NSW Total Allowable Catch Setting and Review Committee

Report and Determination 2017–18

ROCK LOBSTER FISHERY

15 June 2017

EXECUTIVE SUMMARY

Preamble

The NSW Total Allowable Catch Setting and Review Committee (the Committee) has responsibility under the NSW Fisheries Act (1994) for determining the annual total allowable commercial catch of rock lobster by NSW commercial fishers. This determination is for the period 1 August 2017 to 31 July 2018 (the 2017–18 fishing period). The determination is based on a scientific assessment of the status of the rock lobster stocks, reports from managers of the fishery and compliance enforcement officers, comment from fishers, and discussions at a public forum with the Committee on May 17th 2017.

Determination

The Committee has determined that the total allowable catch of rock lobster by NSW commercial fishers during the 2017–18 fishing period should not exceed 160 tonnes (t).

This allocation is the same as the allowable catch in the 2015–16 and 2016–17 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, DPI) and the Lobster Industry Working Group (the Working Group) in the interests of improving performance of the fishery in future years.

Recommendation 1: The Department and industry develop a harvest strategy with specific fishery objectives linked to target reference points for discussion at the 2018 open forum.

Recommendation 2: The Department redevelop the stock assessment model to improve predictions for TACC setting and support robust strategic analyses of longer-term targets and harvest strategies, including explicitly representing the different depth, geographic, and gear components of the fishery.

Recommendation 3: The Department and Industry develop a strategy for economic analysis of the fishery, including through provision of price information for quota transfers and fishing operating costs to facilitate robust economic analyses of the fishery.

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

Recommendation 5: The Department continue targeted enforcement strategies and develop metrics to measure compliance in both the targeted and general populations of fishers.

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.

The scientific assessment to 2015–16 indicates the best estimate of current spawning biomass is 35-40% of unfished levels and provides convincing evidence that spawning biomass is above the 25% legislated trigger point and well within the range considered acceptable for species such as eastern rock lobster. The Committee considers this assessment to be appropriate based on recent observations.

The stock has now recovered to the extent that current status is approaching the range of spawning biomass where common fishery targets are expected to be for this species. A process to identify the desired target is needed, supported by re-development of the assessment model to improve its medium-long term predictive performance.

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 lobster industry in NSW has continued to improve. Recent indications of price declines due to the slowdown in the Chinese market suggest that profits may diminish slightly in coming years, but are likely to remain strong. The lack of information on operating costs and returns from lobster fishing, however, means that conclusions about the economic status of the industry are tentative. Information on the economic structure of fishing businesses would allow both the Department and the Committee to understand better the implications of determinations for industry economic well-being.

Both quota and share prices have increased substantially in recent years indicating a perception by industry that the future outlook for the fishery is positive. This has been fuelled in part by increased catch rates arising from apparent stock increases, and strong export and domestic prices, but there is uncertainty about prices over the next few years, especially on international markets. The Committee therefore suggests that fishers remain cautious about overinvestment driven by optimism in the fishery.

Development of a more spatially explicit assessment model with an improved stock recruitment model and the incorporation of economic parameters such as operating costs and market prices into that model would allow potential economic targets to be assessed, and potential future economic benefits to the lobster industry and broader NSW economy to be estimated. Such a bio-economic model also would allow costs and benefits of alternative quota-settings to be analysed and included in Committee deliberations and discussions with industry.

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 thirteen 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. The absence of survey data means the Committee must continue to rely on judgement calls by managers, field officers, and fishers on the appropriateness of the assumed 10% recreational catch. A growing uncertainty in these estimates relates to the prospect that recreational catch might increase as availability of lobsters improves with growing stocks.

Harvest by Aboriginal fishers under permits for cultural purposes is less than permitted limits and few permits are sought or issued, suggesting that Aboriginal harvest remains low.

An emerging risk for the fishery is the lower compliance rate in the commercial fishery this year compared to previous years. The Committee supports a renewed focus on the compliance risks in the fishery, and in particular the integrity of the quota monitoring system.

The robustness of the fishery now allows management emphasis to move away from stock rebuilding toward optimising outcomes. The Committee therefore again notes the need to for the Department and Industry jointly 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 being available 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 about the degree to which the stock has stabilised or has further rebuilding ahead and weaknesses of the current assessment model limit robust forecasts of consequences of further increases in harvest. 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 not increased the TACC for the coming fishing season.

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1. INTRODUCTION

The Total Allowable Catch Setting and Review Committee (the Committee) is established by Division 4 (S26-34) of the *Fisheries Management Act 1994*. The committee in 2017 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)*. 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 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 31 Division 4 of the *Fisheries Management Act* 1994. 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 Catch Committee Open Forum meeting in Sydney on May 17th 2017 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 17th 2017. 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 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 35-40% depletion.

The stock has now recovered to the extent that current depletion is approaching the range of spawning biomass where common fishery targets are expected to be for this species (e.g. Maximum Sustainable Yield, MSY, and Maximum Economic Yield, MEY). Determining the appropriate TACC levels in the next few years increasingly will incorporate consideration of the proximity of current stock status to a fishery target, whether that target is explicit in management objectives or implicit in Committee determinations. It is recommended that a process to identify a desired Target Reference Point[2] is undertaken jointly by industry and government. The Committee in the interim will treat a spawning stock depletion of 48% as an appropriate default target reference point for setting TACCs, until an explicit target is established for this fishery. This is the default target reference point for MEY in the Commonwealth Harvest Strategy Policy.

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

3.3 Catch rates

Catch rates increased during the 12 years 2000–01 to 2012–13 and have fluctuated at about the 2012–13 level since. It is not clear, however, the extent to which the increased catch rates since about 2010 reflect increases in exploitable biomass, increases in capture efficiency, or both. 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 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 as catch rates increase in the fishery. The Committee recommends, therefore, that either additional work on catch rate standardisation be done or (preferably) the assessment model be restructured to explicitly represent the different depth, geographic, and gear components of the fishery.

Overall catch and catch rate data support interpretations that the rock lobster stock has grown substantially in recent years and is now well above the low levels of 2000–02. Overall catch rates have been approximately stable for the last 4-5 fishing periods. This is a better outcome than the small decrease predicted in recent years under recently increased TACCs. This

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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] '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.

discrepancy is interpreted as being due to limitations in the assessment model, including but not limited to limitations in the method of catch rate standardisation, that result in model predictions being slightly pessimistic. The commercial catch rates continue to increase or be maintained in most components of the fishery that target different sized lobsters. Catch rates of small lobsters on inshore (shallow) grounds have been sustained or have increased, indicating continued good recruitment to the fishery despite lower puerulus settlement 2-3 years ago. Puerulus settlement in the most recent year (2016–17) was again high, which perhaps bodes well for recruitment in about 2-3 years. Catch rates of maturing lobsters from deeper offshore grounds also have been maintained, indicating that substantial numbers continue to reach the size and age at which they join the spawning stock.

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 stock assessment for the past several years has included scenarios for the likely unreported commercial catch post-1994. A possible scenario for unreported commercial catch in the earlier history of the fishery was also included in this year's assessment. This was a somewhat arbitrary scenario (the unreported catch from 1884-85 to 1968-69 was 30% of the reported catch), selected after examining a range of constant historical under-reported catch scenarios from 10%–40%, but it improved the assessment model's match with recent changes in catch rate, recruitment pattern and spawning stock. This is an important input to the stock assessment. It is recommended that a suite of scenarios that are likely to encompass the actual catch history, and time varying under-reporting, are developed and applied in future stock assessments.

The level of discards and high-grading of retained lobsters has increased in recent years as the TACC has become increasingly limiting, and this is expected to continue. Discards were about 10.4t in 2015–16, which is about 6.5% of the reported landed catch and it is assumed that 10% of these do not survive. It is necessary to both monitor discards and include them in the stock assessment.

3.5 Non-commercial catch

There is considerable uncertainty about the level of recreational and unreported 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 recreational catch has decreased in recent years and the catch of 16t that has been assumed coincides with the approximate midpoint of the very imprecise Recreational Fishing Survey conducted in 2013–14. There also is a common view, however, that recreational catch could increase again in future because continued stock recovery may attract additional recreational fishing effort as reports of increasing lobster abundances spread. 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.

3.6 Stock assessment model

The existing assessment model has limitations but has proved adequate to guide stock rebuilding and make short-term (a few years) tactical predictions of likely stock status under alternative TACCs. There are several weaknesses in the model, however, that mean it is not appropriate for making longer-term strategic predictions necessary to support refinement of a Target Reference Point or to evaluate auxiliary aspects of a longer-term management strategy, including better integration of economic with biological considerations, input controls such as size limits and management decision rules. It is recommended that the current assessment model be redeveloped and that this redevelopment specifically include improved treatment of recruitment to the fishery, the catch-effort relationships in the different depth, geographic, and gear components of the fishery, and the catch (including unreported catch) history of the fishery. This is a substantial redevelopment but it would improve stock status assessment, improve short term predictions for TAC setting, and provide the necessary tool for identifying longer-term targets and associated harvest strategies.

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 'overshoot' 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. Further, there is a several year delay between a given estimate of spawning biomass and observation of the recruitment generated from that biomass. There is a risk that catches could be increased above the sustainable level before that level is recognised, and there could be a several year delay before that adverse situation was detectable. Determining and achieving such targets in this fishery will be adaptive by necessity, guided by the stock assessment and monitoring results. The Committee consequently supports constant catches, or relatively small catch increases, in successive years following larger catch increases, as the target is approached so that the effects of increasing spawning stock on recruitment can be evaluated. This approach 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 approach is important particularly in the next few years as the maximum sustainable catch is approached.

The fishery data, scientific monitoring data, and stock assessment provide consistent evidence in support of these interpretations. This 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. A valuable enhancement of the monitoring program that should be considered is an indicator of the number of lobsters surviving the fishery to join the spawning stock each year. This is a 'gauntlet fishery' with survivors of the legal-size gauntlet (104–180 mm carapace length) accumulating in the spawning biomass above the maximum legal size limit. Management of the fishery to rebuild and maintain spawning biomass targets effectively is management of the number of survivors reaching the spawning biomass but there is no direct and leading indicator for this survival and, instead, it is addressed via the stock assessment model. Developing such an indicator would provide an efficient and effective input to management. It would provide early detection of any failure caused by excessively large catches from the exploitable biomass. Such an indicator could be based on the fishery independent spawning stock survey, perhaps augmented by industry discard information.

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 fully assessed. 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

Estimated gross value of production (GVP) is derived by multiplying catch by price received. The 2016–17 catch was the same as in 2015–16, so any change in GVP would reflect change in price. The estimates of GVP provided by the Department are based on prices at the SFM. Prices received on the SFM declined slightly in nominal terms[4] from $75.55/kg in 2015–16 to $75.52/kg up to January 2017. Information provided at the meeting suggested that prices fell after January, with more recent average SFM prices reported by industry at around $65/kg. Around 49% of the product was consigned to the SFM in 2016-17, similar to 2015-16.

Most of the remaining product was exported, primarily to China. Export prices have fallen from $65/kg in 2015–16 to around $58/kg in 2016–17. This decline is believed due to a fall in seasonal demand in China as well as an expansion of US lobsters into the Chinese market.[5]

The fishery had an estimated gross value of production (GVP) of $12.08m in 2016–17, based on the higher SFM prices up to January 2017, similar to that in 2015-16. Price declines since January – both on the SFM and export markets – will reduce this figure. The GVP often is used as an indicator of the value of the fishery and so better information on actual prices is required to derive a more 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 impacts of changes in TACs, 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 the other States, 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 this year, for example, contributing to the decline in price on the market. Any future increase in catch is likely to be diverted to the export market provided the Australian dollar does not strengthen substantially. The 12 month forecast for the Australian dollar against the Chinese Yuan is for it to depreciate slightly[6], which may provide some additional benefits to the NSW exporters over the coming year.

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

4.3 Fishery profits and quota trading prices

Higher quota trading prices are a good indicator of industry expectations of profits, as there generally is a direct relationship between expectations of profits and quota and share prices. Reported quota trading prices increased by 12% between 2015–16 and 2016–17, suggesting that fishery profits also increased. The increase in price also was a result of apparent shortages of quota, as many quota holders filled their quota earlier in the season and were keen to purchase more. The share trading price (on a per kg basis), by comparison, increased by around 41% in real terms, suggesting that longer term expectations were even more optimistic.

Estimates of fishery profits and costs were undertaken based on economic principles, (described in Section A4.5) and the role of different drivers of profitability were estimated. Catch rates were an important driver of profitability, but the dominant driver of profitability in the fishery appears to be real prices for catch. The reported price declines in recent months (above) therefore may have an impact on future profitability in the fishery. This most likely will manifest as a slowdown in changes in quota leasing prices even if catch rates continue to increase.

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 how large this potential is cannot be established with certainty.

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 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 would include:

- 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 above analysis 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 TACs and their impact on fishery profitability as well as identifying potential target reference points for the fishery.

The above information is important to support development of economic objectives for the fishery and for inclusion of economic considerations in a revised assessment model to enable strategic analyses of TACCs appropriate to realising those objectives.

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

5. MANAGEMENT CONSIDERATIONS

5.1 Management implications of stock status

The stock assessment continues to indicate that the lobster stocks are significantly higher than the trigger in the FMS. The Committee is confident, therefore, that the fishery continues to recover and 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 improve the stock assessment model and its underpinning data. This 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. It is reasonable to assume, however, 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.

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 the 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. Only one cultural fishing permit was sought and issued in the 2016–17 fishing period, allowing the take of 150 lobsters, though, as previously, actual take was less than the number permitted.

5.3 Compliance

Overall (recreational and commercial) compliance rates in the lobster fishery for 2015–16 and the first 8 months of 2016–2017 were 79% and 65% respectively. The latter rate is a significant decrease from the previous year, driven entirely by a dramatic drop in the compliance rate for the commercial fishery. The last four years rates are set out below.

	2013–14	2014–15	2015/16	2016/17 (8 mths)
Overall	74%	81%	79%	65%
Commercial	58%	73%	74%	42%
Recreational	91%	88%	83%	87%

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 rock lobster compliance in general, and intelligence-led and targeted effort focussing on specific targets. The observed trends in compliance rate, therefore, are probably reliable, noting that compliance rate is an inherently broad and simplistic measure that usually requires some qualitative analysis to support its interpretation.

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 but there is an increasing number of cautions and infringements. These breaches mostly are at the less serious end of the spectrum but are concerning because many relate to fundamental components of the quota monitoring system. This could be expected when the fishery has high levels of abundance and availability, and when the TACC is genuinely limiting catch. Advice from the Department is that this trend does not reflect widespread quota fraud at this stage, but the Committee supports a sustained focus on addressing this risk in the coming year. 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 decisions.

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.

Cost recovery is relevant to making these long term investments in management of the fishery. The contribution of management charges to total costs has contracted as a share of fishery GVP from around 15% to below 5% over the last decade. 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 Committee recommends that next year's forum is specifically focussed on the long term strategy for the fishery, hopefully building on industry discussions during the year about fishery objectives and targets.

The Lobster Industry Working Group is established and is engaged actively in managing the fishery, and discussed taking a lead in this work over the coming year. The Committee strongly supports this work. 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. 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. This aligns with the Committee's preferred strategy.

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.

Uncertainty about the amount of recreational catch continues to constitute a significant concern for the Committee in setting the TACC.

There 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, now materially affect TACC Determinations. Substantial enhancement or redevelopment of the stock assessment model also is necessary to set TACCs to meet fishery targets and should be a priority action.

6.2 Total Allowable Commercial Catch for 2017–18

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 2017–18 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 between 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' and the 'low' option is appropriate for current assessments;
- Compliance rates for the fishery reportedly have declined in the commercial sector; 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 proposes the TACC remains unchanged for the 2017–18 quota year. The Committee has reached this conclusion after taking into account the positive stock assessment 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 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 also is concerned about over-capitalisation in the fishery. The Committee therefore is reluctant to increase the TACC at this stage and also encourages fishers, individually and collectively, to take a measured approach to investment in the fishery. The Committee's determination for 2017–18 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.

6.3 The Determination

The Total Allowable Catch Setting and Review Committee, pursuant to Division 4 of Part 2 of the Fisheries Management Act 1994, determines that the Total Allowable Commercial Catch of rock lobster that may be taken in the Rock Lobster Fishery during the period 1 August 2017 to 31 July 2018 should be **160 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 17th. 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 in the *Fisheries Management Act 1994, Division 4 S31.*

Date	Fisheries Management Act Reference	Consultation Stages
05.04.2017	Section 31(1)	Call for public submissions on the appropriate level of the annual TACC for Lobster for 2017–18, posted to NSW DPI website and displayed in District Fisheries Offices.
05.04.2017	Section 284 (1b)	Advertisement inviting submissions placed in the Sydney Morning Herald and the Daily Telegraph.
31.03.2017	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; ■ Nature Conservation Council.
07.05.2017	Section 284 (1b)	Public consultation closing date, after at least 30 days.
08.05.2017	Section 31 (2)	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; ■ Shareholders A, North Coast*
17.05.2017		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; ■ Andrew Field: District Fisheries Investigator, DPI; ■ Geoff Liggins: Manager, Scientific Services, DPI; ■ Giles Ballinger, Scientific Services, DPI; ■ Marcus Miller, Scientific Services, DPI; ■ Michael Firkin, commercial fisher; ■ Mark Horne, commercial fisher; ■ Bradley Horne, commercial fisher; ■ Troy McEnally, commercial fisher; ■ Scott Westley (Rock Lobster Working Group) ■ Mark Cranstone, 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; Steve Drake, Ron Firkin, and Barry Aish.

**** This submission was marked 'Confidential'. 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 fishery to be very healthy with high abundances of legal and large (& berried) lobsters. Considered lobster stock to be in excellent condition on all fishing grounds. Catch rates at all depths have been better than for many years. Reached quota early and likely will need to stop fishing up to 2 months early even with additional leased quota. Have deployed less effort to land quota than in previous years. Very high proportion of over-legal-sized lobsters berried females (up to 40%) in many lifts. Commented on difficulty in leasing additional quota because little quota is available. Suggested 10% increase in TACC.

**** This submission was 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 2017–18. 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 have not been derived formally for the fishery but the Committee has operated with implicit target and limit reference points for several years.

***Target reference point*.** A depletion to 0.5 of the unfished biomass has been used by the Committee for reporting of stock status. Performance against this reference point has been reported for 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 has not been operationally relevant to date. It is becoming more urgent and relevant to set an appropriate target reference point formally, however, as the stock recovers and approaches levels consistent with commonly used fishery targets (e.g. Maximum Sustainable Yield, MSY, and Maximum Economic Yield, MEY).

Questions about the appropriate target reference point, and how best to reach and stabilise the stock to meet the target, are now a primary concern in TACC decisions.

It is recommended that a process to identify the desired fishery target is undertaken involving industry and government. The Committee in the interim will treat a spawning stock depletion of 0.48 as the target reference point, being the default target reference point for MEY in the Commonwealth Harvest Strategy Policy.

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. 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 above 0.25 of the unfished biomass with about 84% probability.

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 16–17 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 highly desirable that a means be developed to measure more accurately 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. There is some indication from compliance officers that this is indeed happening, in both the commercial lobster fishery and other commercial fisheries that take lobster as by-catch. This requires ongoing monitoring and examination.
- There are reports from lobster fishers, and data from reported bycatch in the lobster fishery, that there has been considerable increase in octopus numbers in the southern part of the fishery during the last fishing year. This has potential to both increase the unreported lobster catch (i.e. caught lobsters are predated rather than landed and recorded) and reduce the catching efficiency of traps.

Stock assessments since 2013 have recognised uncertainties in the non-commercial and unreported commercial (NCUC) catch post-1994 by considering both a high and a low NCUC catch scenario. The low NCUC catch scenario is considered the most credible and so only this scenario has been used in recent assessments. This low NCUC post-1994 catch scenario is:

> Non-commercial catch of 10-16t annually since 1994–5, this being equal to 10% of the reported commercial catch each year, and unreported commercial catch linearly decreasing from 17% of the reported commercial catch in 1994–5 to 8.5% in 2010–11 and subsequently. The quantities of unreported commercial catch under this scenario are 12–19 t over the past 22 years, approximately 16.4t in 2014–15, and 17.5t in 2015-16, while non-commercial catches were 10-16 t during the past 22 years, approximately 14t in 2014–15, and 14.9t in 2015–16.

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

The scale of NCUC catch in the early history of the fishery is very uncertain. The 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. This year's stock assessment included a historical catch scenario to examine some consequences of early unreported catch. That "Increased Historical Catch" (IHC) scenario was that NCUC catches from 1884–85 to 1968–69 were 30% of the reported commercial catches each year. The figure of 30% was derived by running the assessment model with historical NCUC values of 10%, 20%, 30%, and 40% and adopting that value (30%) which resulted in the best model-fit to modern catch rates.

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. The catch reconstruction in Fig A3.1 is based on different information in different periods: 1884–1926 from the lobsters sold in the main metropolitan markets in Sydney and Newcastle; 1927–1940 from lobsters sold state-wide; 1940–1994 from fisher monthly logbooks; 1995–present from fisher daily logbooks following introduction of the quota system in 1994; and with significantly improved checks on logbook information since 1969, including telephone surveys of fishers 1969–96 and an observer program since 1998 to measure the size composition of the catch. The catch reconstruction in Fig A3.1, which includes the low NCUC catch scenario since 1994–5, is used as the 'base case' catch for the stock assessment.

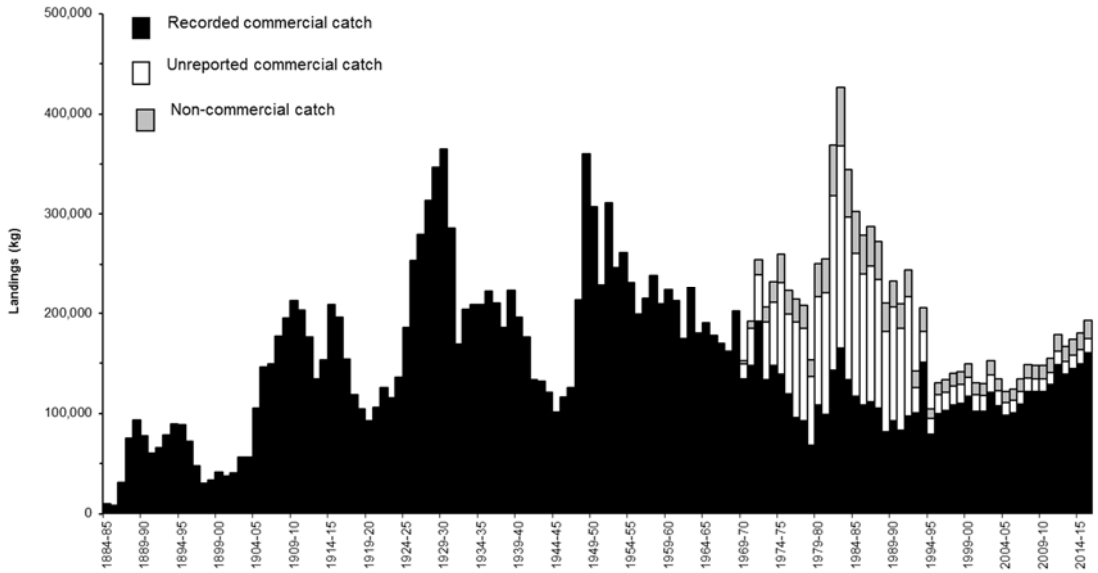

Figure A3.1. The landed catch of rock lobsters since the start of the fishery. The non-commercial and unreported commercial (NCUC) catches are shown since 1969 but the previous historical NCUC scenario is not shown in the figure.

The level of discards and high-grading of retained lobsters has increased in recent years as the stock biomass has rebuilt and the TACC has become increasingly limiting. Discards were about 10.4t in 2015–16, which is about 6.5% of the reported landed catch and it is assumed that 10% of these do not survive. High discards are expected to continue and it is necessary to both monitor these and continue to include them in stock assessments.

Commercial catch rates (catch per unit of effort or CPUE, e.g., lobsters per pot-lift or lobsters per trap-month) historically were calculated simply as total catch divided by the total effort in the area and time of interest. CPUE more recently has been 'standardised' to account for 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 standardised catch rates are considered to reflect lobster abundance better than the un-standardised catch rates so standardised catch rates have been used in interpretations and to calibrate the population assessment model. This standardisation accounts for some of the gross effects of recent shifts from shallow to deeper pot sets but it does not account for all the expected effects of these changes, nor for increases in efficiency related to recent investment in equipment and the increased ability to avoid marginal weather or fishing grounds whilst still realising allocated quota as catch rates improve in the fishery. It is recommended that either additional work on catch rate standardisation be done or, more strategically, the assessment model be restructured to recognise explicitly the different depth, geographic, and gear components of the fishery to address this shortcoming.

The total catch, effort, and catch rates since 1969–70 are shown in Figure A3.2, including both standardised and unstandardised CPUE since 1997. The 2016–17 data are incomplete, but the catch accounts for most of the available TACC (approximately 130t of 160t) and the CPUE reported is likely to be a very good reflection of the overall outcome for the quota year.

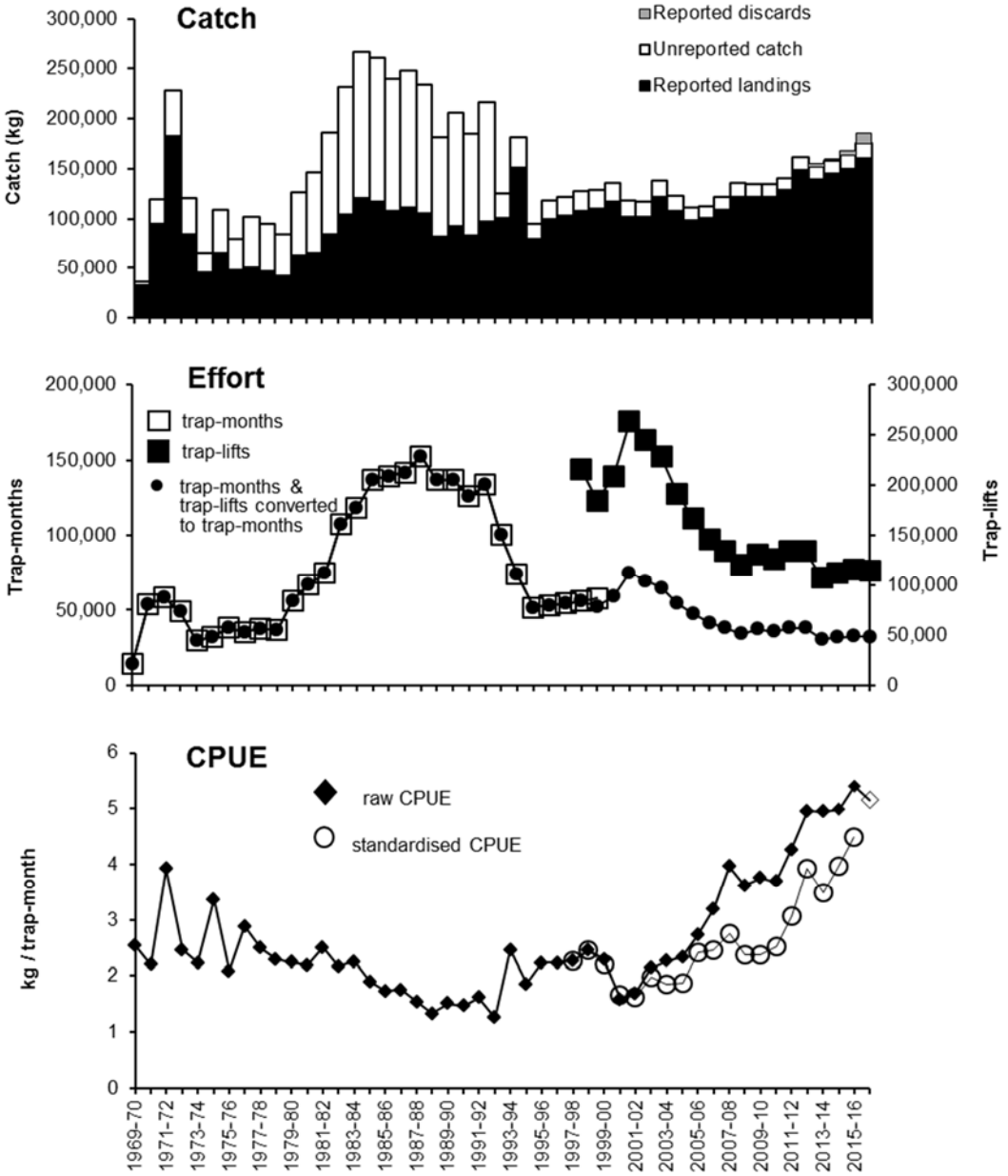

Figure A3.2. Commercial catch, effort, and catch rate since 1969–70 when more reliable effort is available. Data for the 2016–17 fishing period are incomplete but include about 130t of the 160t TACC.

Both unstandardised and standardised catch rates (Figure A3.2) increased during the 12 years 2000–01 to 2012–13 and have fluctuated at about that level since. Failure of the current standardisation of catch rate to adequately capture all the effects of the recent operational changes in the fishery means, however, that it is not clear whether the recent increases in catch rates reflect real increases in the exploitable biomass, increases in capture efficiency, or both.

The stable or increasing catch rate in the last few years is widespread across depths where significant fishing effort has been expended (Fig A3.3). Some very high catch rates have been recorded in the 10–30m depth areas in the far-north coast in the last 7 years. This is encouraging as it implies expansion of 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 are maturing lobsters from southern regions recruiting to the spawning stock, indicating a significant and continued contribution to the spawning stock from lobsters surviving the 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. The catch rate of undersized lobsters in the most recent year (2016–17), which mostly recruit to the fishery about a year later, has remained very high despite the relatively low puerulus settlement 2-3 years prior. This indicates recent inter-annual stability in recruitment to the fishery despite inter-annual fluctuations in puerulus settlement, in addition to the overall increase in average recruitment as average puerulus settlement has increased.

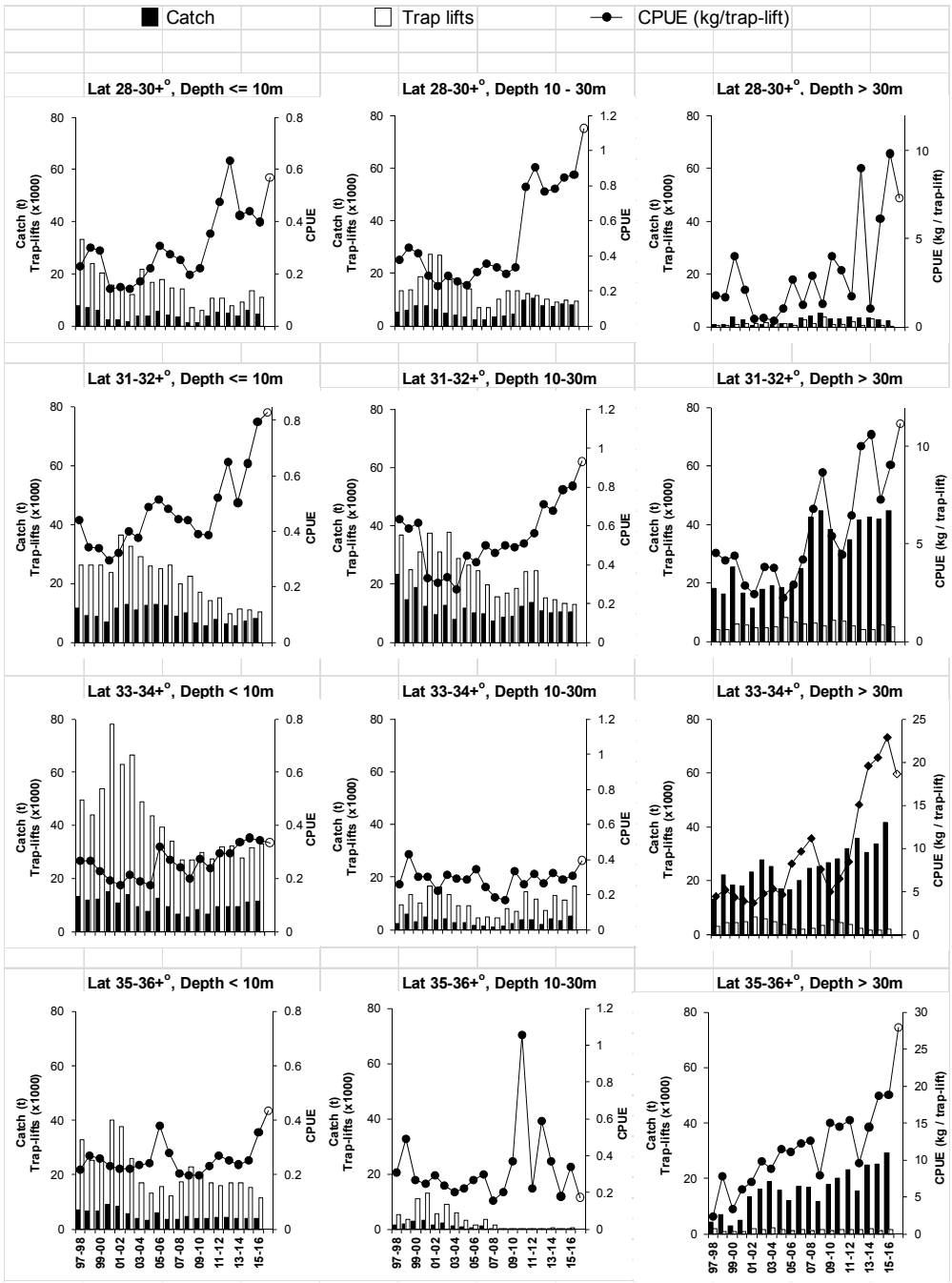

Figure A3.3. Commercial catch, effort, and catch rate by area and depth since 1997–98 when detailed reporting became mandatory. The spawning stock is found mostly in the far north coast (28-30+°) and mid-north coast (31-32°) at depths greater than 10m and especially depths 10–30m. Data for the 2016–17 fishing period are incomplete but include about 130t of the 160t TACC and are expected to be a good indication of the full year information.

The catch and catch rate data overall support interpretations that the stock has been increasing in recent years, it is now well above the low levels of the late 1990s and early 2000s, and it continues to increase. Catch rates of small lobsters on inshore (shallow) grounds show an overall increasing trend with fluctuations that at least partly reflect patterns of post-larval (puerulus) settlement. 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.

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 enforced that is intended to reduce fishing on a significant part of the spawning stock. This management measure protects the older mature animals because they contribute strongly to egg production. It also means, however, that commercial catches and catch rates do not fully reflect the spawning stock.

Two fishery independent monitoring programs have been established to monitor the spawning stock and the settlement of post-larval lobster (puerulus) from the plankton to inshore reef habitats. Puerulus grow and recruit to the fishery about 2-3 years after settlement. 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.

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 of lobsters 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 interpretation 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, which determines the maximum sustainable catch and is very difficult to estimate from modelling.

Puerulus settlement in the northern areas is relatively low (about a tenth of the settlement in the south) but is important in supporting the northern inshore fishery. Low inshore settlement in the north in the past has resulted in undesirable transfer of fishing effort onto deeper water and consequent increased harvest of spawning stock. Settlement in the northern areas in the past three years has been variable but overall about average by historical standards.

Puerulus settlement in the southern areas 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 the most recent year (2016–17) but low settlement in the 2 years prior to that (2014–15 and 2015–16). 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, though still high compared to the settlements in the late 1990s and early 2000s. 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. 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. The stock of spawning sized lobsters continues to build, including numbers of very large lobsters greater than 210mm carapace length. There is indication in the size compositions of a pulse of about 120-150mm lobsters entering the population in 2012–13 and growing through the maximum size limit by about 2016–17, and that in 2016–17 there are relatively few 120–150mm lobsters. That pattern is not reflected in the commercial catch rate trends (Figure A3.3) and the absolute numbers in the 120–150mm size range in 2016–17 remain high compared to past values in this time series. This issue should be monitored in future years and at this time the bi-annual sampling is considered adequate.

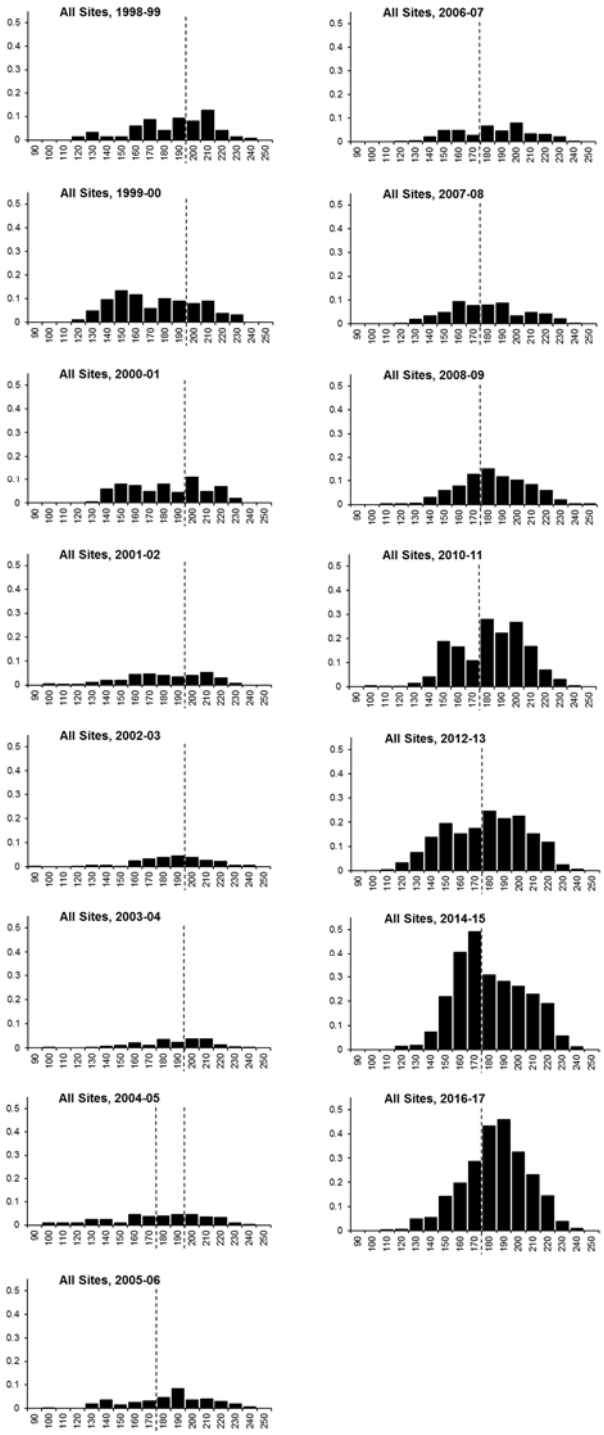

Figure A3.4. Size composition of lobsters in the commercial catch of the mid- and far-northern areas combined from logbook data augmented by observers. The dashed line is the maximum legal size, which changed from 200mm to 180mm in 2004-5, and the vertical axis is number of lobsters per pot-lift. Monitoring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

A composite index of the spawning stock from direct 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.

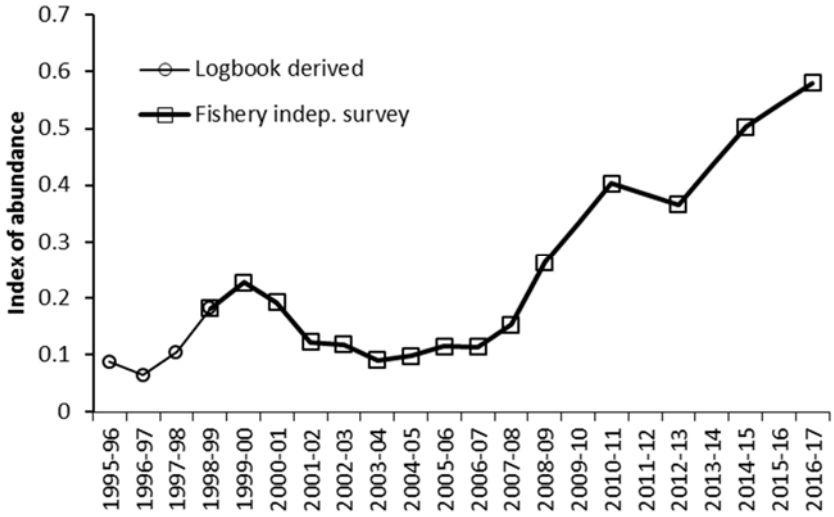

Figure A3.5. Spawning stock index (lobsters per pot-lift) from direct observations. The index is based on commercial catches of berried female lobsters for the period up to 1997–98 and on fishery-independent surveys since 1998. These surveys have been done every second year recently and were updated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

A3.4 Analysis

A3.4.1 Stock assessment

The status of the lobster population was assessed 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 was fitted to the catch data throughout the history of the fishery (with the low NCUC assumptions since 1994–5), 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) was used because it was expected to be less subject to changing fishery practices and the limited range of years was used because the size compositions of catches in those years were collected by observers. The model also incorporates a great deal of other information, including detailed biological information including 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 main uncertainties examined through the stock assessment model concern the pattern of recruitment and spawning stock rebuilding because, as noted in previous years, several observations are not consistent with the assumed relationship (i.e. a Beverton and Holt stock recruitment relationship with ‘steepness’ of 0.9) and the reported historical catches. Specifically: (i) the observed fishery catch rate has increased much faster and to a higher level

than predicted; (ii) the observed spawning stock has increased faster and to a higher level than predicted; and (iii) the observed recruitment to the fishery has increased more persistently than is predicted by the assumed stock-recruitment relationship given the reported historical catches (i.e. it predicts recruitment increase should level of when the stock is recovered above 10% depletion whereas the actual recruitment has continued to increase when the stock is estimated to have recovered to well above 30% depletion).

Three model scenarios were examined.

- A 'Base Case' which used the Beverton and Holt stock recruitment relationship with 'steepness' of 0.9. This allows consistent comparison with the analysis of previous years but it clearly does not match recent observations and it is not considered to be a credible scenario.
- Increased Recent Recruitment (IRR) which used the Beverton and Holt stock recruitment relationship with 'steepness' of 0.9, but with recruitment from 1995–96 to 2012–13 forced to increase linearly by 3% per year and then remain constant at that level for subsequent years. This is the same as the 'High-RR scenario of recent years and is an ad hoc scenario to reflect the increased recruitment observed in the fishery during recent years.
- Increased Historical Catch (IHC) which used the Beverton and Holt stock recruitment relationship with 'steepness' of 0.9, but with NCUC prior to 1969–70 being 30% of the reported catch. The form of the stock recruitment relationship is the same as for the Base Case but the increased historical catch will result in different parameter values being estimated for that relationship. It is expected that the unfished biomass estimated by the IHC scenario will be larger than for the Base Case, the lowest historical depletion level will be lower, and the spawning stock and recruitment will increase more persistently in recent years as the stock recovers from the greater historical depletion.

Both the IRR and IHC scenarios are intended to match the recent observations of commercial catch rate, spawning biomass and recruitment better than the Base Case. The IRR scenario is an ad hoc approach to force a better match, but it lacks internal consistency in the stock-recruitment relationship and has no predictive power beyond showing the effects of the observed increase in recruitment to 2012–13 and assumed continuation at that level. Conversely the IHC scenario is a mechanistic approach that provides an internally consistent set of interpretations of the past and future stock behaviour for the assumed historical NCUC – though clearly there are other credible assumptions about historical NCUC that could be made. The Base case and the IHC scenario can be regarded as sensitivity tests for two different assumptions about historical NCUC – the Base Case accepting historical recorded NCUC as accurate and IHC for one alternative assumption about their inaccuracy.

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 very poor for the Base Case, which consistently underestimates the index throughout the last 10 years. The IRR scenario gives a very slightly better fit but also underestimates the index throughout the last 10 years. The fit of the IHC scenario is a considerable improvement though it also underestimates the index in the past 4 years. None of the models can reproduce the prolonged period of low spawning biomass during 2001–2007 nor the rapid increase that began in about 2008 and continues currently.
- The model fit to the catch rates becomes increasingly poor in the last few years, with the model increasingly underestimating the observed catch rate. The Base Case underestimates the catch rate very badly during the past 5 years. The IRR scenario matches the catch rate slightly better, but still underestimates it in the past 4 years. The IHC scenario does somewhat better still, though it underestimates the catch rates in the past 2 years and somewhat overestimates the catch rates during the 2000s.

The IHC scenario fits the data best of the three scenarios, and consequently is regarded as the most credible, but none of the scenarios matches the data well. They underestimate the rapidly increasing standardised catch rate during the past 5-6 years, they underestimate the growth

rate of the spawning biomass in the past about 10 years, and they do not track the persistent period of low spawning biomass from 2001–2007. Possible reasons for these discrepancies, that are not mutually exclusive, include the following.

- Increases in recruitment since about 2010 are stronger than any scenario represents, including the IHC scenario, implying that the model is underestimating recent stock recovery. This could result from miss-specification of the general form or the steepness or the stock recruitment relationship, or from the effects of different patterns of historical and recent NCUC than in present scenarios, or both.
- 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 are particularly relevant because they are anomalies for all current model scenarios. The first is operational changes during the 1990s and 2000s that could cause the increase in spawning biomass in the late 1990s followed by the decrease and persistent period of low spawning biomass 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 catch rates exaggerate stock recovery since about 2010.

The deviation between model results and observations appears to be growing and casts significant doubt on the overall interpretation of stock status and trends in future assessments if not addressed. Credible interpretations range from the models underestimating recent population recovery to them overestimating it. All models show that recovery has, and is, occurring so the main uncertainties are in the extent of recovery and the prospects for further recovery. These uncertainties are important to the next phase of management of the fishery, however, and they need to be addressed. They not only compromise confidence in model-based assessment of current stock status and recovery progress, but they also limit the reliability of medium term predictions of the effects of different catches and of longer term predictions of fishery performance under alternative harvest strategies. The existing approach is questionable for medium term predictions, and the interpretations here reflect that, and not suitable for longer term predictions. An interpretation of some continued stock recovery during the past 3-4 years is reasonable now, but confidence in this conclusion is based strongly on the fishery independent measures of the spawning stock.

It is recommended that the model and its assumptions be reconsidered and redeveloped, including refinement of the historical and recent NCUC scenarios and the treatment of changes in the gear, season, and location of fishing effort.

A3.4.2 Present stock levels

The key population and depletion estimates are provided in Table A3.1 for the IRR and IHC scenarios. The 95% confidence bounds reflect statistical uncertainty in the fit of each scenario though both scenarios contain additional uncertainty due to structural assumptions about the model and input data assumptions, as discussed above. The IHC scenario is considered to provide the more credible assessment of the two because it matches the observed data better.

Table A3.1. Estimates of total and spawning biomass prior to exploitation and in 2016–17 from the assessment model under IRR and IHC scenarios.

Metric	Scenario	Median	5% limit	95% limit
Unexploited total biomass (K)	IRR	6,097	5,835	7,300
	IHC	7,470	7,407	7,962
2016-17 total biomass	IRR	3,038	2,445	4,204
	IHC	3,165	2,750	4,199
2016-17 total biomass/K	IRR	0.50	0.42	0.59
	IHC	0.42	0.37	0.53
Unexploited spawning biomass (USB)	IRR	2,337	2,237	2,798
	IHC	2,863	2,839	3,052
2016-17 spawning biomass (SB)	IRR	935	727	1,351
	IHC	989	818	1,411
2016-17 SB / USB	IRR	0.40	0.32	0.49
	IHC	0.35	0.29	0.46

The following are key features of the assessment.

- Stock status under the IRR scenario assumptions is very similar to that last year under the same assumptions.
- The IHC scenario estimates higher unexploited total biomass, higher unexploited spawning biomass, higher current total biomass and higher current spawning biomass than does the IRR scenario.
- The higher historic catches of the IHC scenario cause greater historic population depletion from that fishing, as expected. It consequently estimates that the current total biomass and spawning stock biomass are more depleted than estimated by the IRR scenario, and that stock recovery is delayed compared to that in the IRR scenario.
- The maximum depletion of spawning biomass occurs in the mid-1990s for both IRR and IHC scenarios. This depletion is to 8% of the unfished biomass (i.e., about 196t) for the IRR and to 4.6% of the unfished biomass (i.e., about 131t) for the IHC scenario. A very small spawning biomass in the late 1990s and early 2000s is consistent with its about 50% reduction following relatively small increase in catch (i.e., extra few 10s of tonnes) from the spawning stock at that time.
- The spawning biomass has increased measurably and steadily over the past 5 years under both IRR and IHC scenarios. This increase is consistent with all empirical observations. Both model scenario have significant weaknesses, as described above, but these mainly manifest as uncertainty about the current and potential future extent of rebuilding rather than about whether or not rebuilding is occurring.
- The median estimate of spawning stock depletion is 0.35 of unexploited biomass for the more credible IHC scenario, and 0.4 for the IRR scenario. There is a very high probability that the spawning stock is above 0.25 of the unexploited level under both scenario.

These results indicate that the management measures of the past several years have had the desired effect of rebuilding the stock to well above the limit reference point.

A3.4.3 Predictions of future stock levels

Predictions were made under both the IRR and IHC scenarios of the change in biomass that would occur after 5 years of total catch at various levels, starting from the most recent biomass estimate in 2016–17 (i.e. total catch at various constant levels in years 2017–18 to 2022–23). Changes in spawning biomass (Table A3.2) and exploitable biomass (Table A3.3) are very similar for both assessment scenarios.

Table A3.2. Predicted spawning biomass in 2022–23 relative to spawning biomass in 2016–17 ($SB_{2022\text{-}23}/SB_{2016\text{-}17}$) after 5 years of different future constant total catches (including prospective TACCs, estimated non-commercial catches, and unreported catches). All projections assumed the low NCUC scenario

Total Catch (t)	Recruitment assumptions	Median relative spawning biomass [95% confidence interval]
150	IRR IHC	1.15 [1.11-1.19] 1.14 [1.05-1.21]
175	IRR IHC	1.10 [1.04-1.15] 1.09 [1.02-1.15]
200	IRR IHC	1.05 [0.89-1.09] 1.04 [0.99-1.09]
225	IRR IHC	1.00 [0.92-1.06] 0.99 [0.95-1.03)]

Table A3.3. Predicted exploitable biomass of 104–180mm lobsters in 2022–23 relative to that in 2016–17 ($EB_{2022\text{-}23}/EB_{2016\text{-}17}$) after 5 years of different future constant total

catches (including prospective TACCs, estimated non-commercial catches, and unreported catches). All projections assumed the low NCUC scenario.

Total Catch (t)	Recruitment assumptions	Median relative exploitable biomass [95% confidence interval]
150	IRR	1.13 [1.09-1.17]
	IHC	1.12 [1.06-1.18]
175	IRR	1.03 [1.01-1.06]
	IHC	1.03 [0.99-1.07]
200	IRR	0.94 [0.89-0.98]
	IHC	0.94 [0.91-0.96]
225	IRR	0.84 [0.75-0.91]
	IHC	0.84 [0.83-0.86]

The IHC scenario is considered to provide the most credible interpretation of current status, but both the IRR and IHC scenarios are regarded as credible for prediction of effects of different catches because they span a reasonable range of future recruitment patters in the fishery (i.e. no further increase since 2012 for the IRR scenario and slowing further increase for the IHC scenario). It is predicted for catches at about recent levels (TACC = 160t, total catch = 192t)[7] under both scenarios that spawning biomass would continue to rebuild slowly and that median depletion of the spawning biomass would remain above the limit reference point. The stock available for harvest under both scenarios is predicted to decrease slightly from current levels. The 5y stock projections in recent years have been slightly pessimistic compared to actual outcomes, probably because of the limitations of the model scenarios discussed in section A3.4.1. This prediction bias is likely to persist to some extent because both model scenarios under-predict the increases in catch rate and spawning index in the past about 5 years.

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 close to 0.35-0.4 for both the IRR and IHC model scenarios.

There are uncertainties in the model interpretations about the extent of stock rebuilding and the extent of 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 continues to increase and the observer based measurement of the spawning stock size composition continues to show large numbers of large lobsters. Puerulus settlement and recruitment to the fishery, measured by the commercial catch rate of small legal-sized lobsters and predicted a year ahead by the catch rate of undersize lobsters, have all increased on average during the past about 10 years as the

[7] Conversion between TAC and TACC uses the same method and unreported catch assumptions as applied last year. The TACC is expected to equal the reported commercial catch (RCC) given that the complete quota effectively has been landed in recent years, and the TAC is equal to the reported commercial catch plus the estimates of unreported commercial catch and the non-commercial catch. The non-commercial (mainly recreational) catch (NCC) is assumed to be 0.1 of the total reported and unreported commercial catch 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.

spawning stock has increased. Puerulus settlement is an indicator of recruitment to the fishery 2-3 years later. Settlement 2-3 years ago was slightly below the long-term average, but there appears to be compensation occurring and the reduced settlement has not been reflected in lower recruitment to the fishery since 2015–16. Further, the under-size index in 2015–16 suggests that recruitment to the fishery will again be strong next year and puerulus settlement was strong in 2016–17, which also bodes well for recruitment to the fishery in later years.

The eastern rock lobster stock has now recovered to the extent that current depletion is approaching the depletion range where common fishery targets (e.g. Maximum Sustainable Yield, Maximum Economic Yield) are expected to be for such species. There is a growing need to formalise a 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. There is need to redevelop the stock assessment model to support development of the harvest strategy and address several weaknesses that make the current model inappropriate for such strategic analysis.

An important challenge at this stage in recovery, combined with the inability of the stock assessment model to fully reflect some important recent changes in the stock and operation of the fishery, 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. Consequently, there is an about 3-4-year lag in being able to observe the effects on recruitment of changes to the size of the spawning stock, 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.

The intention is to alter the TACC as the stock rebuilds to stabilise the stock at the target level (once specified). TACC changes after the stock has stabilised would be used to reflect changes in biological productivity or economic circumstances or both. Caution is required at this stage in the rebuilding, however, to avoid excessively fast increase in catch because such excesses could result in ‘overshoot’ of the target, consequent stock depletion that would not be detectable for several years, and the associated biological risks, economic risks and the need for abrupt catch reductions in future. Incremental catch increases at this stage in recovery need to be monitored for long enough to observe their consequences, and ensure that they are sustainable, before the next increment is applied. This approach has been applied in the past few years.

The available data and recent resource assessment indicate that it is appropriate to maintain the Total Allowable Commercial Catch (TACC) this year to 160t, which corresponds to a Total Catch of 192.3t including non-commercial and unreported catch. This is expected to allow for some further rebuilding of the spawning stock towards maximum stock productivity in the next year, while allowing reasonable opportunity to detect and understand the effects of the recent catches and spawning stock levels on recruitment and the population more widely.

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. A summary of quota and share market prices is presented as an indicator of both short and long run industry profitability. Analysis of other data affecting the economic performance of the fishery, such as export prices and catch per unit effort, also is 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.

A4.2 Volume and value of production

The volume of reported catch of rock lobster from August 1 2016 to April 28 2017 was 131.3t, representing 82% of the TACC of 160 t being taken in 75% of the 2016–17 fishing period (Figure A4.1). It is expected that the full quota will be taken. The ability of industry to catch virtually the full TACC over a number of consecutive years, with less effort than previously, suggests that recovery of the stock continues, as is suggested elsewhere in this report.

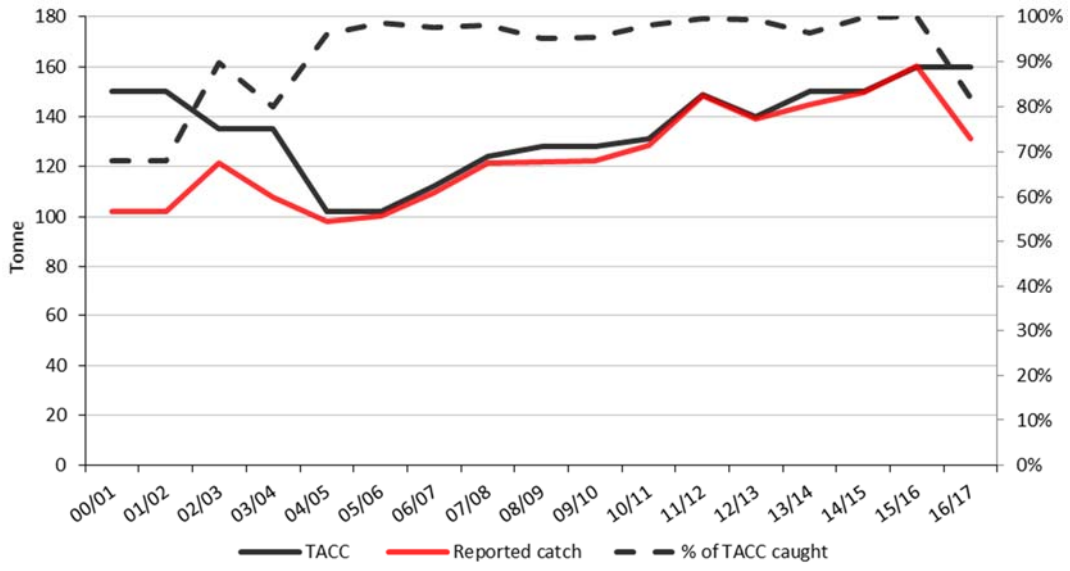

Figure A4.1: Catch, TACC, and per cent of TACC caught 2000–01 to 28 April 2017.

The nominal estimated gross value of production (GVP) based on Sydney Fish Market (SFM) prices was $12.1m for the fishery as a whole (Figure A4.2). GVP in the fishery generally has increased in both real and nominal terms[8] 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.

[8] Consumer Price Index (CPI) adjusted values are calculated using Reserve Bank of Australia (RBA) "all groups" CPI data up to December 2015. 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.

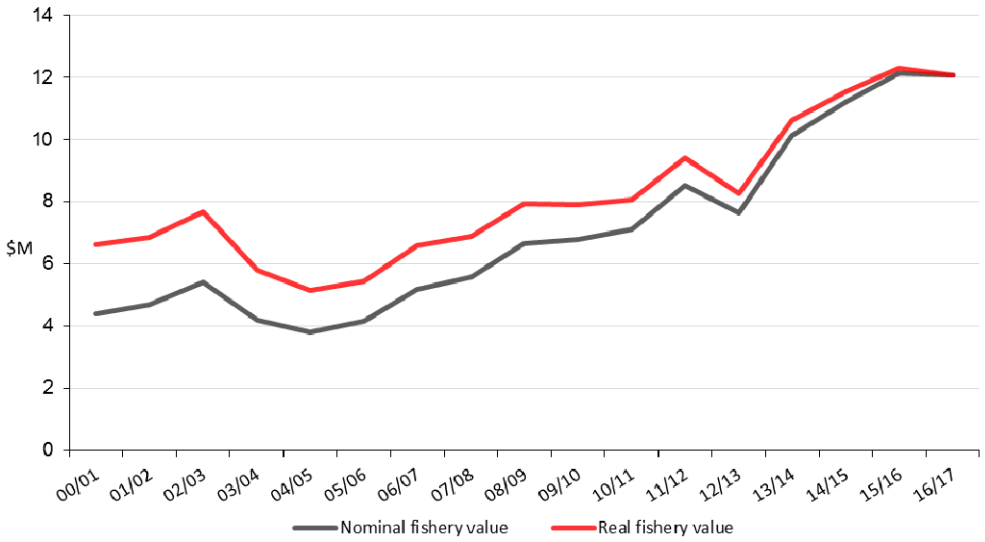

Figure A4.2: Value of production 2000–01 to 2016–17 (Data to 28 April 2017 with predicted return to 31 July assuming full 160 t TACC landed).

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 2015–16 were the highest for the last 44 years, noting greater uncertainty of the data in the earlier years of the period. CPUE in the 2016–17 fishing year seems likely to remain similar to that in the preceding two years given available information.

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. There may be merit, however, in a finer scale 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 2014–15 was 10,300t, of which NSW contributed 150t (1.5%).

Over 97% by weight (98% by value) of all lobsters exported from Australian in 2014–15 were exported fresh (not frozen) with most of these being live[9]. Discussions with industry suggest the proportion increased in the 2015–16 financial year and is likely to remain higher in coming years. The largest markets for Australian exports of rock lobster by weight in 2014–15 were Vietnam (91%), followed by Hong Kong (8%). The Hong Kong market share declined from 37% in 2012–13 to 8% in 2014–15. Anecdotal evidence, however, suggests that Vietnam has been a staging point for re-export to China rather than a consumption market itself. A free trade agreement with China came into force in December 2015 (i.e. after the 2014-15 financial year), and it is likely to result in an increase in exports directly to Hong Kong and mainland China.[10]

The value of the Australian dollar 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

[9] ABARES (2015). Australian fisheries and aquaculture statistics 2014. ABARES, Canberra.

[10] A Western Australian newspaper report suggests that exports of WA lobsters tripled from 2015 to 2016 as a result of the free trade agreement http://www.weeklytimesnow.com.au/agribusiness/china-free-trade-agreement-lobster-grapes-big-winners/news-story/5bc0b285affaed51b44c357ed9628f48.

(including NSW) rock lobster on those markets. The AUD is forecast to depreciate slightly over 2017–18 relative to the Chinese Yuan[11], so prices on export markets are likely to remain relatively attractive to Australian producers. The Committee suggests the Department undertake an analysis of such effects to underpin economic analysis of the rock lobster fishery.

At least half of the NSW product currently is sold domestically. Prices received on the Sydney Fish Market (SFM) have continued to trend upwards (Figure A4.3). These prices provide only a guide to price movements for lobster in NSW, however, as a significant quantity of lobster (around 50 per cent) is sold through other registered fish receivers in Sydney, along the NSW coast, or exported. Fishers estimate that around 27% (roughly 40 tonnes) of this was sold directly to exporters in 2014–15 (comparable figures for 2015–16 and 2016–17 were not available). The final figure exported was likely to be higher as some product sold to fish receivers in Sydney and along the NSW coast also would have been exported.

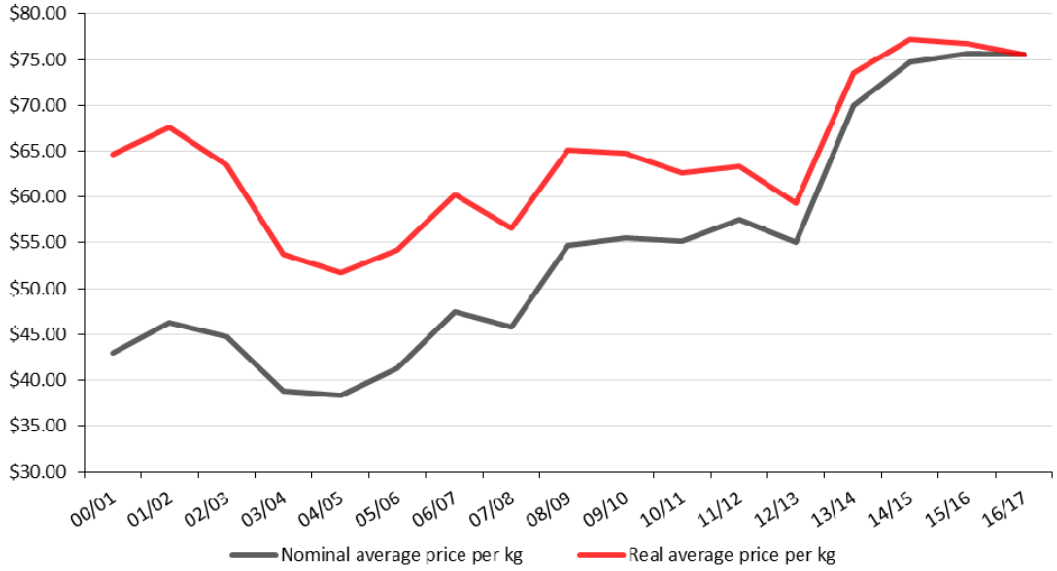

Figure A4.3: Beach prices in real and nominal terms 2000–01 to 31 January 2017.

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 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 them 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 not been confirmed. There is insufficient information available to determine the effects of this on prices received. The Committee again urges industry to investigate alternative marketing approaches, including potential benefits from gaining third party sustainability accreditation such as that offered by the Marine Stewardship Council.

NSW product attracts higher prices on the SFM during the first quarter of the financial year, as other states are not producing lobster at that time. 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. Further analysis of prices received for different size classes on the SFM reveals that this is indeed the case (Table A4.1). The Committee suggests it is worth analysing the relationship between lobster size, market demand, and optimal economic yield.

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

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

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

The industry suggested that prices have declined in the second half of the 2016-17 financial year, with prices on the SFM falling from around $75/kg to $65/kg after January. Export prices declined to $58/kg. The decline in export prices (with a possible flow onto SFM prices) is believed to be a result of a slowdown in the Chinese economy.

A4.5 Costs and fishery profitability

The effects of changes in landings and prices on overall fishery profits remains 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 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. Costs in this case are economic costs, and include a value for owner-operator labour, opportunity cost of capital, 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 increased with the level of quota (Figure A4.4). The management charge, in contrast, has declined over time and with the level of quota.

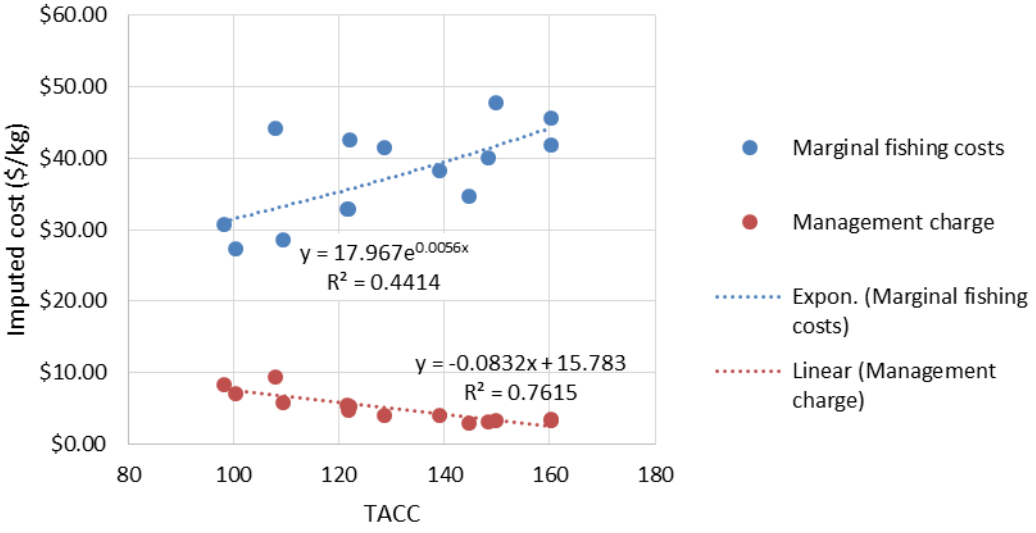

Figure A4.4: Imputed marginal cost ($/kg) and management charges (in real terms).

Second, the key drivers of the increase in quota lease price (and hence short term profitability) also can be broken down into the effects of lobster price, fishing costs (using the imputed costs), changes in management charges (which have declined as a share of revenue), and the effects of improved productivity (due to stock changes). Changes in profits can be decomposed

into changes in each of these measures (see Kompas et al. 2009[12] for details). The key driver of the lease price over the period of available data appears to have been the lobster sale price (Figure A4.5). Increase in the productivity of the stock appears to have had a relatively smaller impact on lease prices (profitability). Fishing costs appear to have increased, but their influence on profits has remained relatively stable. The influence of the management charge on profitability has declined substantially, as would be expected given its level also has declined.

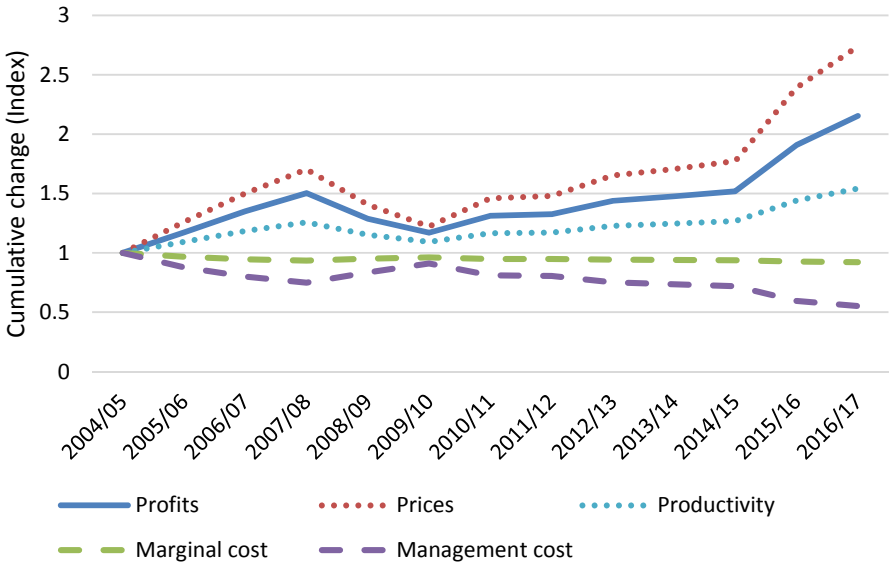

Figure A4.5: "Profit" decomposition, 2004–05 to 2016–17. The graph indicates the relative contribution of changes in prices, productivity and cost to changes in profit (represented by the solid line). The influence of price received on profits has more than doubled since 2004-05. The effects of improvements in stock productivity on profits has also increased, but less than that of prices. The influence of management costs has declined, reflecting the decline in these costs. Changes in fishing costs had only a relatively small impact on changes in profits.

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[13] used by fishers. This generally has declined over the period that the stock has been rebuilding (Figure A4.6), 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.

These results, while indicative only due to the relatively small quota market, have some implications for the future profitability of the fishery. Information presented at the meeting suggested that lobster export prices have declined since December. The above simple analysis would suggest that this is likely to have a negative impact on quota leasing price and profitability of the industry (on a $/kg basis). A higher quota potentially could offset some of this price decline, but the gain in profits from a higher quota will be proportionally less than the change in quota itself if marginal costs increase with quota, as the data appear to suggest.

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[12] 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.

[13] 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

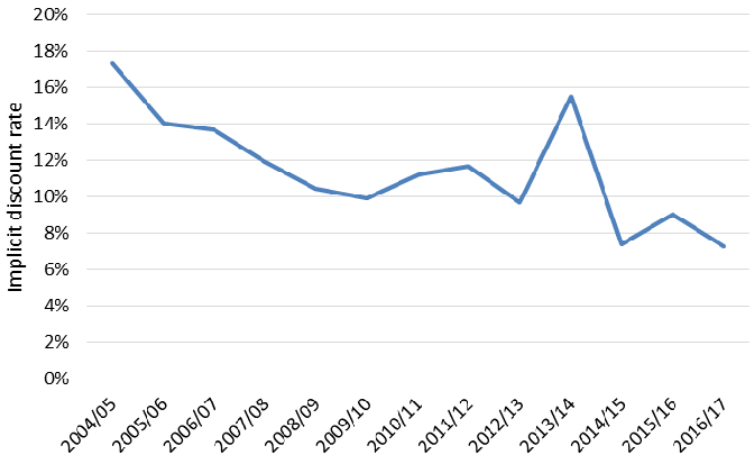

Figure A4.6: Implicit discount rate, 2004–05 to 2016–17.

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 103 shareholders during in 2016–17. There currently are 9,727 rock lobster fishery commercial shares held in packages of 10–350 shares per shareholder. There has been a fairly consistent decline since 2007–08 in the number of shareholders holding 20–100 shares and slight increases in those holding over 100 shares. Consolidation of shareholdings appears to have stabilised in the last 3–4 fishing periods (Figure A4.7), with about 30 fishing businesses landing 75% of the total catch in the last 3 fishing seasons (Figure A4.8). 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.

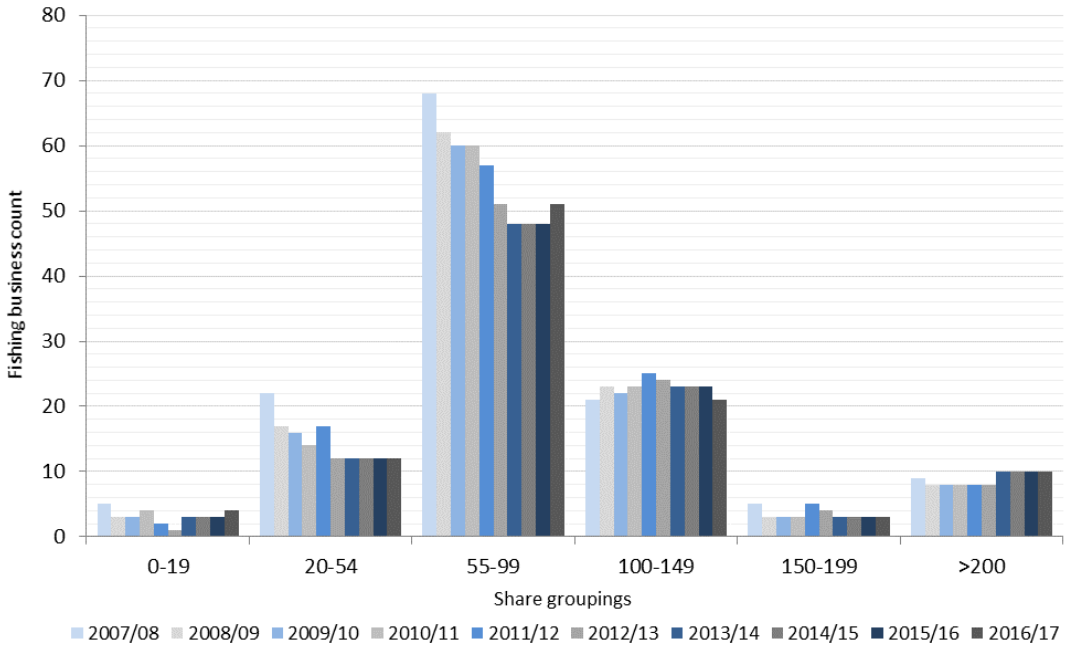

Figure A4.7: Distribution of shareholders by share grouping for the 2007–08 to 2016–17 fishing periods (2016–17 data as at 20 April 2017).

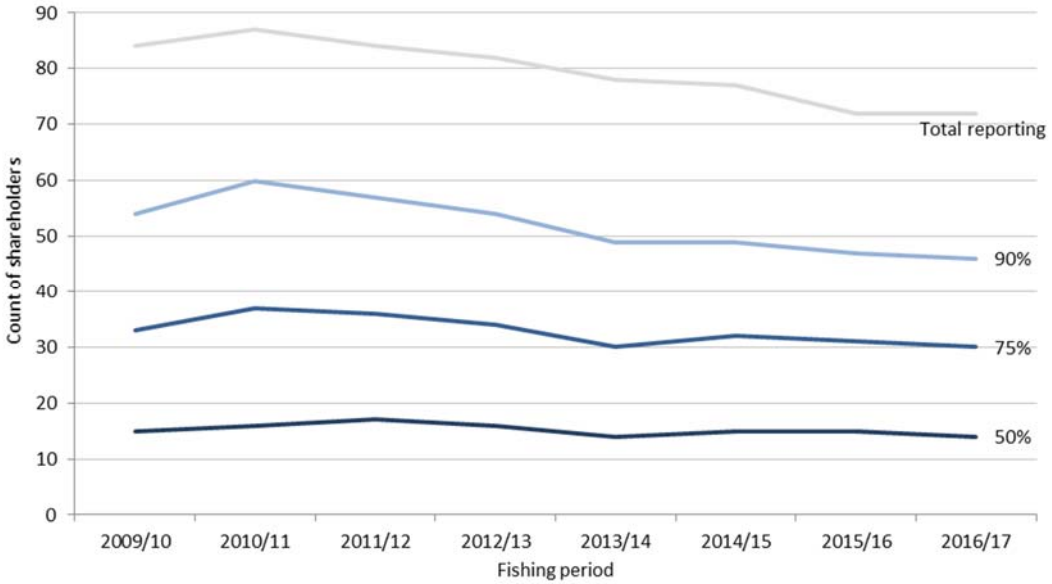

Figure A4.8: Number of shareholders catching % of TACC (2016–17 data to 28 April 2017).

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 for 2016 and 2017 (Table A4.2), however, suggests that fishers generally are more diversified (in terms of endorsements held) than they were in 2015. Around half of all fishing businesses with rock lobster entitlements hold at least one current endorsements in another fishery (Table A4.2). This increase in diversification may be a result of the higher catch rates in 2015–16 and 2016–17 resulting in the lobster quota being taken in less time and providing more opportunity for fishers to operate in other fisheries. The implications of interactions between the lobster TACC and effort transfer to other fisheries may need to be considered in the future, especially if considerable effort is displaced into other fisheries. The Committee notes this is an area for future consideration.

Table A4.2: Endorsements in selected other fisheries held by lobster fishing businesses in 2014–15 (to 7 July 2015), 2015–16 (21 June 2016) and 2016–17 (1 May 2017)

	Lobster Fishing Businesses in		
Other Fishery	**2015**	**2016**	**2017**
Ocean Trawl	4	6	7
Ocean Trap and Line	42	47	52
Ocean Haul	27	39	44
Estuary General	31	44	53
Estuary Prawn Trawl	2	2	3

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 better understand 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 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). The increase from 2014–15 to 2015–16 was substantial (25.8%), but smaller (12.8%) between 2015–16 and 2016–17.

Table A4.3: Total quota transferred (t), number of quota transferors and transferees, amount of TACC transferred (%), and the average price paid for quota ($/kg) in each fishing period from 2000–01 to 20 April 2017.

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	$27.72	$28.08
2016/17	44.0	45	33	28	$31.68	$31.68

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 A4.9). This can be interpreted as reflecting consistently improving economic conditions and optimism about the economic and biological health of the fishery. Reasons for the drop in share prices in 2013–14 remain unclear.

The more recent large increases in share prices (Figure A4.9) 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 growth are unrealistic.

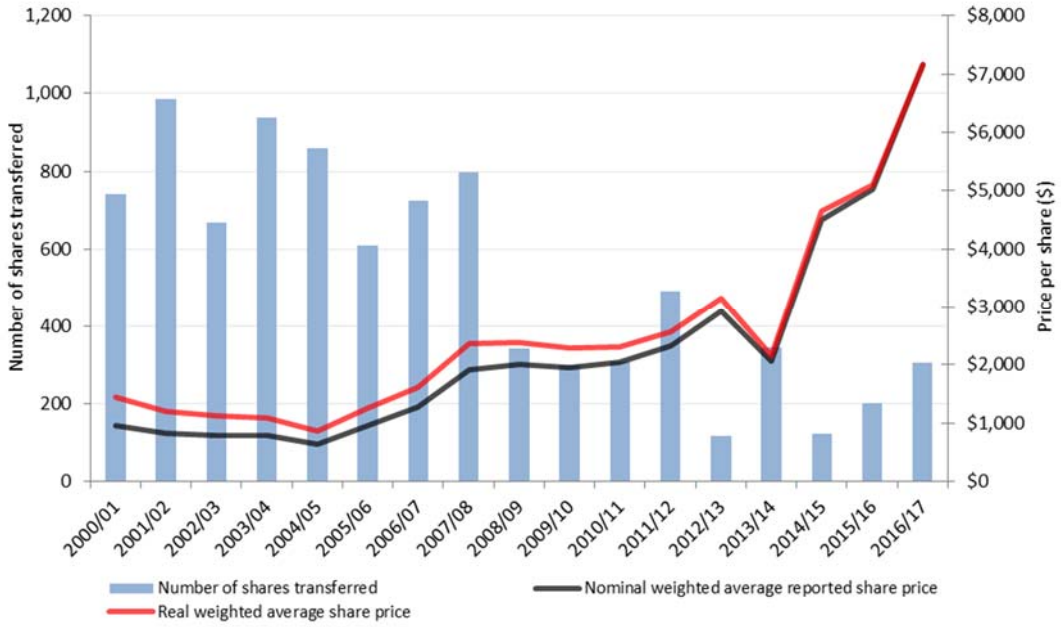

Figure A4.9: Number of shares transferred, estimated share price, and CPI adjusted (real) share price by fishing period from 2000–01 to 20 April 2017

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 analysis of the fishery. 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 analysis 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, which are not mutually exclusive, are presented in more detail in Box A4.1.

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 biologically and economically. The Committee again

recommends that the Department and Industry set up a working group to develop an approach to undertaking economic analysis in the NSW Lobster Fishery.

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

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 routinely reported, however, with as little as 20 per cent of fishers reporting leasing prices, resulting in uncertainty about whether they 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)[14].

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 business in order 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 2017–18 also.

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

[14] 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.

fishers to society. It was designed on the basis that there is potential for economic rent[15] 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. 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 increased in recent years, indicating a perception by industry that the future outlook for the fishery is positive. The increase in viability is a result of a 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 of lobster fishers.

A basic analysis of the available data also suggests that the increase in profits in the industry 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. The Committee again suggests, therefore, 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.

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[15] 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.

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 (8 months)	703	1755	2458	41%

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.

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

The information available about the numbers of inspections and types of offences detected for 2015–16 and the incomplete 2016–17 quota year 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 (8 months)	703	60	49 offences by 35 fishers; *27 cautions, 22 infringements*	1755	359	63 offences by 45 fishers; *39 cautions, 24 infringements*

Some observations from these data:

- Commercial compliance effort has a decreasing trend over the last five years (Table A5.1) but is very consistent between last year and this year (adjusted for 8 months);
- The number of interactions with the commercial fishery generated in 8 months this year is almost the same as for the entire previous year;
- The number of offences detected in the commercial fishery already has exceeded the number from the entire previous year, with similar proportions of cautions and infringements;
- Recreational compliance effort hours have been stable over the last five years but are significantly reduced this year (by approximately 25% estimated on 8 months data);
- The number of interactions with the recreational fishery generated and offences detected this year mirror this reduced effort; and
- The percentage of effort that is classified as 'targeted', being effort dedicated to targeted offenders, for the whole fishery has been relatively stable (~40%).

The relative consistency of amount and type of effort directed at the commercial fishery would suggest that the increased level of detection of offences in the commercial fishery is 'real' and not simply a result of better targeting of suspected offenders based on intelligence. DPI Fisheries Compliance, on request from the Committee, have undertaken some further analysis which confirms this. The data do however indicate a higher number of interactions per hour in the commercial fishery which does suggest greater efficiency in field-based activity. This likely reflects better focus of effort based on experience with the fishery and the quota system, and good risk-based operational planning.

Nevertheless, the drop in compliance rate for the commercial fishery to 42% is concerning. The types of offences detected (for example in relation to non-compliance with the correct use of tags) does indicate that the administration of the quota system is a high priority issue for the fishery at the moment. This is not unusual — it can be expected that offending may increase as abundances and availability of lobsters increases and the TACC becomes a key limiter of catch earlier in the fishing year.

The proportion of serious offences has not increased at this stage, suggesting that the problem is at a stage that it is able to be addressed through good risk-based and intelligence led compliance. 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 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 out 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 legislated SMP and the operational 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: 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 being used 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 (under section 76 of the Act) does not increase significantly, disregarding any increase that is 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 consumer price index), disregarding any increase that is attributable to the provision of additional resources by NSW Fisheries after the commencement of this Plan

Goal	Objective	Performance Indicator	Trigger for Review
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.

The contribution of management charges to total costs has contracted as a share of GVP from the fishery, from around 15% in 2003–05 to currently under 5% (2014–16). 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 legitimate reasons. Industry should prepare to invest in the fishery appropriately, however, in moving through the cost recovery process. It would be appropriate to review costs and look at ways of developing an overall management package (including science and compliance) that has costs appropriate to the scale of the fishery. This review usefully could be done in conjunction with the design of a harvest strategy for the fishery.

Table A5.4: Management charges and fishery value by fishing period (@ 05 July 2015).

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	131.3*	75.52	12.08**	55.32	4.3**

* Based on catches to 28 April 2017

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