NSW Total Allowable Catch Setting and Review Committee

Report and Determination 2016–17

ROCK LOBSTER FISHERY

25 August 2016

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 2016 to 31 July 2017 (the 2016–17 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 August 3rd 2016.

Determination

The Committee has determined that the total allowable catch of rock lobster by NSW commercial fishers during the 2016-17 fishing period should not exceed 160 tonnes (t).

This allocation is the same as the allowable catch in the 2015–16 fishing period.

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.

Recommendations

The Committee 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.

Recommendation 2: The Department obtains more robust estimates of recreational catch.

Recommendation 3: The Department redevelop the current assessment and prediction models to improve predictions for TAC setting and support robust identification of longer-term targets and harvest strategies.

Recommendation 4: The Department develop protocols related to the discarding of lobsters, including operational guidelines to minimise post-release mortality and to account for that mortality in stock assessment.

Recommendation 5: The Department and Industry develop a strategy for economic analysis of the fishery.

Recommendation 6: The Department and the Working Group encourage fishers to provide price information for quota transfers and fishing operating costs to facilitate robust economic analyses of the fishery.

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 about 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 the assessment to be appropriate based on recent observations, but notes that relatively weak year-classes are expected to begin entering the fishery in the next 2-3y and this may affect future catch settings commensurate with continued stock recovery.

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 continues to be an important risk in setting allowable commercial catches from the common stock.

Economic Considerations

The evidence available to the Committee suggests that the economic performance of the lobster industry in NSW has continued to improve. 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. The heterogeneous nature of the fishery related to the spatial nature of the stock distribution and the different operating characteristics of fishers working at different depths means that economic gains are not uniform across the fishery, and hence a conclusion that all sectors are performing equally well cannot be made. 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 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. There is uncertainty about the ongoing strength of these catch rates over coming years given the decline in observed puerulus over recent years. The Committee therefore suggests that fishers remain cautious about overinvestment driven by optimism in the fishery and consider carefully potential future events such as changes in recruitment.

The Committee speculates that there is potential for increased economic performance of the fishery based on limited information about current economic performance and an assumption that the stock will continue to rebuild for some time. The fishery has the potential to contribute considerably to the Department's target of 30% growth in value of NSW primary industries by 2020. The potential economic performance of the fishery cannot be assessed robustly at this stage, however, with the current level of economic information and the current stock assessment model. Development of a more spatially explicit model with an improved stock recruitment model, as discussed elsewhere, and the incorporation of economic parameters such as operating costs and market prices into this model would allow potential economic targets to be assessed, and potential economic benefits to the lobster industry and broader NSW economy to be estimated. Such a bio-economic model also would allow the costs and benefits of alternative annual quota-setting options to be analysed and included in Committee deliberations and discussions with industry.

Management Considerations

The commercial rock lobster fishery clearly has the capacity to take the allowable catch, with annual landings above 95% of the TACC for the past twelve years. Rationalisation in the fishery between 2000 (174 shareholders) and 2013 (103) has stabilised at 99 shareholders for the last 2 fishing periods. A trend of share consolidation in larger (>100 shares) holdings up to 2012 also appears to have levelled-off in the last three fishing periods (2013–16), as has the proportion of catch being taken by the most productive fishers (e.g., around 75% of catch taken by about 1/3 of fishers). This consolidation is consistent with management objectives for the fishery.

Uncertainty about the recreational catch of lobster remains a key risk for confident management of the total harvest. Harvest by Aboriginal fishers under permits for cultural purposes is less than permitted limits, which together with low numbers of permits issued suggests that Aboriginal harvest is low at this stage.

Estimated compliance in the commercial fishery (73%) continues to be poorer than in the recreational fishery (88%) but has shown marked improvement in the past 2 fishing periods. Overall compliance remains above the management trigger point.

The solid biological status of the fishery indicates that management emphasis might move away from stock rebuilding toward improving (sustainable) economic outcomes. The Committee again notes the need to develop a harvest strategy incorporating targets that maximise the economic yield from the fishery. The lack of target reference points now

materially impacts TACC-setting but poor or absent economic data impede development of economically-based targets. The Committee again recommends that the Department and industry work to collect economic data and develop a robust harvest strategy for the fishery.

Two performance triggers were exceeded in 2015-16: Increases in management charges and share prices[1] both exceeded the respective trigger values set in the lobster Share Management Plan or Fishery Management Strategy. The Committee considers the material increase in share prices over the most recent 2 fishing periods a reflection of economic confidence in the fishery combined with the evident capacity to realise the TACC and does not recommend specific action at this time. The Committee notes that the percentage of fishery GVP (4.2%) represented by nominal management charges continues to decline and the absolute amount paid remains below the amounts paid in 10 of the last 18 years.

Industry cooperation with the Department and the Committee continues to be effective. The Lobster Industry Working Group will be important particularly as a new management plan and harvest strategy are developed that will enable the fishery to reach full potential. 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.

[1] The Committee has interpreted the trigger for movement in share prices (FMS Goal 5, Performance Indicator 4) to be movement of 25% over a two-year interval rather than 25% movement in each of two successive years.

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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 2016 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, to 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 is 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 directly the TACC. The degree to which the Committee's suggestions or recommendations beyond that scope are accepted is a matter entirely for the 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 August 3rd 2016 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 August 4th 2016. In-camera discussions were requested with NSW DPI management and research officers.

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[2] of 25% of the unfished level; the median estimate from the most credible assessments is about 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[3] is undertaken jointly by industry and government. The Committee in the interim will treat a spawning stock depletion of 48% as an appropriate target reference point for setting TACCs. 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 recently reduced levels of puerulus settlement suggest that rebuilding is likely to be slower than model predictions over at least the next 3 years. It is expected that puerulus settlement and recruitment to the fishery will continue to grow as the spawning stock increases, albeit with shorter term fluctuations, up to some presently unknown limit that is higher than the average settlement and recruitment observed to date. The pattern of settlement and recruitment as spawning biomass continues to increase will determine the long-term future optimum productivity that is possible for the fishery.

3.3 Catch rates

Catch rates have 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[4] 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 of fishing grounds facilitated by the generally higher catch rates 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.

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[2] 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.

[3] 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).

[4] '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.

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 3-4 fishing periods. This is a slightly better outcome than the small decrease predicted in recent years under recently increased TACCs and this discrepancy is interpreted as being due to the better than average puerulus settlement detected 4-5 years ago that is now growing through the population. Current catch rates of small lobsters on inshore (shallow) grounds, in part, have maintained the sustained recent catch rates. Catch rates of maturing lobsters from deeper offshore grounds also have been maintained and indicate substantial numbers continue to reach the size and age at which they join the spawning stock. Puerulus settlements in the past 3 annual surveys, however, have returned to or below the long-term average levels and so fishery catch rates are expected to decrease in the next few years.

3.4 Discards

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. Research in Western Australia found that immediate return of lobsters to the water was very important in reducing post-release mortality and that research may be a useful reference for developing approaches to managing discards in the NSW fishery. It is recommended that:

(i) protocols for discarding be developed to minimise post-release mortality;
(ii) measures are taken to ensure discards are reliably recorded; and
(iii) appropriate estimates of post-release mortality are included in stock assessments.

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 in 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 proved adequate to estimate current stock status 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 and input controls such as size limits. It is recommended that the current assessment model be redeveloped and that this redevelopment specifically include improved treatment of recruitment to the fishery and of the catch-effort relationships in the different depth, geographic, and gear components of the fishery. This redevelopment would improve both stock assessment and short term predictions for TAC setting and provide the capability necessary for identifying longer-term targets and associated harvest strategies.

3.7 The future

The dual challenge in coming years are to continue steady rebuilding of the spawning stock to the target level and to avoid catches ‘overshooting’ the desired sustainable level, which would have negative impacts on the stock and require subsequent TACC reductions. The challenge of not ‘overshooting’ is complicated because the stock status giving MSY or MEY will be known accurately only when the recruitment to the fishery can be seen to plateau on average as

spawning biomass continues to increase, and there is a several year delay between a given estimate of spawning biomass and observation of the recruitment generated from that biomass. Determining and achieving such targets in this fishery will be adaptive by necessity, guided by the stock assessment and monitoring results. There is a risk that catches could be increased above the sustainable level before that level is recognised. The Committee consequently, supports relatively small catch increases, or constant catches of 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 serious 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 target is approached, especially given knowledge that catches over the next few fishing periods will be affected by a recent series of relatively weak puerulus settlements.

The fishery data, scientific monitoring data, and stock assessment provide consistent evidence in support of these interpretations. This is a significant source of confidence in the assessment and management of this fishery. The scientific monitoring program is a 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. Focussing on gross returns alone means that the economic implications of different alternative 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

The estimated gross value of production (GVP) has increased over the last decade as a result of both increasing catches and increasing real prices on the SFM. The fishery had an estimated gross value of production (GVP) of $12.1m in 2015-16, the highest value of the fishery for at least two decades in both nominal and real terms[5].

Using SFM prices for assessing GVP, however, may overestimate the value of the fishery. The net price received by the fisher needs to take into consideration transport costs and commissions, which will vary depending on location of landings. Export prices are believed to be lower, with several fishers volunteering a price of around $65/kg compared to $75–$85/kg from the SFM. The logic behind accepting a lower price than that of the SFM is that: i) it saves transport and commission costs, which were estimated by some fishers to average about $4/kg; and ii) selling large quantities on the SFM would result in a substantial price decline not just for themselves, but for all other fishers selling at that time.

The price-quantity relationship for NSW lobster is complicated. There appears to be a negative relationship between quantity on the SFM and the price received by fishers on a month-by-month basis, 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 supply, and so more stable over time. NSW product is highly substitutable with lobster from the other States, so the overall price received will be more dependent on total Australian (and to some extent international) production than on NSW production alone. Any increase in catch in the future is likely to be diverted to the export market provided the Australian dollar does not strengthen substantially. The short term (12 month) forecast for the Australian dollar against the Chinese Yuan is for it to remain relatively stable (http://www.nab.com.au/business/international-and-foreign-exchange/financial-markets/exchange-rate-forecast).

The effect of increasing export of lobster has been seen already in the decline in quantity sent to the SFM in 2014-15 (47% of production) compared with 2013-14 (54%). Discussions with industry suggest an even lower proportion of the total (higher) catch in 2015-16 was sent to the SFM, with increased focus on the export market from some large operators. The real “average” price for the fishery may decline further as a result, even if the SFM prices remain above export prices since a smaller proportion of the catch will receiving the higher SFM prices.

The GVP often is used as an indicator of the value of the fishery and so better information on actual average prices is required to derive a more accurate picture of the economic performance of the fishery. Information on how prices change with landings, either as a result

[5] 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.

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 on prices and hence fishery revenue.

4.3 Fishery profits and quota trading prices

The effects of changes in landings and prices on overall fishery profits remains uncertain without information about fishing costs. Higher quota trading prices are a good indicator of industry expectations of profits, as there is generally a direct relationship between expectations around fishery profits and quota and share prices. Reported quota trading prices increased by 26% between 2014-15 and 2015-16 suggesting that fishery profits increased substantially between the two years. The increase in price was also a result of an apparent "shortage" 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 15% in real terms, suggesting that longer term expectations were less optimistic, although there was still an expectation of higher future profits.

4.4 Economic targets for the fishery

The Committee 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 has demonstrated to the industry that the fishery has the potential to generate substantial profits, although how large this potential is has not been established.

It is important that industry, managers and policy makers determine what they want to achieve in the fishery, especially now that the stock is considered confidently to be well above the limit reference point implicit in the legislated management trigger (25% of pre-exploitation biomass). Failure to set specific objectives and targets for the fishery exposes the fishery to risks of not achieving its full potential 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 the NSW coastal community. Key economic analyses would include:

- Productivity analysis to estimate effects of heterogeneity in fishing behaviour and operational characteristics on performance;
- 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;.
- Fishing cost analysis to document how fishing costs vary between different sectors in the fishery (e.g. inshore vs offshore operations) and quantify cost-production relationships;

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 most recent stock assessment estimates the status of the lobster stocks to be 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 benefits from the fishery.

5.2 Non-commercial components of fishery

Commercial fishers have made comments consistently that recreational fishers appear to be increasing their rock lobster catches in NSW as stocks improve and accessibility to recreational fishers increases, with the potential to erode intended gains to the commercial sector. The issue was raised again this year. 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, that as rock lobster become easier to catch recreational fishers will target them more, or are more likely to take them while targeting other species such as abalone.

The uncertainty in the estimate of recreational catches is discussed in the stock status section, as are methods for improving estimates of recreational lobster catch. It is noted also that Fisheries Officers have started collecting some limited information on numbers of rock lobsters in recreational catches observed during patrols. Those observations currently are collected inconsistently but potentially, if standardised and consistent, offer another source of recreational catch data.

The paucity of data means that change or stability in the recreational harvest cannot be inferred with confidence. Nevertheless, for the time being, the Committee is assuming that any increase in recreational catch as a result of higher abundances reflects the existing share of the sector and broadly is in proportion to increases in commercial catch (in other words, the recreational sector is not growing wildly out of proportion to the commercial sector). The Committee caution against any consideration of increases to recreational catch or effort limits, however, 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 2015–16 fishing period, allowing the take of 25 lobsters.

5.3 Compliance

Overall (recreational and commercial) compliance rates in the lobster fishery for 2014–15 and 2015–16 were 81% and 82% respectively, noting that only 8 months of 2015–16 data were available at the time of calculation. These rates were improvements compared to 2013–14, when the overall compliance rate was 74%. Commercial and recreational compliance rates again differed but not as significantly as in previous years. The last three years rates are set out below.

	2013–14	2014–15	2015/16 (8 months)
Overall	74%	81%	82%
Commercial	58%	73%	73%
Recreational	91%	88%	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 and intelligence-led and targeted effort.. 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.

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 that were finalised in 2007. Both frameworks are generally 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. In particular, current CPUE far exceeds the 1998–99 benchmark set in the SMP and the current biomass is well above the management trigger point in the FMS of 25% of pre-exploitation levels.

The Committee must use its own targets and objectives, implicitly or explicitly, to guide decisions in the absence of formally specified targets (Section 3, Appendix 3). 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 GVP from the fishery and has varied 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

Industry consultation and cooperation with the Department and the Committee continues to be working very effectively. The Committee is pleased to note that the Lobster Industry Working Group met the day before the public forum. This body continues to engage constructively. This group will be important particularly as a new management plan and harvest strategy are developed that will enable the fishery to reach full potential. Industry generally continue to support a precautionary approach to setting the TACC and express a desire to maintain a consistent catch and return that is available from a more stable, robust stock.

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.

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.

Recreational lobster fishing continues to be popular but uncertainty about the amount of recreational catch continues to constitute a significant concern for the Committee in setting the TACC. The Committee looks forward to receiving better information on recreational fishing.

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 is 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, will affect materially future 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 2016–17

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 2016–17 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, notwithstanding evidence of only average peurulus settlement in recent years;
- There are reasonable levels of consistency between the fishery data, scientific survey, and model-based indicators for the fishery;
- There is unanimous 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 improved and are at a relatively high level for both recreational and commercial sectors; and
- Industry opinion favours a cautious approach whist the lobster stock continues to rebuild and general favour a small or zero increase in TACC accordingly.

The Committee proposes the TACC remain at 160t for the 2016–17 quota year on this basis.

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. The recent decline in peurulus settlement is of some concern and also indicates a cautious approach is prudent. The Committee also is concerned about over-capitalisation in the fishery. The Committee therefore is reluctant to increase the TACC and also encourages fishers, individually and collectively, to take a measured approach to investment in the fishery. The Committee's determination for 2016–17 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 2016 to 31 July 2017 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 the open forum on August 3rd. We also thank the Departmental officers who prepared comprehensive and 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
13.04.2016	Section 31(1)	Call for public submissions on the appropriate level of the annual TACC for Lobster for 2016–17, posted to NSW DPI website, and displayed in District Fisheries Offices.
13.04.2016	Section 284 (1b)	Advertisement inviting submissions placed in the Sydney Morning Herald and the Daily Telegraph.
04.05.2016	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 ■ NSW DPI Fisheries Offices ■ All Members of the NSW Lobster Fishery Working Group (which includes positions for conservation and Indigenous members).
18.05.2016	Section 284 (1b)	Closing date for period of at 30 days for public consultation.
19.07.2016	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* ■ Shareholders B, North Coast* ■ Shareholders C, Central Coast*
03.08.2016		The Committee considered submissions and heard formal presentations and opinions at the Total Allowable Catch Committee Open Forum meeting in Sydney on 03 August 2016. The following made presentations, or provided information to the Committee: ■ Nicholas Giles: Fisheries Manager, DPI; ■ Andrew Field: District Fisheries Investigator, DPI; ■ Geoff Liggins: Manager, Scientific Services, DPI; ■ Giles Ballinger, Scientific Services, DPI; ■ Steven Burt, commercial fisher; ■ Steve Drake, commercial fisher; ■ Michael Firkin, commercial fisher; ■ Mark Horne, commercial fisher; ■ Scott Westley (Rock Lobster Working Group) ■ Mark Cranstone, commercial fisher; ■ Lee Monin (Rock Lobster Working Group) ■ Daniel Gogerly, commercial fisher; ■ Noel Gogerly (Rock Lobster Working Group) ■ Daniel Stewart (Rock Lobster Working Group)

**** These submissions were 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 is in a healthy and reliable state.' Considered lobster stock to be in good condition on all fishing grounds, including deep and shallow water, with large numbers of undersized, legal sized, and oversized lobsters and plenty of females carrying eggs. Again provided photographs of catches of large lobsters and large numbers of lobsters in traps as an indication of sound stock condition. Noted warmer than usual water offshore, with attendant strong currents making operations difficult. Commented on increased share and quota trading prices and short supply of quota for trades. Consider these features to signal sound condition of the fishery. Suggested 5% increase in TACC.
Shareholders B	Again noted that quota was taken easily early in the fishing period and that additional quota was difficult to obtain in the market place. Reported good beach prices for his catch throughout the fishing period. Catch rates have been 'fantastic', with good catches from all grounds fished (inshore, mid-shelf, deep water). Breeding stock 'looking great' with 'plenty of oversized and berried lobsters' off mid-shelf and inshore grounds. Suggests '…there's room for another small increase …' in the TACC.
Shareholders C	Noted his existing quota was easily taken in a few months but that leasing additional quota is becoming more difficult. Raised concern about recreational catch. Would like to see quota at 200t but suggested annual increase of 10t.

**** These submissions were confidential. Identification of the authors have 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 Catch Determination for 2016–17. 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 recommending a TACC.

A3.2 Fishery reference points

Target and limit reference points have not been derived formally for the fishery but the TACC 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 arrangements were 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. An important challenge at this stage in recovery is the time lags between different signals from the fishery, especially the about 4-year lag between the size of the spawning stock and the subsequent recruitment of lobsters from that spawning stock into the exploitable biomass. Caution is required to avoid excessive increase in fishery catch. Too rapid an increase in catch could result in 'overshoot' of the fishing mortality compared to the appropriate target level, which would both increase biological risks and require subsequent reduction in catch with attendant economic impacts.

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. This is 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. The limit reference point of a median 0.3 depletion is used by the Committee because the stock assessment results are reported in terms of the median, meaning that there is a 50% probability that the actual population is above the 0.3 depletion level and an equal probability that it being below 0.3. The standard error of estimated depletion in recent assessments 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 limit reference point adopted by the Committee is that the true population is above 0.25 of the unfished biomass with at least 84% probability.

Performance against the adopted limit reference point has been reported 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. 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 catches are extremely difficult to estimate but the assumed amounts are considered sufficient to include 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 non-commercial and unreported commercial (NCUC) catch in the early history of the fishery (i.e. prior to introduction of the quota system in 1994) is very uncertain, with catch reconstruction (Fig A3.1) based on various early reports and interviews with some fishers who operated in that period. These early estimates of NCUC catch are recognised to be both imprecise and potentially biased. Stock assessments since 2013 have recognised uncertainties in the post-1994 NCUC catch by considering both a high and a low NCUC catch scenario. The lower NCUC catch scenario was considered the more credible of the two based on management, compliance, and industry reports over recent years. Compliance reports, for example, indicate that the unreported commercial catch has decreased markedly since about 1994–5. Consequently, only the low NCUC catch scenario was considered this year. This low NCUC 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 unreported commercial catches under this scenario were 12 – 19 t over the past 21 years, approximately 16.4t in 2014–15, and 17.5t in 2015-16, while non-commercial catches were 10-16 t during the past 21 years, approximately 14t in 2014–15, and 14.9t in 2015-16.

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[6]. 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 if continued stock recovery attracts greater recreational fishing effort and lobsters become easier to catch by free-divers. It is highly desirable that a means be developed to measure more accurately the amount of recreational catch and to track time trends in catch. One approach that is used in some other jurisdictions, and that should be considered for NSW, is to require registration of an interest in taking lobsters when applying for a recreational fishing permit. This would provide information to allow surveys to be targeted to those people potentially in the recreational lobster fishery, which would greatly increase the efficiency, accuracy and precision of recreational catch estimates. There also are other mechanisms that could be considered for better measurement of the recreational catch.

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. Effort data up to 1958, however, are poor or absent, and unreliable.

Commercial fishery data since 1969 are better understood, more detailed, and monitor more than just catch and fishing effort. Telephone surveys of commercial catch were conducted from 1969-1996, monthly fisher returns were used from 1984-1994, compulsory fishing logbooks

[6] The recreational fishing survey estimated a total catch of 23,216 (se 12,501) lobsters in 2013–14. This number of lobsters has been converted to estimated total weight by assuming the average weight of lobsters taken in shallow water (<= 10 m) by recreational fishers was the same as the average weight of individuals taken commercially in shallow water (0.661–0.689 kg/lobster).

were introduced in 1994, and a standardised observer program to measure independently the size composition of lobsters caught has operated since 1998. The history of estimated total catches is shown in Figure A3.1.

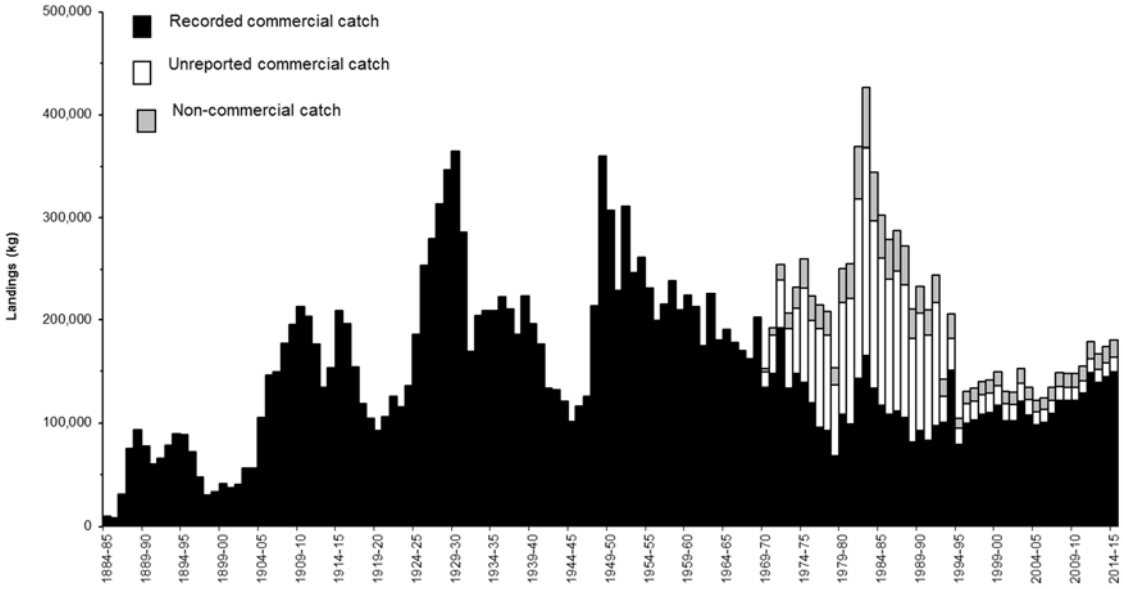


Figure A3.1. The landed catch of rock lobsters since the start of the fishery. The non-commercial and unreported commercial (NCUC) catches are derived from the *low NCUC catch* scenario above.

The level of discards and high-grading of retained lobsters has increased in recent years as the TACC has become increasingly limiting. Discards were about 11.5t in 2015–16 and high discards are expected to continue. It is recommended that: (i) protocols for discarding be developed to minimise post-release mortality; (ii) measures are taken to ensure that discards are reliably recorded; and (iii) appropriate estimates of post-release mortality is included in stock assessments. Research in Western Australia may be useful for developing these approaches; for example, that research found that immediate return of lobsters to the water was very important in reducing post-release mortality.

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. These are the catch rates that would be experienced by fishers. 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 because they adjust for some of the effects of changes in fishing methods. It is appropriate, therefore, that standardised catch rates have been used in interpretations and to calibrate the population assessment model. The current 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 afforded by higher catch rates in the fishery. It is recommended that either additional work on catch rate standardisation be done or the assessment model be restructured to recognise explicitly the different depth, geographic, and gear components of the fishery to address this shortcoming (see further comments below).

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 2015–16 data are incomplete, but the catch accounts for almost all of the available TACC (159t of 160t) and the CPUE reported is a very good reflection of the overall outcome for the quota year.

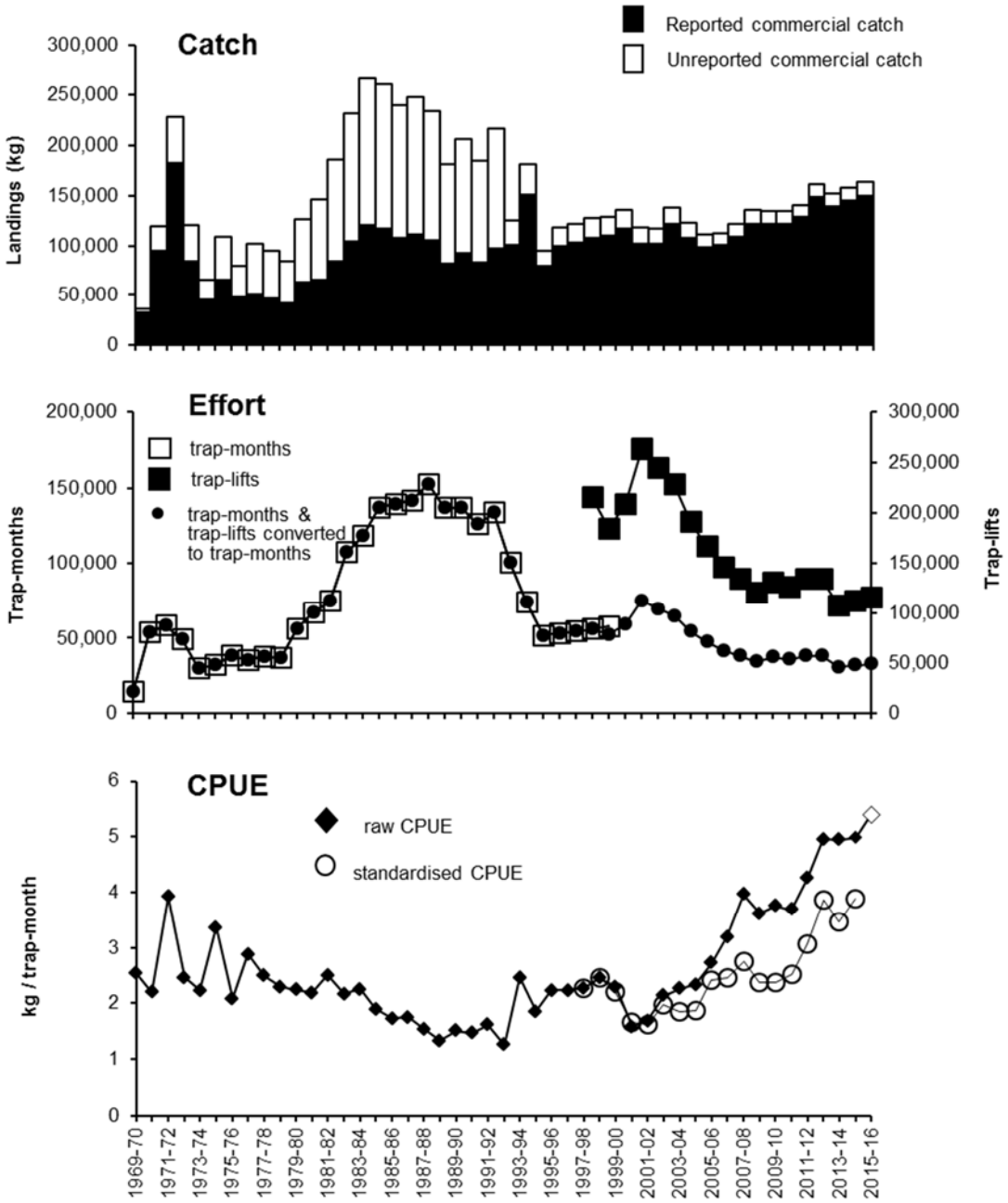


Figure A3.2. Commercial catch, effort and catch rate since 1969–70 when more reliable effort is available. Data for the 2015–16 fishing period are incomplete but include 159t of the 160t TACC.

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 capture adequately all the effects of the recent operational changes in the fishery, however, means that it is not clear whether 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 4-6 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. Catch

rates of small 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.

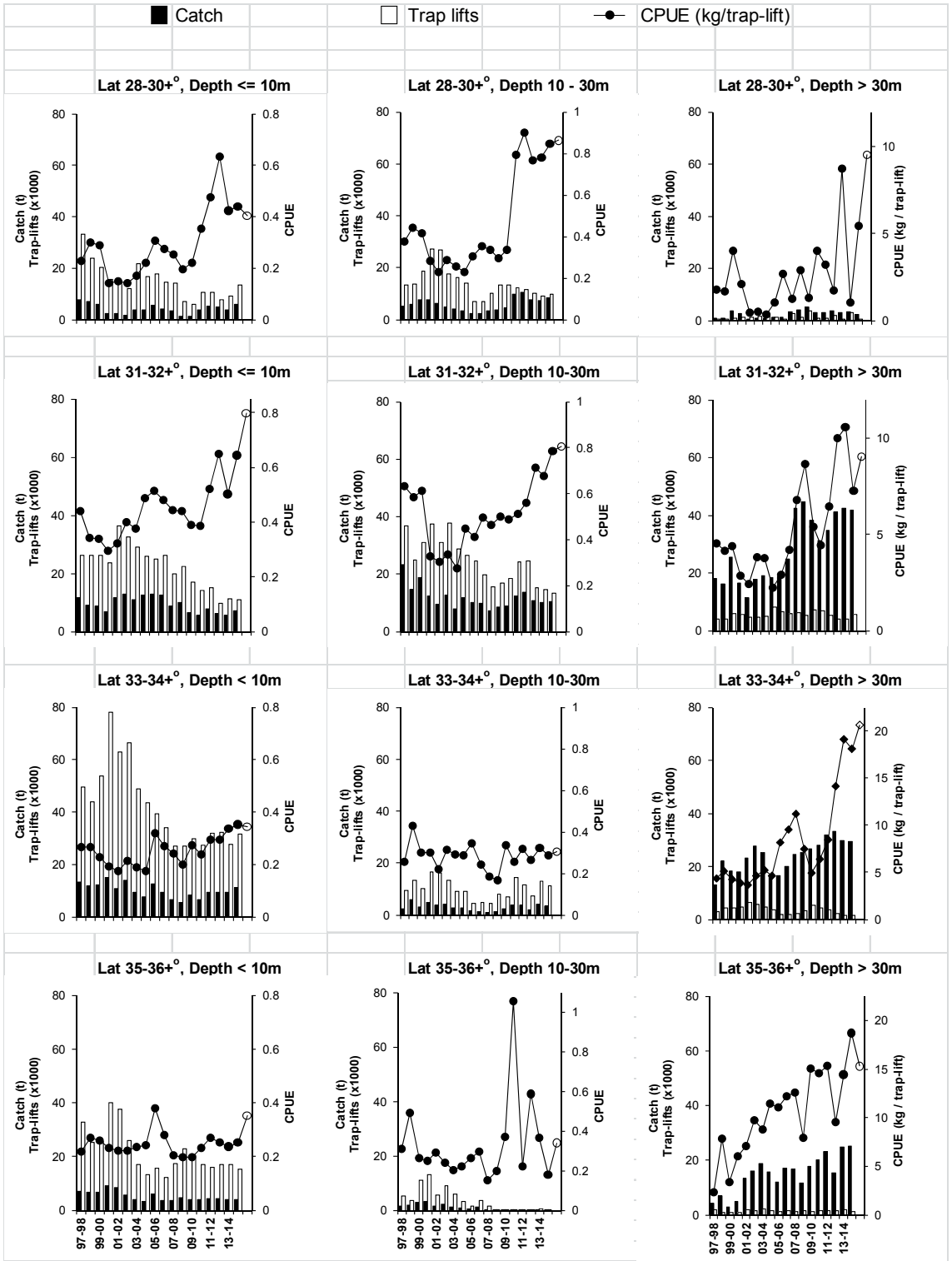


Figure A3.3. Commercial catch, effort and catch rate by area and depth since 1997–98 when detailed reporting became mandatory. The spawning stock is found mostly in the far north coast (28-30+°) and mid-north coast (31-32°) at depths greater than 10m and especially depths 10-30m. Data for the 2015–16 fishing period are incomplete but include 159t of the 160t TACC.

The catch and catch rate data overall support interpretations that the stock has been increasing in recent years and is now well above the low levels of 2000–02. 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, and subsequently to recruitment. 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, one to monitor the spawning stock and the other to monitor settlement of post-larval lobster (puerulus) from the plankton to reef habitats. Puerulus grow and recruit to the fishery about 2-3 years after settlement. The spawning stock surveys started in 1998–99 and use standardised pot sets in the northern areas where eastern rock lobster spawn. The puerulus surveys started in 1995–96. 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. The value of these data will increase greatly during the next few years; they 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.

Puerulus settlement in the northern areas usually is 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 previously has resulted in undesirable transfer of fishing effort onto deeper water, with 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. 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 relatively weak by recent standards, and in the past 2y (2014–15 and 2015–16) it has been below the long-term average. This is expected to result in somewhat reduced recruitment into the southern inshore fishery during the next 1-2 years, and longer if the recent reduced puerulus settlement continues. Multi-year (3-4y) fluctuations in puerulus settlement have occurred previously in the fishery, presumably reflecting broad oceanographic conditions, and can be expected in future.

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 last updated in 2014–15. 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.

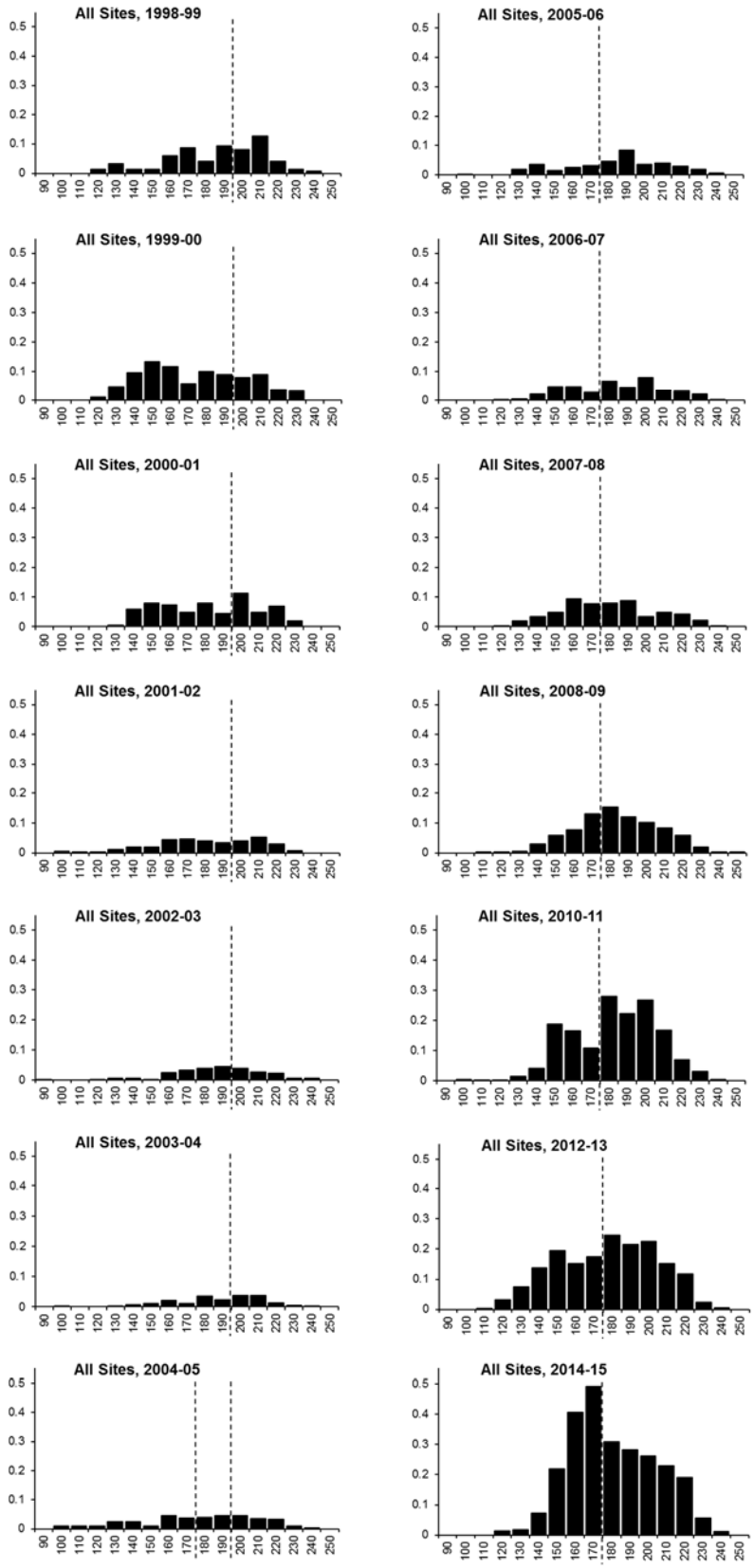


Figure A3.4. Size composition of lobsters in the commercial catch of the mid- and far-northern areas combined from logbook data augmented by observers. The dashed line is the maximum legal size, which changed from 200mm to 180mm in 2004-5, and the vertical axis is number of lobsters per pot-lift. Monitoring is conducted every second year and was last conducted in 2014–15.

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.

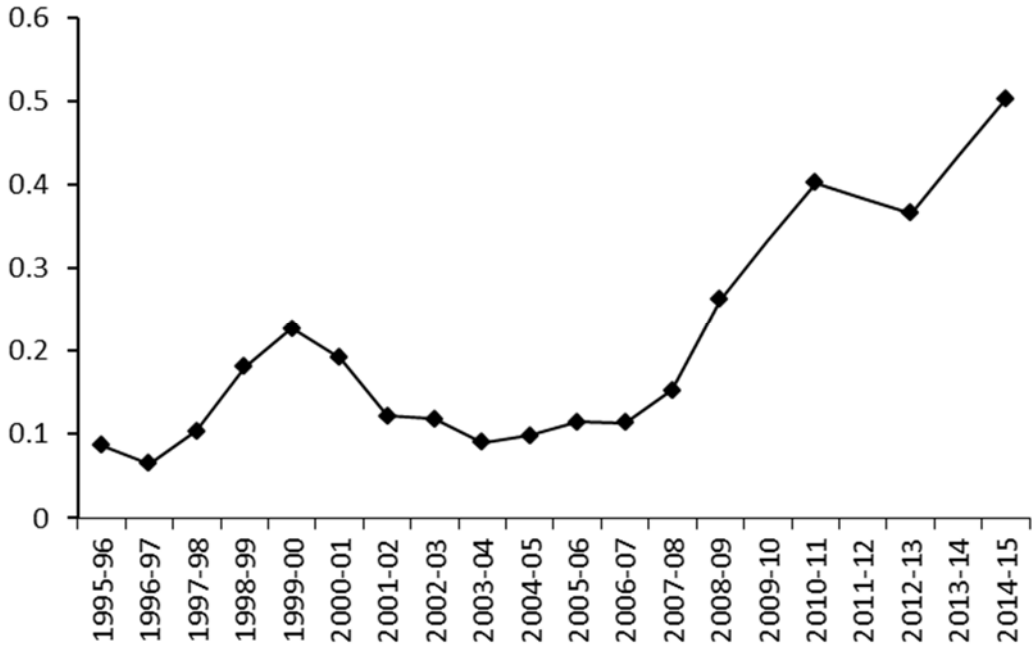


Figure A3.5. Index of abundance (lobsters per pot-lift) of spawning stock from direct observations. The index is based on commercial catches of berried female lobsters for the period up to 1997–98 and on fishery-independent surveys since 1998. These data are updated every second year and were updated last in 2014–15.

Overall this direct monitoring of the spawning stock is very encouraging with respect to the strength of rebuilding. It greatly increases confidence in assessing the status of the stock. It clearly and directly demonstrates 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 characteristically 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 in recent years), 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 uncertainty examined through the stock assessment model concerns the pattern of recruitment because, as noted in previous years, the observed pattern is not consistent with the assumed relationship (i.e. a Beverton and Holt stock recruitment relationship with 'steepness' of 0.9) for the estimates of recent spawning stock depletion given the inferred levels of historical catches. Recruitment to the fishery observed through the direct monitoring program indicates an increase in recent recruitment that is faster and more persistent as spawning stock has increased than is predicted by that assumed stock-recruitment relationship. Three stock-recruitment scenarios were examined:

- Low recruitment relationship (Low-RR) which used the Beverton and Holt stock recruitment relationship with 'steepness' of 0.9. This was the 'base case' analysis in previous years but it is now clearly not matching recent observations.
- Medium recruitment relationship (Med-RR) 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 2.15% per year and then remain constant at that level for subsequent years.
- High recruitment relationship (High-RR) 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.

The Med-RR and High-RR scenarios reflect the effects of the observed recent increase in recruits to the fishery, which averaged approximately 3% per year in the period 1997-98 to 2014-15. Neither of these scenarios match the 'increased recruitment IRR' scenario used in last year's assessment, which used an increase in recruitment of 2.5% per year and so was intermediate between the Med-RR and High-RR scenarios examined this year.

The effect of the Med-RR and High-RR scenarios is to lower the 'steepness' assumption during the years when increased recruitment has been observed directly in the monitoring program. This is a cautious treatment because it does not assume that the increased recruitment will continue to increase beyond what has been observed during the period depicted in these recruitment scenarios, as it would if a lower 'steepness' was simply assumed to apply in the past and future. The Med-RR and High-RR scenarios do assume, however, that recruitment will remain at the high levels seen in 2012–13 and will not revert to earlier lower levels. This is essentially an assumption that recent increased recruitment is due to increased spawning biomass, rather than to a reversible change in the environment that happened to result in improved larval survival in recent years.

The model fit to the length frequency data is 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 in the length frequency distribution. The model fit to the catch rates becomes increasingly poor in the last few years, however, with the model increasingly underestimating the standardised empirical catch rate. The High-RR scenario matches the catch rate slightly better than the Low-RR and Med-RR Scenarios and so should be seen as an improvement, but none of the scenarios matches the rapidly increasing catch rate observed during 2012–14. Two possible reasons for this discrepancy, that are not mutually exclusive, are:

- Increases in recruitment since 2010 are stronger even than the High-RR scenario represents, implying that the model is underestimating recent stock recovery; and
- Operational increases in fishing efficiency since 2010 are greater than the catch rate standardisation estimates, implying catch rates exaggerate recent stock recovery.

The deviation between model results and observations appears to be growing and will cast significant doubt on the overall interpretation of stock status and trends in future assessments if not rectified. The ad-hoc High-RR scenario has strong empirical support and is a feasible representation of the population but a more formal modelling structure that can accommodate the observed trends in recruitment and CPUE should be developed and applied in future. This issue needs to be addressed because it not only compromises confidence in model-based

assessment of current stock status and recovery progress but also severely limits the reliability of medium and longer term predictions of outcomes under different catch and harvest strategies, to the extent that the existing model is not suitable for such predictions.

An interpretation of some continued stock recovery during the past 3-4 years is reasonable at this time, but confidence in this conclusion is based strongly on the fishery independent measures of the spawning stock.

A3.4.2 Present stock levels

The key population and depletion estimates are provided in Table A3.1 for the Med-RR and High-RR scenarios. The High-RR scenario is considered to provide the more credible assessment of the two because it more closely matches the observed recent recruitment.

Table A3.1. Estimates of total and spawning biomass prior to exploitation and in 2015–16 from the assessment model under Med-RR and High-RR scenarios.

Metric & Scenario	Median	5% limit	95% limit
Unexploited total biomass (K)			
Med-RR	6,099	5,834	7,441
High-RR	6,102	5,833	7,457
2015-16 total biomass			
Med-RR	2,800	2,020	4,175
High-RR	3,239	2,331	4,715
2015-16 total biomass/K			
Med-RR	0.46	0.34	0.58
High-RR	0.53	0.40	0.65
Unexploited spawning biomass			
Med-RR	2,337	2,236	2,852
High-RR	2,339	2,236	2,858
2015-16 spawning biomass			
Med-RR	877	600	1,376
High-RR	1,003	675	1,536
2015-16 spawning biomass/ unexploited spawning biomass			
Med-RR	0.38	0.27	0.49
High-RR	0.43	0.30	0.55

Key features of the assessment are:

- Stock status is very similar to last year, with the main difference being increased credibility of the Med-RR and High-RR interpretations over the previous base-case interpretation which is the same as the Low-RR interpretation this year;
- Spawning biomass has increased measurably and steadily over the past 5 years, which is matched approximately by both Med-RR and High-RR scenarios;
- The median estimate of spawning stock depletion is close to 0.4 of unexploited biomass across both Med-RR and High-RR scenarios; and
- Spawning biomass has rebuilt to well above the management trigger point and for both Med-RR and High-RR scenarios there now is a very low probability that the spawning stock is below 0.25 of the unfished biomass.

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 Med-RR and High-RR 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 2015–16 (i.e. total catch at various constant levels in years 2016–17 to 2020–21). These predictions were based on the HRR and MRR assumptions of constant recruitment for all years after 2012–13 and so should be considered cautiously given the above discussion. Changes in spawning biomass (Table A3.2) and exploitable biomass (Table A3.3) are calculated by the predicted biomass in 2020–21 divided by biomass in 2015–16.

Table A3.2. Predicted spawning biomass in 2020–21 relative to spawning biomass in 2015–16 ($SB_{2020\text{-}21}/SB_{2015\text{-}16}$) 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 in spawning biomass [95% confidence interval]
150	Med-RR	1.08 [1.01-1.12]
	High-RR	1.16 [1.12-1.21]
175	Med-RR	1.03 [0.95-1.08]
	High-RR	1.11 [1.06-1.15]
200	Med-RR	0.97 [0.87-1.04]
	High-RR	1.07 [1.00-1.11]
225	Med-RR	0.92 (0.79-1.01)
	High-RR	1.02 (0.94-1.08)

Table A3.3. Predicted exploitable biomass of 104–180mm lobsters in 2020–21 relative to that in 2015–16 ($EB_{2020\text{-}21}/EB_{2015\text{-}16}$) 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	Med-RR	1.10 [1.07-1.14]
	High-RR	1.12 [1.09-1.17]
175	Med-RR	0.99 [0.93-1.03]
	High-RR	1.04 [1.01-1.06]
200	Med-RR	0.88 [0.75-0.97]
	High-RR	0.95 [0.88-0.99]
225	Med-RR	0.77 (0.55-0.89)
	High-RR	0.86 (0.74-0.94)

The high-RR assessment is considered to provide the most credible interpretation of current status but the observed recent reductions in puerulus settlement suggest that recruitment to the fishery in the next few years may not continue at the recent high levels. Consequently, both the Med-RR and High-RR scenarios are regarded as credible for prediction of effects of different catches. Keeping catches at about recent levels (TACC = 160t, total catch = 192t)[7] gives predictions that spawning biomass would remain about the same under the Med-RR assumption or slowly rebuild under the High-RR scenario, and that median depletion of the spawning biomass would remain above the limit reference point under both recruitment scenarios. The stock available for harvest would decrease slightly from current levels under

[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

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

and hence

$$\begin{aligned} TACC = RCC &= TAC/1.202 \\ &= 0.832\,TAC, \text{ and} \end{aligned}$$

$$NCC + UCC = 0.168\,TAC.$$

both recruitment scenarios. These predictions are expected to be slightly pessimistic in the earlier years of the 5 year prediction period because the recruitment scenarios both assume that future recruitment will remain constant at the 2012–13 level, whereas direct observations of recruitment to the fishery indicate that it has continued to increase through to 2015-16. The predictions are expected slightly optimistic in the later years of the 5 year prediction period because the low puerulus numbers observed in the past 2-3 years will begin to enter the fishery (starting in about 2016–17) and condition the state of exploitable biomass for some years thereafter. This ambiguity highlights the need for caution in the harvest rate in the next few years and for continued close monitoring of stock condition and recruitment to the fishery.

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 0.4 for both Med-RR and High-RR scenarios.

Puerulus settlement and recruitment to the fishery have both increased on average during the past about 10 years as the spawning stock has increased. Puerulus settlement is an indicator of recruitment to the fishery about 3 years later. Settlement 3 years ago was about at the long-term average, which is somewhat lower than the levels that gave rise to the high fishery catch rates in the last few years. Puerulus settlements 1 and 2 years ago, however, both were lower than the long-term average. The lower settlement in the past 3 years is interpreted as being due to environmental effects and, on average, the recruitment is expected to increase as the spawning stock continues to increase, albeit with considerable inter-annual variations related to unknown environmental conditions. The recent lower settlement, and the expected subsequent decrease in recruitment to the fishery, can be expected to reduce the scope for maintaining both high catches and significant spawning stock rebuilding in the next few years. The extent of this impact is difficult to predict at this time, with effects likely to be observable in the next 1-3 years as the weaker year-classes recruit to the fishery. This situation requires both caution in the size of the harvest and continued close monitoring of the fishery and stock status.

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 species such as this. There is a growing need to identify desired target state for this fishery and formally set relevant targets and limits for management. Review of the upper size limit for harvest should be an element of formalising a harvest strategy but should not be considered in isolation.

The 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 Allowable Catch (TAC) 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 spawning stock levels on recruitment. The expected entry of weaker year-classes into the fishery in the next 2-3 years while the TACC is at its highest level since the introduction of the quota system is an important consideration in this conclusion.

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.

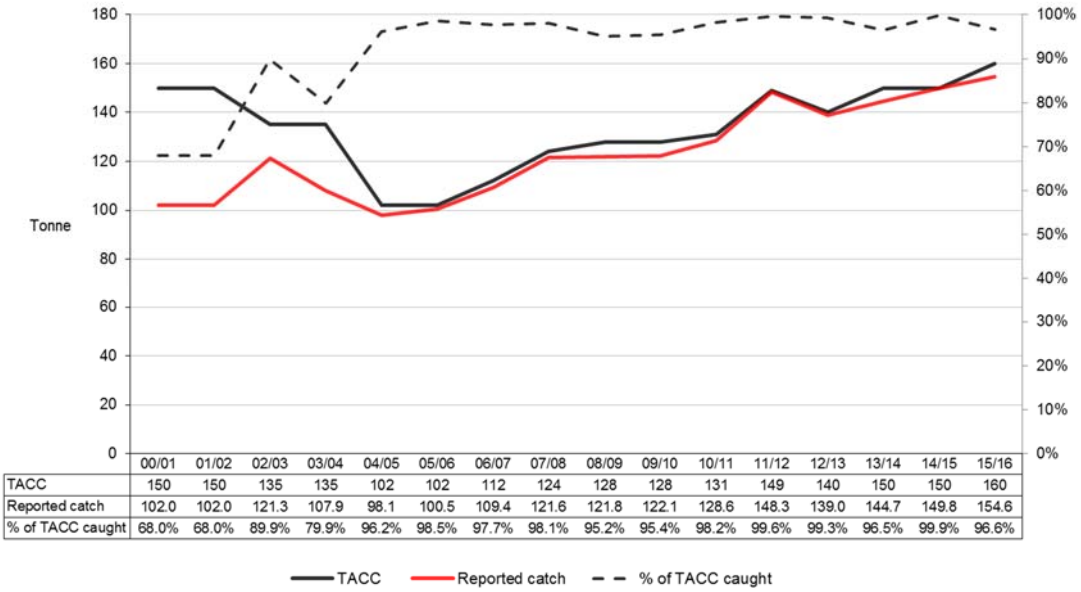
A4.2 Volume and value of production

The volume of reported catch of rock lobster from August 1 2015 to June 30 2016 was 158.9t, representing 99.3% of the TACC of 160 t (Figure A4.1). The ability of industry to catch virtually the full TACC over a number of consecutive years, with less effort than previously in the fishery, suggests that recovery of the stock continues, as is suggested elsewhere in this report.

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 has increased in both real and nominal terms since 2012–13, a result of increases in both catches and prices (see the next section).

CPI adjusted values (real values)

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.



	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16
TACC	150	150	135	135	102	102	112	124	128	128	131	149	140	150	150	160
Reported catch	102.0	102.0	121.3	107.9	98.1	100.5	109.4	121.6	121.8	122.1	128.6	148.3	139.0	144.7	149.8	154.6
% of TACC caught	68.0%	68.0%	89.9%	79.9%	96.2%	98.5%	97.7%	98.1%	95.2%	95.4%	98.2%	99.6%	99.3%	96.5%	99.9%	96.6%

Figure A4.1: Catch, TACC, and per cent of TACC caught 2000–01 to 30 June 2016.

	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16
Nominal fishery value ($m)	4.4	4.7	5.4	4.2	3.8	4.2	5.2	5.6	6.7	6.8	7.1	8.5	7.7	10.1	11.2	12.1
Real fishery value ($m)	6.5	6.8	7.5	5.7	5.1	5.4	6.5	6.8	7.8	7.8	7.9	9.3	8.1	10.5	11.4	12.1

Figure A4.2: Value of production 2000–01 to 2014–15 (Data to 30 June 2016 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 2016–17 seems likely to remain similar to that in the preceding two years given available information about the current status of the stock.

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 particularly relevant 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 2013–14 was 10,400t, of which NSW contributed 146t (1.3%).

Over 76% (by weight) of all lobsters caught Australian in 2013–14 were exported whereas only about 23% of the rock lobster catch from NSW was exported in that year, the most recent year for which data are available[8]. 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 (85%), followed by Hong Kong (12%). Anecdotal evidence suggests that Vietnam has been a staging point for re-export to China rather than a consumption market and the recent free trade agreement with China is likely to result in an increase in exports directly to Hong Kong and mainland China.

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 (including NSW) rock lobster on those markets. The AUD is forecast to remain at current levels over 2016–17 (http://www.nab.com.au/business/international-and-foreign-exchange/financial-

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

markets/exchange-rate-forecast), 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.

Most 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, howevr, 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. 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.

Price information for lobster sold through outlets other than the SFM is not publicly available. 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 be improved in the 2015–16 fishing period by using the NSW waratah logo on lobster tags, although this prospect has not been confirmed. 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.

	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16
Nominal average price per kg	$42.98	$46.33	$44.77	$38.83	$38.30	$41.30	$47.46	$45.81	$54.67	$55.49	$55.18	$57.52	$55.03	$70.02	$74.76	$75.82
Real average price per kg	$63.74	$66.61	$62.54	$52.95	$50.94	$53.42	$59.41	$55.73	$64.14	$63.79	$61.73	$62.48	$58.48	$72.43	$76.02	$75.82

Figure A4.3: Beach prices in real and nominal terms 2000–01 to 30 June 2016.

Table A4.1: Eastern rock lobster weight and average price (Sydney Fish Markets) by grade for the 2013–14 fishing period.

Sydney Fish Market Grade	Weight (kg)	Carapace length (mm)	Nominal average price ($/kg)
Extra Large	1.7 – 2.46	158 – 179	75.85
Large	1.2 – 1.7	140 – 158	73.91
Medium	0.7 – 1.2	117 – 140	70.43
Small	<0.7	104 – 117	65.20

A4.5 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 99 shareholders during the last two fishing periods (2014–5, 2015–16), with 80 reporting fishing in each year. 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 with 20–100 shares and slight increases in those holding over 100 shares. Consolidation of shareholdings appears to have stabilised in the last 3 fishing periods (Figure A4.4), with about 30 fishing businesses landing 75% of the total catch in the last 3 fishing seasons (Figure A4.5). 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.

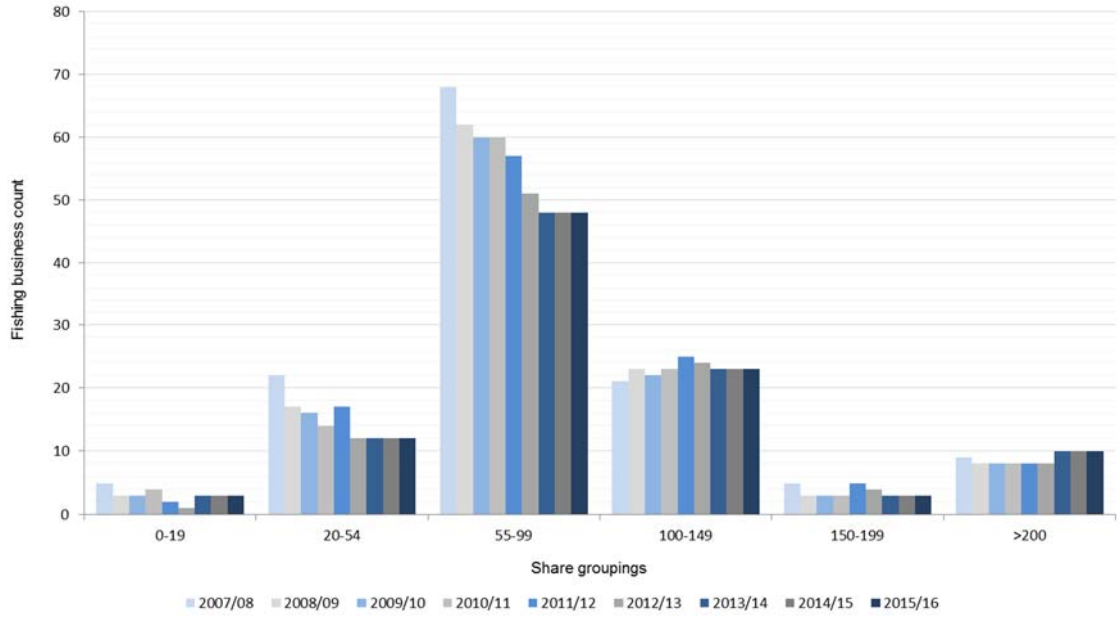


Figure A4.4: Distribution of shareholders by share grouping for the 2007–08 to 2015–16 fishing periods (2015–16 data as at 5 July 2016).

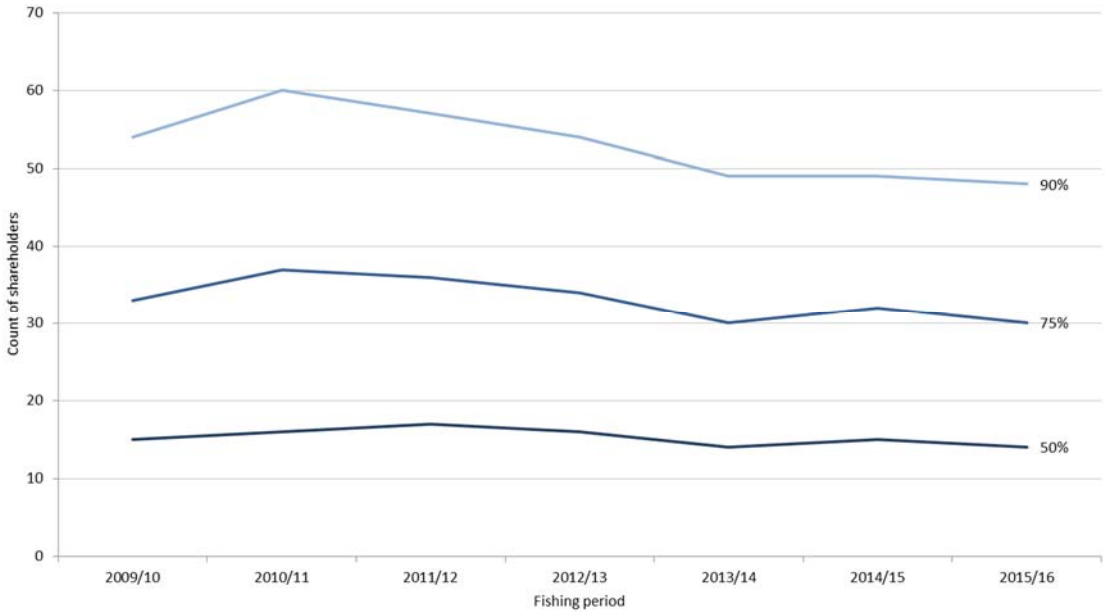


Figure A4.5: Number of shareholders catching % of TACC (2015–16 data to 18 May 2016).

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 structure for 2016 (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 resulting in the lobster quota being taken in less time and providing more opportunity for the fishers to operate in other fisheries. The implications of interactions between TACC size 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 held by lobster fishing businesses in 2014–15 (@ 07 July 2015) and 2015–16 (@ 21 June 2016)

Fishery	Fishing Business 2015	Fishing Businesses 2016
Lobster	99	99
Ocean Trawl	4	6
Ocean Trap and Line	42	47
Ocean Haul	27	39
Estuary General	31	44
Estuary Prawn Trawl	2	2

Many fishers see a diversified business structure as a way to counter environmental variability, provide income after they have caught their lobster quota, or provide income should returns

from lobster fishing fall. There are some endorsements held by fishing businesses in fisheries other than rock lobster that are not actively fished. The extent to which fishers will continue to hold endorsements in other fisheries without actively fishing them is likely to change as a result of the current structural review of the NSW fishing industry and 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 of past and future management decisions across fisheries on those businesses. Economic analysis also will help the Committee to understand better the impact of its determinations on the economic viability of lobster fishing businesses. The Committee's recommendations on the types of analysis that could be done are discussed further in Section A4.8.

A4.6 Fisher net income

Lack of information about changes in fishing costs over the last few years means it is difficult to ascertain the extent to which increases in gross revenue from lobster fishing have resulted in higher net incomes. The recent large jump in share prices (Section A4.7) suggests a positive outlook for future profitability of the fishery and an increase in current net returns from fishing. It is reasonable to assume that net incomes have risen as a result of higher gross incomes but it remains unclear how costs have changed, if at all, and by how much net income has changed.

It would be helpful to have structured information on the costs of fishing to understand better the impact of changes in costs on the economic performance of the NSW lobster fishery (Section A4.8). Such information will become essential if a future harvest strategy is to be framed around specific economic, as well as biological, objectives and targets.

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.

Available information about prices of quota transfers indicates that quota transfer prices have been gradually increasing since 2009–10 after having fallen for the previous two fishing periods (Table A4.3). The increase from 2014–15 to 2015–16 is substantial (25.8%). The reason for this unusual acceleration is not clear but it is possibly a result of increased demand for additional quota as existing quota is landed earlier in the fishing period.

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, and more than doubled between 2013–14 and 2015–16 (Figure A4.7). 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 A4.6) 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.

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 05 July 2016.

Fishing period	Quota transferred (t)	Quota transferors (out)	Quota transferees (in)	% total TACC transferred	Nominal weighted average transfer price ($/kg)	Real average transfer price ($/kg)
2000–01	17	31	29	11%		
2001–02	30.6	40	24	20%		
2002–03	44	77	60	33%		
2003–04	29.3	56	41	22%	$7.17	$9.78
2004–05	34.5	68	47	34%	$10.89	$14.48
2005–06	30.1	64	45	30%	$13.15	$17.01
2006–07	35.6	59	23	32%	$15.64	$19.58
2007–08	42.3	60	32	34%	$17.90	$21.78
2008–09	42.2	48	36	33%	$15.90	$18.65
2009–10	39.3	52	43	31%	$14.76	$16.97
2010–11	36.3	48	41	28%	$17.00	$19.02
2011–12	48	51	45	32%	$17.69	$19.21
2012–13	48.9	49	36	35%	$19.61	$20.84
2013–14	44.8	55	34	30%	$20.68	$21.39
2014–15	45.8	49	38	31%	$21.67	$22.04
2015–16	45	45	31	28%	$27.72	$27.72

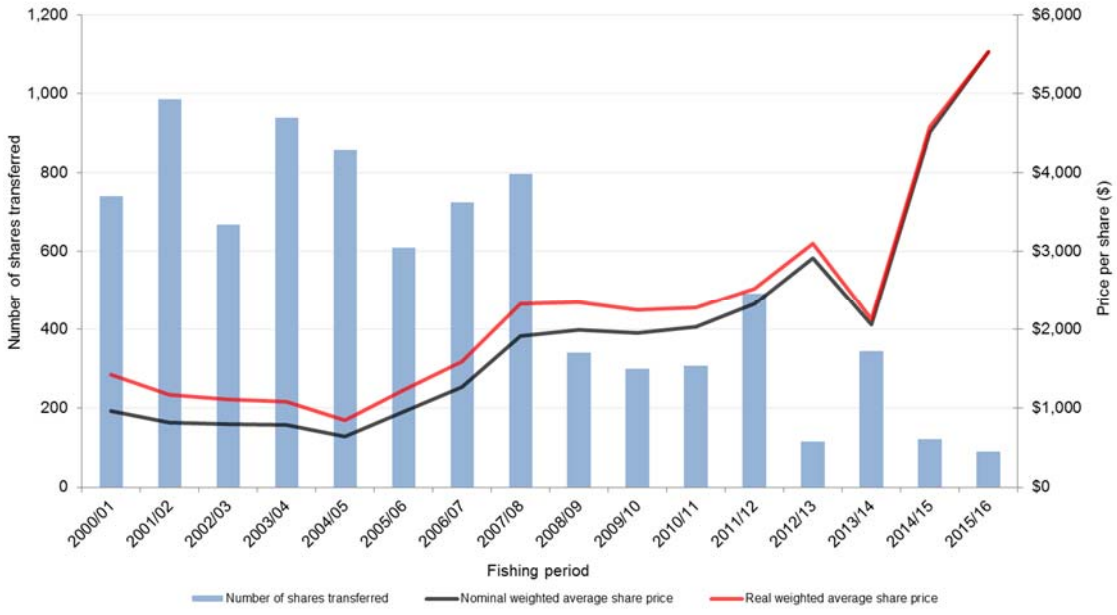


Figure A4.6: Number of shares transferred, estimated share price, and CPI adjusted (real) share price by fishing period from 2000–01 to 06 July 2016.

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, as well as 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.* (2013a, 2013b)[9].

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

Pascoe, S., Hutton, T., van Putten, I., Dennis, D., Skewes, T., Plagányi, É. and Deng, R. (2013b). DEA-based predictors for estimating fleet size changes when modelling the introduction of rights-based management, *European Journal of Operational Research* 230, 681-687.

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 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 (as outlined in 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.

The community contribution charge in the NSW commercial lobster fishery was based on a decision by the NSW Government to return part of the economic rent being earned by lobster fishers to society. It was designed on the basis that there is potential for economic rent[10] 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 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.

The Committee suggests that fishers remain cautious about overinvestment, however, and take into account potential impacts of future events such as changes in recruitment, market demand, or future management arrangements (e.g. increases in cost recovery).

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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[10] 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 for the fishery is to minimise the number of offences that occur in the fishery. The SMP specifies a trigger of 70% compliance rate.

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 approach should lead to a higher rates of detections, making it difficult to draw conclusions 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

Year	Compliance effort commercial (hours)	Compliance effort recreational (hours)	Total patrol hours	Estimated % of effort targeted
2012–13	1722	2959	4681	30%
2013–14	2269	3160	5429	57%
2014–15	1811	3340	5151	38%
2015-16 (8 months)	638	1896	2543	33%

In addition to the 70% trigger in the SMP, the FMS also specifies triggers of 10% & 20% non-compliance for serious & minor offences respectively:

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 in relation to numbers of inspections and offences detected for 2014–15 and 2015–16 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 (8 months)	492	49	15 offences by 13 fishers; *9 cautions, 6 infringements*	1888	300	59 offences by 38 fishers; *39 cautions, 15 infringements, 5 prosecutions*

These performance measures, as with compliance rate, can be difficult to interpret in the context of improved targeting of effort. The figures in table A5.2 do not translate neatly into percentage of inspections leading to offences, for example, but they do indicate that 28% of commercial fisher inspections detected some type of offence in both 2014–15 and 2015–16 but that these were overwhelmingly minor (25%). Similarly, 18-20% of inspections detected some type of offence in the recreational sector, the majority being minor (80-90%).

The Committee is satisfied, based on the totality of the compliance report, that overall compliance is stable in recent years and improving in the long term, despite the trigger points specified in the FMS.

Information provided to the Committee and discussion at the public forum satisfied the Committee that the level of offending detected in the commercial sector over the previous two complete fishing periods reflects well on the compliance regime and does not represent a breakdown of compliance in the sector. The majority of industry represented at the public forum, and particularly through the Industry Working Group, have a position that the strongest penalties possible should be applied in these cases, indicating strong industry support for enforcement of the fishery rules. Loss of demerit points and forfeiture of shares represent the biggest deterrent for commercial operators and both penalties were endorsed by the Working Group as appropriate for serious fishery offences.

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 also 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. One of the triggers legislated in the SMP (Table A5.3) was exceeded during the 2015–16 fishing period, specifically the increase in management charges exceeded the CPI for the period. This matter was discussed at length in the Department management report to the Committee and at the TACC Committee Open Forum and was considered to be reasonable, given that the percentage of fishery GVP represented by nominal management charges continues to decline (4.2% for 2015–16) and the absolute amount paid remains below the amounts paid in 10 of the last 18 years (see A5.4.3 below).

Table A5.3: Breakdown of compliance effort and resulting inspections and detections.

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
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

A core objective in terms of TACC setting is that biomass is maintained above 25% of pre-exploitation levels. Current exploitation rates are estimated to leave the stock comfortably above that trigger point.

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 the 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. The Committee and industry members had a good discussion about the benefits of specifying economic objectives and building a framework for meeting those objectives within an agreed timeframe as such a framework (or its absence) will affect materially how future TACCs are set. The Committee, industry, and government up until now have been focussed on rebuilding lobster biomass, understandably. The Committee stated last year that it strongly believes that the now secure biological status of the fishery provides the opportunity to consider more specific economic objectives. This year's consideration of the TACC has affirmed that the fishery is at the point of needing a more sophisticated harvest strategy to guide TACC-setting in line with specific objectives and targets.

A5.3.2 Quota trading

The Committee supports the full implementation of the web-based FishOnline/Fisher Direct program, which will assist by having all quota for lease or sale accessible in one place and provide an open and transparent market for leasing and transferring quota. This initiative is in line with previous Committee recommendations and should prove useful for increasing industry returns since online transfers will not incur a transaction charge.

The Department reports that full implementation of the FishOnline self-service system (Fisher Direct component) is still dependent on legislative amendment which is being progressed through the Fisheries Management Amendment Bill 2014. The Department continues to build industry capacity in use of external components of the FishOnline system as circumstances allow and has expanded the initial pilot group using the system.

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	38.3	3.80	58.60	15.5
2005–06	102	100.5	41.3	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	154.6	75.82	12.13*	54.62	4.2*

* Estimated values assuming that the 160t TACC is taken at the average price to date
# Expected commencement of full cost recovery

A5.3.4 Industry Consultation

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 fishing sectors became more engaged with this process.

The Lobster Industry Working Group is established and is actively engaged in managing the fishery. The fact that industry generally continues to support a precautionary approach to the TACC reflects well on the maturity of the group and the process. It is noted, however, that this is still an evolving process and that the fishery management arrangements are still developing. 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 of the fishery (research, management, compliance) and would benefit greatly from a framework for assessing how and when to invest in specific elements of management. Developing a harvest strategy should be a core component of such a framework and industry is urged to drive that processes.

APPENDIX 6. BACKGROUND INFORMATION

A6.1 The stock

The Eastern rock lobster (Sagmariasus *verreauxi,* formerly *Jasus verreauxi*) is the main lobster species found off the NSW coast, although small numbers of southern rock lobster (*Jasus edwardsii)* and painted rock lobster (*Panulirus ornatus, Panulirus longipes*) also occur. Eastern rock lobsters occur in depths of 1–200m around much of south eastern Australia, including northern Tasmania, and New Zealand.

Easter rock lobster reach maturity at carapace lengths of 140–180mm and can reproduce over many years subsequently. Spawning off NSW occurs only in deeper waters off the north coast following migrations of maturing lobsters northwards and off-shore. An approximately 9 month larval phase follows spawning with settlement of post-larval (puerulus) lobsters occurring subsequently mainly in shallow waters, predominantly off southern NSW. Juvenile lobsters reach legally harvestable size approximately 2-3 years after settlement and migrate northwards toward the spawning grounds as they mature.

A6.2 The Fishery

Rock lobsters have been harvested commercially in New South Wales since the 1800s and long before that by local Aborigines. The fishery is based almost exclusively on the Eastern rock lobster (Sagmariasus *verreauxi,* formerly *Jasus verreauxi*). Occasional landings of southern rock lobster and painted rock lobster occur but these amount to less than 1% of the catch.

A6.2.1 Commercial fishing

Management of the commercial fishery for eastern rock lobster has particular challenges compared to other Australian lobster fisheries because the larger, mature lobsters that make up the breeding stock of the fishery are found only in the north of the state. Smaller immature lobsters that have yet to breed are harvested throughout the state but catches of those lobsters are greatest in central and southern waters.

The fishery is managed through a system of individual transferable shares and quotas, complemented with licencing provisions, minimum and maximum size limits for harvest, prohibition on taking berried females, and gear controls. The maximum size for harvestable lobsters was reduced in 2004 from 200 to 180 mm to enhance rebuilding and protection of adult spawning stock protection. The minimum size limit was reviewed in 2005 and held at 104mm.

Licensed fishers hold shares in the fishery and are allocated a portion of a Total Allowable Commercial Catch (TACC), their quota, in proportion to their shareholding. This quota (i.e. kilograms of allowable catch) is transferable among shareholders temporarily within each fishing year but permanent transfers require sale of shares, with the associated quota. The ability to trade quota within fishing years allows fishers to adjust their catch based on performance during the year whilst the permanent transfer of shares allows existing shareholders to adjust the longer-tem structure of their operations.

The *Fisheries Management (Lobster Share Management Plan) Regulation 2000* originally stipulated that shares could be traded in packages of 10 or other sizes as approved. Quota can be transferred, effectively in any amounts, only within the current fishing period and transfers cannot be carried-over between fishing periods. Shareholders may not acquire, by any such transfer, more than twice the amount of the shareholder's initial quota for the fishing period. Current management arrangements for the lobster fishery limit individual entities (fishers or businesses) to owning no more than 350 shares, though it is possible for a person to hold shares both as an individual and by virtue of their interest in a separate business. Minimum quota holdings also apply: 55 shares must be held before a shareholder is eligible for an endorsement to fish, although shareholders who held less than 55 shares at the time the quota system was introduced are also eligible.

The total number of shareholders in the fishery has contracted over the past fifteen years from 174 shareholders in 2000–01 down to 99 in 2014–15 and 2015-16. Similarly, the proportion of shareholders that hold less than the minimum shareholding (55) has reduced drastically since the introduction of quota, reflecting a general trend of share reallocation from small (<55) to large (>100) shareholdings. Concerns expressed previously about the incapacity of the

commercial sector to take all of the allocated TACC are now redundant, with annual landings above 95% of the TACC for more than ten years. 50% of the reported catch has been landed each year since 2012–13 by around 15 fishing businesses and 75% of the annual catch since 2013–14 has been landed by about 30 fishing businesses. This consolidation is consistent with the management objectives for the fishery.

The NSW commercial fishery for rock lobster is small by comparison to similar fisheries in other States. Other lobster fisheries depend strongly on export markets but the NSW fishery has an established market within the State and has exported only small quantities historically, although this is changing with approximately 30% being exported in 2014–15, mainly to Vietnam.

Eastern rock lobsters clearly are sought-after by local consumers, particularly by the Chinese community, and attract relatively high prices and strong demand domestically. The relative lack of volatility enjoyed by domestic fisheries compared to mainly export fisheries is a strength for the fishery and likely to temper growth of the exports from the fishery compared to domestic sales.

A6.2.2 Recreational fishing

There are about one million people in New South Wales who partake in some form of recreational fishing. A licence is required, although exemptions exist for many sectors of the community, such as children and retirees. The recreational sector pays approximately $12,000,000 in licence fees. Recreational fishing for rock lobster is restricted to the use of a single pot used in waters less than ten metres or taking by hand whilst free-diving without any assistance from scuba or hookah equipment. No aids such as hooks or sticks are allowed to be used. A daily bag and total possession limit of two lobsters applies and recreational fishers are subject to the same minimum and maximum size restrictions as the commercial sector.

Estimating the number of people who target rock lobsters and how many lobsters they catch is the subject of regular and ongoing discussion, with existing estimates having very low precision. The 2000–01 National Recreational and Indigenous Fishing Survey (NRIFS) and the 2013–14 NSW and ACT recreational fishing survey provide the only state-wide estimates of recreational effort and catch for both freshwater and saltwater fisheries in NSW but neither provides robust estimates of lobster harvest.

Anecdotal information suggests that the use of recreational pots is contracting and recreational diving for lobsters is becoming more popular. Some observers speculate that recreational fishing for lobsters might increase as rock lobster stocks improve and labsters become easier to catch by free-divers or in recreational pots. There is no quantitative evidence available to support or refute that contention.

An estimate for recreational catch of 10% of the total commercial catch is used for stock assessment for the lobster fishery, which translated to 10–17.5t per year over the last 10 fishing periods. Updated and regular, robust measures of recreational harvest are required urgently.

A6.2.3 Aboriginal fishing

Aboriginal peoples' connection to fisheries resources was formally recognised in fisheries legislation in 2010 through the introduction, by amendment, of a new object to the *Fisheries Management Act 1994* (the Act). Aboriginal cultural fishing is now also articulated in the Act as distinct from recreational and commercial fishing.

Section 21AA was inserted into the Act at the same time but has not commenced. That section provides regulation-making powers that allow limits, including bag and possession limits or other management options, to be applied to the special cultural fishing provisions. The regulations that may be made under section 21AA cannot be made without consulting the Aboriginal Fishing Advisory Council (AFAC). Consultation the with AFAC and a broader cross sector working group has commenced to develop proposals to balance sustainability with the needs of Aboriginal people, recreational fishers, and the commercial industry.

An interim compliance policy is in place to capture the spirit of this yet-to-be-commenced provision of the Act. The current interim compliance policy allows an Aboriginal person to take double that of the prescribed recreational bag or possession limit (other than for abalone, for which the extended limit is 10 animals) to provide for cultural needs where elders, the incapacitated, or other community members are unable to fish for themselves. The

arrangements apply by increasing an individual fisher's limit – it is not an accumulated limit related to the number of people for who the fish are being provided. The interim arrangements also allow for shucking of abalone, rock lobster, and turban shell within 100 metres of the high water mark but only if the animals are consumed in that area.

The policy applies to cultural fishing in State waters, including appropriate zones of the NSW marine parks. All other fishing activity and possession of fish or fishing gear must comply with the current fisheries legislation.

An application for an Aboriginal cultural fishing authority under section 37(1)(c1) of the Act also can be made if Aboriginal people wish to access fisheries resources for larger cultural events where the amended daily bag and possession limits would be exceeded. Section 37 permits provide defences against some aspects of the fisheries laws, subject to conditions. Only 3, 4, and 2 cultural permits were sought and issued respectively in 2012–13, 2013–14, and 2014–15 fishing periods. Fisheries Officers reported that the actual take under these permits was less than the maximum permitted.

A6.3 Marine Parks

Marine sanctuary zones make up less than 7% of NSW state waters and cover a range of estuarine and marine habitats including those with mud, sand, and rocky substrata. Well under half the area of sanctuary zone would include habitat suitable for rock lobsters and these areas would cover a range of depths from the intertidal to around 80 metres.

All five coastal marine parks include sanctuary zones over reef area likely to provide habitat for rock lobsters. Lobster shares were purchased by government in amounts estimated to be proportional to catch from grounds lost to the fishery in four of these parks (507 shares in total). The TACC and management charges for commercial shareholders were adjusted accordingly.

The existence of sanctuary zones raises two primary considerations for the rock lobster stock and fishery management:

1) The extent to which these areas reduce fishing mortality by an amount that allows juveniles to survive and migrate to make an appreciable contribution to the adult spawning stock; and
2) The degree to which any spawning biomass protected from fishing mortality within sanctuary zones makes a significant contribution to recruitment.

Evidence from a range of published studies indicates that there would be an increase in the number and size of lobsters in sanctuary zones, though those increases might decline over time due to the effects of intraspecific competition and foraging and migration into fished areas surrounding reserves. It is expected that juvenile rock lobsters settling in sanctuary zones will benefit from protection from fishing for a period but would then enter the fishery as they reached sexual maturity, foraged more widely, and moved into deeper water for spawning.

It is unlikely that current marine sanctuary zones have significant influences on stock assessments and TACC setting processes for rock lobster, given the relatively small size of the sanctuary zones, the small percentage of them in depths preferred by adult rock lobsters (generally 10 to 150m), and the migratory nature of rock lobsters.

A6.4 EPBC Act Assessment of the NSW Rock Lobster fishery

The NSW Department of Primary Industries in January 2012 provided an application to the Department of Sustainability, Environment, Water, Population and Communities for EPBC Act assessment, seeking continued export approval for the NSW Lobster fishery. The application was assessed for the purposes of the protected species provisions of Part 13 and the wildlife trade provisions of Part 13A of the EPBC Act and approved until 30 March 2017. Important factors taken into consideration were management arrangements and precautionary measures currently in place for the fishery, including annually reviewed total allowable catch limits, limited entry, mandatory tagging of commercially harvested lobsters, recreational bag limits, minimum and maximum size limits, prohibition on the take of berried females, area closures, and gear restrictions.