NSW Total Allowable Fishing Committee

Report and Determination 2018–19

ROCK LOBSTER FISHERY

01 June 2018

EXECUTIVE SUMMARY

Preamble

The NSW Total Allowable Fishing Committee (the Committee, formerly the Total Allowable Catch Setting and Review 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 2018 to 31 July 2019. 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 2nd 2018.

Determination

The Committee has determined that the total allowable catch of rock lobster by NSW commercial fishers during the 2018–19 fishing period should not exceed 170 tonnes (t).

This allocation is an increase of 10 t (6.25%) from the allowable catches in the 2015–16, 2016–17, and 2017–18 fishing periods. The determination is set given likely catches of rock lobster by non-commercial fishers of approximately 17.5 t and illegal and unreported commercial catches of approximately 14.9 t.

Primary Recommendations

The Committee again provides the following non-binding recommendations to the NSW Department 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 develop a harvest strategy with specific fishery objectives linked to target reference points for discussion at the 2019 forum.

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.

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 of 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 occurred progressively through most of the period and might continue for some unknown period.

The scientific assessment provided this year contains significant improvements over previous versions and indicates the best estimate of current spawning biomass is at 33% of unfished levels. There is convincing evidence that spawning biomass remains above the 25% legislated trigger point. The Committee considers this assessment to be the most appropriate and robust to date.

The stock has now rebuilt to a level approaching the range of spawning biomass where common fishery targets are expected to be for this species and likely close to that consistent with maintenance of current harvest rates in the long term. A process is needed, supported by further development of the assessment model, to identify desired targets for the fishery and facilitate resolution of the appropriate allowable catches to meet those fishery objectives.

Uncertainty about the level of recreational catch and historical unreported catch continues to be an important risk in setting allowable commercial catches from the common stock.

Economic Considerations

Economic performance of the NSW lobster fishery has declined slightly in 2017–18, mostly due to changes in market prices, although profitability remains strong. The main export market for Australian lobsters has been relatively weak, though there are indications that export prices will increase over 2018 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 commercial fishery clearly has the capacity to take the allowable catch, with annual landings above 95% of the TACC for the past fourteen years. Licensing and management arrangements in the commercial fishery remain stable and effective.

Uncertainty about the recreational catch of lobster remains a risk for confident management of the total harvest, especially as knowledge of improved stocks becomes widespread. 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 notes that a renewed focus on the compliance risks in the commercial fishery appear to have been effective, particularly related to the integrity of quota monitoring.

The robustness of the fishery now allows management emphasis to move away from stock rebuilding toward optimising outcomes. The Committee therefore again emphasises the need for the Department and Industry jointly to develop a harvest strategy and recommends that a first step should be to formulate medium–long term objectives for performance of the fishery.

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

Conclusions

The NSW eastern rock lobster stock has rebuilt to a robust state apparently capable of supporting current levels of harvest. Key uncertainties remain, however, about the degree to which the stock has stabilised or has further rebuilding ahead.

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.

The absence of specific biological or economic targets for the fishery prevent any conclusion about whether the stock, and harvest, are at preferred levels. Unavailability of solid economic information about fishery and market operations also hinder such conclusions. These factors together indicate the need for prudence in setting future harvest levels to minimise the risk of again overfishing the stock. The Committee therefore has set a modest increase in the TACC for the coming fishing season, whilst noting that careful monitoring of the stock and fishery will be required to detect any early indicators that even this small increase might require future revision.

TABLE OF CONTENTS

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 2018 was:

- Dr Bruce Mapstone – Chair
- Dr Keith Sainsbury – fisheries science
- Dr Sean Pascoe – natural resources economics
- Ms Kelly Crosthwaite – 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 where relevant by *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 a matter entirely for 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 components of the non-commercial fishery currently 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 summarised in Appendix 2.

The Committee obtained input from participants in the Total Allowable Fishing Committee Open Forum meeting in Sydney on May 2nd 2018 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 2nd 2018. 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. 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 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 measurable evidence that significant rebuilding of the spawning biomass has been achieved since about 2000. There is now very little chance that the spawning biomass is depleted below the limit reference point[1] of 25% of the unfished level. The median estimate from the current assessment is 33% depletion.

Initial analyses of long-term yield at various levels of catch and population depletion were provided this year. The exploratory nature of these initial analyses is recognised but they indicate the following main conclusions.

- The interim target and limit reference points that have been used in recent years are not inappropriate. The Committee will continue to use these interim reference points until more formally agreed values are available.
- The long-term maximum sustainable catch and maximum economic catch may be similar to current catches. It also is possible, however, that this is a pessimistic interpretation and the stock in future might support greater catches. There are not yet direct observations of stock productivity at spawning stock levels higher than recent levels to allow demarcation of these alternatives. The modelling this year assumed that there will be little further increase in productivity with further recovery, but productivity to date has increase consistently with stock recovery.
- The 'gauntlet' nature of the fishery, with juvenile lobsters fished as they migrate to join the spawning stock and grow beyond the maximum legal size for harvest, results in a threshold harvest rate beyond which the spawning stock would collapse because of over-harvest of those juveniles. The existence of the upper size limit to protect large, mature lobsters would not prevent collapse if such harvest rates occurred. Such a collapse would be very slow, however, and likely would be recognisable eventually through the various monitoring programs, but it is an important risk in the fishery that should be recognised explicitly in management and monitoring arrangements. It is recommended that an 'index of escapement' of lobsters from the legally harvestable size range to above the maximum size limit be explored based on existing monitoring programs.

This year's analyses, and refinements of them, provide useful input for identification of reference points for fishery management. It is recommended that the initial analysis be extended and used in a joint industry and government process to identify desired limit and target Reference Points[2].

Rebuilding of the spawning stock is predicted to continue at a moderate rate under recent and slightly higher catch levels, but the exploitable biomass is predicted to remain about the same or reduce slightly in the near term.

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[1] A limit reference point indicates a stock status that is undesirable and that should be avoided with high probability. The Committee interprets the legislated management trigger of 25% of unfished biomass to be the *de facto* limit reference point for the lobster fishery, pending 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).

3.3 Catch rates

Commercial catch rates have increased substantially since 2000 and have increased rapidly each year since about 2011. The catch rate in the last few years has been broadly stable or increasing across all the depths and regions, implying stable or increasing abundance of lobsters of all sizes and maturity groups. There has been substantial increase in catch rate 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 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 standardisation[3] 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, while 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 sub-fisheries in different areas.

3.4 Unreported commercial catch

The scale of unreported commercial catch in the fishery is uncertain. The 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 performed 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 7t in 2016–17, which is about 4.5% 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 17.5 t that has been assumed coincides approximately with the midpoint of the very imprecise Recreational Fishing Survey conducted in 2013–14. It is again recommended that more accurate measures of the amount of recreational catch be established. There is a variety of mechanisms that could be considered for closer measurement and management of the recreational catch, including a register of those fishers expressing an intention to take rock lobster or additional endorsements on the existing recreational licence.

[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.

3.6 Stock assessment model

The assessment model has been redeveloped and refined this year, and it is considerably improved. Key results were based on a 'base-case' model that reflects the most credible parameter values. A wide range of sensitivity scenarios also were run to examine the consequences of uncertainties in key parameters, including: the accuracy of historical catch reports; natural mortality; the stock-recruitment relationship; fishery size selectivity; and several biological life-history parameters.

Some discrepancies between model results and observations remain, particularly the inability of the model to match the high rate of recovery in catch rates since about 2012, but the revised model used this year provides much better consistency and match to the available data than previous versions. The revised model confirms earlier concern that the spawning stock was more depleted in the mid-1990s than previously estimated, and estimates that depletion was to about 4% of the unfished level, compared to estimates of about 10% from the model used previously.

3.7 The future

The dual challenges in coming years are to continue steady rebuilding of the spawning stock to 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 the 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 different quota alternatives 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 on a voluntary basis. Indirect productivity measures were available in the form of average catch rates for the fishery as a whole.

The absence of relevant 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 an attempt has been made to look at key drivers of profitability using some simplifying assumptions around profit decomposition. Focussing on gross returns alone means that the economic implications of different quota scenarios cannot be assessed fully. The constraints of limited economic information have been highlighted in several previous determination reports.

4.2 Changes in gross value of the fishery, lobster prices and market destinations

The estimated gross value of production (GVP) of the fishery in 2017–18, based on Sydney Fish Market (SFM) prices and assuming the whole quota (160 t) is taken, was $11.7m. Prices received on the SFM remained relatively constant in nominal terms[4] from $73.31/kg in 2016–17 to $73.40/kg up to April 2018. Around 41% of the product was consigned to the SFM in 2017–18 (up to April 2018), lower than in 2016–17 (47%).

Around half of the remaining product was exported, primarily to China. Export prices have fallen in recent years, from $65/kg in 2015–16 to around $58/kg in 2016–17. This decline is believed to be due to a fall in seasonal demand in China as a consequence of a slowdown in the Chinese economy, as well as an expansion of sales of US lobsters into the Chinese market.[5] More recent price information from the Chinese market is not available, although the progressive reduction in tariffs as part of the Australia–China free trade agreement and the relative devaluation of the Australian dollar (AUD) against the Chinese Yuan (CNY) are likely to result in improved prices in 2017–18 and the coming years. The total value of Australian exports of rock lobster is forecast to be slightly lower in 2017–18 than 2016–17, but increase in 2018–19 and following years in both real and nominal terms.[6]

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 hence 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 again this year, for example, contributing to the decline in price on the Chinese market. 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

[4] Nominal values are the actual or 'raw' transaction values recorded at given times, without any 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 standard reference period. Comparison of real values over time are more sensible because the effects of inflation have been removed. The Consumer Price Index (CPI) often is applied for this adjustment since it reflects changes in the costs of living, and so inflation, over time.

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

[6] ABARES 2018, Agricultural commodities: March quarter 2018, ABARES, Canberra.

forecast for the AUD against the CNY is for it to again depreciate slightly[7], 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 fell by 13% between 2016–17 and 2017–18, suggesting that fishery profits also declined over that year. The share trading price (on a per kg basis), by contrast, increased by around 33% in real terms, suggesting that longer term expectations about future profits were more optimistic.

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 is 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 between 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 impact of different TACCs on 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.

[7] http://www.nab.com.au/business/international-and-foreign-exchange/financial-markets/exchange-rate-forecast

5. MANAGEMENT CONSIDERATIONS

5.1 Management implications of stock status

The stock assessment continues to indicate that the lobster stocks are significantly higher than the trigger in the FMS and the basic economics of the fishery are sound. The Committee is confident, therefore, that it can make informed and low-risk decisions in the short term. There are uncertainties in the stock assessment, however, which reinforce the need to continue improvements to the stock assessment model and its underpinning data that the Department have been implementing progressively. That work, plus additional economic data and analysis, will be necessary to detect any downturn in the stocks reliably, and to make medium to long term decisions that optimise fishery benefits.

5.2 Non-commercial components of 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 new requirement 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. 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.

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. No cultural fishing permits were issued in 2017–18 (as of April 2018).

5.3 Compliance

Overall (recreational and commercial) compliance rates in the lobster fishery for the first 8 months of 2017–18 was 77%. This is a significant increase from the year before, driven by an increase in the compliance rate for the commercial fishery. The last five years' rates are set out below.

	2013–14	2014–15	2015–16	2016–17	2018–18 (8 mths)
Overall	74%	81%	79%	66%	77%
Commercial	58%	73%	74%	46%	63%
Recreational	91%	88%	83%	89%	91%

The information provided on compliance effort (number of patrol hours, see Appendix 5) 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 and targeted effort focussing on specific rock lobster targets. 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 to support its interpretation.

It is noted that the level of compliance effort directed at the recreational sector this year has decreased dramatically, despite the longer-term relative stability in the program. This change

has been attributed to an overall state-wide emphasis on commercial fishery compliance in line with the Commercial Fisheries Business Adjustment Process.

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. The types of offences detected (e.g., tagging and reporting) 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 electronic systems, and provides confidence that the integrity of the quota system is being actively addressed.

Compliance with the TACC goes to the integrity of the quota system and can lead to uncertainties in the reported catch, which in turn can affect future TACC determinations.

Licence holders expressed to the Committee their 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. The SMP triggers legislated in 2000 are more simplistic than the non-legislated FMS triggers finalised in 2007. Both frameworks generally are out of date and both Industry and government again acknowledged the need to develop targets as the fishery continues to improve biologically and move away from its trigger points. Both current CPUE and estimated stock biomass far exceed their triggers in the SMP and FMS respectively.

The Committee must use its own targets and objectives, implicitly or explicitly, to guide decisions in the absence of formally specified targets. The cautious approach taken to date by the Committee is appropriate given the need to improve the status of the stocks but the ability to make medium and long term forecasts (and therefore strategic decisions) is limited by the lack of a decision-making framework including objectives, targets, strategies for achieving them, supporting research and information programs, and risk-based decision rules. These limitations will become increasingly constraining as the stock matures and potential grows to optimise economic returns to the fishery. The Committee recommends, therefore, that investment be made in a) developing a formal harvest strategy with formal fishery objectives and targets and b) an improved stock assessment model capable of informing strategic decisions about how to realise those objectives and targets. It is noted that the Department is working on an overall harvest strategy policy. This is a positive step, but the rock lobster is a mature fishery in a solid position and work on its own harvest strategy needn't wait for a harvest strategy policy to be finalised.

Cost recovery is relevant to making these 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.

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 to drive that process.

Fishermen's observations reported to the Committee were very positive about the status of the fishery, measured by catch rates and peurulus settlement. This was reflected in a confidence that the fishery could handle a small increase in TACC, but 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. Some industry members expressed a preference to hold the TACC constant and wait for a more substantial increase.

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 there 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. Fishery managers, with the fishing sectors, should determine what is most valued in the lobster fishery, such as stability of catches, maximising catches, or maximising profits. Having clearly defined objectives is necessary for a harvest strategy and an investment framework for the fishery. Such an approach should recognise the need for formal limits and targets that incorporate economic as well as biological considerations. This framework, or lack of it, continues to affect materially TACC Determinations. Continued improvement of the stock assessment model also is necessary to refine TACC-setting to meet fishery targets.

6.2 Total Allowable Commercial Catch for 2018–19

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

The key factors in arriving at the Total Allowable Commercial Catch for 2018–19 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 (peurulus 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 between last year and this year;
- 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 whist the lobster stock continues to rebuild and generally favour a small or zero increase in TACC accordingly.

The Committee therefore has resolved to apply a modest (6.25%) increase in the TACC for the 2018–19 quota year, after three years of constant TACC. 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 2018–19 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 Rock Lobster Fishery during the period 1 August 2018 to 31 July 2019 should be **170 tonnes.**

Bruce Mapstone,
Chair

Keith Sainsbury,
Fisheries Scientist

Sean Pascoe,
Natural Resource Economist

Kelly Crosthwaite
Fisheries Management

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 2nd. 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
28.03.2018	Section 40F(1)	Call for public submissions on the appropriate level of the annual TACC for Lobster for 2018–19, posted to NSW DPI website and displayed in District Fisheries Offices.
28.03.2018	Section 284 (1b)	Advertisement inviting submissions placed in the Sydney Morning Herald and the Daily Telegraph.
26.03.2018	Section 284 (1b)	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: ■ All NSW Lobster Shareholders; ■ All Members of the NSW Lobster Fishery Working Group (including conservation and Indigenous members); ■ NSW DPI Fisheries Offices; ■ NSW DPI Head Office.
25.04.2018	Section 284 (1b)	Public consultation closing date, after at least 30 days.
	Section 40F (1)	The Committee received the following collated submissions: ■ NSW DPI Commercial Fisheries Management Report; ■ NSW DPI Research and Resource Assessment Report; ■ NSW DPI Fishery Compliance Report; ■ 3 Shareholder submissions.*
02.05.2018	Section 40F (2)	The Committee considered submissions and heard formal presentations and opinions at the Total Allowable Catch Committee Open Forum meeting in Sydney on 17 May 2017. The following attended the meeting: ■ Nicholas Giles: Fisheries Manager, DPI; ■ Joseph Wright: A/District Fisheries Investigator, DPI; ■ Geoff Liggins: Manager, Scientific Services, DPI; ■ Giles Ballinger, Scientific Services, DPI; ■ Marcus Miller, Scientific Services, DPI; ■ Ron Firkin, commercial fisher; ■ Mark Horne, commercial fisher; ■ Les Muller, commercial fisher; ■ Troy McEnally, commercial fisher; ■ Scott Westley (Rock Lobster Working Group) ■ Steve Drake, commercial fisher; ■ Lee Monin (Rock Lobster Working Group) ■ Peter Offner, commercial fisher; ■ Daniel Gogerly, commercial fisher; ■ Noel Gogerly (Rock Lobster Working Group) ■ Daniel Stewart (Rock Lobster Working Group) ***Apologies*** were received from commercial fishers Steven Burt, Michael Firkin, and Bradley Horne, and TAFC Member Kelly Crossthwaite.

**** These submissions were either marked 'Confidential' or contained confidential commercial information. Identification of the authors has been withheld from the Report and Determination.***

APPENDIX 2*. SUMMARY OF SUBMISSIONS

Submission provided by	Issue(s)
Shareholders A	Consider lobster stock to have accumulated high abundances of large mature lobsters. Noted reduce fishing capacity north or Port Macquarie as result of retirement of several (smaller) operators. Catches continue to be strong with quota likely to be realised again this year, and little quota available for lease. Concerned that static TACC 'rewards' recreational fishers, implying inappropriate redistribution of benefits. Suggested 10% increase in TACC.
Shareholders B	Reported lobster stock and catch rates to be best ever experienced. Confidence in fishery stimulated increased investment. Catches very strong with quota realised early in fishing year again this year, and little quota available for lease. Expressed some concern that (increasing) quota lease prices were too high, given fairly static sale prices for lobster. Endorsed cautious approach to TACC setting but considered small increase warranted by several years of very healthy stocks and reportedly very large puerulus abundance in the last DPI survey.
Shareholders C	Reported very high catches of lobster at all depths; generally best experienced for at least a decade. Reached quota very early. Very high discards of over-size lobsters and of over-quota lobsters from traps that could not be recovered (because of bad weather) when quota was realised. Noted higher than previous by-catches of lobster in fish traps & reported large by-catches of lobster by trawlers. All evidence of very healthy stock. Also noted evidence of very large puerulus abundance in the most recent DPI survey. Suggested a "decent and substantial increase" in TACC.

**** These submissiosn were 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 Determination for 2018–19. The focus here is on the key features of data regarding rock lobster stock status and what can be inferred from those data about current and likely future state of the 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 operated with implicit target and limit reference points for several years.

Target reference point. The Committee for many years used a depletion to 0.5 of the unfished biomass for reporting the status of both total biomass and spawning biomass. The stock has been well below 0.5 of the unfished biomass for most of the time since the Share Management Plan was introduced so this reference point was not operationally relevant. It has become more urgent to identify an appropriate target reference point, however, as the stock has recovered to a state potentially closer to 0.5 of the unfished status. The Committee in recent years has recommended that a process to formally identify a target reference point be undertaken jointly by the Department and Industry. The Committee has treated a spawning stock depletion of 0.48 as the target reference point in the (recent) interim, this being the default target reference point for Maximum Economic Yield (MEY) in the Commonwealth Harvest Strategy Policy.

Initial analyses of long-term yield at various levels of catch and population depletion were provided this year. The exploratory nature of these initial analyses is recognised, as is the fact that a formal process will be needed to adopt a target reference point. The initial results, however, suggest that a spawning stock depletion to 0.48 of the unfished level is expected to provide close to the maximum yield at a relatively high exploitable biomass density (i.e. at relatively high commercial catch rate). These are characteristics expected of MEY and support ongoing use by the Committee of 0.48 as an interim target reference point.

The initial analyses also identified two aspects of the fishery that are highly relevant to selection of a target reference points, development of a harvest strategy, and to current management.

1. This is gauntlet fishery, in which a maximum legal size is set to protect the bulk of the breeding stock while the harvest is mainly of immature and small mature lobsters and, particularly, lobsters migrating from the southern nursery areas to the northern breeding areas. This gives yield characteristics that are different from ‘usual’ fisheries in which the harvest is spread across all size classes above a legally or gear determined minimum size at first capture. In gauntlet fisheries the level ‘escapement’ of juveniles through the fishery to join the breeding stock is a critical factor in determining long-term sustainability. The initial analyses reported this year for this fishery suggest that there is an abrupt threshold in the escapement, and consequently the harvest rate on exploitable biomass, beyond which the population slowly collapses despite the protection provided by the upper size limit. The initial analyses suggest that this threshold likely is close to current catch levels, given certain underpinning assumptions. The current apparent size of the spawning biomass, however, suggests that such a collapse is predicted to be very slow (i.e., occur over decades) and, further, would be readily corrected if detected early in that decline. Detection of impending collapse should be provided through the current spawning stock monitoring surveys, but detection would be most directly achieved through monitoring the escapement of juveniles through the fishery to reach the upper size limit and, more specifically, to join the larger spawning stock. An index of escapement for the fishery based on information already collected appears possible and should be developed for presentation in future assessments.

2. The long-term Maximum Sustainable Yield (MSY) and Maximum Economic Yield (MEY) may be similar, or close, to current catches. This inference, and the stock assessment modelling more generally, is based on assumptions about the relationship between spawning biomass and subsequent settlement and recruitment to the fishery that are still being clarified from observations as the fishery recovers. Puerulus settlement and subsequent recruitment to the fishery during recent years of population recovery have increased on average as the spawning biomass has increased. This increase ultimately must plateau for a spawning biomass at or larger than the current spawning biomass. The current analyses are based on the information currently available and so do not include the possibility of further increase of settlement or recruitment on average. The current analyses therefore are conservative, both with respect to the target and limit reference points and the long-term sustainable catches, to the extent that settlement and recruitment eventually plateaus at spawning biomass levels higher than those currently estimated. The model predictions are expected to correct as further information is obtained about how settlement and recruitment change as spawning biomass is increases further, or plateaus. The extent of any such further growth in settlement and recruitment must be explored with caution, especially given point (1) above.

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 (i.e., a management trigger reference point). The Committee has treated this as a limit reference point to be avoided with high probability, and has focused on its application to the spawning biomass in particular.

The Committee has used median depletion to 0.3 of the unfished level as a limit reference point. These two different values (i.e., 0.25 and 0.3) are consistent and equivalent when applied with different requirements for the probability that the reference point is avoided. A median 0.3 depletion is used as the limit reference point by the Committee because the stock assessment results are reported in terms of the median. The standard error of estimated depletion is about 0.05 so an estimated median depletion of 0.3 implies (approximately) an 84% probability that the true population is above 0.25 depletion, the legislated trigger for management action. Put another way, the median depletion of 0.3 that is the limit reference point used by the Committee is equivalent to requiring that the true population is inferred to be above 0.25 of the unfished biomass with about 84% probability.

The refined assessment analyses provided this year indicated that a median spawning biomass of 0.25-0.3 of the unfished level is consistent with avoiding unsustainable catch levels and harvest rates. The available analyses therefore suggest that a limit reference point for the spawning biomass at a median depletion of between 0.25 and 0.3 seems appropriate. The interactions between, and practical implications of, the options for the target and limit reference points for both spawning biomass and exploitable biomass should be further examined but the previous value of 0.3 is maintained here as a default limit reference point for reporting prior to formal stipulation of a limit reference point by the Department.

Performance against the limit reference point is examined for both total biomass and spawning biomass, with most importance being given to the spawning biomass.

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 approximate midpoint of the very imprecise Recreational Fishing Survey conducted in 2013–14. Uncertainty in estimates of recreational catch nevertheless remains of significant concern. Recreational catch is considered by many to have decreased in recent years but there also is a common view that it might increase again as continued stock recovery makes lobsters more available to

recreational divers and attracts greater recreational fishing effort. It is very important that a 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. Several high-profile prosecutions and the penalties imposed, however, 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 lobster 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. The NCUC catch is considered to have increased during the 1970s and reached 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 and 14.9 t in 2015–18; 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, and 17.5 t in 2015-18.

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.

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.

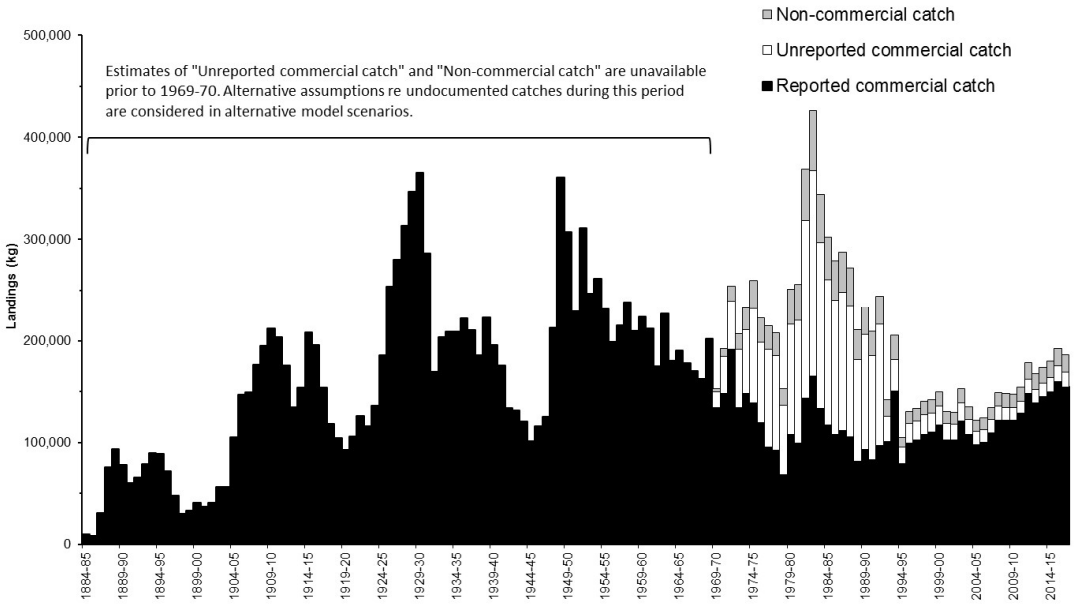

Figure A3.1. The landed catch of rock lobsters since the start of the fishery. The non-commercial and unreported commercial (NCUC) catches are shown since 1969 but the earlier NCUC scenario is not shown in the figure.

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 limiting. Discards were about 7 t in 2016–17, which is about 4.5% of the reported landed catch and it is assumed that 10% of discards do not survive. High discards are expected to continue in the fishery and it is necessary to both monitor and include them in stock assessments.

The total catch, effort, and catch per unit effort (CPUE) since 1969–70 are shown in Figure A3.2, including both standardised and unstandardised CPUE since 1997. The standardisation accounts for the gross effects of recent shifts in fishing effort from shallower grounds (less than 30m) 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 the increasing ability to avoid marginal weather or fishing grounds because of improved catch rates. The 2017–18 data are incomplete, but the catch accounts for most of the available TACC (approximately 80%) and the CPUE reported is likely to be a good reflection of the overall outcome 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.

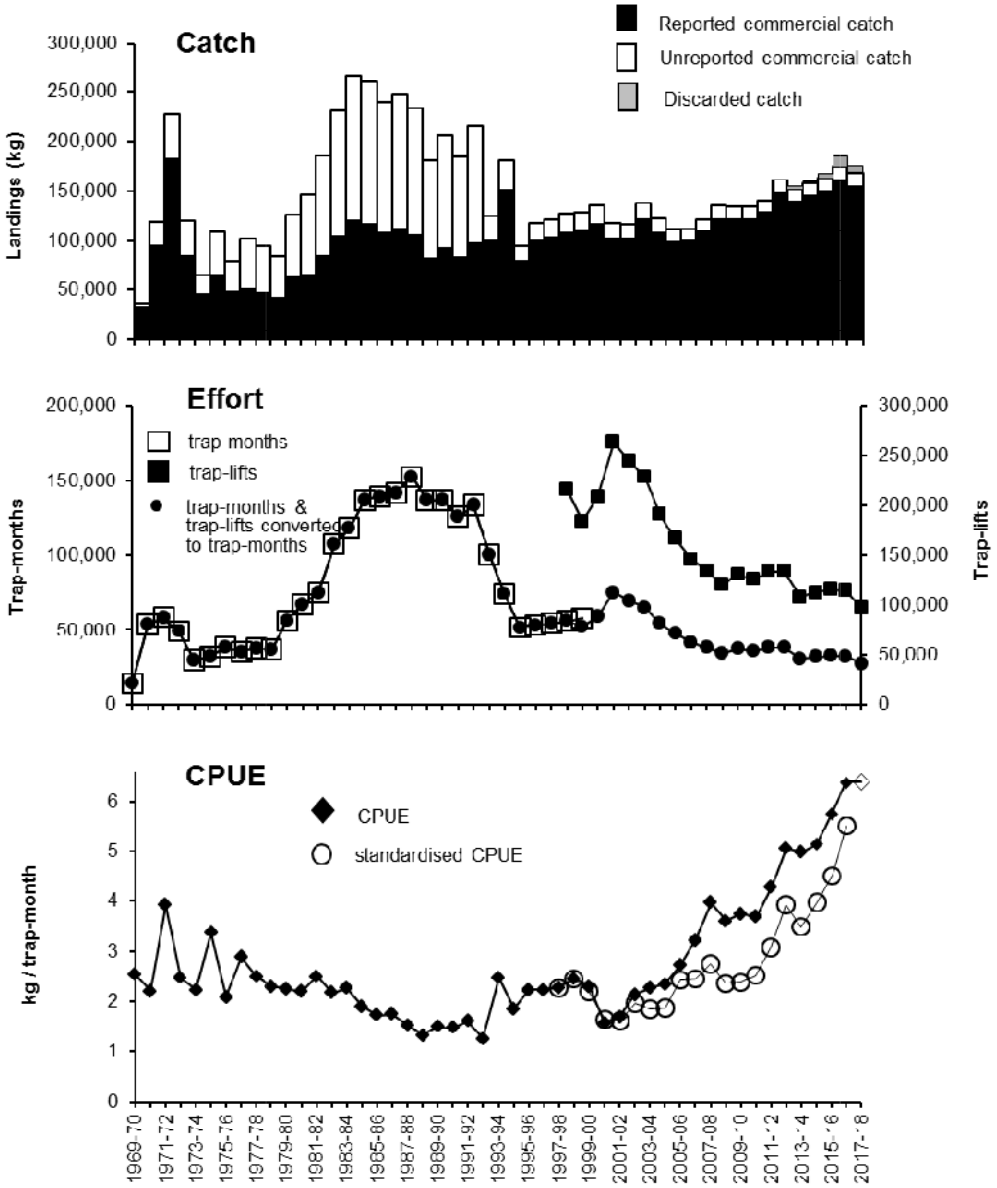

Figure A3.2. Commercial catch, effort, and catch rate since 1969–70 when more reliable effort is available. Data for the 2017–18 fishing period are incomplete but represents about 80% of the TACC.

The catch rate in the last few years has 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 7–8 years, which implies expansion of the breeding stock back to this area after many years of depletion. The catch rates in deep water (>30m) on the central and north coast remain high. These 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 (2017–18), which mostly recruit to the fishery about a year later, has remained very high despite the relatively low puerulus settlement 2-3 years prior. 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.

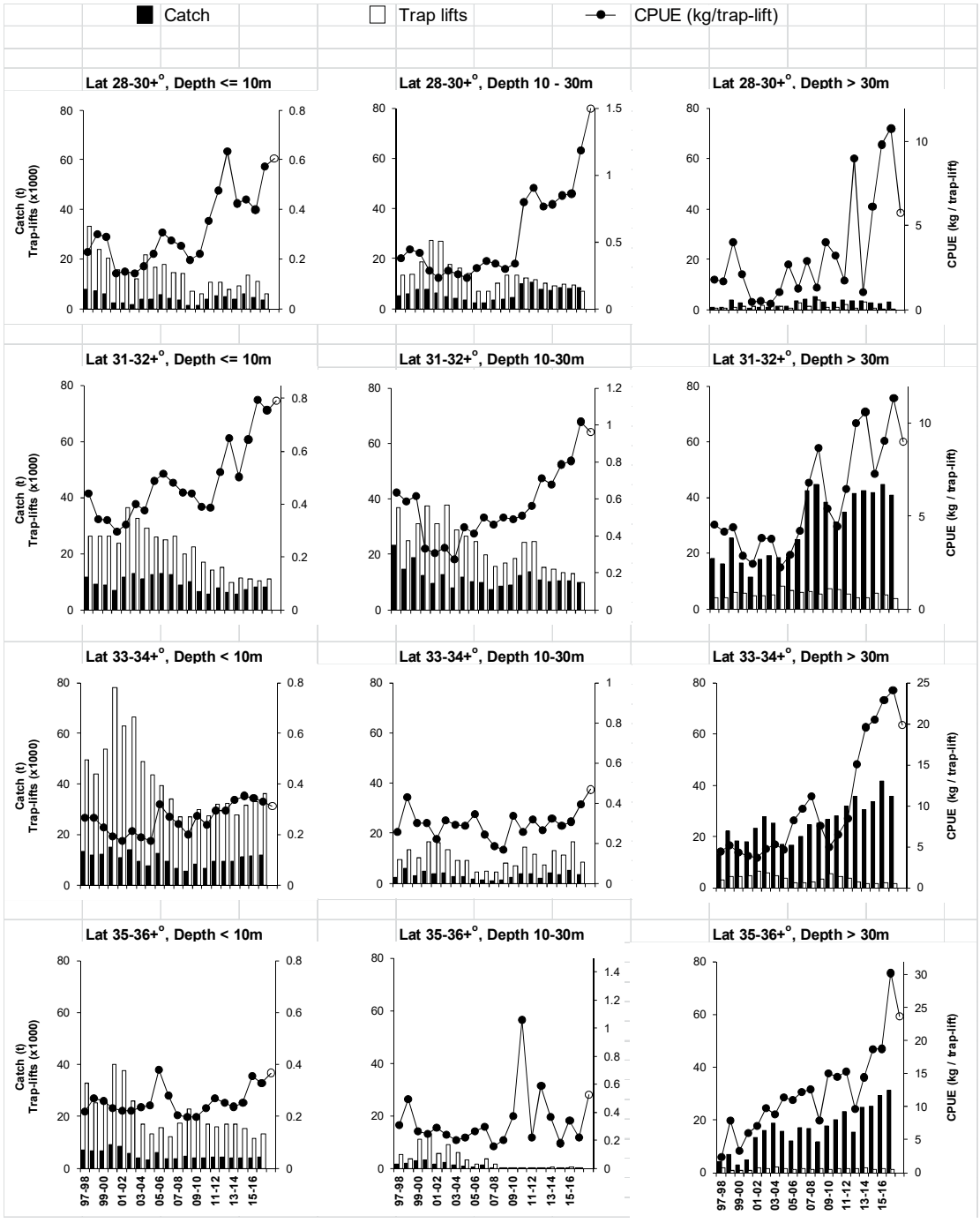

Figure A3.3. Commercial catch, effort, and catch rate by area and depth since 1997–98 when detailed reporting became mandatory. The spawning stock is found mostly in the far north coast (28-30+°) and mid-north coast (31-32°) at depths greater than 10m and especially depths 10–30m. Data for the 2017–18 fishing period are incomplete but include about 80% TACC and are expected to be a good pro-rata (catch, effort) or average (CPUE) indication 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 the spawning biomass does not result in increased average recruitment. That state determines the maximum sustainable catch and is very difficult to estimate from modelling alone.

Puerulus settlement has been increasing on average since about the mid-2000s, and on average this increase in settlement has been accompanied by an increase in recruitment to the fishery. Average settlement since 2010 is more than double the settlement in the late 1990s and early 2000s. Settlement in the past 3 years, however, has been very variable, with high settlement in some areas in the most recent two years but relatively low settlement 3 years ago (though still high compared to the settlements in the late 1990s and early 2000s). This could be expected to result in somewhat reduced recruitment into the southern inshore fishery during the next 1-2 years. The undersize catch monitoring, however, indicates that there is some compensation occurring and that recent recruitment to the fishery has been maintained despite recent periods of puerulus settlement that are low by modern standards. The risk of reduced recruitment to the fishery in the next 1-2 years consequently is considered to be low.

The size composition of the catch from standardised trap surveys on the mid-north and far-north coast is shown in Figure A3.4. This is the area where mature lobsters are found. The size composition is monitored every second year and was updated in 2016–17 so is unchanged in this year's report. 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.

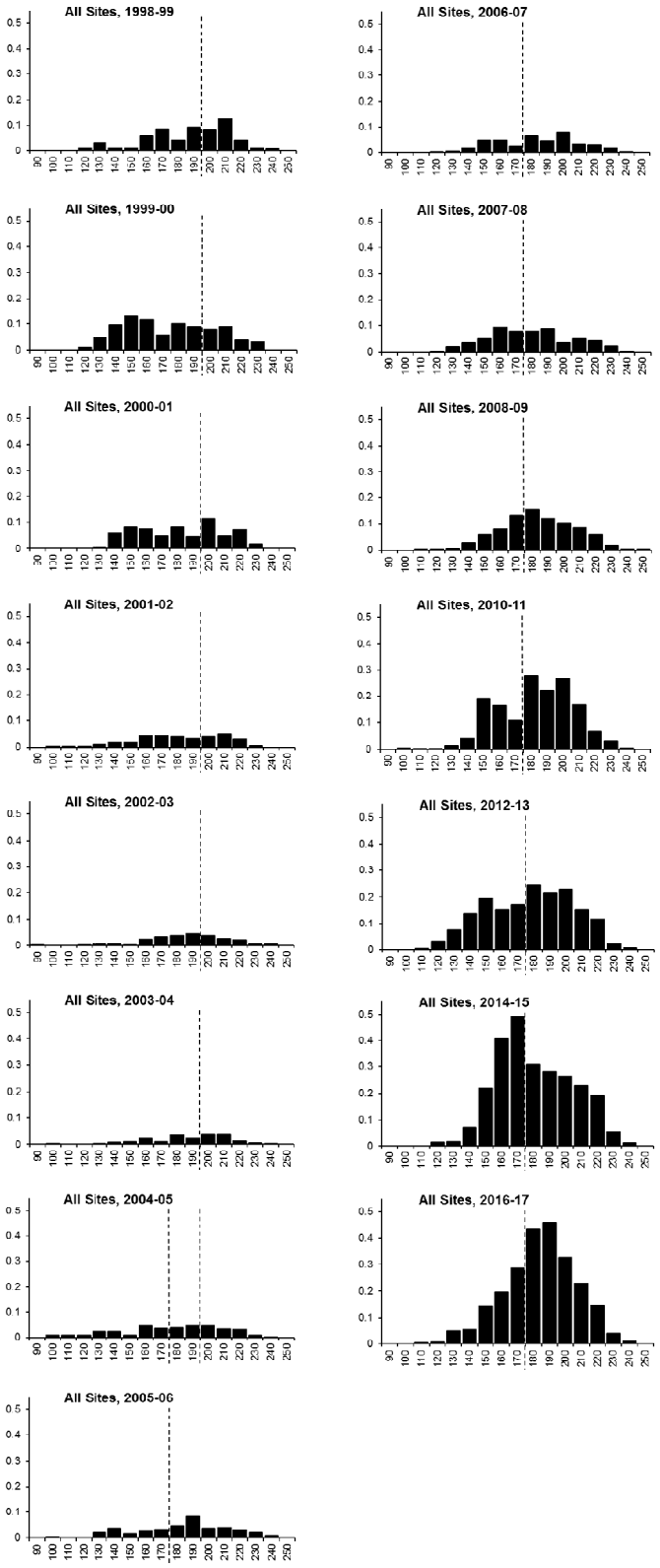

Figure A3.4. Size composition of lobsters in the commercial catch of the mid- and far-northern areas combined from logbook data augmented by observers. The dashed line is the maximum legal size, which changed from 200mm to 180mm in 2004–5, and the vertical axis is number of lobsters per pot-lift. Monitoring is done every second year and was done last in 2016–17.

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.

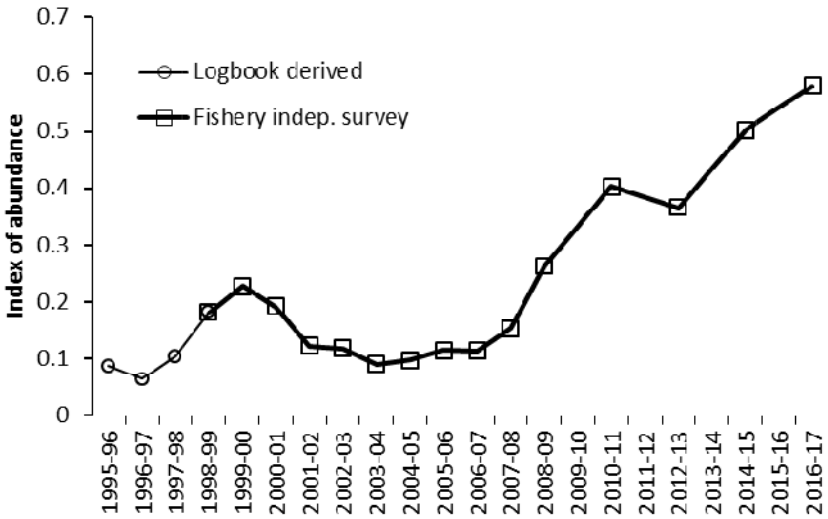

Figure A3.5. Spawning stock index (lobsters per pot-lift) from direct observations. The index is based on commercial catches of berried female lobsters for the period up to 1997–98 and on fishery-independent surveys since 1998. These surveys have been done every second year recently and were updated last in 2016–17.

The results from direct monitoring of the spawning stock are very encouraging overall with respect to the strength of rebuilding. They greatly increase confidence in assessing the status of the stock. They clearly and directly demonstrate that the decreased maximum size limit, decreased fishery targeting of the areas occupied by mature lobsters, the TACC reductions in the mid to late-2000s, and continued restraint in setting more recent TACCs is allowing rebuilding of the spawning biomass. The spawning stock initially rebuilt slowly under these management interventions, with rebuilding first occurring in the pre-mature lobsters in the deep-water parts of the fishery in the south, then feeding into the mature and pre-mature lobsters in the deep-water parts of the mid-north coast, and now also into the far-north coast. The increase in spawning stock has been particularly strong in the recent few years. The increased spawning stock appears to have resulted in an average trend of increasing puerulus settlement and recent recruitment to the fishery, albeit with large inter-annual variation. 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 the mortality of discarded lobsters.

The is fitted to the catch data (this year 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.

The model this year was modified substantially to reflect better the recent trends of increasing recruitment as the spawning stock has increased. 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 applied, fishery size selectivity, and several biological life-history parameters. A 'base-case' model was selected that reflects the most credible parameter values across these uncertainties and that best fit available data and this base-case model 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 also underestimates the index since 2012 and cannot reproduce the prolonged period of low spawning biomass during 2001–2007.
- The model fit to the catch rates is good for most of the time series but becomes increasingly poor since about 2012, with the model increasingly underestimating observed catch rates.

Possible reasons for these discrepancies, that are not mutually exclusive, include the following.

- Increases in recruitment since about 2012 have been stronger than estimated.
- Inadequate representation in the model of the relationship between fishing effort and fishing mortality on different components of the lobster population, including the effects of gear, season, and location of fishing effort. There are two aspects of this that likely are relevant. The first is operational changes during the 1990s and 2000s, especially in the northern part of the fishery, that could have caused the decrease in spawning biomass and its persistence at low levels through the early-mid 2000s. The second is increase in fishing efficiency since 2010 that is greater than that accounted for by the current catch-rate standardisation, implying that observed catch rates exaggerate stock recovery since about 2010.

The revised model used this year provides a better match to the available data than the previous versions, despite the remaining discrepancies. In particular, the improved treatment of the stock-recruitment relationship gives much more consistent interpretations. This reinforces earlier concerns, however, that the spawning stock was extremely depleted in the mid-1990s, with the revised model estimating that depletion was to about 4% of the unfished level compared to estimates of about 10% from the previous model. This level of depletion represents serious recruitment overfishing and is consistent with the substantially increased recruitment observed as the spawning stock recovers. 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 to be still-increasing as the spawning biomass increases. The population assessment model in future will be revised to match future observations, and such revisions would be expected to increase the estimated population productivity and the long-term yield available to the extent that recent observed increases continue.

A3.4.2 Present stock levels

The key population and depletion estimates are provided in Table A3.1 for the base-case assessment. The 95% confidence bounds reflect statistical uncertainty in the fit of the base-case model. Sensitivity scenarios contain additional uncertainty due to structural assumptions about the model and input data, as discussed above, 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 2017–18 from the base-case assessment model.

Metric	Median	5% limit	95% limit
Unexploited total biomass (K) (t)	7,472	7,409	7,980
2017-18 total biomass (t)	3,073	2,737	4,299
2017-18 total biomass/K	0.412	0.368	0.538
Unexploited spawning biomass (USB) (t)	2,864	2,840	3,058
2017-18 spawning biomass (SB) (t)	955	819	1,462
2017-18 SB / USB	0.334	0.288	0.478

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 above the interim limit reference point of 0.3 of unfished spawning biomass and there is a very high probability that the spawning stock is above 0.25 of unfished spawning biomass. The spawning stock continues to build toward the interim target reference point of 0.48 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 catch[8] at various levels, starting from the most recent biomass estimate in 2017–18 (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.

Table A3.2. Predicted spawning biomass in 2023–24 relative to spawning biomass in 2017–18 ($SB_{2023\text{-}24}/SB_{2017\text{-}18}$) 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	1.09 [1.01-1.14]
200	1.04 [0.97- 1.08]
225	0.99 [0.93- 1.02]

Table A3.3. Predicted exploitable biomass of 104–180mm lobsters in 2023–24 relative to that in 2017–18 ($EB_{2023\text{-}24}/EB_{2017\text{-}18}$) 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 [0.99-1.08]
200	0.95 [0.92- 0.97]
225	0.85 [0.83-0.89]

[8] 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 has been 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:

UCC=0.085 (RCC + UCC) =0.085 RCC/(1-0.085); and
TAC = RCC + UCC + NCC
= RCC + UCC + 0.1 (RCC+UCC)
= RCC + 0.085 RCC/(1-0.085) + 0.1 [RCC + 0.085 RCC/(1-0.085)]
= 1.202 RCC;
and hence
TACC = RCC = TAC/1.202
= 0.832 TAC, and
NCC + UCC = 0.168 TAC.

It is predicted that for catches at about recent levels [TACC = 160t, total catch (TAC) = 192t] that spawning biomass would continue to rebuild slowly. The exploitable biomass is predicted to decrease slightly from current levels under the same catches. The 5y stock projections in recent years have been pessimistic compared to actual outcomes, probably because of the limitations of the model scenarios discussed in section A3.4.1 and in previous reports. The revised assessment model used this year is expected to have lower prediction bias than the previous versions, but there remains the fundamental uncertainty about the extent to which future recruitment will continue to increase as the spawning biomass increases. 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 (i.e., predict stock decline at lower harvest rates than likely). 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 0.25 of the unfished level. The median estimate of spawning stock depletion is 0.33, above the interim limit reference point of 0.3 depletion.

There are uncertainties in the model interpretations about the extent of stock rebuilding and the potential for further rebuilding, but all model interpretations demonstrate that significant rebuilding has occurred in the past about 10 years and that it is continuing. This is supported by all the empirical observations from the fishery. 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 undated 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 y. There was relatively weak settlement 3 y ago but this appears not to have resulted in decreased recruitment to the fishery, perhaps because of compensatory mechanisms and good settlement in adjacent years. The under-size index in 2016–17 and the preliminary index for 2017–18 are the two highest since observations began in 1998–99, suggesting that recruitment to the fishery will again be strong in the coming year and also boding well for recruitment to the fishery in later years.

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

The preliminary analyses of the long-term sustainable catch provide a very useful basis to begin development of a formal harvest strategy for the fishery, including targets, limits and guidance for management decisions (including TACC setting). Review of the upper size limit for harvest should be an element of formalising a harvest strategy but should not be considered in isolation. The initial analyses suggest that the current working reference points for spawning biomass (i.e., a target depletion of 0.48 and a limit depletion of 0.3) adopted by the TAFC are not unreasonable, and will continue to be applied as interim reference points.

The preliminary analyses of long-term sustainable catch indicate that the gauntlet nature of the fishery means that there is a threshold in the catch and harvest rate above which the spawning stock slowly collapses, despite the protection of large mature lobsters above the upper size limit, because of inadequate escapement of juveniles through the southern fisheries to join the spawning biomass. This analysis also suggests that the threshold may be close to the current total catch. This clearly needs both further examination and cautious management, but there are two important implications in relation to short-term management.

1. The model on which the preliminary analyses are based has been pessimistic in its fit to recent observations and its short-term predictions. The model has not been able to match the rapid increase in spawning biomass and commercial catch rate in recent years, and has been predicting a decrease in commercial catch rate that has not eventuated. The model assumptions about the relationship between spawning

biomass and recruitment also imply that the spawning biomass has recovered already to the point where recruitment is expected to stop increasing and to stabilize, on average, whereas observations suggest that recruitment continues to increase. The model will be updated with additional observations of recruitment at higher spawning stock sizes, and recruitment must stabilize at some spawning stock size, but the predicted maximum productivity currently is limited by these assumptions.

2. The current size of the spawning stock indicates that collapse as a result of inadequate escapement through the juvenile fisheries would be very slow, occurring over decades. The extensive monitoring in this fishery means that inadequate escapement through the juvenile fisheries would be recognised quickly. The commercial catch rates in the spatially structured juvenile fisheries, as in Fig A3.3, and in the fishery independent monitoring of the spawning stock size composition, as in Fig A3.4, would characteristically collapse from the smallest sizes first, signalling warning signs of escapement decline. There is little risk therefore that the start of such a collapse would go un-noticed and un-addressed. It is recommended, however, that an index of escapement based on existing monitoring programs be developed and evaluated to formalise the analysis of prospective collapse stemming from diminished escapement.

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. For example, a low catch 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, consequently prevent observation of recruitment at higher stock levels, and lock the fishery into a sub-optimal harvest situation, while also risking over-shooting the catch associated with maximum productivity and subsequently precipitating catch reductions and resumed rebuilding. 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 the catch rates of the inshore fishery. Hence, there is an about 3-4-year lag in being able to observe the effects of changes in the size of the spawning stock on recruitment, and an even longer lag in being able to observe the effects on the abundance of larger lobsters in the fishery. Expressed slightly differently, there 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 150t applied for 2 years then a TACC of 160t applied for the following 3 years, and this approach is applied again here.

The available data and recent resource assessment indicate that it is appropriate to increase Total Allowable Commercial Catch (TACC) this year to 170t, which corresponds to a Total Catch of 202.3t including non-commercial and unreported catch. This is expected to allow for some further rebuilding of the spawning stock towards maximum stock productivity while also increasing fishery production based on the recovery already achieved. The strategy outlined above indicates that this increase should stand for the next few years unless contrary indicators suggest it is beyond sustainable stock productivity.

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. Economic considerations at this stage must focus on gross returns to the industry, rather than net returns, given the absence of specific information on fishing costs. 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. 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 absence of relevant data on fishing costs means that it is not possible to make a complete analysis of the economic performance of the NSW rock lobster fishery. Data limitations constraining analyses to gross returns alone mean that any impacts of changing costs on profitability cannot be taken into account in determining economic performance or efficiency. The absence of any formal economic objective for the fishery also means that performance cannot be assessed relative to any target. Further, the absence of appropriate economic data means that a maximum economic yield cannot be determined for the fishery.

A4.2 Volume and value of production

The volume of reported catch of rock lobster from August 1 2017 to 4 April 2018 was 123.7t, representing 77% of the TACC of 160 t being taken in the 2017–18 fishing period (Figure A4.1). This is a lower proportion of the TACC than taken in previous years at this stage of the fishing season. In 2016–17, only 96.6 of the TACC was taken over the full fishing period.

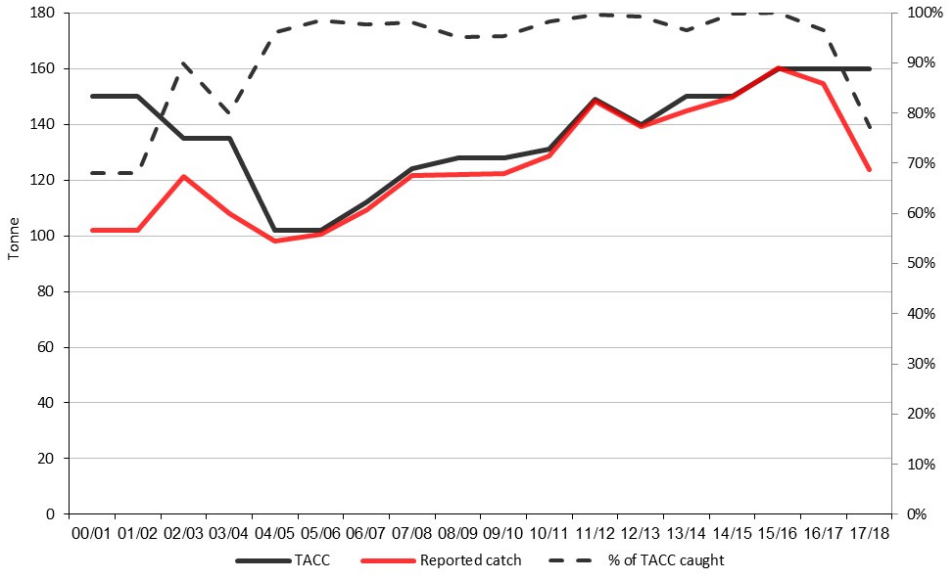

Figure A4.1: Catch, TACC, and per cent of TACC caught 2000–01 to 4 April 2018.

The nominal estimated gross value of production (GVP) over 2017–18, based on Sydney Fish Market (SFM) prices and assuming the whole quota (160t) is taken, was $11.7m for the fishery as a whole (Figure A4.2). GVP in the fishery generally has increased in both real and nominal terms[9] since 2012–13, a result of increases in both catches and prices (see next section), but has remained relatively stable over the last two years due to a common TACC of 160t and relatively static prices.

[9] Consumer Price Index (CPI) adjusted values are calculated using Reserve Bank of Australia (RBA) "all groups" CPI data up to December 2017. Fiscal year adjustments are taken from the December quarter of the appropriate year. CPI adjusted data are identified as "real" price or value figures on graphs.

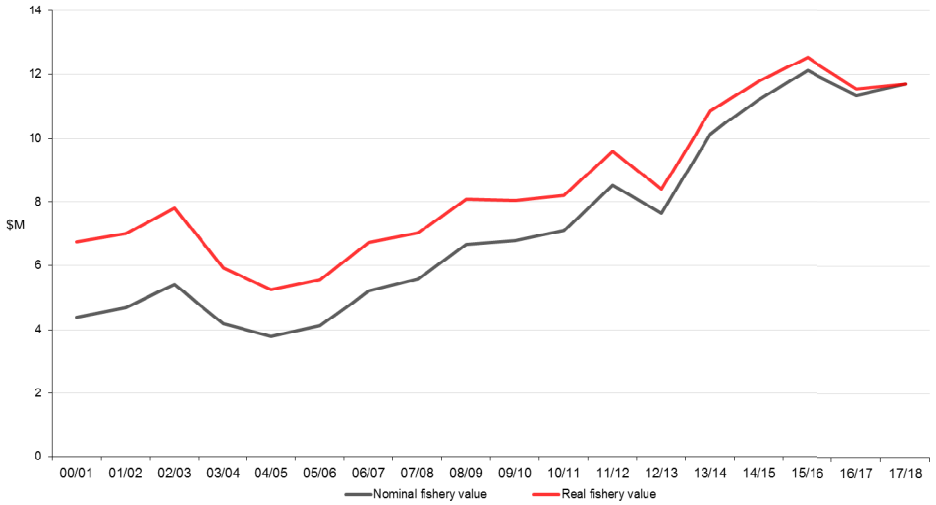

Figure A4.2: Value of production 2000–01 to 2017–18 (Data to 4 April 2018 with predicted return to 31 July assuming full 160 t TACC landed).

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 the earlier years of the period (Figure A4.3).

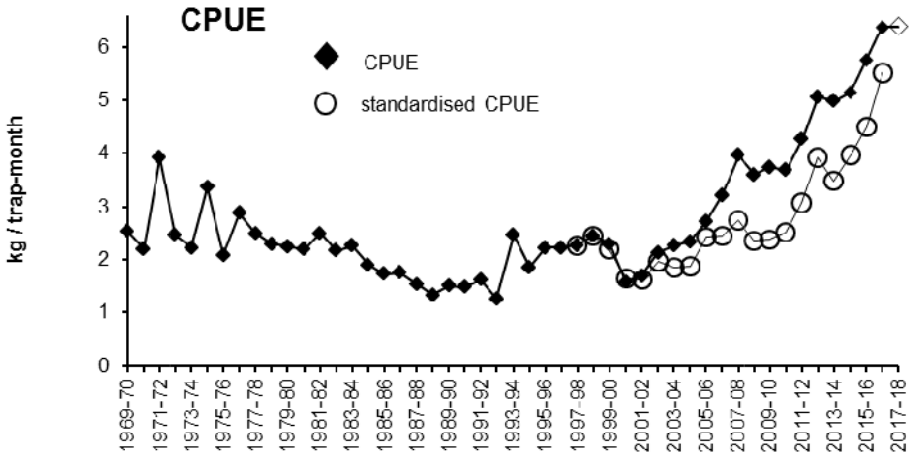

Figure A4.3: Estimated catch per unit effort, 1969–70 to 2017–18.

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 historically high, even allowing for these productivity changes (Figure A4.2). 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 was 10,516t, of which NSW contributed 146t (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 animals[10]. 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 will be reduce to zero in 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.[11] The AUD is forecast to further depreciate slightly over 2018–19 relative to the CNY[12], so prices on export markets are likely to remain relatively attractive to Australian producers, particularly given the further reduction in tariffs over this period. ABARES forecast that the export values for lobster will increase in 2018–19 and following years.[13] The Committee suggests the Department undertake an analysis of such effects to inform economic analysis of the rock lobster fishery.

Thirty-seven (37) t of lobster were exported directly from NSW In 2015–16, representing less than 1% of Australian exports of rock lobster but 25% of the State's production. The actual figure exported may be higher, however, as some product may have been sold through interstate-based agents before export. This suggests, nevertheless, that as much as 75% of the catch is sold domestically. The Sydney Fish Market (SFM) is the major single market, with 47% sold through the SFM in 2016–17 and 41% in 2017–18 (to April 2018).

Prices received on the SFM have declined in recent years but still remain 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.

Figure A4.4: Average beach prices in real and nominal terms 2000–01 to 4 April 2018.

[10] ABARES (2017). Australian fisheries and aquaculture statistics 2016. ABARES, Canberra.

[11] https://www.xe.com/currencycharts/?from=AUD&to=CNY&view=10Y

[12] http://www.nab.com.au/business/international-and-foreign-exchange/financial-markets/exchange-rate-forecast

[13] ABARES (2018), Agricultural commodities: March quarter 2018. ABARES, Canberra.

Price information for lobster sold through outlets other than the SFM is not available publicly. Anecdotal evidence, however, suggests that prices all along the coast follow the SFM price, although the prices received by fishers will vary due to differences in transport costs. Fishers also report that prices for product that is exported are lower than those received on the SFM but the export market is able to take greater volumes without resulting in price drops. The Committee encourages the Department to collect information on export prices and include it in next year's price figures.

NSW product competes to some extent with Western Australian and South Australian product at the SFM. The Committee noted in the 2015 determination 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 alternative marketing strategies, including potential benefits from gaining third party sustainability accreditation such as that offered by the Marine Stewardship Council.

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 2017-–-18 are not yet available. The Committee suggests it is worth analysing the relationship between lobster size, market demand, and optimal economic yield.

Table A4.1: Eastern rock lobster weight and average price (Sydney Fish Markets) by grade for the 2015–16 and 2016–17 fishing periods.

Sydney Fish Market Grade	Weight (kg)	Carapace length (mm)	Nominal average price ($/kg)	
			2015-16	2016-17
Extra Large	1.7 – 2.46	158 – 179	$78.97	$77.75
Large	1.2 – 1.7	140 – 158	$79.21	$77.55
Medium	0.7 – 1.2	117 – 140	$75.81	$72.09
Small	< 0.7	104 – 117	$72.98	$69.64
Ungraded	-	-	$75.03	$72.49

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). Similarly, 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. In a well-functioning market (which may not be the case for the lobster fishery due to the relative small number of participants in the lease-transfer market), the equilibrium will be reached 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.).

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). 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. The management charge, in contrast, has declined over time and with the level of quota.

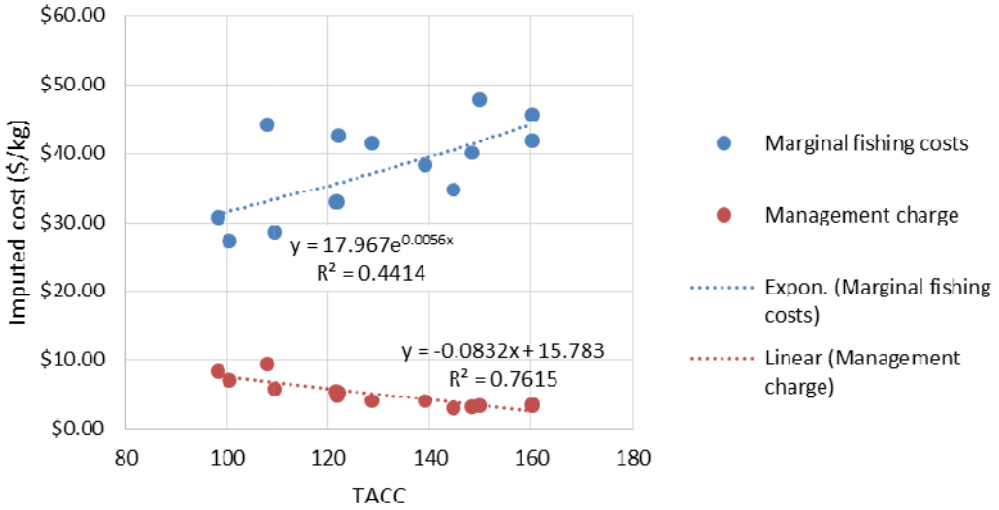

Figure A4.5: Imputed marginal cost ($/kg) and management charges (in real terms).

The key drivers of the 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 Kompas et al. 2009[14] for details). The key driver of the lease price over the last few years (since 2014–15) appears to have been the lobster sale price (Figure A4.6). The contribution of costs of capture to profitability appear to have increased in recent years. The calculation of the cost index involves treating costs as a negative "price", so an increase in the index represents a decrease in the cost of catching lobster.

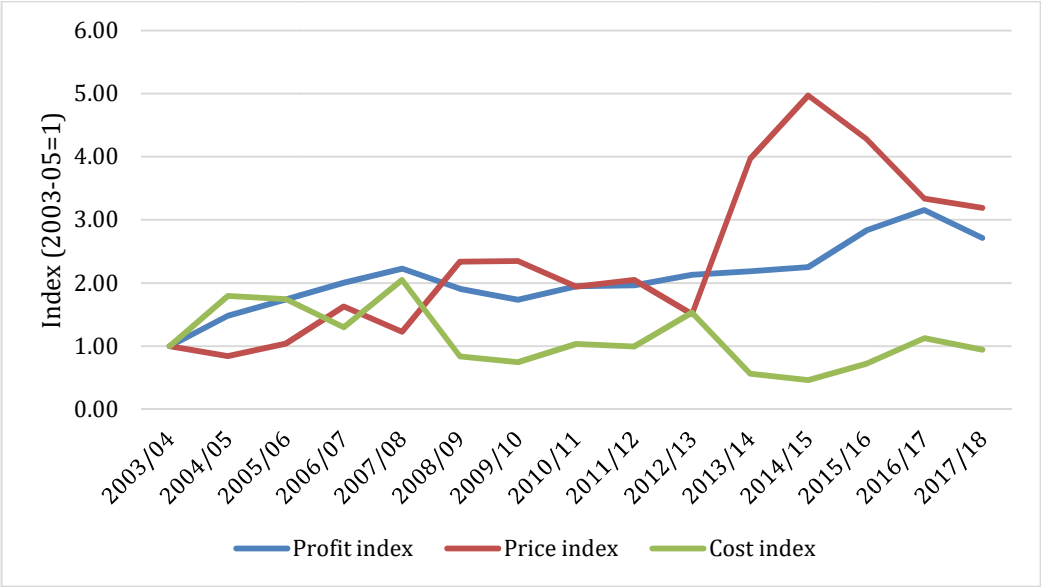

Figure A4.6: "Profit" decomposition, 2004–05 to 2017–18. The graph indicates the relative contribution of changes in prices and cost to changes in profit.

[14] Kompas, T., R.Q. Grafton, N. Che and P. Gooday 2009. Development of Methods and Information to Support the Assessment of Economic Performance in Commonwealth Fisheries. ABARE report for the Fisheries Research and Development Corporation: ABARES.

Finally, the relationship between the annual lease price and the share sale price (on a $/kg basis) also provides an indication of the implicit discount rate[15] 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. From Figure A4.7, 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.

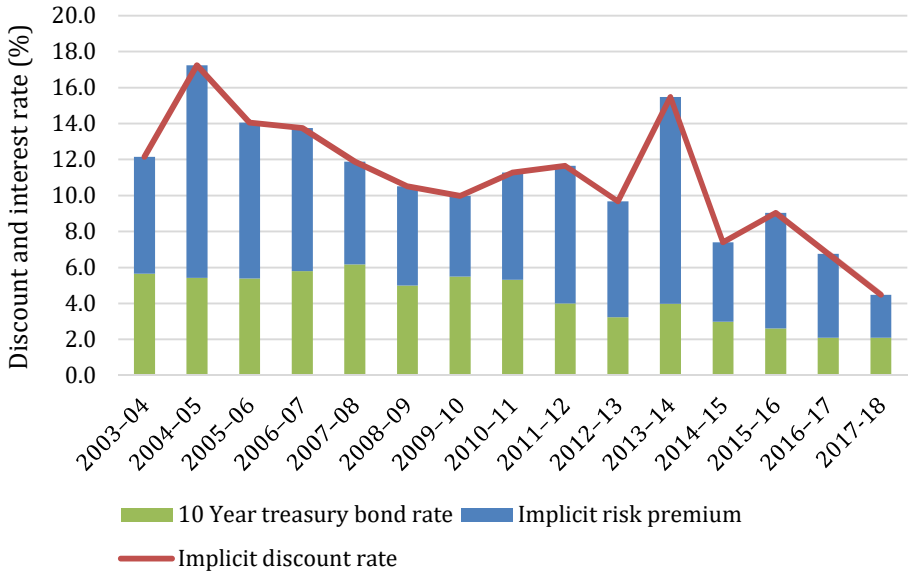

Figure A4.7: Implicit discount rate, 2004–05 to 2017–18.

A4.6 Shareholders and business structures

The number of shareholders in the lobster fishery has fallen considerably from 174 shareholders at the commencement of the Share Management Plan in 2000 to 102 shareholders during in 2017–18, a decline of 41%. 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 for lobster shareholdings.

[15] 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.

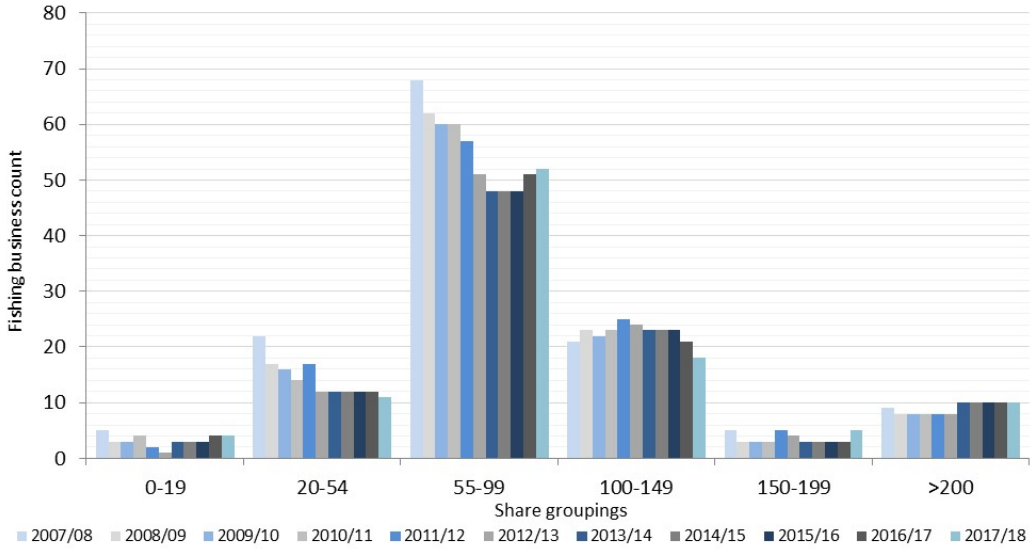

Figure A4.8: Distribution of shareholders by share grouping for the 2007–08 to 2017–18 fishing periods (2016–17 data as at 20 April 2017).

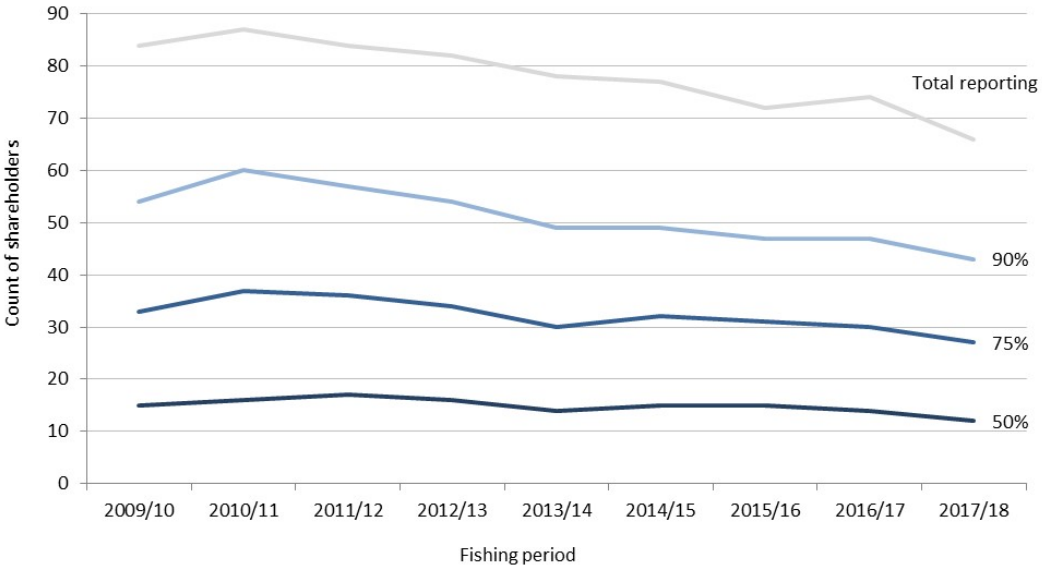

Figure A4.9: Number of shareholders catching % of TACC (2017–18 to 21 March 2018).

The structures of fishing businesses that hold a lobster endorsement is not uniform and varies widely according to size of shareholdings, location of operations, and historical or personal fishing preferences. These differences affect the number and types of endorsements held by a fishing business and the size or type of vessels and traps used. Lobster fishers focussed on deep water fishing, for example, typically use larger traps and larger vessels and are more likely to be specialised lobster fishers. Lobster fishers favouring the shallower inshore fishing, alternatively, are more likely to have smaller boats and traps and fish other endorsements in a less specialised business structure.

Nearly all 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 hold at least one current endorsement in another fishery (Table A4.2). 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 A4.2: Endorsements in selected other fisheries held by lobster fishing businesses in 2014–15 (to 7 July 2015), 2015–16 (to 21 June 2016), 2016–17 (to 1 May 2017) and 2017-18 (to 9 April 2018)

	Lobster Fishing Businesses in			
Other Fishery	**2014-15**	**2015-16**	**2016-17**	**2017-18**
Ocean Trawl	4	6	7	6
Ocean Trap and Line	42	47	52	43
Ocean Haul	27	39	44	42
Estuary General	31	44	53	47
Estuary Prawn Trawl	2	2	3	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 the 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 considers that it would be pertinent for the Department to undertake economic analysis of the structure 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. The Committee's recommendations on the 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 fishing periods (2011–2016) whilst the number of shareholders trading quota has varied by up to 20% over that same period (Table A4.3). Transferability (leasing) of quota allows for some flexibility in fishing operations during the fishing period in response to catch dynamics but fishers contend that it often is difficult to source quota to lease and there are high transaction costs associated with 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 A4.3). Transfer prices fell slightly in 2017–18, largely as a result of the decline in lobster price noted previously.

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 A4.3: 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 4 April 2018.

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	$9.92
2004–05	34.5	68	47	34	$10.89	$14.70
2005–06	30.1	64	45	30	$13.15	$17.26
2006–07	35.6	59	23	32	$15.64	$19.87
2007–08	42.3	60	32	34	$17.90	$22.10
2008–09	42.2	48	36	33	$15.90	$18.93
2009–10	39.3	52	43	31	$14.76	$17.22
2010–11	36.3	48	41	28	$17.00	$19.30
2011–12	48.0	51	45	32	$17.69	$19.50
2012–13	48.9	49	36	35	$19.61	$21.15
2013–14	44.8	55	34	30	$20.68	$21.71
2014–15	45.8	49	38	31	$21.67	$22.36
2015–16	45.0	45	31	28	$27.68	$28.08
2016/17	44.0	45	33	28	$31.29	$31.89
2017/18	52.2	52	31	33	$27.61	$27.61

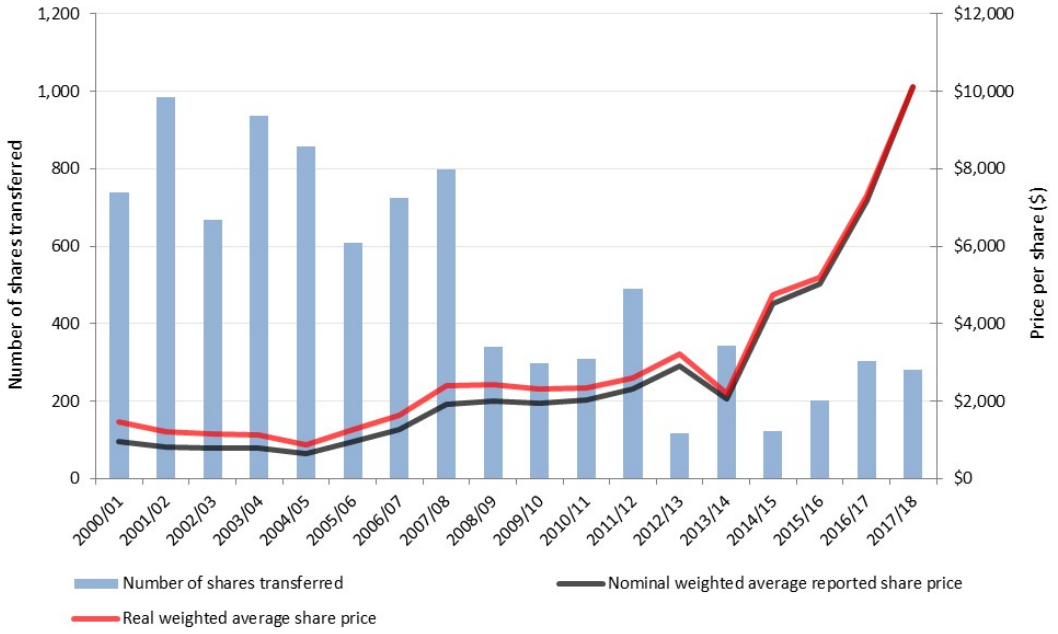

Figure A4.10: Number of shares transferred, estimated share price, and CPI adjusted (real) share price by fishing period from 2000–01 to 23 March 2018

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

The Committee is pleased that the Department has started discussions with industry about the importance of collecting economic data to underpin economic analyses of the fishery, but notes that there has not been progress beyond initial discussions. 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, however, remains unanswered and unanswerable whilst economic data about industry operations are scant.

There are several ways in which economic analyses of the fishery could be tackled, 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 through a survey of lobster fishing businesses. Some options are presented in more detail in 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 the collection of economic data on the South Australian Southern and Northern Zone Rock Lobster Fisheries (and other 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.

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.

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)[16].

The Committee is of the view that calculation of net return through collection of data on the costs and earnings of lobster fishing businesses would be the best place to start an economic analysis of the lobster fishery. This would allow for the heterogeneous nature of lobster businesses to be taken into account in economic analyses.

The Committee believes the development of a bioeconomic model of the fishery would provide substantial benefits to the industry, both in determining appropriate biomass and TACC for a specific economic target that maximises net economic returns, and also providing information on both short term and longer term implications of different TACCs both

[16] 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.

biologically and economically. Including economic information into current stock assessment models and analyses would be relatively straightforward provided appropriate data existed. The Committee again recommends that the Department and Industry set up a working group to develop an approach to undertaking economic analyses in the NSW Lobster Fishery. One approach may be to develop a PhD project in collaboration with FRDC and a University to undertake the analyses and work with the Department to develop an appropriate bioeconomic model based on future development of the current assessment model.

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) 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, which includes rock lobster, 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 the apparent increase in profitability in the fishery, and is expected to be retained for 2018–19.

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 rent[17] 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 for future economic rent generation with regard to alternative TACC scenarios requires a bioeconomic model. There is no objective basis from which 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 a perception by industry that the future outlook for the fishery is positive. The decline in quota trading price in 2017–18 largely is driven by a decline in market prices. Increasing share trading prices and the declining implicit discount rate suggest that the industry has strong confidence in the future economic performance of the fishery. This increase in performance is a result of a

[17] 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 therefore will earn more profit. Rents attributable to the skill of fishers are described as entrepreneurial rents. Entrepreneurial rents should be left with fishers. Entrepreneurial rents can be as high as 36 per cent of total economic rent in a fishery. Fishers may earn large surpluses over costs in the short-term, which may provide *prima facie* evidence of substantial resource rents. There are some circumstances, however, where such surpluses can occur but they are not true rents. These are referred to as quasi-rents and might arise, for example, when there is under-investment in a recovering fishery or where short-term but unsustainable increases in prices flow 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 and also are a component of economic rent.

number of factors, including increases in stock abundance and catch per unit effort, the latter believed to have been influenced partly by efficiency and practice improvements.

A basic analysis of the available data also suggests that the increase in profits in the industry, with the exception of 2017–18, largely has been influenced by the increase in 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 overinvestment, 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 if the industry. Better economic data, such as information on the costs and earnings of lobster fishing businesses, and bioeconomic models will allow future TACCs to be set that maximise economic returns from lobster fishing and facilitate better management decisions by allowing the Department to understand better the financial impacts of alternative management options.

APPENDIX 5. MANAGEMENT EVALUATION

A5.1 Introduction

This section of the report provides more detailed information and discussion of components of the fishery's management that underpin the assertions and conclusions in the body of the report. Some recommendations also are made for consideration by the Department.

A5.2 Compliance

A key objective of the Share Management Plan (SMP) for the fishery is to minimise the number of offences that occur 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.

Data on the number of hours dedicated to rock lobster compliance indicate increasing levels of targeting (Table A5.1). There was a spike in 2013–14 in particular that reflected a focus on a small number of high-end offences. This reinforces the relationship between targeted, intelligence-led compliance effort and detection rate, which appears in the outcomes as a decreased compliance rate but actually reflects well on the compliance regime in the fishery.

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

	Compliance effort (hours)			Targeted Effort
Year	**Commercial**	**Recreational**	**Total**	**(Estimated %)***
2012–13	1722	2959	4681	30%
2013–14	2269	3160	5429	57%
2014–15	1811	3340	5151	38%
2015–16	939	3150	4089	36%
2016–17	877	3227	4104	35% total *30% commercial* *37% recreational*
2017–18	856	1102	1958	38% total *63% commercial* *19% recreational*

* The proportion of compliance effort hours that were targeted

The Fishery Management Strategy (FMS) also specifies triggers at 10% and 20% non-compliance (equivalent to 90% and 80% compliance) for serious and minor offences respectively, in addition to the 70% trigger for compliance in the SMP.

indicator	Data requirements	Trigger point	Robustness	Justification/comments
Percentages of total inspections which result in the detection of major (share forfeiture) or minor (all other) offences	Includes records of number and type of offences and the compliance effort expended (e.g., number of inspections). Data on the number and types of offences detected by Fisheries Officers are held in records kept by DPI.	Percentage of inspections resulting in detection of offences exceeds either: (i) 20% for minor offences; (ii) 10% for major offences	Low	This indicator provides a simple low cost measure of compliance with management rules. More sophisticated indicators and trigger points can be developed based on new data that may become available in the future.

The information available about the numbers of inspections and types of offences detected for recent years is set out in table A5.2.

Table A5.2: Breakdown of compliance effort and resulting inspections and detections.

	Commercial Compliance			Recreational Compliance		
Year	**Patrol hours**	**No. contacts**	**No. offences detected**	**Patrol hours**	**No. contacts**	**No. offences detected**
2014–15	1202	152	43 offences by 41 fishers; *37 cautions,* *1 infringement,* *5 prosecutions*	3260	598	107 offences by 73 fishers; *59 cautions,* *25 infringements,* *23 prosecutions*
2015–16	939	68	36 offences by 18 fishers; *19 cautions,* *10 infringements* *7 prosecutions*	3150	557	100 offences by 89 fishers; *66 cautions,* *23 infringements,* *11 prosecutions*
2016–17	877	83	58 offences by 45 fishers; *28 cautions* *25 infringements* *5 prosecutions*	3227	626	112 offences by 69 fishers; *63 cautions* *42 infringements* *6 prosecutions* *1 pending*
2017–18 (8 mo)	856	46	18 offences by 17 fishers; *7 cautions* *2 infringements* *9 pending*	1102	282	35 offences by 24 fishers; *18 Cautions* *15 infringements* *1 prosecution* *1 pending*

Some observations from these data:

- There are approximately only half as many interactions with the commercial fishery for the same amount of hours in 20017–18 compared with2016–17.
- The figures for the recreational fishery are comparable to the previous year, accounting for 8 months and the reduction in effort in the recreational fishery (which is intentional and justifiable in terms of the Department's priority in the commercial fishery this year).
- The percentage of effort classified as 'targeted', being dedicated to targeted offenders, for the whole fishery has been relatively stable (~40%), although this year targeted effort has been weighted heavily toward the commercial sector.

It is difficult to read too much into changes from year to year in these data. Nevertheless the relative consistency in the last five years of the amount and type of compliance effort would suggest that the decrease in detections this year (despite increased targeted effort) is a reliable indicator of the state of compliance in the fishery. This would be consistent with the increased focus last year on particular types of offences, and would suggest that this has had a deterrent impact and improved compliance with requirements of the quota system.

The proportion of serious offences has not increased. The industry did emphasise, however, that meaningful penalties need to be applied to create effective deterrence and that share forfeiture is the best deterrent that could be implemented in the fishery. Industry members from the Rock Lobster Fishery Working Group strongly supported reforms to the legislation and the practice of forfeiting quota shares.

The Committee supports continued focus on ensuring compliance with the quota monitoring system, which 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.

It is important to note that there is a category of person that engages in illegal fishing that is undertaken by unlicensed fishers but 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 an 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. 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 A5.3, Goal 6) was exceeded during the 2016–17 fishing period, specifically the drop in compliance rate.

Table A5.3: 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

Industry and government acknowledge the need to develop specific stock and harvest targets that maximise the economic yield from the fishery as the fishery continues to improve biologically and move away from the biological trigger points. 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. There is a wide range of international, national, and State instruments and policies that establish the use of *limits and targets* as standard practice in harvest strategy design.

A5.3.3 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.

Table A5.4: 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	123.7*	73.40	11.73**	57.09	4.7**

* Based on catches to 28 April 2018

** Estimated values assuming that the 160t TACC is taken at the average price to date

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% (2014–17). 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.