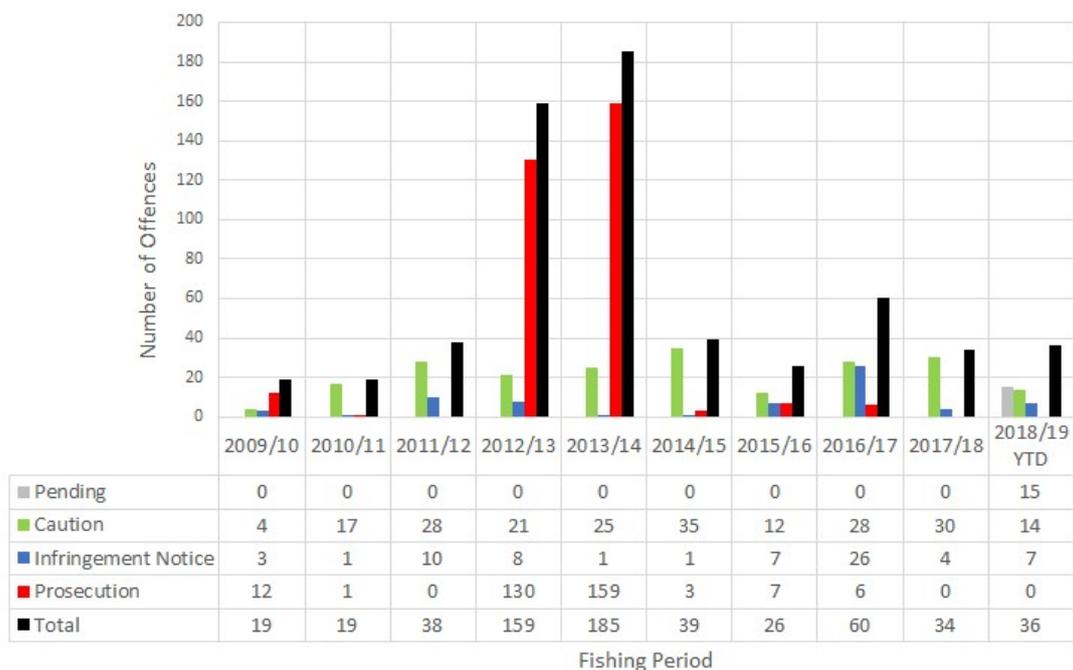


Figure A5.1: Breakdown of commercial fisheries compliance sanctions over time

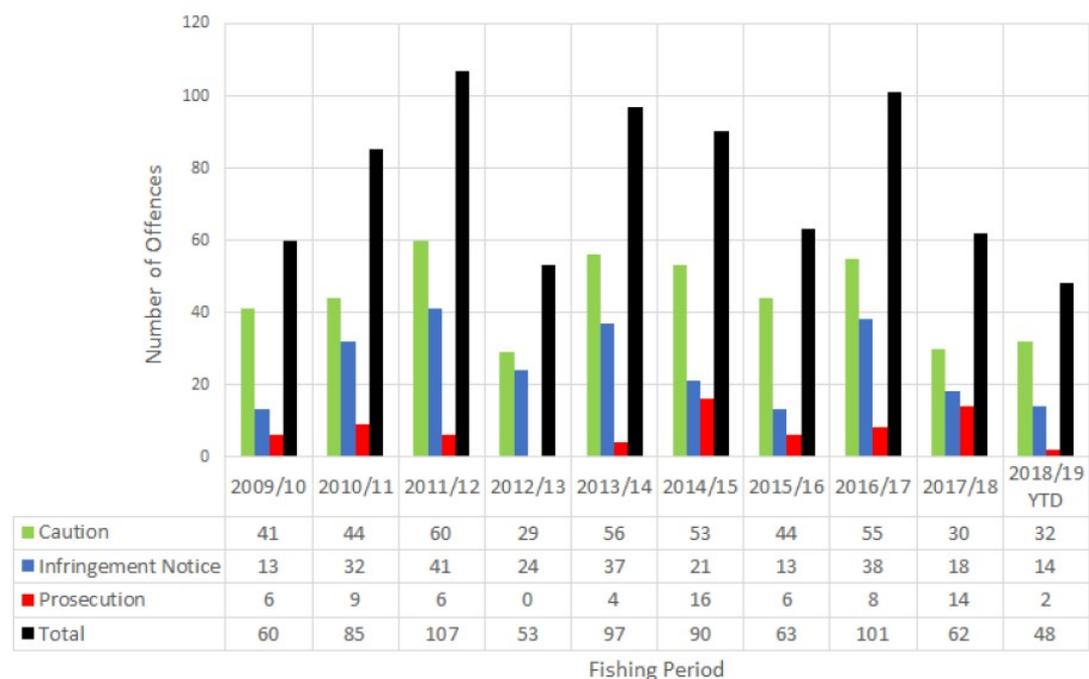


Figure A5.2: Breakdown of recreational fisheries compliance sanctions over time

The Department provided an update on the legal proceedings associated with the outcomes of strategic operations, and offences detected in previous fishing seasons. They reported the successful finalisation of prosecutions related to Operation Talon, a major investigation into the systematic theft and sale of rock lobsters in 2012–14, that resulted in strong penalties being imposed including fines, gaol time, and forfeiture of lobster shares.

The industry has been emphasising the need for meaningful penalties to create effective deterrence and welcomed these results, in particular the imposition of a significant share

forfeiture. Department officers advised that share forfeiture provisions cannot be applied for lobster offences committed by fishers operating in other fisheries, for example the ocean trawl fishery, and therefore share forfeiture is not available as a deterrent to illegal harvest of lobster by those fishers. The committee recommends that reforms be considered to enable share forfeiture penalties for operators committing lobster offences in other fisheries.

The Committee supports continued focus on ensuring compliance with the quota monitoring system. That focus can seem minor and administrative but that nonetheless will have significant cumulative impact over time if failures to comply are left unaddressed. These things also are important to running an efficient and cost-effective quota monitoring system.

The recreational fishery generally displays a high level of compliance, which is ascribed in part to the fact that lobster fishing is highly specialised and those that do it do it well. A high percentage of the recreational catch apparently is taken by a small percentage of fishers, as with other recreational fisheries. The increased abundance of lobster resulting from the recovery of the stock, combined with the ongoing increase in the price of lobster, is likely to contribute to an increase in recreational interest in lobster harvesting. These factors also will contribute to a greater risk of increased illegal activity in the fishery. Retaining a strong compliance presence and greater informal or formal monitoring of the number of recreational fishers participating in lobster harvesting is necessary to manage this increasing risk.

It is important to note that there is a category of unlicensed persons who engage in illegal fishing that is commercial in nature. Sometimes this activity gets picked up in recreational figures because the activity is conducted under the guise of legitimate recreational fishing but is better described as illegal commercial fishing. This is a risk for any fishery of a high-value species, particularly when stocks are healthy and readily available. The Department considers it likely that there continues to be isolated but serious cases of such offences. Such behaviours again reinforce the value of an intelligence-led and risk-based approach to fisheries compliance. The Committee fully supports the Department's continued use and development of such a targeted approach.

A5.3 Management framework

A5.3.1 Fishery Management Strategy

The *Fisheries Management (Lobster Share Management Plan) Regulations 2000* (SMP) set arrangements for day-to-day operation of the commercial fishery. The *NSW Lobster Fishery Management Strategy* (FMS) provides detailed management arrangements for the fishery.

Both the SMP and the FMS specify objectives, performance indicators, and trigger points that provide a framework to measure the performance of the fishery against the objectives (Table A5.2). The performance indicators provide a measure of whether the objectives are being achieved and the trigger points signify a potential problem with the fishery requiring review of management arrangements. Only one of the triggers legislated in the SMP (Table A5.2, Goal 4) was exceeded this season, specifically the increase in management charges. The management charge is reviewed and redetermined annually, and although the charge per share increased by 3.3% in 2018–19 due to an increase in total expenses to manage the fishery, the fee actually decreased when viewed as a % of the fishery's GVP and remains well below the statutory Lobster Plan limit per share.

The Department has been progressing the development of a harvest strategy for the lobster fishery in consultation with industry, including the development of specific stock and harvest targets that maximise the economic yield from the fishery. The Committee is strongly of the view that a modern harvest strategy should be incorporated into an updated FMS and that, in particular, explicit target and limit reference points should be specified to complement the existing management triggers. The Committee therefore encourages the Department and Industry to continue development of the draft harvest strategy, noting the useful analyses already available from the scientific assessments to support the development of appropriate performance indicators and reference points.

Table A5.2: Summary of SMP objectives, performance indicators and triggers.

Goal	Objective	Performance Indicator	Trigger for Review
1.	Increase the biomass of eastern rock lobster stock	Levels of eastern rock lobster stock increase or remain stable (with 1998–1999 levels as a benchmark), or are likely to do so, having regard to total allowable catch	Annual catch per unit effort (CPUE) is below 1998–99 levels in 2 consecutive years
2.	Promote commercial fishing practices for rock lobster that do not have an adverse environmental impact on the broader ecosystem	Research conducted periodically by or on behalf of NSW Fisheries indicates that commercial fishing practices for rock lobster do not have an adverse environmental impact on the broader ecosystem	Research conducted by or on behalf of NSW Fisheries indicates that commercial fishing practices for rock lobster are having an adverse environmental impact on the broader ecosystem
3.	Ensure management arrangements for the fishery do not have a significant impact on the costs of taking eastern rock lobster for sale	Management charge for the fishery (section 76 of the Act) does not increase significantly, disregarding any increase attributable to the provision of additional resources by NSW Fisheries (e.g., the provision of additional compliance officers)	Management charge for the fishery increases in any year at a rate that exceeds the rate of inflation (as measured by the CPI), disregarding any increase that is attributable to the provision of additional resources by NSW Fisheries after the commencement of this Plan
4.	Promote cost efficient management	Independent review of the management arrangements for the fishery, conducted periodically at the request of the Minister, determines that management arrangements are appropriate	Independent review determines that the management arrangements for the fishery are inappropriate
5.	Ensure appropriate research and monitoring in relation to the fishery	Sufficient data is available for assessment of rock lobster stocks	Insufficient data is available for the purpose of setting the total allowable catch for rock lobster
6.	Minimise the number of offences committed by fishers in relation to rock lobster	Number of offences in relation to rock lobster committed annually, as indicated by quality inspections conducted by NSW Fisheries, indicates substantial compliance with the Act, this Plan and the other regulations under the Act.	Overall rate of compliance with the Act, this Plan and the other regulations under the Act in relation to rock lobster (estimated annually by the Secretary) is less than 70 percent

A5.3.2 Management Costs

Category 1 share management fisheries are subject to cost recovery of government services. Charges for management services provided by the Department are payable in proportion to the shareholding. Implementation of full cost recovery in the fishery was staged over three fishing periods from the 1998–1999 fishing period, as indicated in Table A5.4.

The contribution of management charges to total costs has contracted as a share of fishery GVP, from around 15% in 2003–05 to currently under 5% (2014–19). The Committee continues to support a transparent system of cost recovery where services received by industry against management and other charges are fully justified and delivered efficiently. The totality of fees applying to the fishery should be considered when considering 'management' charges. There remain significant costs in running this fishery, particularly in the areas of research and compliance. It is noted that the lobster fishery is not fully cost recovered and benefits from discounts for various reasons. Industry should prepare to invest in the fishery appropriately, however. It would be appropriate to review costs and look at ways of developing an overall management package (including science and compliance) that has costs appropriate to the scale of the fishery. This review usefully could be done in conjunction with the design of a harvest strategy for the fishery.

Table A5.3: Management charges and fishery value by fishing period.

Fishing Period	TACC (t)	Reported Catch (t)	Average Price (\$/kg)	Value (\$m)	Management Charge / share	Management Charge % GVP
1998–99	125	110.0	34.76	3.80	38.00	10.0
1999–00	140	117.0	39.16	4.60	48.00	10.4
2000–01 [#]	150	102.0	42.98	4.40	58.80	13.5
2001–02	150	102.0	46.33	4.70	58.00	12.6
2002–03	135	121.3	44.77	5.40	59.70	11.1
2003–04	135	107.9	38.83	4.20	61.70	14.8
2004–05	102	98.1	38.30	3.80	58.60	15.5
2005–06	102	100.5	41.30	4.15	63.09	13.6
2006–07	112	109.4	47.46	5.19	62.06	10.7
2007–08	124	121.6	45.81	5.57	57.91	8.9
2008–09	128	121.8	54.67	6.66	64.04	8.3
2009–10	128	122.1	55.49	6.78	64.70	8.2
2010–11	131	128.6	55.18	7.10	52.64	6.2
2011–12	149	148.3	57.52	8.53	44.21	5.0
2012–13	140	139.0	55.03	7.65	49.32	6.3
2013–14	150	144.7	70.02	10.13	51.57	5.0
2014–15	150	149.8	74.76	11.20	52.81	4.5
2015–16	160	160.2	75.66	12.12	54.62	4.4
2016–17	160	154.6	73.31	11.33	55.32	4.7
2017–18	160	157.5	75.13	12.02	57.09	4.6
2018–19	170	140.5*	80.90	13.75**	58.98	4.2**

* Based on catches to 3 May 2019

** Estimated values assuming that the entire 170 t TACC is taken at the nominal average price to date

A5.3.3 Management of non-commercial harvest

A daily and possession limit of two lobster per person, a minimum size limit of 104 mm and maximum size limit of 180 mm apply to recreational harvest of lobster. The Department advises that recreational harvest is most likely to occur around high population areas and the most recent estimate of recreational lobster harvest (West et al. 2015), estimated the harvest at 23,200 lobsters, with a 95% confidence limit of +/- 24,500.

The results of an updated recreational fishing survey are expected in mid-2019, though estimates of lobster harvest from that survey also are likely to contain significant uncertainty. The new option to notify an intention to fish for rock lobster when making a recreational fishing licence application is a positive step that may help future assessments by providing a sampling frame, though that benefit would be improved if the advise of intention was obligatory rather than optional. There is no current plan, however, to use that database for a survey of lobster fishers to improve harvest estimates.

The Aboriginal Cultural Fishing Interim Access arrangements allow an Aboriginal person to take and possess double the recreational bag limit, or up to specified limits for certain species to provide for cultural needs where community members are unable to fish for themselves. Applications for an Aboriginal cultural fishing permit also can be made to take a higher catch for larger cultural events. A written request to the Department outlining species and numbers proposed to be taken is required before Aboriginal cultural fishing permits can be issued. A number of such permits have been issued over the past few years that allow for a basket of species, not just lobster, and so it is unlikely that the full number taken will be all lobster. Advice from fishery compliance officers is that actual take is often significantly less than the

amounts formally permitted. The catch under Aboriginal cultural fishing permits remains unlikely to have a detectable impact on the resource, even though the number of permits has increased over the past year.

The Committee for some time now has used a precautionary estimate of 17.5t for non-commercial harvest, which includes both recreational and Aboriginal fishing. There is some suggestion that recreational effort targeting lobster may have increased as stock conditions have improved and the current increase to 18.5 t therefore is considered appropriate, pending improved estimates of actual non-commercial harvest.

It is essential that regular monitoring of recreational catch is established and the status of the resource is better understood before any changes to management of the recreational fishery are considered, as noted in previous reports. Targeted surveys to estimate recreational lobster catch and effort would be required to provide robust estimates of total harvest and the distribution of recreational fishing. The Committee recommends that options to obtain more useful estimates be investigated by the Department.

NSW Total Allowable Fishing Committee

Dr Bruce Mapstone,
TAF Committee Chair,
18 Shepherd Street,
Hobart. TAS. 7005.

17 June 2019

The Honourable Adam Marshall MLA,
Minister for Agriculture and Western New South Wales,
Parliament House,
Macquarie Street,
Sydney. NSW. 2000

Dear Minister,

RE: Total Allowable Commercial Catch of Rock Lobster, 2019–20

The NSW Total Allowable Fishing Committee has concluded its review of the rock lobster share management fishery to set the total allowable commercial catch for the 2019–20 fishing period. Our Determination Report is enclosed, which sets out our reasoning for this year's determination.

The Committee is pleased to report that the NSW rock lobster stock remains in a robust condition and that fishery catch, revenue, and profitability reflect this sound state. Industry confidence in the fishery is signalled by strengthening share values that have again increased over the last year.

The Committee has determined a Total Allowable Commercial Catch (TACC) of NSW rock lobster for 2019–20 of **170 tonnes**. This is the same TACC as set for 2018–19.

The Committee has made this year's determination after considering the status of the stock, recent fishery performance and compliance, expectations about future recruitment to the fishery, and key uncertainties about sustainable harvest. We consider the consistent rebuilding of spawning stock over the last decade, continued improvements notwithstanding regularly increasing quota, and materially improved assessment information all signal a robust fishery likely nearing its optimal performance.

Quota setting in this fishery necessarily is adaptive and we recommend a strategy of periodic small increases in quota followed by periods of quota stability until the optimal quota setting for the fishery can be verified. Holding the TACC stable this year is consistent with that approach. The Committee also has noted in the attached report that future increases in TACC, if any, likely will be small because available analyses suggest harvest now is close to that most economically efficient and near the maximum sustainable yield from the NSW rock lobster stock. The Committee therefore again emphasises the need to avoid over-capitalisation in the fishery.

The fishery is now at a stage where explicit strategic objectives are essential to guide setting of future TACCs. The paucity of a specific harvest strategy is a material constraint to the Committee's assessment of what is the most appropriate level of harvest but the Committee was pleased to see this year that the Department and Industry now are progressing development of an agreed harvest strategy. Robust economic data also is required for the fishery to enable us to verify optimal economic production whilst maintaining a healthy stock and sustainable harvests. We have recommended that the Department and industry jointly garner the economic information necessary to allow economic objectives to be addressed. We congratulate the Department on improvements in the assessment model over the last year and encourage further development of the model into a bio-economic model.

The Committee commends the fishing industry for its cooperation with managers, researchers, and the TAFC. Fishers again have demonstrated a prudent approach to stewardship of the now-robust fishery.

I am happy to expand on any of the above if you wish.

Sincerely,



Bruce Mapstone,
Committee Chair.