# ECONOMIC AND SOCIAL ASSESSMENT OF TASMANIAN FISHERIES 2016/17

Emily Ogier, Caleb Gardner, Klaas Hartmann, Eriko Hoshino, Rafael Leon, Jeremy Lyle, Craig Mundy

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**Errata statement**

Please note the following error in data reported Table 2. C (page 61):
Catch volumes (tonnes) for Rock Lobster in 2014, 2015 and 2016 should have been reported as 1056, 1057 and 1067 respectively. Data in this table has been corrected.

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Institute for Marine and Antarctic Studies, University of Tasmania, Private Bag 49, Hobart TAS 7001

Enquires should be directed to:
Dr Emily Ogier
Institute for Marine and Antarctic Studies
University of Tasmania
Private Bag 49, Hobart, Tasmania 7001, Australia
Email address
Ph. (03) 6226 8225
Fax (03) 6227 8035

# Contents

# EXECUTIVE SUMMARY

This report provides an assessment of Tasmanian fisheries using a range of indicators of economic and social performance. The findings are based on a range of assessment and research activities undertaken by the Institute for Marine and Antarctic Studies (IMAS) of the University of Tasmania.

This is the first attempt to assess the economic and social performance of Tasmanian fisheries. One purpose of this report was to identify areas that could be improved with further research and many possible refinements are noted throughout.

***Assessing social and economic performance***

Achieving economic and social benefits from marine resources is an objective of fisheries management in Tasmania, as outlined in The *Living Marine Resources Management Act 1995* (hereafter referred to as Act). Management of fisheries is required to consider community-wellbeing (that is, make provisions for economic, social, and equity considerations) under the National Strategy for Ecologically Sustainable Development (1991), as endorsed by the Tasmanian Government.

In Tasmania, stock assessments of wild fisheries are conducted by IMAS. While these assessment reports have been useful to track biological performance of the stocks, information regarding economic and social aspects of the fisheries is limited. The application of modern harvest strategies require defining the objectives for the fishery (which include economic and social outcomes for the community in this case), relevant performance indicators for the objectives, and reference points for these indicators. These steps are required for the fishery to be managed towards objectives within a harvest strategy.

***Scope of assessment***

This report presents an analysis of trends and changes in a range of indicators of different types of economic and social performance. There was no attempt to develop or propose reference points at this stage although these are generally developed for harvest strategies. The indicators were chosen to be relevant to managing fleet-wide and community outcomes from these fisheries with no attempt to examine profitability of firms. For example, changes in lending rates is relevant to profitability of individual operators but not economic performance of the fishery.

This assessment includes the Tasmanian Abalone, Commercial Dive, Giant Crab, Rock Lobster, Scalefish and Scallop fisheries. Not all fisheries are assessed using all performance indicators, due to data availability. Fisheries not assessed are Small Bivalve and Octopus, based on lack of available data. Inclusion of all Tasmanian fisheries and greater coverage of the recommended performance indicators will be attempted in future assessments. This assessment covers commercial, recreational and Indigenous fishing activity for these fisheries.

Indicators were selected on the basis of the availability of existing data over relevant time periods, including from the introduction of changes in management instruments, such as the implementation of Individual Transferable Quota (ITQ) systems. Economic performance of resource industries is often described in terms of Gross Value of Product or GVP, which is not useful or relevant in the case of most Tasmanian wild fisheries. This is because all of the larger fisheries are managed with individual quota systems which are used to reduce catch and GVP with the objective of increasing economic yield.

***Major findings***

Economic and social performance indicators directly relevant to the fishery objectives were identified and are reported. These can be tracked at low cost as they rely either on existing data collected by DPIPWE (such as number of operators) or information revealed by markets (such as quota lease price). This conclusion is important as there is often a perception that reporting of economic and social data involves high cost surveys.

The assessment has found that a range of benefits is generated by the Tasmanian fisheries assessed, including economic yield, employment and recreational amenity (Table 1). The level at which these benefits are generated, and the beneficiaries themselves, have changed over the time period assessed for all fisheries and types of participants (commercial, recreational and Indigenous).

On the basis of this assessment, economic and social data is being collated and managed as a standard part of IMAS fisheries assessment procedures. Areas warranting further research were also identified (Table 3).

**Table 1.** Performance of Tasmanian fisheries against selected economic and social indicators

| COMMERCIAL FISHERIES | Economic yield performance indicators | Factors affecting economic performance | Community benefit: Economic indicators | Community benefit: Social indicators |
|---|---|---|---|---|
| **ABALONE** | Economic yield $63 million and steady<br>Quota market capitalisation (economic "size") $875 million and increasing | Beach price increasing<br>Efficiency of production (EY/GVP ratio) extremely high and steady (rent 76% of revenue) | Royalty $4 million, 7% of the total economic yield, and decreasing<br>No indication of quota market concentration<br>Export of rent with 29% quota investors residing outside Tasmania and increasing<br>30% value-adding | Employed 170 people in 2016<br>Diver numbers declined 14% from 2009 to 2016<br>Proportion of divers who are owner-operators declined<br>Approx. 1% product consumed in Tasmania |
| **COMMERCIAL DIVE** | License market capitalisation (economic "size") $2.8 million and increasing | Beach price increasing | Economic yield fully private ($0 million public)<br>No data on proportion of rent that flows outside Tasmania. | Employed 55 people in 2016 |
| **GIANT CRAB** | Quota market capitalisation (economic "size") $52 million | Beach price increasing | Economic yield fully private ($0 million public)<br>No data on proportion of economic yield that flows outside Tasmania. | Employed 16 people in 2016<br>100% of product sold to interstate markets |
| **ROCK LOBSTER** | Economic yield $47 million and steady<br>Quota market capitalisation (economic "size") $630 million and increasing | Beach price increasing<br>Efficiency of production (EY/GVP ratio)steady, though highly variable (rent 50% of revenue) | Economic yield fully private ($0 million public rent) | Employed 383 people in 2016<br>Active vessels numbers declined 14% from 2014 to 2016 |

| COMMERCIAL FISHERIES | Economic yield performance indicators | Factors affecting economic performance | Community benefit: Economic indicators | Community benefit: Social indicators |
|---|---|---|---|---|
| | | | No indication of quota market concentration Dissipation of yield with 23% quota investors residing outside Tasmania and increasing<br>15% value-adding | Proportion of fishers who are owner-operators declining<br>Approx. 13% product consumed in Tasmania |
| **SCALEFISH** | License market capitalisation (economic "size") of the Wrasse sub-sector $5.3 million<br>Overall, high level of inactivated licenses indicates economic yield is near zero. | Beach price for Wrasse and Striped Trumpeter steady or declining, when adjusted for inflation | No economic yield for distribution either privately or to the public | Employed 90 people in 2016<br>Product available for local consumption, although catch volumes declining |
| **SCALLOP** | Economic yield $0<br>Quota market capitalisation (economic "size") $0 million | Beach price low but steady | High level of value adding, though % not available<br>Data for other indicators unavailable | Employment 30 people in 2016<br>Majority of product available for local consumption, although catch volumes variable |

| RECREATIONAL AND TASMANIAN ABORIGINAL FISHERIES | Social benefit indicators |
|---|---|
| **RECREATIONAL FISHERIES (ABALONE)** | Participation in recreational fishing for Abalone declining<br>Quality of fishing (based on levels of individual harvest per dive) remained steady |
| **RECREATIONAL FISHERIES (ROCK LOBSTER)** | Participation in recreational fishing for rock lobster steady<br>Quality of fishing (based on annual individual harvest levels) increased |
| **RECREATIONAL FISHERIES (ALL / OTHER)** | Participation in recreational fishing (all types) declining |
| **TASMANIAN ABORIGINAL COMMUNITY** | Tasmanian Aboriginal access for customary purposes<br>Catchability of traditionally-harvested inshore fish stocks declined |

**Table 2.** Recommended future research

| Economic Yield | Economic Yield factors | Community Benefit: Economic | Community Benefit: Social | Other Social Performance |
|---|---|---|---|---|
| Refine data on costs of production and use to calculate economic yield (A, RL, SC)<br><br>More detailed assessment of market value of quota units over time (GC, SC)<br><br>Market value of licenses (O, SF)<br><br>Liquidity of general licenses (A and B) and species/gear licenses (SF) | Obtain real-time beach price data (RL)<br><br>Determine price elasticity of supply (A, RL) | Measurement and reporting of government costs for management (A, RL)<br><br>Refine the data on public yield from Royalty fee (A)<br><br>Refine the data on residency location of quota unit owners (A, RL)<br><br>Level of re-investment of private yield in Tasmanian economy (A, RL)<br><br>More detailed assessment of contribution to the Tasmanian economic through local value-adding and associated employment (SC, CD) | Better understanding the overall effect of Tasmania's fisheries on state employment (A, CD, GC, O, RL, SF)<br><br>Assess the size of any local consumer surplus from being able to access Tasmanian seafood (A, RL)<br><br>Assess the effect of price flexibility (the percentage change in the price of a product due to 1% change in quantity supplied) on the transfer of benefits from consumer to producers (A, RL) | Quantitatively assess recreational fishing quality by obtaining measures of utility through survey techniques (Rec)<br><br>Explore options for capturing and reporting catch and effort data, and reporting on cultural benefits, with Tasmanian Aboriginal Community organisations (Indigenous) |

# 1. INTRODUCTION

This report presents an analysis of trends and changes in a range of indicators of different types of social and economic performance. There was no attempt to develop or propose reference points at this stage although these are generally developed for harvest strategies. The indicators were chosen to be relevant to managing fleet-wide and community outcomes from these fisheries with no attempt to examine profitability at the level of the firm.

This assessment includes the Tasmanian Abalone, Commercial Dive, Giant Crab, Rock Lobster, Scalefish and Scallop fisheries. Not all fisheries are assessed using all performance indicators, due to data availability. Fisheries not assessed are Small Bivalve and Octopus, based on lack of available data. Inclusion of all Tasmanian fisheries and greater coverage of the recommended performance indicators will be attempted in future assessments. This assessment covers commercial, recreational and Indigenous community fishing activity for these fisheries.

Indicators were selected on the basis of the availability of existing data over relevant time periods, including from the introduction of changes in management instruments, such as the implementation of Individual Transferable Quota (ITQ) systems.

## 1.1. Overview of Tasmania's fisheries

***Commercial fisheries***

### Abalone

The target species are Blacklip Abalone (*Haliotis rubra*) and, to a lesser extent, Greenlip Abalone (H*aliotis laevigata*). Belonging to the family of molluscs, abalone are large marine snails or gastropods with a hard ear-shaped shell and a muscular foot. They inhabit Australia's rocky shorelines, from shallow water up to depths of 40, or sometimes 50 metres. Tasmania's commercial abalone fishery is the largest wild abalone fishery in the world, providing around 25% of the annual harvest. This commercial dive fishery is a managed using an Individual Transferable Quota system, which entails limiting entry, as well as using size limits, setting a total annual commercial catch as well as catch caps for each zone, spatial management arrangements and other operational rules that govern the commercial harvest of abalone in Tasmania (Mundy and Jones 2017).

### Commercial Dive

A number of different species are collected by the commercial dive fishery; the major species being sea urchin (*Heliocidaris erythrogramma* and, increasingly, *Centrostephanus rogersii*) and periwinkles (*Lunella undulata*). The commercial dive fishery also provides access to some developing fisheries such as clams and other fisheries based on exotic species, notably introduced Pacific oysters and the Japanese kelp (*Undaria pinnatifida*, or Wakame). Sea urchins and most other target species are harvested by divers using surface supply compressed air hookah gear operated mainly out of small boats.

### Giant Crab

The Giant Crab (*Pseudocarcinus gigas*) fishery is a comparatively small fishery with annual harvest set at 46.6 tonnes, but is of relatively high value, with the landed valued estimated to be around $2 million. The Tasmanian Giant Crab fishery is managed by limited entry, setting a total annual commercial catch and by an individual transferable quota management system. This regime is supplemented by size limits, gear restrictions and seasonal closures (Emery, Hartmann et al. 2014). The permitted gear types are pot (or trap) for the commercial fishery.

### Scalefish
The Tasmanian scalefish fishery is a multi-gear and multi-species fishery. The main gear types include gillnet, hooks and seine nets, harvesting a diverse range of scalefish, shark and cephalopod (for example, octopus and calamari) species. The Tasmanian commercial scalefish fishery is managed using a limited entry licensing system. Catch and effort are also controlled through closed seasons and gear restrictions. Output controls such as size limits and trip limits are also used, and recently a quota management system was introduced to manage the commercial take of banded morwong from the east coast. Only a small proportion of the fleet has specialised in a single activity or targeting a primary species (Ziegler 2012). For many commercial operators, scalefish represent an adjunct to other activities, for instance rock lobster fishing. Other fishing gears in use include traps, Danish seine, dip nets and spears (Moore, Lyle et al. 2018).

### Scallop
The Tasmanian Scallop Fishery is primarily based on the harvest of the commercial scallop (*Pecten fumatus*). Although commercial fishers can legally take the doughboy scallop and the queen scallop, these species have only minor commercial significance in Tasmania. Commercial fishing for scallops in Tasmania is done solely by dredging. The gear is typically deployed on the shelf in water deeper than 20 metres where the best scallop beds tend to occur. The limited entry fishery is managed by a combination of input controls (including spatial management and seasonal closures) and outputs controls (including a Individual Transferable Quota management system and total allowable annual catch). Pre-season surveys are carried out to determine which areas meet pre-determined criteria and can be opened for scallop fishing. The market for commercial harvested scallops is largely domestic.

### Rock Lobster
The target species is the Southern Rock Lobster (*Jasus edwardsii)*. Commonly known in Tasmania as crayfish, the rock lobster lives in a variety of habitats ranging from shallow rocky inshore pools out to the continental shelf. The Tasmanian commercial rock lobster fishery is managed by limited entry, setting a total annual commercial catch and by an Individual Transferable Quota management system. This regime is supplemented by size limits, gear restrictions and seasonal closures (Gardner, Hartmann et al. 2012). The permitted commercial gear types are pot (or trap).

## ***Recreational fisheries***

### Abalone
Recreational diving for abalone requires a recreational abalone license. The recreational fishery is managed using size limits, bag and possession limits and other spatial management arrangements.

### Rock Lobster and Crab
The recreational rock lobster fishery is managed by gear, area and seasonal restrictions, as well as size, bag and possession limits. The permitted gear types are pot (or trap) and dive for the recreational and traditional fisheries. A licence to take rock lobster recreationally by pot or by hook (dive) is required. This licence includes fishing for Giant Crab also.

### Scallop
The recreational scallop fishery targets commercial and doughboy scallops and is managed by gear, area and seasonal restrictions, as well as size, bag and possession limits. Recreational diving for scallops requires a recreational scallop licence. Scallops may only be taken by hand. The D'Entrecasteaux Channel, which historically accounts for 95% of the recreational fishery, is managed as a separate scallop fishing area to other state waters.

### Scalefish
The large and varied recreational scalefish fishery is managed using area, gear, size and possession limits which vary by species. A recreational fishing license is not required.

### ***Tasmanian Aboriginal fisheries***

Traditional Aboriginal fishing practices are protected under the *Native Title Act 1993.* The *LMRMA 1995* provides for Indigenous (Aboriginal) activities, including non-commercial fishing, the taking of prescribed fish for the manufacture of artefacts for sale and by the issuing of permits and exemptions. People engaging in Aboriginal activities associated with fish and fishing must be able to prove that they are Aboriginal and that their fishing is an Aboriginal activity. The Act exempts Aboriginal non-commercial fishers from requirements to hold a sea fishing licence but requires that they must comply with all other fisheries rules, including bag and possession limits, size restrictions and seasons.

## 1.2 Policy and management context

### ***Legislative and Management Objectives***

Management arrangements for Tasmania's fisheries are required to have regard for the need to "take account of the community's interests in living marine resources" (Objective (d) of the *Living Marine Resources Management Act 1995)*. More specifically, Section 7 and Schedule 1 of the Act states that the objectives of the resource management and planning system of Tasmania are:

a) to promote the sustainable development of natural and physical resources and the maintenance of ecological processes and genetic diversity; and
b) to provide for the fair, orderly and sustainable use and development of air, land and water; and
c) to encourage public involvement in resource management and planning; and
d) to facilitate economic development in accordance with the objectives set out in paragraphs (a), (b) and (c).

In addition to these objectives, management plans for individual fisheries set out specific objectives that refer to economic and social benefits (Table 3). The Tasmanian Abalone Fishery Revised Policy Paper (DPIWE 2000), for example, sets out eight objectives, of which two directly address economics and social objectives. Similarly, the Rock Lobster Fishery Policy Document (DPIF 1997) contains eight objectives, of which five can be considered economic and social objectives (Table 3).

## 1.3 Assessing performance

### ***Selecting indicators***

Numerous possible social, economic and socioeconomic indicators for fisheries have been proposed (Triantafillos, Brooks et al. 2014, Anderson, Anderson et al. 2015). While the importance of social and economic objectives is widely acknowledged, economic and social performance reporting from most jurisdictions has been either limited or absent, and there is increasing interest in developing basic frameworks for the collection and reporting of fisheries economic data (Econsearch 2015).

No social and economic performance indicators are identified in current policy documents for Tasmanian fisheries. The social and economic indicators used in the assessment (Table 3) have been recommended because reporting against them rely either on existing data or data that can be collected at almost no cost and without requiring additional expenditure on social and economic surveys. The indicators were directed to fleet-wide and community benefit from these fisheries. That is, they are not intended to be indicators of the financial profitability of firms. This is because the objectives in policy relate to fleet-wide and public benefit from these resources.

### ***Assessment methods***

A description of how indicator values were obtained is given in the description of each performance indicator and further detail in Appendix B (see Table B.1). This description includes data sources, data requirements, assumptions and calculations.

**Table 3.** Selected economic and social performance indicators, and links to current policy and management objectives for Tasmanian fisheries. Sources: DPIF (1994), DPIF (1997), DPIWE (2000), Gardner, Hartmann et al. (2012), Emery, Hartmann et al. (2014), Moore, Lyle et al. (2018)

| **Performance Indicators** | **Measures** | **Objectives and target reference points for Tasmanian Fisheries, where provided** | |
|---|---|---|---|
| | | **Legislation** | **Fishery-specific Policy (including harvest strategies)** |
| **Economic Yield** | *Economic Yield (AU$/year)*<br><br>*Market Capitalisation(AU$/year)* | LMRMA 1995:<br>(1) d) take account of the community's interests in living marine resources | ***Abalone***<br>*Sustaining yield and economic return*<br>• To take abalone at a size likely to result in the best use of the yield from the fishery.<br>• To maintain economic returns by restricting the level of catch and the number of participants in the commercial fishery.<br><br>***Commercial Dive***<br>*Sustaining Yield and Economic Returns*<br>To optimise the yield able to be gained from the fishery by requiring or encouraging appropriate fishing practices<br><br>***Rock Lobster***<br>*Sustaining yield and reducing incidental fishing mortality*<br>To take fish at a size likely to result in the best use of the yield from the fishery.<br><br>***Scalefish***<br>To optimise yield and/or value per recruit<br><br>***Scallop***<br>*Improving yield*<br>To take a fish at a size likely to result in the best use of the yield from the fishery. |
| **Economic Yield Factors** | *Beach Price (AU$/kg)*<br><br>*Efficiency of production ( ITQ-managed fisheries):*<br>• Economic yield as a percentage of total revenue (%, or EY/GVP ratio) | LMRMA 1995:<br>(1) d) take account of the community's interests in living marine resources | ***Abalone***<br>*Sustaining yield and economic return*<br>• To take abalone at a size likely to result in the best use of the yield from the fishery.<br>• To maintain economic returns by restricting the level of catch and the number of participants in the commercial fishery.<br><br>***Rock Lobster*** |

| Performance Indicators | Measures | Objectives and target reference points for Tasmanian Fisheries, where provided | |
|---|---|---|---|
| | | **Legislation** | **Fishery-specific Policy (including harvest strategies)** |
| | • Change in employment levels<br>• Change in number of active vessels in the fleet | Schedule 1 – Objectives of the Resource Management and Planning System (RMPS) of Tasmania<br>1. d) to facilitate economic development in accordance with [sustainable development] | *Sustaining yield and reducing incidental fishing mortality*<br>To take fish at a size likely to result in the best use of the yield from the fishery.<br><br>Target Reference Points:<br>• 70% probability of rebuilding exploitable biomass to 05/06 peak in 8-10 years<br>• 70% probability of 1.2 kg per pot lift by 2019 |
| **Community benefits: Economic** | *Direct shares of economic yield paid to public*<br>• Royalty payments to the State in real terms (AU$)<br>• Payment as a proportion of economic yield (%)<br><br>*Locally-accrued economic yield*<br>Economic yield flowing to Tasmanian investors, compared with interstate/overseas (AU$)<br><br>*Level of value-adding in Tasmania (AU$)* | LMRMA 1995:<br>(1) d) take account of the community's interests in living marine resources<br><br>Schedule 1 – Objectives of the RMPS:<br>1. b) to provide for the fair, orderly and sustainable use and development of… water; | ***Abalone***<br>*Cost recovery and return to the community*<br>To recover a portion of the resource rent generated by the commercial fishery through fees agreed in the Abalone Deed of Agreement and licence fees from holders of abalone quota licences. |
| **Community benefits: Social** | *Level and quality of employment*<br>• Size of workforce<br>• Proportion of lease dependent skippers (%) | LMRMA 1995:<br>(1) d) take account of the community's interests in living marine resources | ***Giant Crab***<br>• Provide socio-economic benefits to the community<br>• Provide high quality products.<br><br>***Rock Lobster***<br>*Providing socio-economic benefits to the community* |

| Performance Indicators | Measures | Objectives and target reference points for Tasmanian Fisheries, where provided | |
|---|---|---|---|
| | | **Legislation** | **Fishery-specific Policy (including harvest strategies)** |
| | *Local food supply*<br>• Proportion of Tasmanian-caught seafood that is supplied to local markets (kg and %) | | To ensure the rock lobster fishing fleet continues to provide employment and an economic return to coastal communities of Tasmania<br><br>*Providing high quality produce*<br>To promote and maintain handling and processing practices which ensure the highest quality rock lobster product for human consumption.<br><br>***Scallop***<br>*Providing socio-economic benefits to the community*<br>To ensure the scallop fishing fleet and scallop processors continue to provide employment and an economic return to the coastal communities of Tasmania.<br>*Providing high quality produce*<br>To promote and maintain handling and processing practises at a high level aboard fishing vessels and by fish processors. |
| **Other Social Performance** | *Recreational amenity*<br>• Participation and avidity levels<br>• Quality of recreational opportunity levels<br><br>*Tasmanian Aboriginal Community level of access and opportunity*<br>• Access provisions<br>• Catchability of traditionally targeted stocks | LMRMA 1995:<br>(1) c) take account of the community's needs in living marine resources<br><br>Schedule 1 – Objectives of the RMPS:<br>1. b) to provide for the fair, orderly and sustainable use and development of… water; | ***Commercial Dive***<br>*Access to fish stocks to Recreational fishers*<br>To maintain or provide reasonable access to commercial dive species for recreational divers.<br><br>***Rock Lobster***<br>*Ensuring access to fish stocks by recreational fishers*<br>To maintain or provide reasonable access to rock lobster stocks for recreational fishers.<br><br>***Scalefish***<br>• To maintain or provide reasonable access to fish stocks for recreational fishers.<br>• To mitigate any adverse interactions that result from competition between different fishing methods or sectors for access to shared fish stocks and/or fishing grounds.<br><br>***Scallop***<br>*Providing access to fish stocks by recreational fishers* |

| Performance Indicators | Measures | Objectives and target reference points for Tasmanian Fisheries, where provided | |
|---|---|---|---|
| | | **Legislation** | **Fishery-specific Policy (including harvest strategies)** |
| | | | • To recognise that the bulk fishing nature of commercial scallop fishing has the potential to deplete fish stocks in areas that are of particular significance to recreational fishers.<br>• To provide reasonable access to scallop stocks for recreational fishers. |

# 2. COMMERCIAL FISHERIES

## 2.1. Economic performance

Economic performance in limited entry commercial fisheries is measured by determining the yield derived each year from that fishery.

The total economic yield of a commercial fishery is the amount of surplus (or economic profit) available once all costs have been deducted from the sales of landed fish (revenue). Costs include implicit costs such as the unpaid labour and the opportunity cost of capital. Economic yield is different (and smaller) than accounting profit, which does not include these implicit costs.

Most competitive businesses in the economy generate zero economic yield -this is sustainable and occurs when the opportunity costs of labour and capital generate normal returns. In contrast, commercial fishing often has unusually high or positive economic yield due to the government limiting the number of firms (with licences) and the volume of catch (with quotas). This scarcity creates positive economic yield which is revealed in the value of fishing licences or quota units and/or the rent payments made by harvesters to quota owners. The creation of positive economic yield is the objective of quota fisheries and so is a logical performance indicator. Economic yield from fisheries can be private or public (or a combination) with government objectives driving different approaches globally.

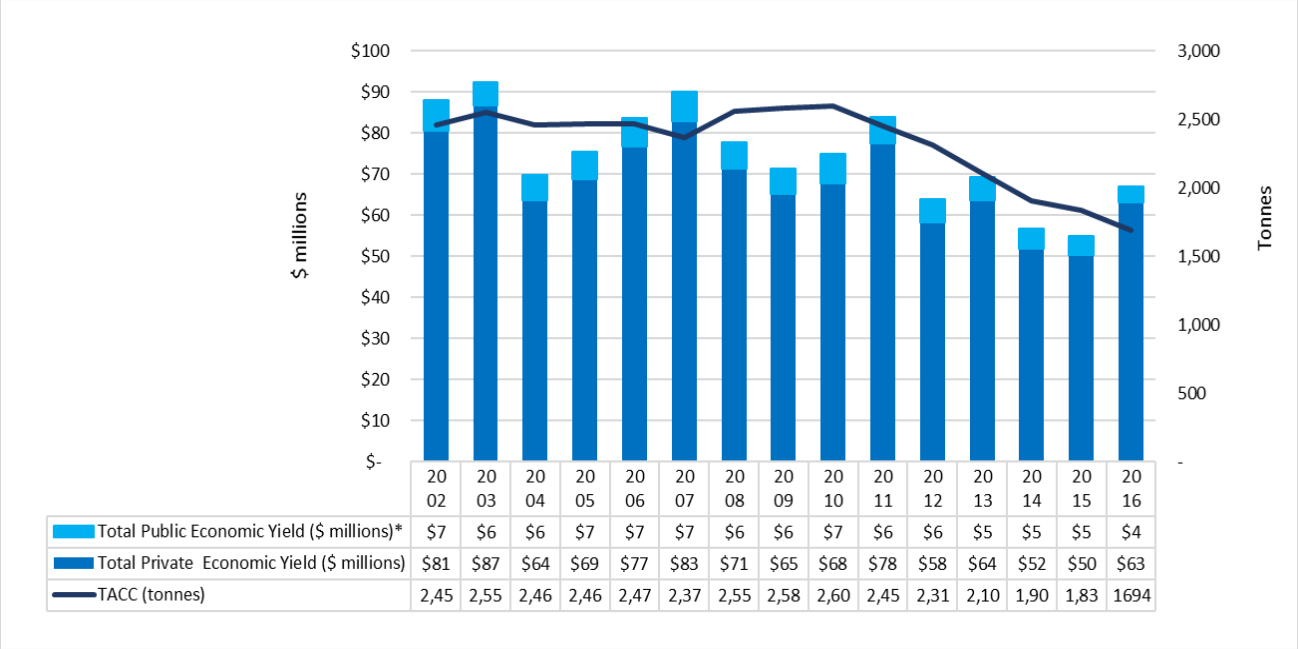
In most fisheries, economic yield is inversely correlated with employment, volume of catch, and gross value of catch. Limited entry and quota management systems are deliberate interventions to reduce catch and employment below levels that could otherwise occur sustainably and this is done to create positive economic yield. For this reason, reporting of employment and gross value of product as performance indicators for fisheries can be misleading so economic yield is emphasised here.

### 2.1.1 Economic yield estimates

| | |
|---|---|
| **What is *economic yield* and how is it estimated?** | Economic yield from the **Abalone fishery** can be estimated relatively easily because the cost for harvest is determined by a market rate for divers. This 'diver charge' has been very stable over years, is inelastic to catch rate, and averaged $7 per kg (2000-2014) and $7.5 per kg (2015 and 2016). Originally there was an intent to ensure some of the positive or surplus economic yield from the fishery was paid to the community as royalty payments, hence we have split the total economic yield into both private and public components. The royalty now overstates the public economic yield from the abalone fishery because the income from royalty and licence fees approximates the public costs associated with the fishery (management, research, compliance and crown prosecutor). (See Appendix B for the formula).<br><br>One notable issue of estimating economic yield based on diver charge is that the returns for diver are likely to be different for those who own quota (price of abalone per kg minus diver charge) and those who do not own quota (diver charge minus the cost of diving) and may result in overestimation of the economic yield, although available economic studies (e.g. Flemingham and van Putten 2009) suggest that their cost structure is similar. |

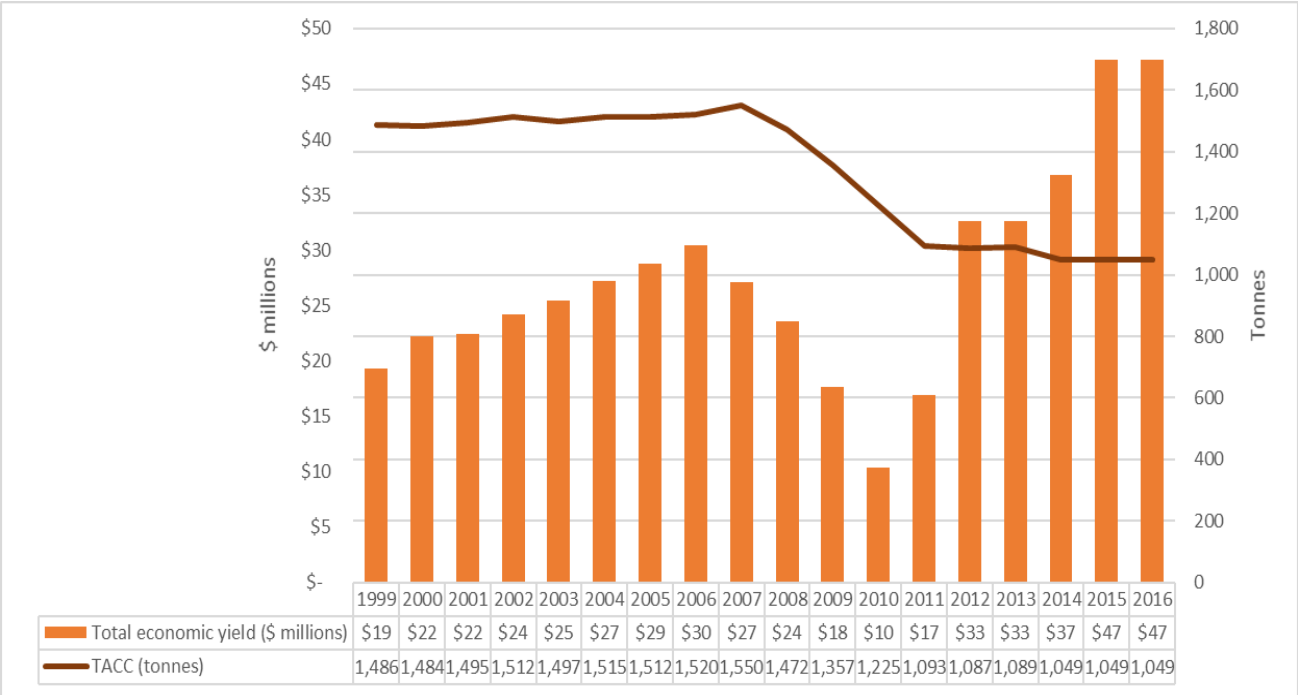
| | |
|---|---|
| | Trends in economic yield for the **Rock Lobster** and **Giant Crab** fisheries can be estimated by tracking changes in revealed lease price paid for access to quota. Lease price is determined in a market between quota holders and fishers. Fishers who lease quota need to cover all their fishing costs, including the opportunity cost of the capital in their vessel and labour. The difference between these costs and the beach price can thus be paid as lease price. The yield in this fishery is entirely private – there is no royalty or other payment for access to the fishery. Licence fees are only a contribution to the public costs involved in management of the fishery. (See Appendix B for the formula). A potential limitation of measuring economic yield in this way is that the changes in quota price may be affected by other factors that are not directly related to economic yield (e.g. subsidies, partnership with processors etc).<br><br>Economic yield for the **Commercial Dive**, **Scallop** and **Scalefish fishery** is not presented due to the lack of data or suitable proxy indicators for costs. |
| **Why measure *economic yield*?** | The stocks of fish harvested by commercial fisheries are common-pool resources – that is, they belong to the state of Tasmania.<br><br>By generating positive economic yield, these commercial fisheries generate economic benefit to licence or quota owners beyond the opportunity cost of the labour and capital required to take the fish. This is apparent through the value of licences and rent payments made to quota owners. In some countries the public benefit from commercial fisheries is easy to measure because there is an access payment (such as royalty payments for tuna in the south Pacific). Determining if there is a public benefit from Tasmanian fisheries is less straight-forward because it relies on indirect economic benefit if the economic yield is reinvested in the State.<br><br>Determining economic yield provides an indication of:<br>• Whether commercial fisheries are generating positive economic yield;<br>• Trends through time and thus success of management systems;<br>• The economic impact of the fishery (as a more logical measure than GVP or employment)<br>• Whether economic yield is being maximised (an implicit objective of transferrable quota systems)<br><br>Individual transferrable quota systems, as used in the Tasmanian **Abalone** and **Rock Lobster** fisheries, are intended to increase economic yield by three processes:<br>• promoting technical efficiency in the fleet through allowing trading of catch so that more catch can be taken by more efficient operators.<br>• setting TACs that target maximum economic yield by balancing the cost of fishing (via catch rate) with the revenue (via catch)<br>• spreading and constraining supply to increase price. |
| **What does the analysis show?** | The Abalone and Rock Lobster fisheries have generated positive economic yield across the assessment period. Economic yield for the **Abalone fishery** has undergone an overall decline from $94 million in 2002 to $55 million in 2014, however the level of yield increased in 2016 to $66 million. |

| | |
|---|---|
| | Economic yield based on revealed quota lease price for the **Rock Lobster fishery** has increased, on average, since 1999 from $19 million to $47 million in 2016.<br><br>In 2016, economic yield based on revealed quota lease price for the **Giant Crab fishery** is estimated to have been $168,112. No data on market values for **Scallop** quota units was available for the end of 2016. The closure of the fishery for the 2016/17 season and the under catch of the TAC in 2015/16 (72% of the TACC was taken) is reported to have resulted in no demand for these quota units. The apparent 2016 quota unit value of $0.00 indicates that there was no positive economic yield. For both of these fisheries these snapshots of economic yield in 2016 are based on available market data for quota unit lease price. Renewal of quota units continues to attract a management fee to contribute to ongoing management costs.<br><br>Economic yield for the **Commercial Dive** and **Scalefish fishery** is not estimated due to lack of available data. The level of latent effort and declining catches of target species in the **Scalefish fishery** across this period indicates economic yield near zero. The large number of unused licences in this fishery (section 2.4.2) indicates there is a dynamic equilibrium of people entering and exiting. Economic yield is likely to have approximated zero because access was not limited by licence numbers, a pre-requisite for positive economic yield. This is supported by the limited market for leasing only a sub-set of the species-specific Scalefish Fishing Licenses (Calamari, Wrasse) (section 2.1.2). |
| **What factors explain this performance?** | Both **Abalone** and **Rock lobster** commercial fisheries had very high levels of economic yield because the cost of catch is unusually low relative to revenue. Economic yield was kept positive by limiting both the catch and the number of participants - this combination of controls was not a pre-requisite for stock sustainability, rather, they were implemented to limit catch and employment to (successfully) create positive economic yield.<br><br>Economic yield of both fisheries has varied through time with greatest volatility in **Rock lobster**. The change through time was driven by stock abundance and catch rate. Economic yield increased because lower catch / GVP led to higher stock abundance which reduced cost of fishing. The marginal decrease in revenue from a lower total allowable catch was less than the marginal decrease in the cost of fishing.<br><br>Although the main driver of economic yield was stock abundance, other factors also had an effect including changes in costs (for example diesel fuel costs) and beach price. Beach price is affected by demand as well as by macro economic factors, such as the exchange rates.<br><br>Changes in targeting practices and market demand are likely to at least partly account for the declining catches of target species, increasing latency and declining or negligible economic yield in the **Scalefish** fishery.<br><br>For the **Scallop** fishery, under caught and negligible levels of catch in 2015/16 and 2016/17 due to low recruitment and stock abundance at harvestable sizes is the primary reason for the lack of market demand for quota units and therefore the lack of any estimated economic yield for this year. |




| | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Public Economic Yield ($ millions)* | $7 | $6 | $6 | $7 | $7 | $7 | $6 | $6 | $7 | $6 | $6 | $5 | $5 | $5 | $4 |
| Total Private Economic Yield ($ millions) | $81 | $87 | $64 | $69 | $77 | $83 | $71 | $65 | $68 | $78 | $58 | $64 | $52 | $50 | $63 |
| TACC (tonnes) | 2,45 | 2,55 | 2,46 | 2,46 | 2,47 | 2,37 | 2,55 | 2,58 | 2,60 | 2,45 | 2,31 | 2,10 | 1,90 | 1,83 | 1694 |

**Figure 1**. Total economic yield (private and public components) of the Abalone Fishery relative to the Total Allowable Commercial Catch (TACC). *Public benefit here is a known over-estimate because it does not include the cost of fisheries management, research, compliance and crown prosecutor, all of which are publically funded. These costs are not reported but certainly reduce and may exceed the public benefit from royalty payment shown here. Refer to Table B.1. (Appendix B) for information on how estimates and calculation of Royalty payments were derived. *Sources:* DPIPWE - refer Table B.1 (Appendix B) for data sources and Table C.1. (Appendix C) for supplementary data.




| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total economic yield ($ millions) | $19 | $22 | $22 | $24 | $25 | $27 | $29 | $30 | $27 | $24 | $18 | $10 | $17 | $33 | $33 | $37 | $47 | $47 |
| TACC (tonnes) | 1,486 | 1,484 | 1,495 | 1,512 | 1,497 | 1,515 | 1,512 | 1,520 | 1,550 | 1,472 | 1,357 | 1,225 | 1,093 | 1,087 | 1,089 | 1,049 | 1,049 | 1,049 |

**Figure 2.** Total economic yield based on revealed quota lease price of the Rock Lobster fishery relative to the Total Allowable Commercial Catch (TACC). Note that the management intervention of a lower TACC has successfully increased economic yield implying this is a logical performance indicator for the management approach being applied. *Sources:* DPIPWE - refer Table B.1 (Appendix B) for data sources and Table C.2. (Appendix C) for supplementary data.

### 2.1.2 Market capitalisation

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| **How is *economic "size"* defined and measured?** | Market capitalisation provides a simple measure of the economic "size" of the industry and is also useful in tracking performance of the fishery through time. It is calculated as the total number of licences/quota units multiplied by the market value of the licences/quota units. This approach is similar to that used to estimate the size of listed companies but does not include real capital (e.g. vessels or processing facilities).<br><br>The "value" or "size" of fishing industries are commonly described in terms of gross value of product (GVP) or tonnage – these would be useful measures for fisheries where the economic impact was correlated with GVP or where community value is through the provision of food. Neither of these are relevant for Tasmanian's fisheries as currently managed, and in particular for quota managed export industries like **Abalone** and **Rock Lobster**. This is because the product is exported and catch is deliberately reduced below the maximum sustainable yield by quota systems that target maximum economic yield, which in turn increases rent payments to quota owners. Hence, quota market capitalisation provides a more appropriate and useful guide to fishery size, impact and performance. This same measure is also applied to the quota-managed **Giant Crab** and **Scallop** fisheries. For the **Commercial Dive** and **Scalefish** fisheries, license market capitalisation is measured as a similar guide to fishery size, impact and performance as these are not quota-managed fisheries. |
| **Why is this measure important?** | Quota units and licenses are traded in a market and this market reveals expectations about future flows of economic yield to the holder of the unit or license. The value of the units or licenses responds to changes in economic yield of the fishery which can vary with changes in beach price, total allowable catch, harvesting cost, and access to finance (Anderson, Anderson et al. 2015). This means that quota unit and license values provide a readily obtained proxy for measuring and reporting economic yield.<br><br>The value of quota units and tradeable licenses is also somewhat forward-looking in that the market theoretically responds to expectations about future cash flow, rather than current economic yield. |
| **What does this analysis show?** | The economic "size" of the **Abalone fishery**, as measured by market capitalisation of private quota holdings was approximately $875 million in 2016. Some of the economic yield from the fishery was paid to the community as royalty payments. The market capitalisation of this public component can be estimated by scaling against the capitalisation of the private component (which has varied between 7% and 11% across years). Including this production results in an estimate of market capitalisation of $938 million.<br><br>The economic "size" of the **Giant Crab fishery** in 2016 is estimated to have been $52 million, based on a quota unit sale price of $5,000. However this is likely to be an overestimate as the quota unit sale price includes the market price of the Giant Crab Fishing Entitlement. None of the economic yield from the fishery is paid to the community as access or royalty payments. |

| | |
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| | The economic "size" of the **Scallop fishery** at the end of 2016 is estimated to be zero as quota units are being reported as having no market value. This is in contrast to 2006 when the market capitalisation is estimated to have been $16 million, based on a market value of $1,500 per unit.<br><br>The economic "size" of the **Rock Lobster fishery**, as measured by market capitalisation of private quota holdings was approximately $630 million in 2016. None of the economic yield from the lobster fishery is paid to the community as access or royalty payments.<br><br>The economic "size" of the **Commercial Dive fishery**, as measured by market prices for licenses, has increased across the short term. In 2016 it was estimated to be $1.1 million while at the end of 2017 it was estimated to be $2.8 million (based on a market value of $20,000 and $50,000 per license respectively). These prices include the price of a Fishing Boat Licence.<br><br>Estimating the economic "size" of the **Scalefish fishery** based on market prices for licenses is complex due to the multiple types of licenses operators require (Scalefish A, B or C license, Fishing Boat License, Gear and Species license types), and the variable market demand for these licenses. Only Scalefish A and B licenses are transferable. In 2016 there were 210 transferable Scalefish A and B licenses, of which 123 were active. Some 'inactive' Scalefish Fishing Licences are attached to licence packages that include either a Rock lobster or a Shark licence. Market prices for Scalefish A or B license packages that included a Species License for Wrasse (high-value target species), as well as gear licenses, were obtained at the end of 2017 and averaged. The economic "size" of the Wrasse sub-sector was estimated to be $5.3 million, based on the existence of 62 Wrasse Species Licenses. |
| **What factors contribute to this result?** | The value of quota units can vary in response to external economic factors such as the yield on other investment options, and the availability of loans and interest rates. The recent upward trend in quota market capitalisation for the **Abalone** and **Rock Lobster** fisheries indicates that higher future expected profits are anticipated by participants in these quota markets.<br><br>Some of the changes in the market capitalisation of the **Abalone fishery** between years were due to concerns in the market about future effects of possible outbreaks in Abalone Viral Ganglioneuritis (AVG), with bio-security measures implemented in November of 2011. Investors factored in more risk which flows through to a requirement of a higher return on investment to balance the increased risk profile, which resulted in a static or lower capital value. It also led to a reduction in the number of units traded.<br><br>Changes in quota unit sales price for **Abalone**, **Rock Lobster**, **Giant Crab** and **Scallop** in recent years have been affected by trends in recruitment, stock abundance at size, catch rate and beach price. |

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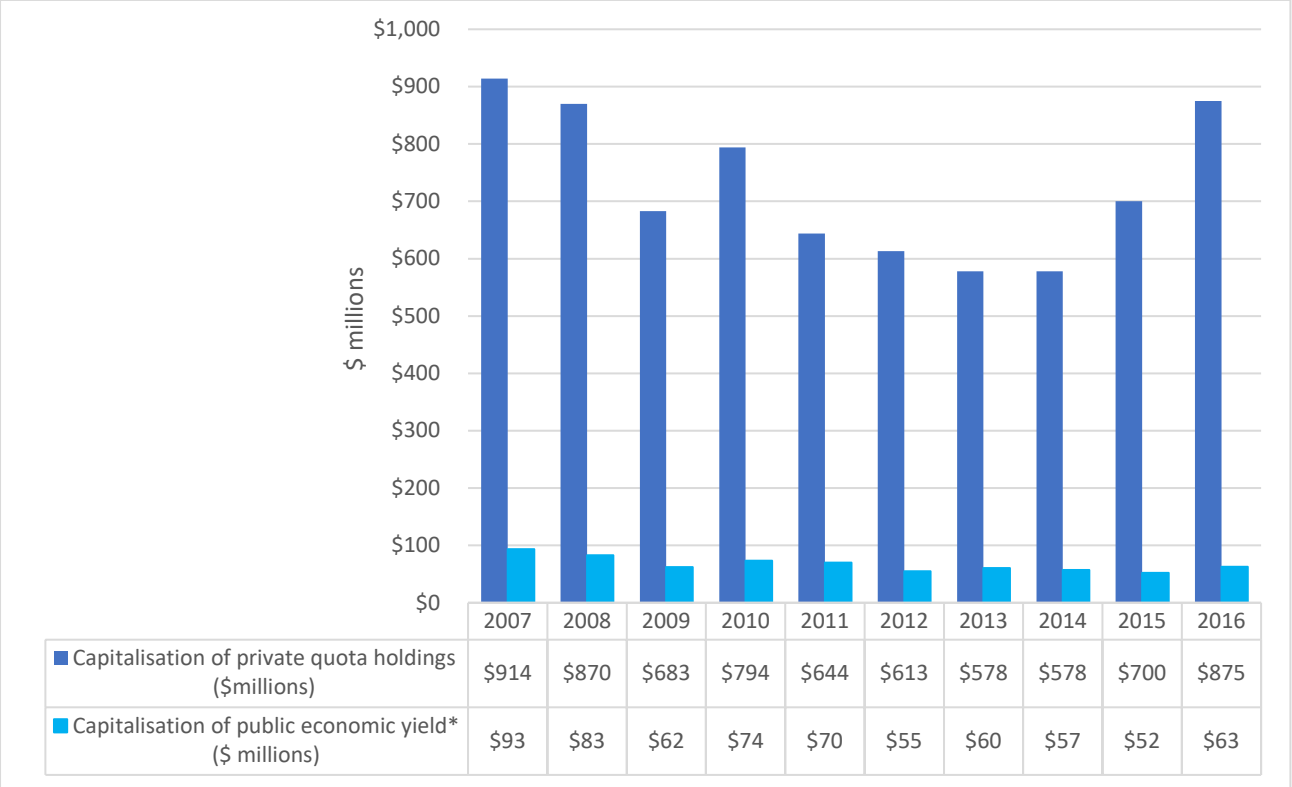
| | Changes in market demand and targeting practices have affected the market value of **Commercial Dive** and **Scalefish** licenses. In particular, market demand for urchins, periwinkles, southern calamari, and wrasse have driven increases in some licence values. Substitution by farmed salmonid and imported scalefish products has led to low beach prices and low demand for other scalefish species previously targeted, and has driven declines in the license values of more generalist net and beach seine sub-sectors. |




| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|
| Capitalisation of private quota holdings ($millions) | $914 | $870 | $683 | $794 | $644 | $613 | $578 | $578 | $700 | $875 |
| Capitalisation of public economic yield* ($ millions) | $93 | $83 | $62 | $74 | $70 | $55 | $60 | $57 | $52 | $63 |

**Figure 3.** Quota market capitalisation (or economic "size") of the Abalone fishery, public and private components. *Refer to Table B.1 (Appendix B) for information on how estimates and calculation of Royalty payments were derived. *Sources:* DPIPWE - refer Table B.1 (Appendix B) for data sources and Table C.1. (Appendix C) for supplementary data.

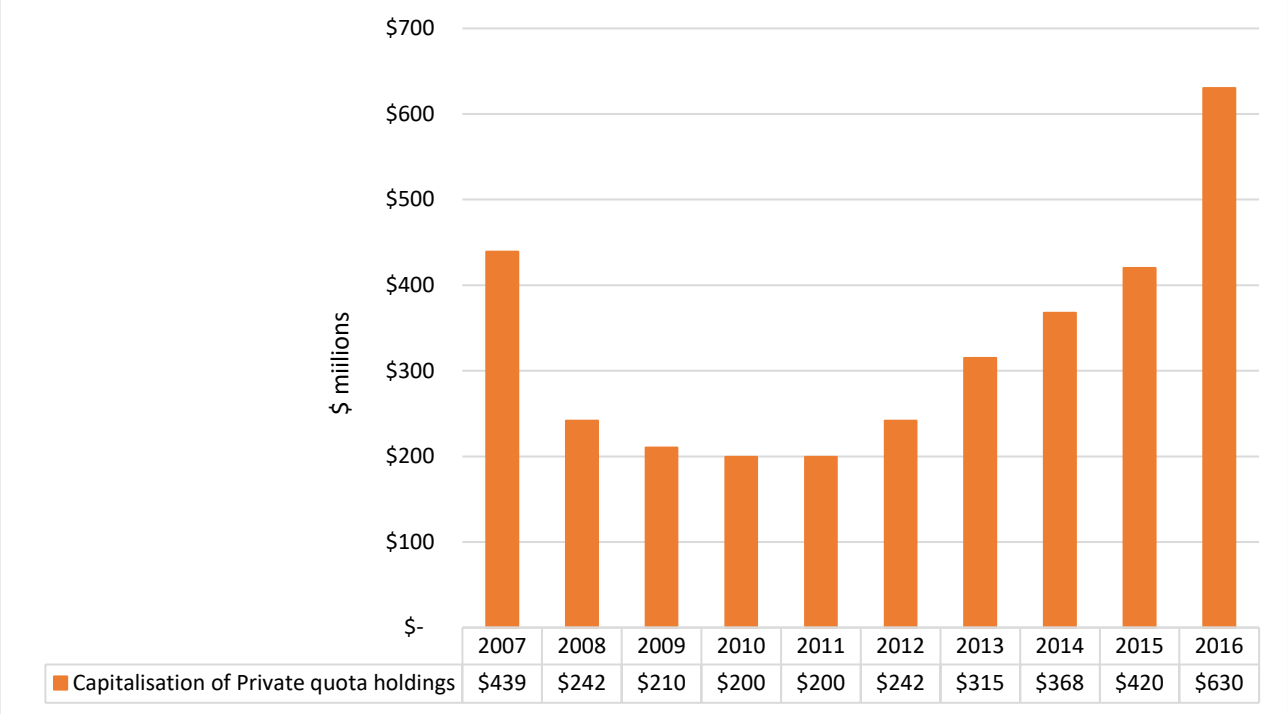



**Figure 4.** Quota market capitalisation (or economic "size") of the Rock Lobster fishery. *Sources:* ABARES (2016) and DPIPWE - refer Table B.1 (Appendix B) for data sources and Table C.2. (Appendix C) for supplementary data.

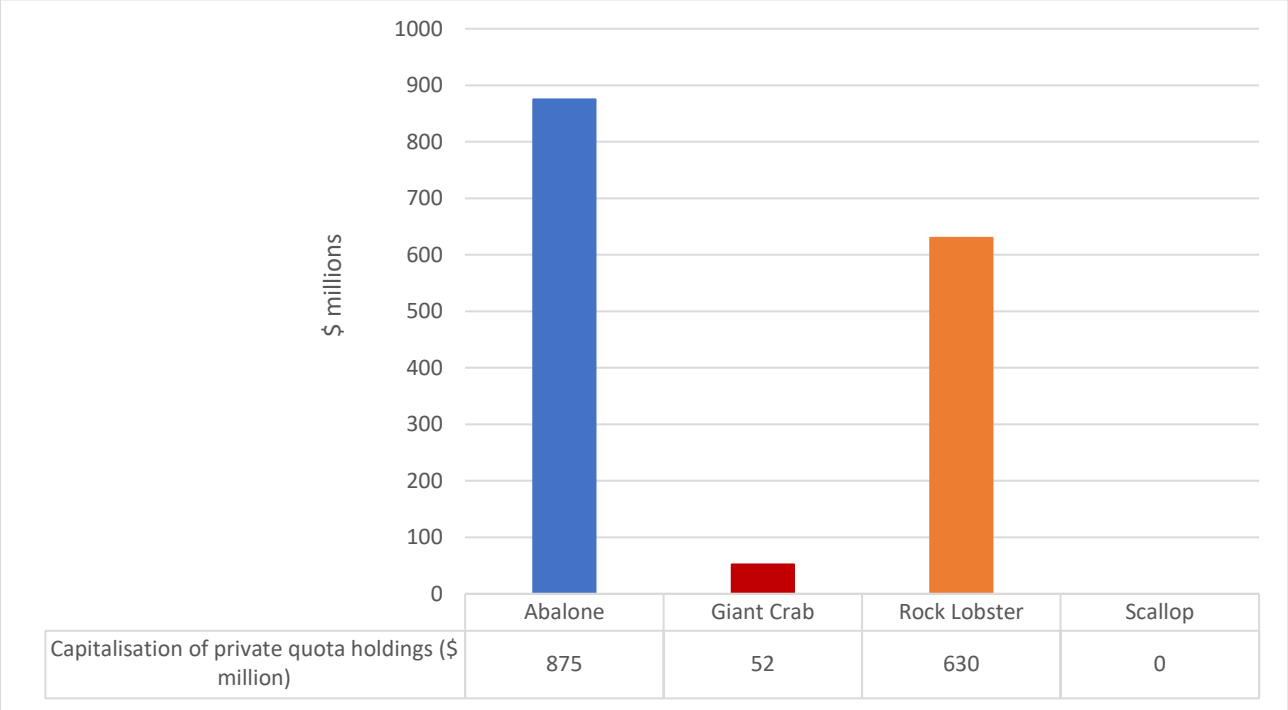



**Figure 5.** Comparison of quota market capitalisation (or, economic “size”) of Abalone, Giant Crab, Rock Lobster and Scallop fisheries in 2016. *Sources:* Online market data; DPIPWE - refer Table B.1 (Appendix B) for data sources and Table C.1. and C.2. (Appendix C) for supplementary data.

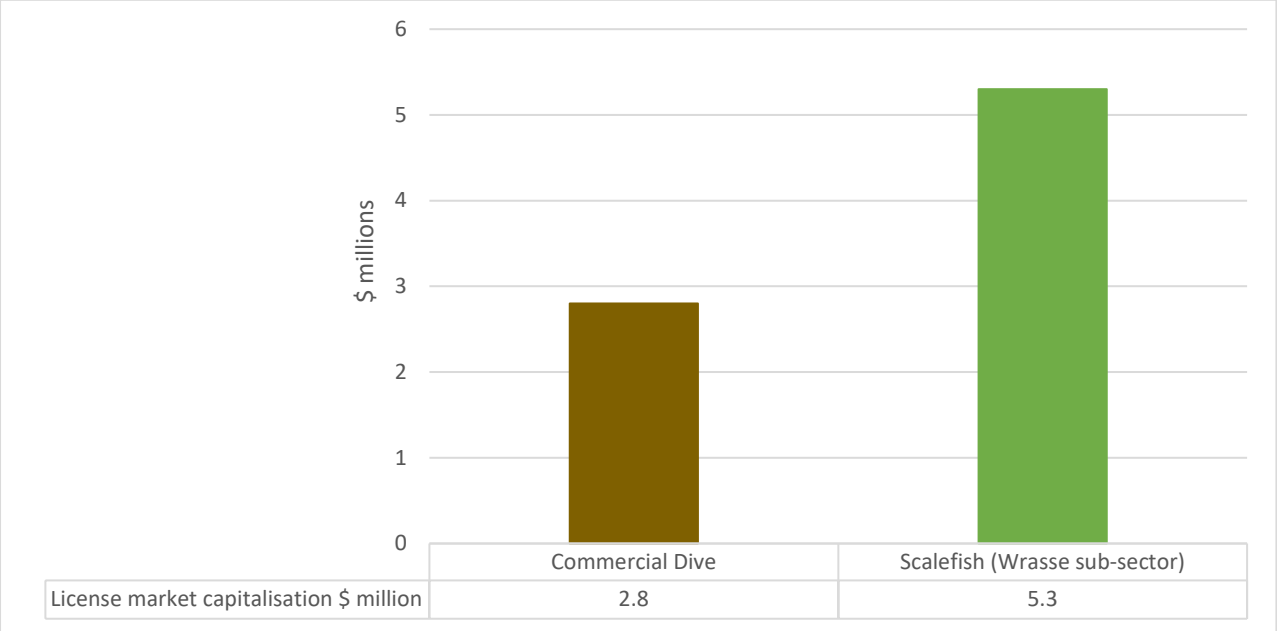



**Figure 6.** License market capitalisation (or, economic "size") of Commercial Dive and Scalefish fisheries in 2017, based on online market data.

## 2.2. Factors affecting economic yield

Key factors which affect the level of economic yield generated by commercial fisheries are price and efficiency. Tracking indicators of both of these factors through time is undertaken to understand performance of ITQ-managed fisheries by assessing performance in these two areas for which ITQ systems are meant to affect; as well as of other fisheries with negative trends in economic yield.

### 2.2.1. Beach Price

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| **How is *price* measured?** | The price paid for the landed product to the harvester (fisher) by the purchaser (usually a wholesaler) is known as the beach price. It is equivalent to the term farm gate price used for agricultural products. This price is typically recorded on the landing and processor dockets at point of landing and sale.<br><br>The beach price for commercially-caught fish products can be highly variable according to season, level of supply and market targeted. Average catch-weighted beach price per kilo ($) is calculated to track annual trends in price. |
| **Why is this measure important?** | Trends in beach price through time indicate changing levels of revenue earned by fishers from sales of fish. More generally, they indicate changing economic performance, due to management settings and/or industry behaviours. Increased price can be driven by changing fisher behaviour (i.e. fishing to meet market demand, rather than stock availability), which results in prices driven by scarcity and smoothed supply of catch to market. Increased beach prices can also be driven by management settings (i.e. economic target reference points) that support prices driven by scarcity and remove barriers to fishing to market. |

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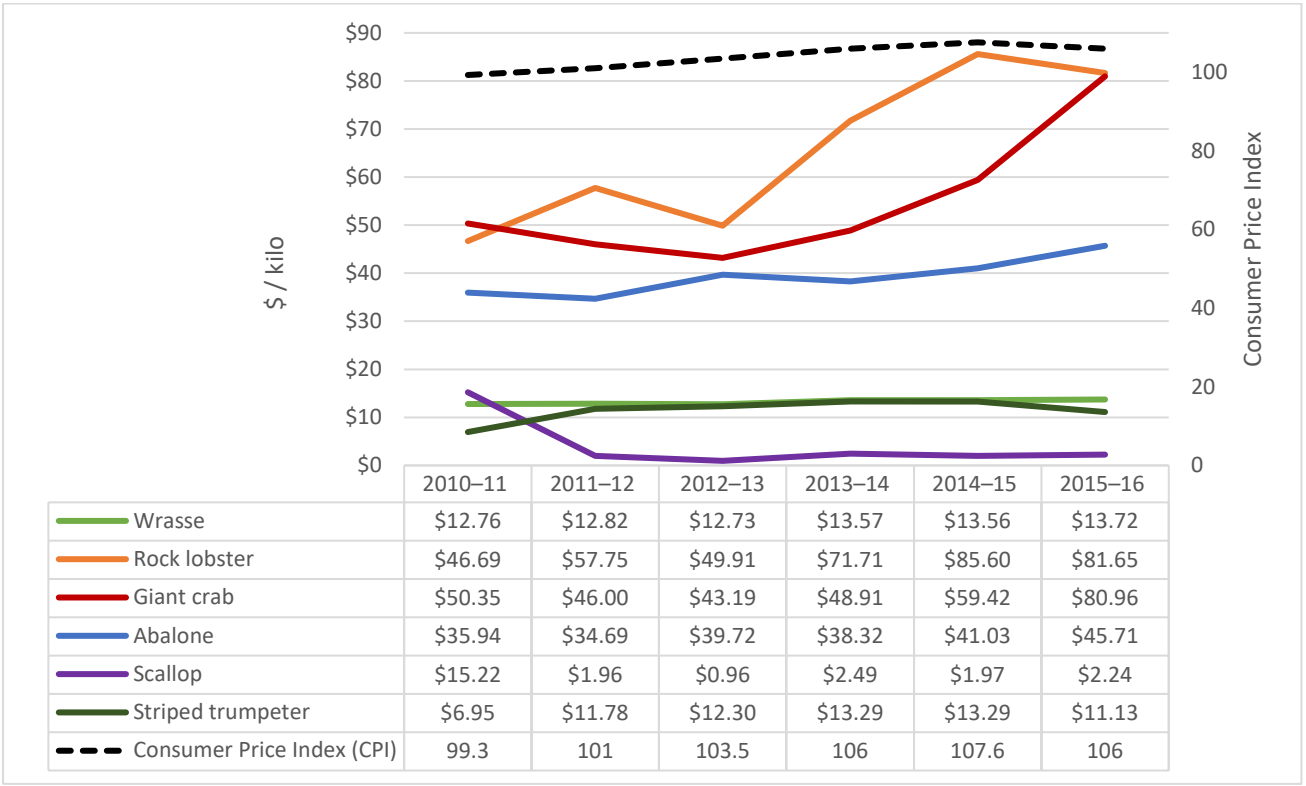
| **What does this analysis show?** | **Abalone** has increased in beach price in nominal terms from $35/kg to $45/kg across this period, which is likely to represent a small increase when adjusted for inflation. Across this period prices for **Giant Crab** and **Rock Lobster** have increased in real terms from $50/kg and $46/kg in 2010/11to $80/kg for both in 2015/16, respectively. This represents a substantial increase even when adjusted for inflation.<br><br>Average annual beach prices for selected species targeted in the **Scalefish fishery** (Wrasse and Striped Trumpeter) have increased in nominalterms but either declined or remained constant, relative to inflation. Across this period, prices for **Scallop** (measured as $/kg whole weight) have declined significantly, both in nominal terms (from $15/kg to approx. $2/kg) and when adjusted for inflation. Beach prices for species targeted by the **Commercial Dive fishery** are not available. |
| **What factors contribute to this result?** | Exchange rates directly affect beach price in the case of export-oriented fisheries, and can indirectly affect beach price for domestically-oriented fisheries through changes in the price of competing imported seafood products. Volatility in prices can also reflect the extent to which specific products are responsive to these external factors.<br><br>Levels of supply can also directly affect beach price negatively. In the case of **Giant Crab** and **Rock Lobster**, reduced TACCs across this period are likely to have increased levels of scarcity and therefore increased price. |




| | 2010–11 | 2011–12 | 2012–13 | 2013–14 | 2014–15 | 2015–16 |
|---|---|---|---|---|---|---|
| Wrasse | $12.76 | $12.82 | $12.73 | $13.57 | $13.56 | $13.72 |
| Rock lobster | $46.69 | $57.75 | $49.91 | $71.71 | $85.60 | $81.65 |
| Giant crab | $50.35 | $46.00 | $43.19 | $48.91 | $59.42 | $80.96 |
| Abalone | $35.94 | $34.69 | $39.72 | $38.32 | $41.03 | $45.71 |
| Scallop | $15.22 | $1.96 | $0.96 | $2.49 | $1.97 | $2.24 |
| Striped trumpeter | $6.95 | $11.78 | $12.30 | $13.29 | $13.29 | $11.13 |
| Consumer Price Index (CPI) | 99.3 | 101 | 103.5 | 106 | 107.6 | 106 |

**Figure 7.** Trend in nominal average annual beach price across time for Abalone, Giant Crab, Rock Lobster, Scallop, Striped Trumpeter, Wrasse. National CPI is presented for the same years to compare changes in nominal beach price with levels of inflation. *Source:* ABARES (2017).

### 2.2.2. Efficiency in production

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|---|---|
| **How is *efficiency* measured?** | Measuring the productive efficiency of a fishing industry is important for managers as it allows them to evaluate the impacts of policy changes on harvesting sector. In the case of ITQ fisheries, efficiency gain can be achieved through transfer of quota from high to low marginal cost producers, improving economic efficiency overall, since fishing inputs are distributed to the ones who use them the best (Kompas et al 2009).<br><br>Economic efficiency in a fishery is commonly measured using individual firm level input/output data over time. However, the detailed economic data required for such analysis is not currently available for the Tasmanian fisheries. For this assessment, a proxy for the level of economic efficiency, that is economic yield (i.e. based on lease price, see section 2.1.1) as a percentage of total revenue (i.e. GVP) was used. Changes in the number of active divers or vessels in the fleet are also measured as an indicator fishing capacity. |
| **Why is this measure important?** | Measuring levels of economic efficiency provides an indication of the effective functioning of ITQ systems. A key perceived advantage of ITQ systems is that they facilitate autonomous adjustment in the fishery, where the fleet size adjusts on its own without the need for government support (e.g. a buyback program). Reducing the number of active vessels and people employed in fleet eliminates overcapacity, thereby increasing efficiency. |
| **What does this analysis show?** | Across the period from 2001 to 2016, levels of economic yield (EY) relative to GVP (hereafter EY/GVP ratio) in the **Abalone fishery** have averaged 76% with no significant change in this level. Numbers of active divers have declined from 118 in 2009 to 102 in 2016.<br><br>**For the Rock Lobster** fishery, the EY/GVP ratio have been comparatively lower and more volatile, ranging from 58% in 2006 to 16% in 2010 and back to 51% in 2016. Numbers of active vessels have remained stable however there are signs of a recent decline in numbers from 239 vessels in 2014 to 205 vessels in 2016.<br><br>EY/GVP ratio was not measured for the **Giant Crab fishery** as fishers targeting this species are dual licensed in the Rock Lobster fishery and separate analysis of efficiency cannot be undertaken with available data.<br><br>EY/GVP ratio was not measured for the **Commercial Dive, Scalefish,** or **Scallop** fishery as these fisheries are not quota-managed, or are not currently producing economic yield. |
| **What factors contribute to this result?** | Changes in export market conditions (i.e. beach price) and stock abundance (i.e. catch rates) are likely to have positive or negative effect on this indicator. Catch rate is partly a function of the TACC setting process, which in the case of both the Abalone and Rock Lobster fisheries include target reference points for Catch Per Unit Effort (CPUE, or catch rates). In 2009/10 and 2010/11 the TACC for the Rock Lobster fishery was under caught. This period of an unconstrained TACC reflect the years of lowest EY/GVP ratio. |

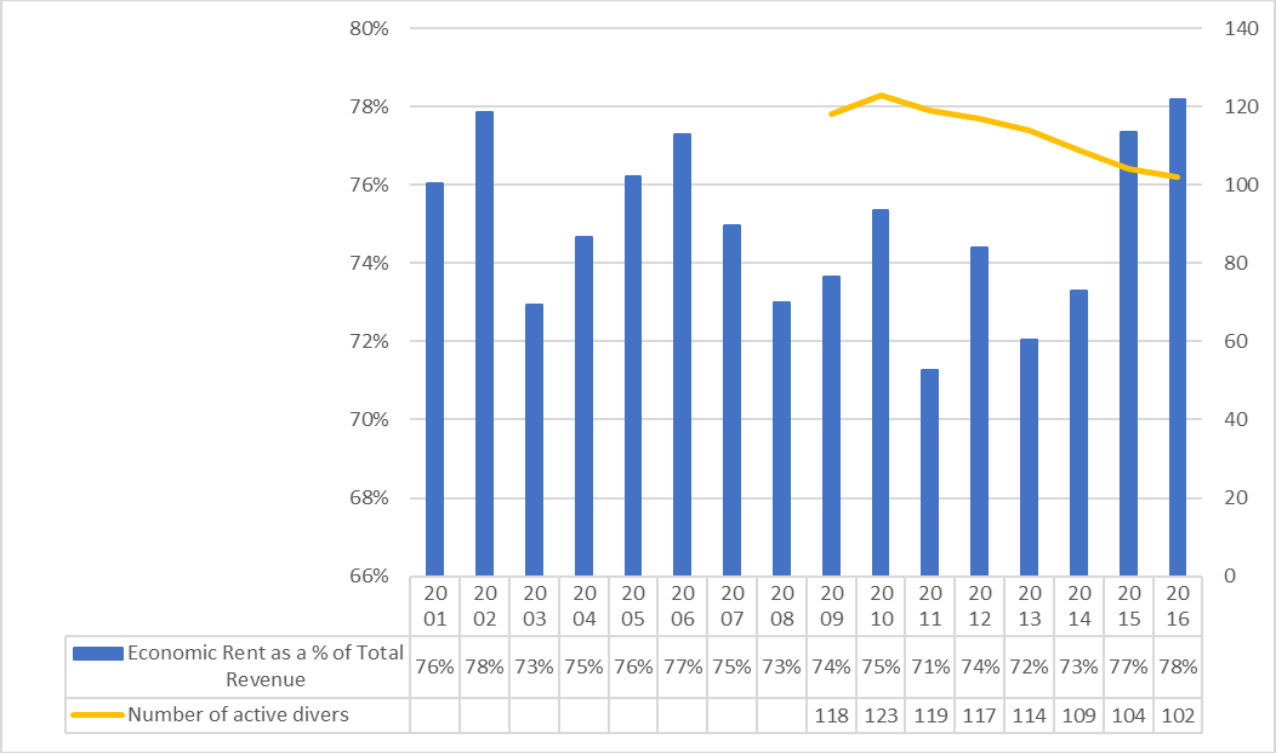


**Figure 8.** Economic yield generated annually as a proportion (%) of Total Revenue for the Abalone fishery, compared with the number of active divers. *Sources:* ABARES (ABARES 2017). DPIPWE - refer Table B.1 (Appendix B) for specific data sources and Table C.1. (Appendix C) for supplementary data.

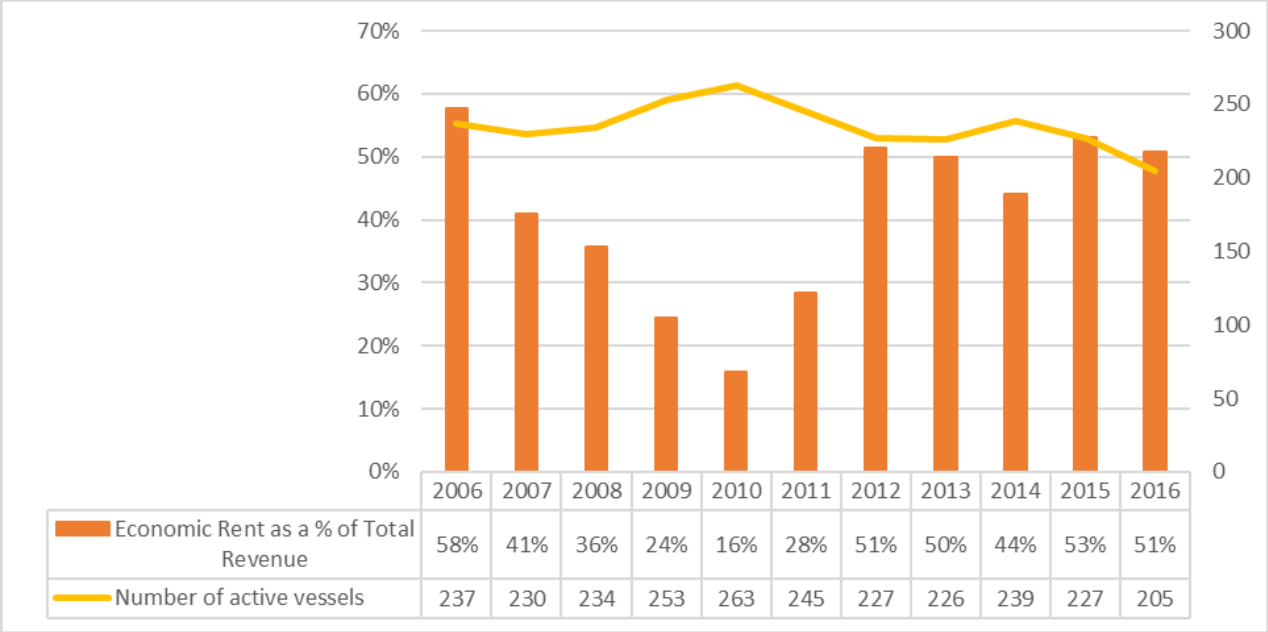


**Figure 9.** Economic Rent generated annually as a proportion (%) of Total Revenue for the Rock Lobster fishery, compared with the number of active vessels. *Sources:* ABARES (ABARES 2017). DPIPWE - refer Table B.1 (Appendix B) for specific data sources and Table C.2. (Appendix C) for supplementary data.

## 2.3. Community Benefits: Economic Indicators

Economic benefits from Tasmania's fisheries are distributed through employment and additional indirect economic activity that supports the harvesting operations. Commercial fisheries are an unusual type of business because they also generate a positive economic yield because government controls limit entry and production. In most other parts of the economy, large positive economic yields would attract new entrants/employment until the positive economic yield reduced to zero.

In terms of the largest fisheries for **Abalone** and **Rock lobster** currently, more than 50% of the revenue is economic yield which is revealed as rent. This is an exceptionally high economic yield for any industry. The scale of rent payments from these fisheries means that standard indicators of economic benefit like employment and indirect impact are less important or useful for these commercial fisheries.

Higher employment and activity in support industries is usually viewed as an indicator of economic benefit. However, in commercial fisheries, the catch / revenue is limited by regulations, so higher employment comes at the cost of lower economic yield. There is a direct trade-off here – higher economic yield in fisheries like the Tasmanian **Rock lobster** and **Abalone** fisheries is inversely correlated with employment. This means there is a choice to be made in distributing economic benefit through employment versus economic yield and different countries take different approaches.

Public policy and management settings have historically favoured trying to increase economic yield and thus rent payments rather than employment. This policy has been implemented through regulations that promote efficiency of the harvesting sector, such as separation of quota ownership and harvesting, extended seasons, more lobster pots per vessel etc. This means that lower employment (and thus higher economic yield) is technically an indicator of successful resource management in Tasmania.

Tracking economic yield is critical to understanding the flow of economic benefit from the largest Tasmanian fisheries resources. Economic yield is revealed as rent or lease fees paid by fishers to the quota owners (sometimes the same person) net of costs for managing the fishery. These benefit the wider community where economic yield is paid to the government through royalties or taxes. Economic yield provided to quota owners may or may not benefit the community depending on how and where the economic yield is spent (also known as the 'trickle down' effect).

### 2.3.1. Direct shares of the economic yield paid to private and public components

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| **How are *direct shares of economic yield* defined and measured?** | For the purposes of this assessment, the distribution of economic benefits is measured by the direct shares of the economic yield paid to private and public components. The private component is the revenue net of payments to the Tasmanian government and harvesting costs.<br><br>This analysis provides a general guide to distribution of benefit but could be refined in future assessments. The private component will be overstated here because it is reduced by company tax, which is not included because it is paid federally rather than to the Tasmanian government and also because it varies between firms depending on factors unrelated to the fishery (such as losses in other parts of the business). |

| | |
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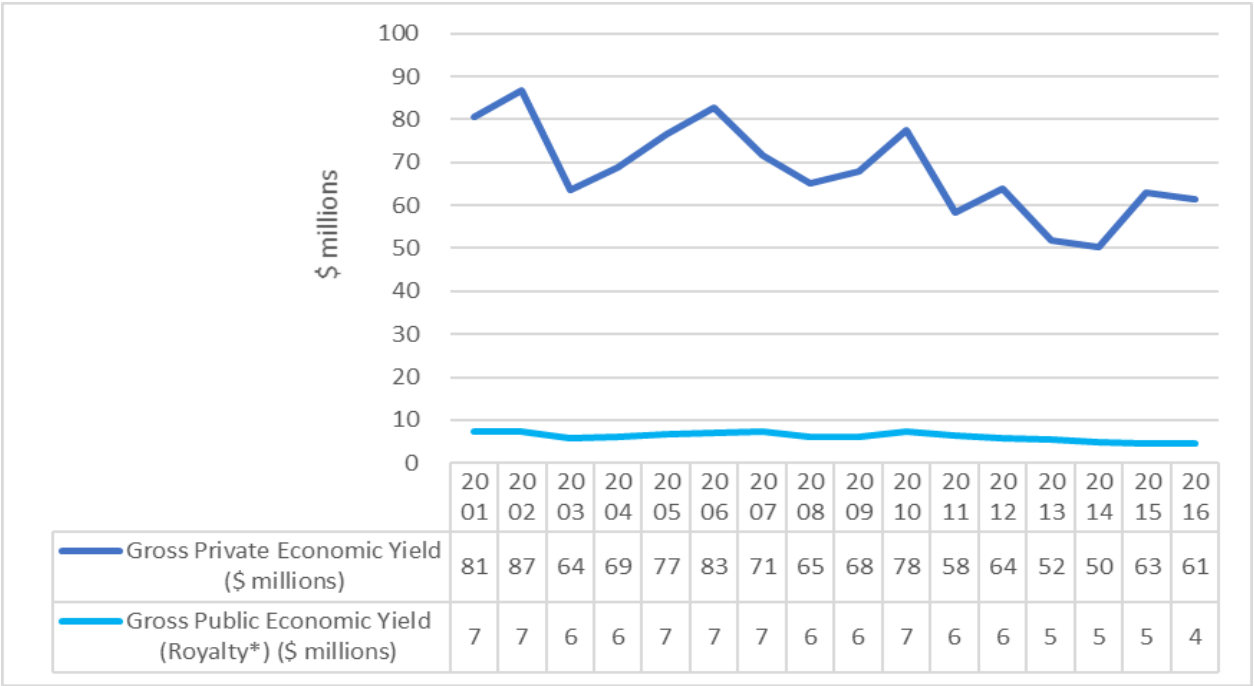
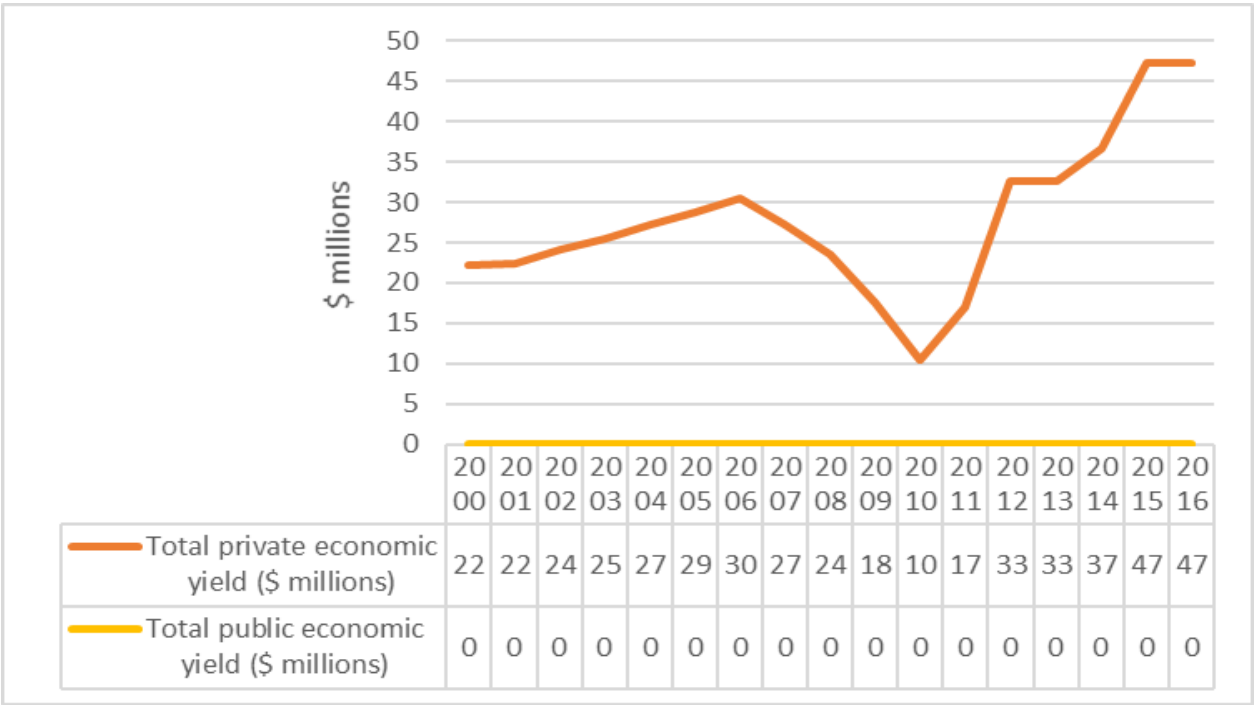
| | The public component is measured by obtaining the reported royalty fees paid annually. The Tasmanian **Abalone** industry is currently governed by two separate Deeds that set out two separate fee calculations. For Old Deed Quota Holders a fee structure between 4% and 12% of the beach price is in place. For New Deed Quota Holders (which includes approximately 80% of all quota units), the fee is calculated on a formula of 7% of the average beach price (this proportion has been reduced by the Tasmanian Government in more recent years).<br><br>Royalty payments are not a payment for services provided by government, rather, they are a return to the community from commercial harvesting of a public resource. Costs for government services to industry (management, research, compliance) are normally collected additionally through licence fees although there is no direct cost-recovery through licence fees in Tasmanian fisheries. This means that licence fees and royalties are now effectively pooled so public benefit from royalties will be reduced by their use for management, research and compliance of the commercial fishery.<br><br>No measurement or assessment has been undertaken of indirect economic benefits and this is a possible future research need. |
| **Why is this measure important?** | Fish stocks are common-pool resources and management of these resources is intended to take into account the Tasmanian community's needs and interests, in accordance with the objectives of Tasmania's *LMRMA 1995.* |
| **What does this analysis show?** | Economic yield from the **Abalone fishery** that flows to the public as a proportion of the value of the private economic yield has declined from approximately 10% in 2007 to 7.2% in 2016 (noting this not net of government costs). Measurement and reporting of government costs for the rock lobster and abalone fisheries is a possible research need and would help refine reporting.<br><br>For the **Rock Lobster fishery** there is no royalty payment so 100% of the economic yield from the fishery flows to private holders of quota units.<br><br>Economic yield is not currently available for minor Tasmanian fisheries.<br><br>These results show that public benefit from commercial harvesting of abalone and lobster resources relies on whether private economic yield is invested to the benefit to the community. This has been explored in fisheries elsewhere (eg. South Australian Abalone Fishery) and is a possible future research need for Tasmania. A step towards exploring the extent of public benefit from reinvestment of private economic yield is explored below in terms of geographic distribution. The principle here is that rents from the fishery are unlikely to be invested to the benefit of the Tasmanian community if they are paid to quota owners interstate or overseas. |
| **What factors explain this result?** | Public policy is the major determinant of the extent to which economic benefits are directly distributed from commercial fisheries to public beneficiaries. Formulas for calculating royalty payments for the **Abalone fishery** are outlined in subsidiary legislation on the basis of Tasmanian Government policy. |



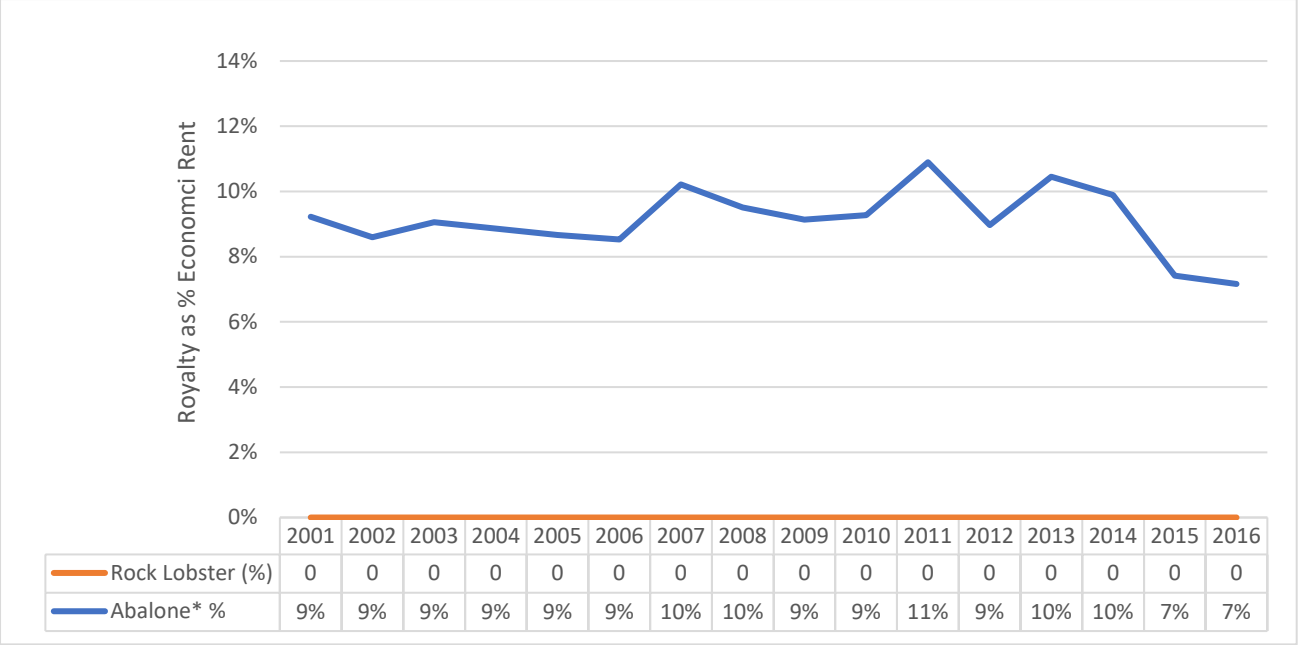

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gross Private Economic Yield ($ millions) | 81 | 87 | 64 | 69 | 77 | 83 | 71 | 65 | 68 | 78 | 58 | 64 | 52 | 50 | 63 | 61 |
| Gross Public Economic Yield (Royalty*) ($ millions) | 7 | 7 | 6 | 6 | 7 | 7 | 7 | 6 | 6 | 7 | 6 | 6 | 5 | 5 | 5 | 4 |

**Figure 10.** Distribution of economic yield from the Abalone fishery with private and public allocations through time. These yields are gross because private does not include company tax and public does not include costs for government services. *Refer to Table B.1 (Appendix B) for information on how estimates and calculation of Royalty payments were derived. *Sources:* DPIPWE - refer Table B.1 (Appendix B) for data sources and Table C.1. (Appendix C) for supplementary data.




| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total private economic yield ($ millions) | 22 | 22 | 24 | 25 | 27 | 29 | 30 | 27 | 24 | 18 | 10 | 17 | 33 | 33 | 37 | 47 | 47 |
| Total public economic yield ($ millions) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Figure 11.** Distribution of economic yield from the Rock Lobster fishery with private and public allocations through time. Government costs for services are assumed to be covered in full by licence fees, and that private yield is net of these licence fees. Sources: DPIPWE - refer Table B.1 (Appendix B) for data sources and Table C.2. (Appendix C) for supplementary data




| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rock Lobster (%) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Abalone* % | 9% | 9% | 9% | 9% | 9% | 9% | 10% | 10% | 9% | 9% | 11% | 9% | 10% | 10% | 7% | 7% |

**Figure 12.** Royalty payment to the Tasmanian Government as a proportion of Economic Rent generated for the Abalone and Rock Lobster fisheries. *Refer to Table B.1 (Appendix B) for information on how estimates and calculation of Royalty payments were derived. *Sources:* DPIPWE - refer Table B.1 (Appendix B) for data sources and Table C.1. and C.2. (Appendix C) for supplementary data.

### 2.3.2. Direct shares of the economic yield paid to harvesters and investors

| | |
|---|---|
| **How are *direct shares paid to harvesters and investors* defined and measured?** | Tasmania's **Abalone** and **Rock Lobster** fisheries are increasing in complexity as different types of participants or 'agents' are active and to varying degrees.<br><br>Industry participants are defined by level of harvest, level of ownership of quota units and/or entitlements, and lease behaviour (van Putten, Hamon et al. 2011).<br><br>Harvesters are those participants with an annual recorded catch of > 0 tonnes. Investors are those participants whose annual recorded catch = 0.<br><br>Distribution of economic yield from these fisheries is a function of levels of quota unit ownership across different types of industry agents and concentration of that ownership.<br><br>Quota market concentration is measured using the Herfindahl-Hirschman Index (HHI), in which markets shares of individual agents are calculated and squared to produce scores of between 0 (which equals nil concentration and perfect conditions for competition) and 10,000 (which indicates perfect concentration of ownership by one agent). |

| | |
|---|---|
| **Why is this *distribution* important?** | Changes in the levels of participation by harvesters and investors in the quota markets for these fisheries affects the distribution of economic benefits by changing the incentives and market conditions for the sale and lease of quota units.<br><br>Quota management relies on functional markets to promote efficiency of harvesting. High concentration of quota by firms is associated with market failure issues due to the control on the quota leasing price, greater ability to manipulate the market; and, with equity issues (Anderson 2008). |
| **What does this analysis show?** | In the **Abalone fishery** there are approximately 436 direct private beneficiaries (quota unit holders) of whom 85% are investors who do not participate in harvesting activities.<br><br>In the **Rock Lobster fishery** there are approximately 311 direct private beneficiaries (quota unit holders) of whom 55% are investors who do not participate in harvesting activities.<br><br>For both fisheries more than 50% of the total number of quota units are held by small-scale investors and owner-operators whose total holdings are 50 units or less. Analysis of the level of concentration using the Herfindahl-Hirschman Index (HHI) shows very low levels of concentration in the **Abalone** and **Rock Lobster** fisheries (score of 187 and 52 respectively). |
| **What factors explain this result?** | Ownership of quota units within the Rock Lobster fishery is tied to ownership of a Rock Lobster entitlement to harvest, of which there are currently 311. This limits the extent of market concentration and links quota unit lease market conditions more closely with the harvesting sector. |

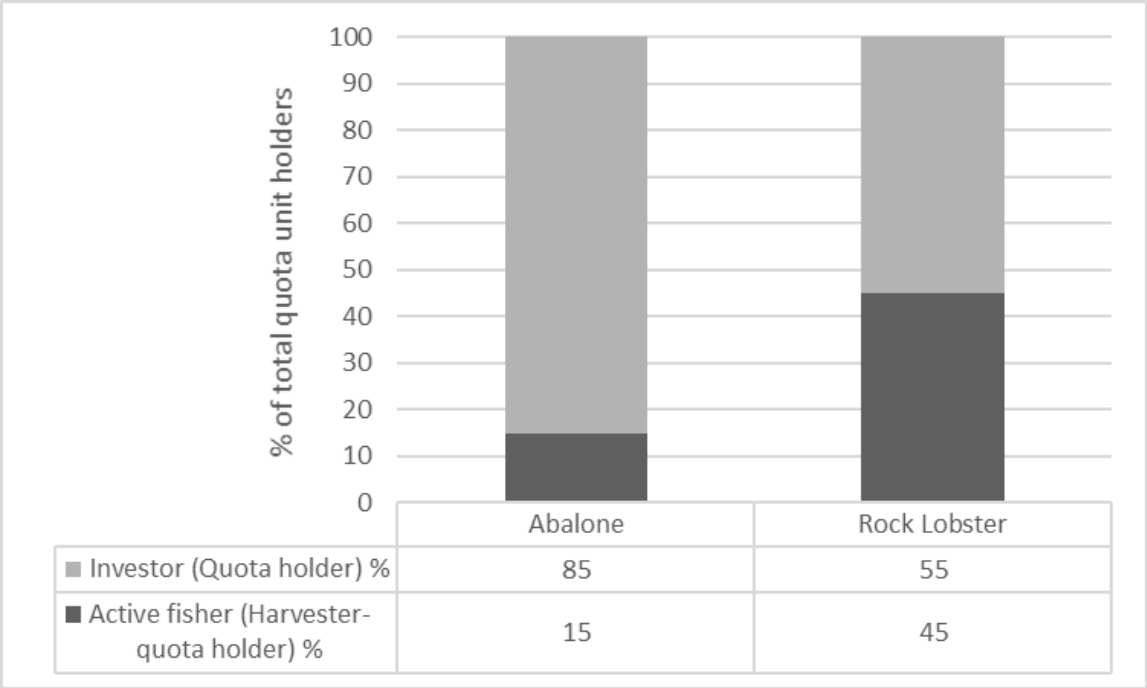
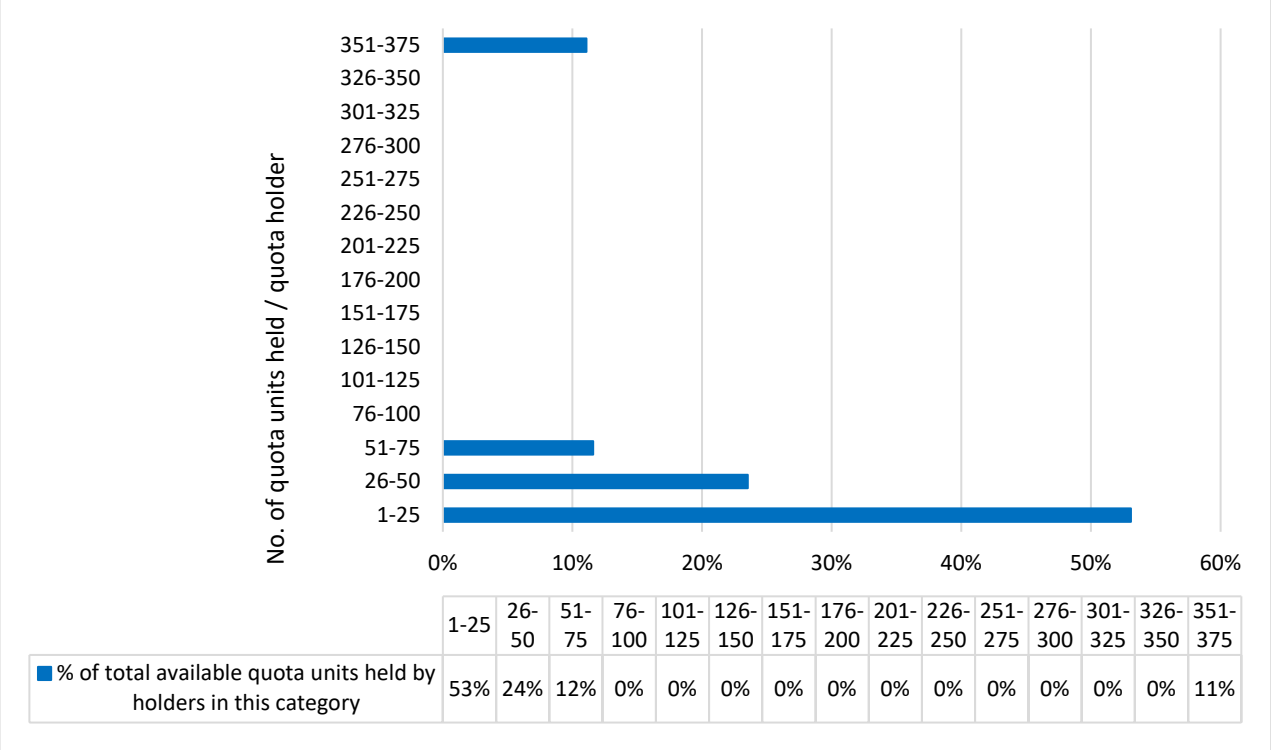
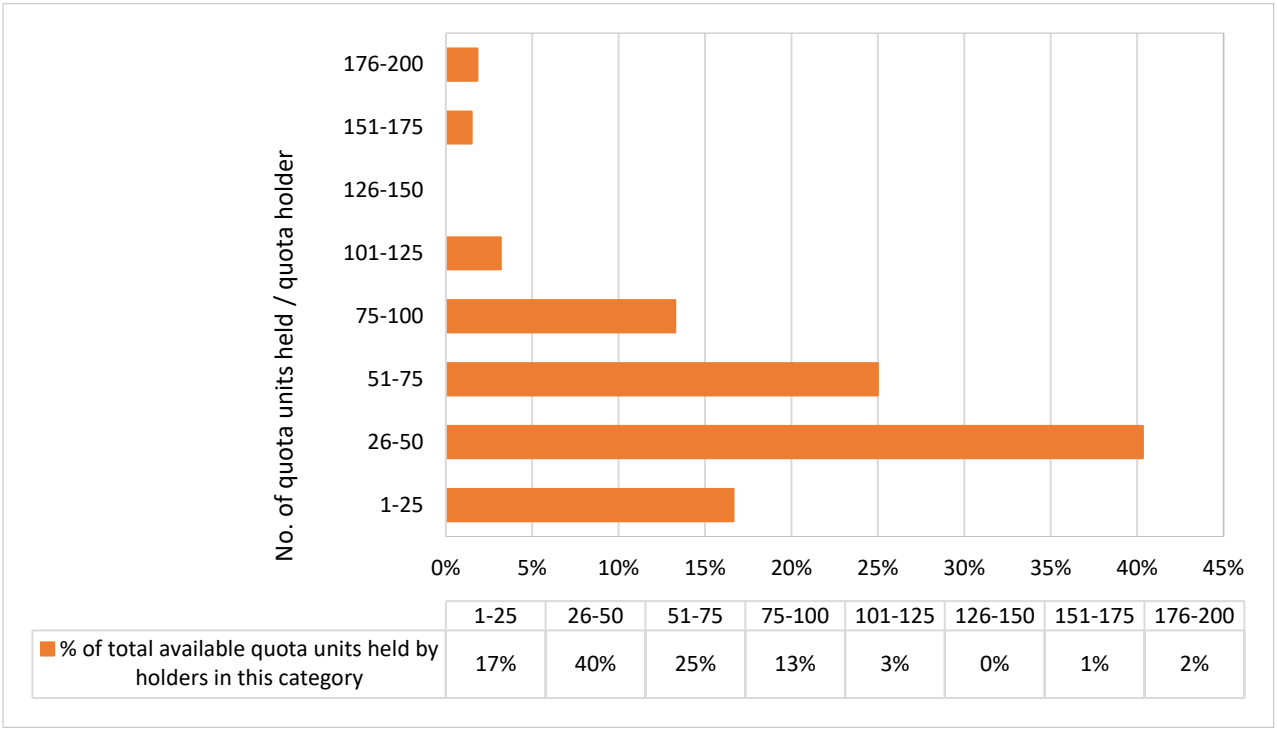



**Figure 13.** Proportion of participants in the Tasmanian Abalone and Rock Lobster Fishery quota markets in 2017 by types of participation in the fishery (active harvester-and-quota-holder or quota investor).
*Sources:* DPIPWE - refer Table B.1 (Appendix B) for data sources.




| | 1-25 | 26-50 | 51-75 | 76-100 | 101-125 | 126-150 | 151-175 | 176-200 | 201-225 | 226-250 | 251-275 | 276-300 | 301-325 | 326-350 | 351-375 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of total available quota units held by holders in this category | 53% | 24% | 12% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 11% |

**Figure 14.** Levels of Abalone quota unit ownership by holders grouped by the number of units held, 2017. *Sources:* DPIPWE - refer Table B.1 (Appendix B) for data sources.




| | 1-25 | 26-50 | 51-75 | 75-100 | 101-125 | 126-150 | 151-175 | 176-200 |
|---|---|---|---|---|---|---|---|---|
| % of total available quota units held by holders in this category | 17% | 40% | 25% | 13% | 3% | 0% | 1% | 2% |

**Figure 15.** Levels of Rock Lobster unit ownership by holders grouped by the number of units held, 2017. *Sources:* DPIPWE - refer Table B.1 (Appendix B) for data sources.

### 2.3.3. Direct shares of the economic yield paid to local investors

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|---|---|
| **How are *regional flows of economic yield* defined and measured?** | A portion of the economic yield from the **Abalone fishery** is returned to the Tasmanian Government as royalty payments, however the majority flows to private holders of quota units. All of the economic yield generated in **Rock lobster fishery** flows to private holders of quota units.<br><br>This private economic yield may benefit the Tasmanian community if it is reinvested in Tasmania but this potential is reduced when the quota holder is not resident within Tasmania.<br><br>The proportion of quota holders who are resident in Tasmania, compared with the proportion resident outside of Tasmania, is an indicator of the distribution of economic yield to the intended beneficiaries (i.e. the Tasmanian community). Similarly, the percentage of the quota units held by non-resident beneficiaries compared with beneficiaries residing in Tasmania is another such indicator. Note that our data under-estimates the flow of rents outside of Tasmania because many quota owners have a registered address in Tasmania although they reside elsewhere. |
| **Why is *regional distribution* important?** | Fish stocks are common-pool resources and management of these resources is intended to take into account the Tasmanian community's needs and interests, in accordance with the objectives of Tasmania's *LMRMA 1995.* |
| **What does this analysis show?** | The percentage of **Abalone** quota unit holders residing or located outside of Tasmania has increased from 0% prior to the introduction of an Individual Transferable Quota management system in 1985 to approximately 29% in 2017.<br><br>Similarly, the percentage of **Rock Lobster** quota unit holders residing or located outside of the state increased from 0% in 1998 (at the introduction of an ITQ system) to approximately 23% in 2017.<br><br>This increase in residency of **Abalone** and **Rock lobster** quota holders outside of Tasmania suggests a reduction in the potential for economic yield from the fishery to be invested to the benefit of the Tasmanian community (for example in new businesses that increase gross state product).<br><br>Of the private economic yield from these fisheries that is paid to quota owners resident in Tasmania, an unknown proportion is reinvested in Tasmania. This proportion has been measured in the South Australian abalone fishery and is possible future research need for Tasmania.<br><br>Another possible research need is to refine the data used here on ownership. Several companies have a business address in Tasmania although the actual beneficiary of the rent payments from the fishery may reside elsewhere. This means the results presented here are known to be under-estimates of the extent of flow of rents outside Tasmania. |

| | |
|---|---|
| **What factors explain this result?** | For both the **Abalone** and **Rock Lobster** fisheries, quota unit holders are not required to be active harvesters. This provision enables participation in these fisheries by investors, who are not constrained to residing in Tasmania or Australia. |

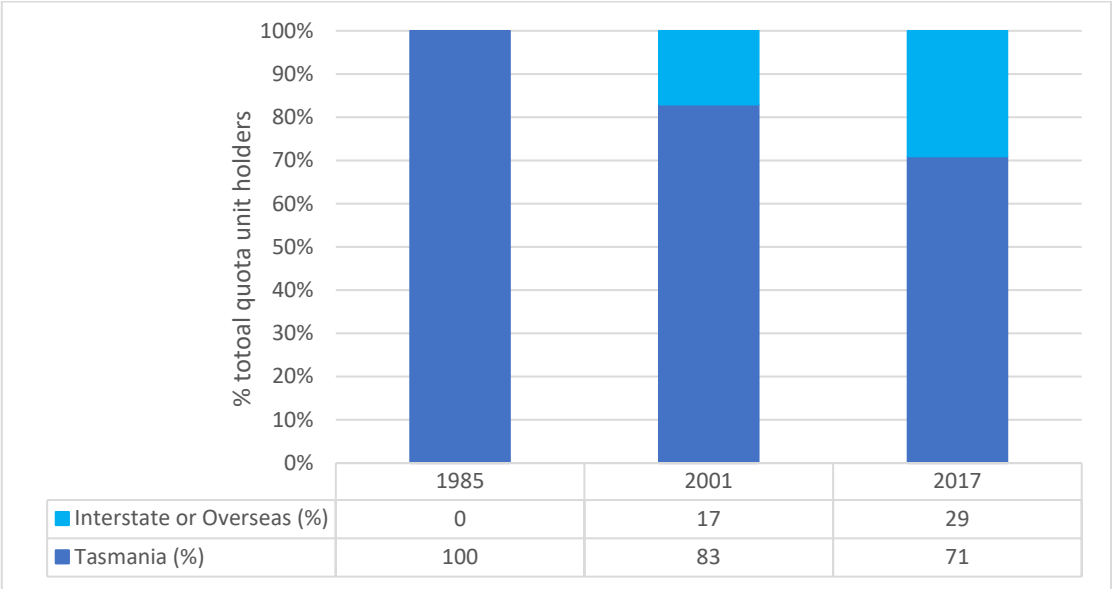


**Figure 16.** Proportion of Abalone quota unit holders (direct beneficiaries) who are resident in Tasmania or non-resident across time. *Sources:* DPIPWE - refer Table B.1 (Appendix B) for data sources.

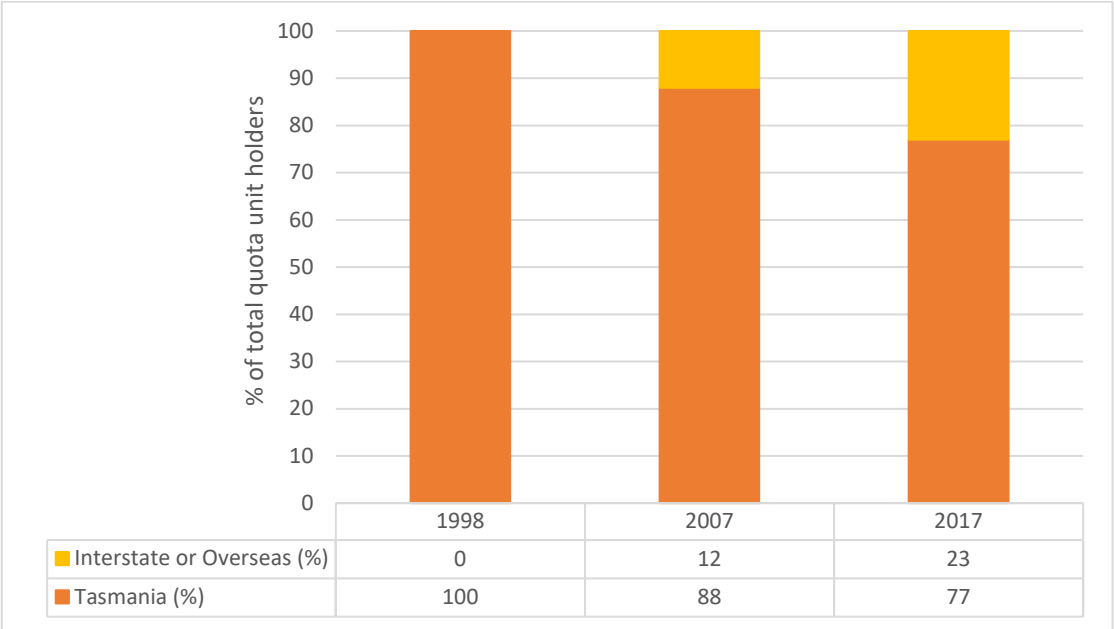


**Figure 17.** Proportion of Rock Lobster quota unit holders (direct beneficiaries) who are resident in Tasmania or non-resident across time. *Sources:* DPIPWE - refer Table B.1 (Appendix B) for data sources

### 2.3.4. Indirect economic contributions from value adding

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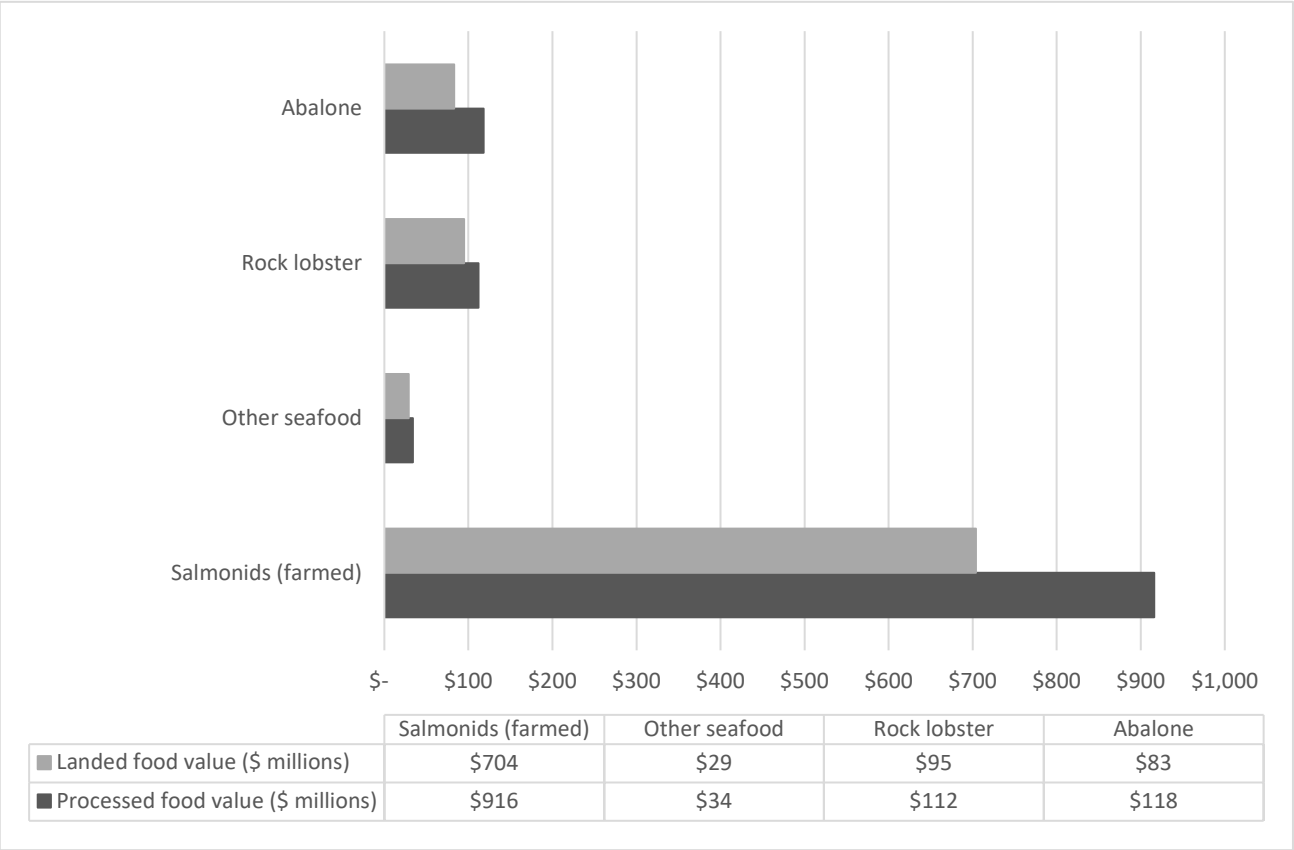
| **How is *value-adding* defined and measured?** | Value-adding is defined as the increase in wholesale price of seafood product added due to processing and packing of product. It is measured by calculating the difference between beach price (price paid to the fisher on landing) and the wholesale price of the processed product (DPIPWE 2017), scaled to the total landings. |
| **Why is the *level of value adding* important?** | Value is added through processing to product from Tasmania's **Abalone**, **Commercial Dive**, **Giant Crab**, **Rock Lobster**, **Scalefish** and **Scallop** fisheries. This represents a contribution to levels of economic activity in Tasmania, generating flow-on benefits through employment in the post harvest seafood sector. |
| **What does this analysis show?** | Local processing of **Abalone** product in 2015/16 added $35 million to the wholesale value of Abalone, which increased the value of the product by approximately 30%. Processing of **Rock Lobster** in Tasmania added $17 million to the wholesale value of the product, which increased its value by approximately 15%.<br><br>**Scallop** product is processed in Tasmania and the majority is consumed domestically, rather than exported. The level of value-adding is not currently available.<br><br>In comparison, the level of value-added to farmed salmonids by locally-based processing is far higher in real terms. |
| **What factors explain this result?** | The **Abalone** and **Rock Lobster** fisheries target high value export markets, which receive the product live. Product is shipped live either directly or to interstate wholesalers, where it is often re-tanked and then exported live to predominantly Chinese markets. Given the comparatively high price received in Asian markets, incentives for further local value-adding activity are low. |




| | Salmonids (farmed) | Other seafood | Rock lobster | Abalone |
|---|---|---|---|---|
| Landed food value ($ millions) | $704 | $29 | $95 | $83 |
| Processed food value ($ millions) | $916 | $34 | $112 | $118 |

**Figure 18.** Comparative level of value-adding along the Tasmanian Seafood supply chain. *Sources:* Tas Agri-Food Scorecard 2015/16 (DPIPWE), ABS and ABARES.

## 2.4 Community Benefits: Social Indicators

### 2.4.1. Levels of employment

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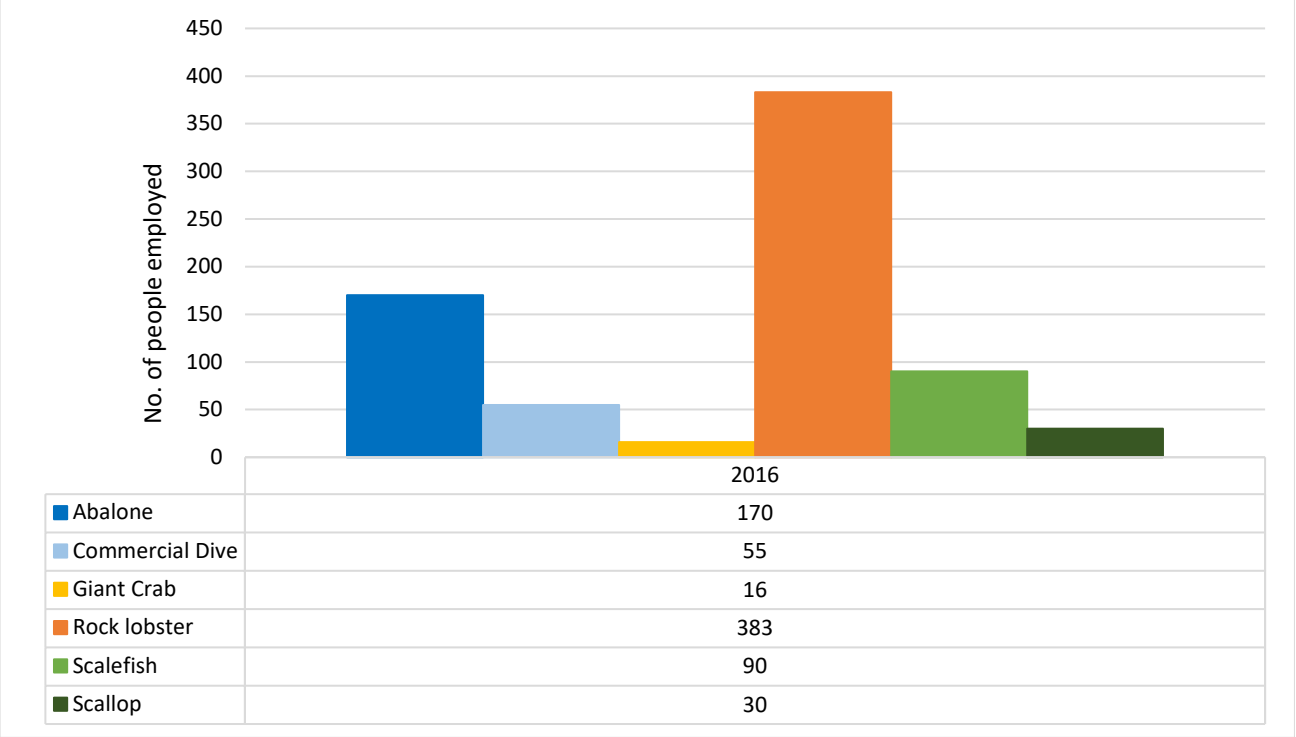
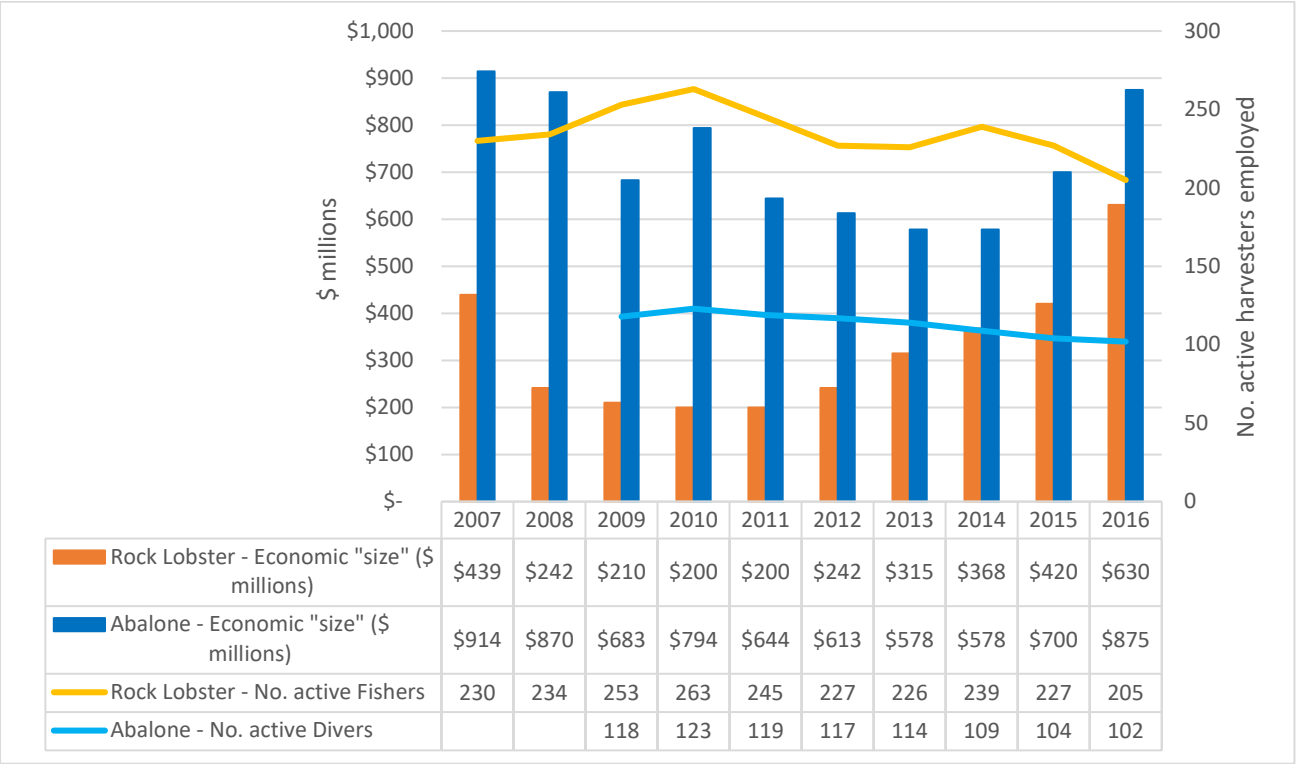
|---|---|
| **How is *employment* defined and measured?** | Employment in Tasmania's fishing industry is defined as engagement in economic activity (work) across or at a given time, either in paid employment or self-employment. For fisheries this includes skippers and crew employed as sub-contractors and paid on a share of catch arrangement. Employment levels reported and assessed are for direct employment only, and include both full time and part time employment. Estimates of FTEs (Full-time Equivalent) positions are not undertaken for commercial fisheries given the seasonal nature of commercial fishing activity and the difficulties in converting time at sea to number of paid hours of employment per day or week.<br><br>Employment data is collected every five years by the Australian Bureau of Statistics through its Census of Population and Housing. Industry of occupation is classified using the Australian and New Zealand Standard Industrial Classification (ANZSIC) 2006. However the classification used generates data that is insufficiently fine-scale for the Tasmanian fishing industry, hence Census data is not reported in this assessment.<br><br>The Tasmanian Seafood Industry Council undertook a Seafood Industry Workforce profile in 2016 to collect more fine-scale data of employment levels in Tasmania's commercial fisheries.<br><br>Employment levels in the **Abalone** and **Rock Lobster** fisheries also can be measured by the number of active harvesters or divers in a given year, and compared to the economic "size" of these fisheries (that is, market capitalization of quota holdings) to provide an indication of relative levels of employment contributed by each fishery. |
| **Why is the *level of employment* important?** | Employment is a difficult indicator to interpret in Tasmanian fisheries because lower employment is an implicit outcome of current policy although higher employment is usually considered desirable in other areas of the economy.<br><br>ITQs have been implemented in most Tasmanian fisheries and these are economic instruments designed to increase technical efficiency of the fleet. Further, fisheries managed by ITQs use quotas (TACs) to target maximum economic yield (MEY), which means lower catches and employment than if we targeted maximum sustainable yield (MSY). The combination of low catch, high stock levels, and an efficient fleet means that the fleet (and employment) is reduced. Low costs from a small, efficient fleet leads to positive economic yield, rent payments to quota owners, and market value of quota units. Fisheries elsewhere that prioritise employment forego economic yield and eliminate market value of units by splitting the TAC amongst a larger number of less-efficient fishers.<br><br>Efficient production is pursued in most parts of the economy to keep businesses competitive and viable. More efficient firms can often increase production and employment. This is not relevant in Tasmanian fisheries because production is controlled by the TAC not the efficiency of the fleet. The presence of large |

| | |
|---|---|
| | private rent payments in Tasmania's abalone and rock lobster fisheries demonstrates that employment could be far higher without affecting viability of harvesting operations. However, this is considered undesirable by the Tasmanian Government because they have prioritized the creation of positive economic yield. Given the government policy applied in Tasmania, lower employment should be interpreted as successful capacity reduction.<br><br>Changes in the numbers of people employed in the commercial harvest sector is of interest to regional areas because it can influence social and economic benefits at a local communities level.<br><br>Better understanding the overall effect of Tasmania's fisheries on state employment is a possible future research need. The direct effect of ITQ management on employment is reported here but the extent of growth elsewhere in the economy through investment of private economic yield is unknown. |
| **What does this analysis show?** | The Tasmanian Seafood Industry Council Workforce profile estimated the real size of the commercial fisheries harvesting sector to be 674 workers in 2016. This figure is based on the number of active fishing licences, combined with data on the core crew complement requirements of fishing vessels used under active wild-catch licences. It includes workers employed on both full-time and part-time basis (TSIC 2017). The **Abalone** fishery employed approximately 170 people in 2016, while for the **Commercial Dive** fishery the number of people employed was 55 people and for the **Giant Crab** fishery it was 16 people. The **Rock Lobster fishery** is the highest employer of Tasmania's commercial fishers, employing 383 people in 2016. For the **Scalefish** fishery, the number of people employed was 90 while for the **Scallop** fishery the number was 30, noting that this figure varies substantially depending on the extent to which scallop areas are opened.<br><br>Levels of active harvesters in the **Abalone** and **Rock Lobster** fisheries appeared to have decreased across the time period assessed. In the case of the **Rock Lobster fishery**, economic yield has increased as employment has fallen. This indicates that management has successfully increased efficiency in the fishery to increase rent payments to quota owners and the capitalisation of units. Relative to economic "size", the **Abalone fishery** generates comparatively lower levels of employment. |
| **What factors explain this result?** | The TSIC Seafood Workforce profile identified that many fishers are engaged in employment in multiple fisheries or other marine sectors in order to supplement fishing incomes and pursue full-time employment. This livelihood strategy is likely to be deployed partly in response to the pursuit of economic efficiency in harvesting and the corresponding reduction in required fishing effort, and therefore employment. |




| | 2016 |
|---|---|
| Abalone | 170 |
| Commercial Dive | 55 |
| Giant Crab | 16 |
| Rock lobster | 383 |
| Scalefish | 90 |
| Scallop | 30 |

**Figure 19.** Estimated number of people employed in Commercial Fishing in Tasmania in 2016. *Source:* TSIC Workforce Report, May 2017.




| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|
| Rock Lobster - Economic "size" ($ millions) | $439 | $242 | $210 | $200 | $200 | $242 | $315 | $368 | $420 | $630 |
| Abalone - Economic "size" ($ millions) | $914 | $870 | $683 | $794 | $644 | $613 | $578 | $578 | $700 | $875 |
| Rock Lobster - No. active Fishers | 230 | 234 | 253 | 263 | 245 | 227 | 226 | 239 | 227 | 205 |
| Abalone - No. active Divers | | | 118 | 123 | 119 | 117 | 114 | 109 | 104 | 102 |

**Figure 20.** Numbers of active harvesters employed in the Abalone and Rock Lobster fisheries relative to economic "size" (capitalisation of private quota holdings). *Sources:* DPIPWE - refer Table B.1 (Appendix B) for data sources and Table C.1. & C.2. (Appendix C) for supplementary data.

### 2.4.2. Levels of livelihood opportunity and vulnerability

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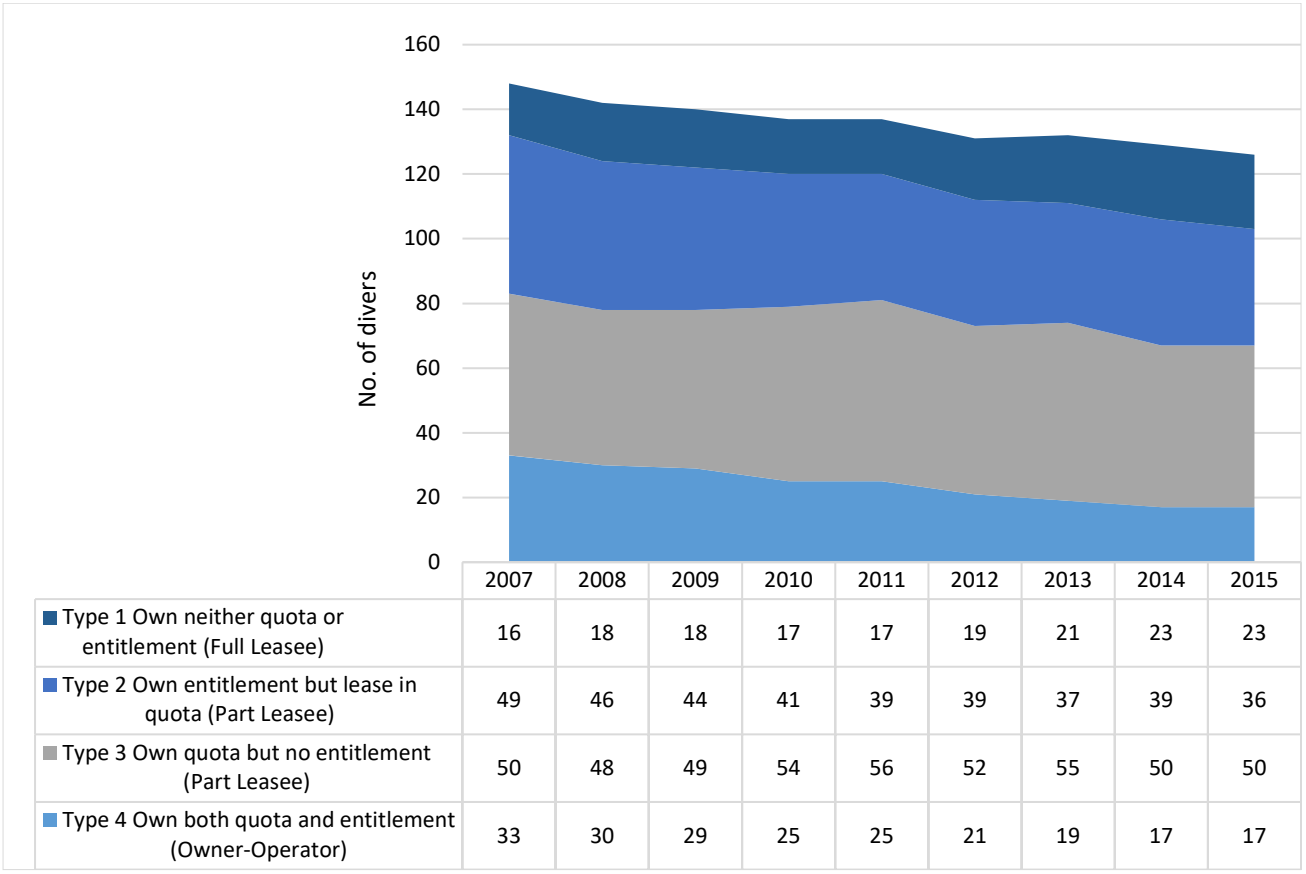
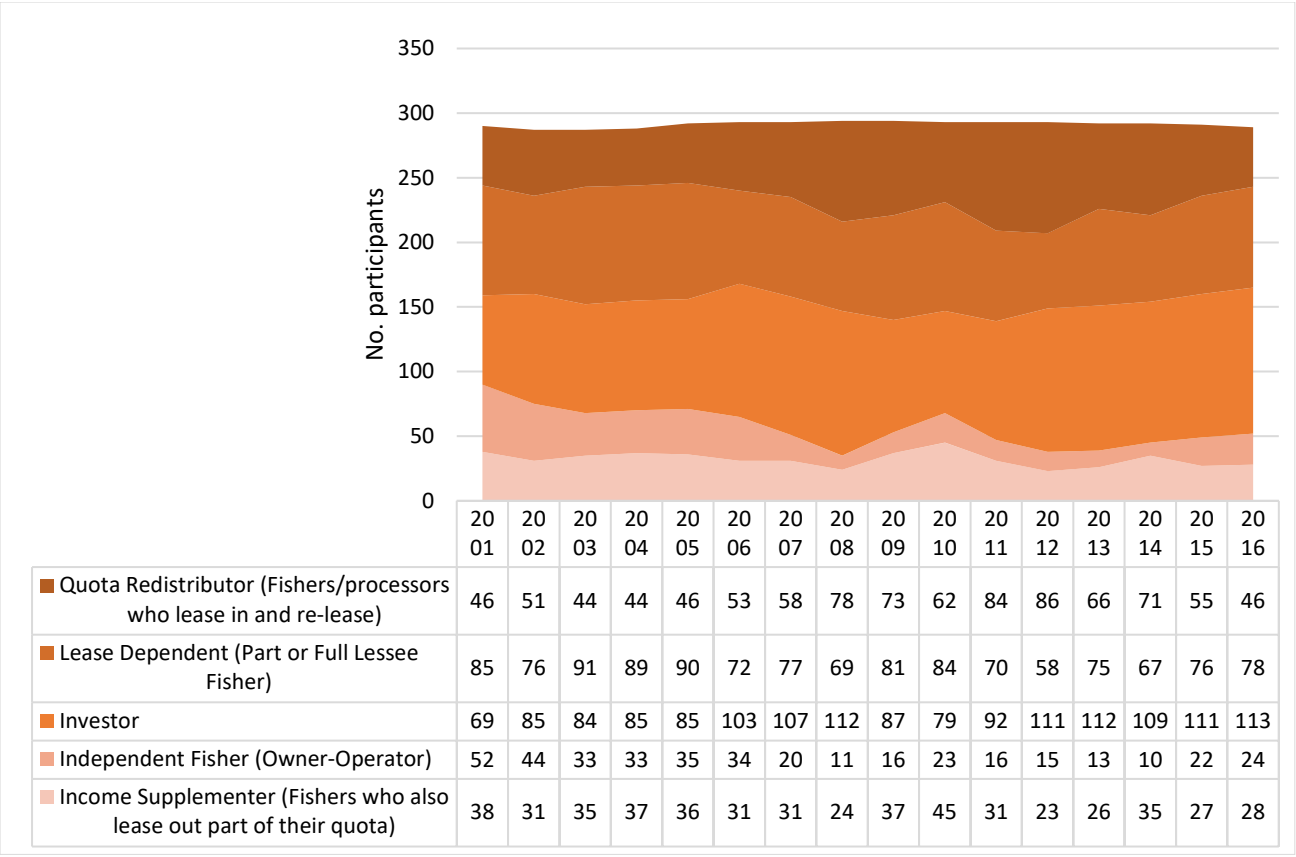
|---|---|
| **How is the *level of livelihood vulnerability* defined and measured?** | Fishers in commercial fisheries require access to enter (in the form of licenses or entitlements) and permissions to extract (in the form of quota units in quota-managed fisheries), in order to pursue a livelihood. Licenses or entitlements and quota units can be either owned by fishers or leased from investors. Markets for licences, entitlements and quota units can generate both opportunities and constraints for participating fishers.<br><br>Changes in levels of license access and activation, ownership by fishers, and lease-dependency of fishers indicate changing levels of social and economic benefits and livelihood vulnerability distributed across active fishers.<br><br>Participation types are defined by level of ownership; level of harvest; and, lease behaviour. |
| **Why is assessment of this measure important?** | Ownership of fishing licenses, entitlements and quota units can indicate social standing and employment status of harvesters, which is in turn an important indicator of socioeconomic status and of social vulnerability.<br><br>Levels of lease-dependency indicate the extent to which participation in the fishery is by fishers who do not benefit from the economic yields from harvesting the resource, and whose participation is subject to the conditions of quota or entitlement lease markets. |
| **What does this analysis show?** | In both the **Abalone** and **Rock Lobster** fisheries the proportion of participants who are owner-operators has declined across the period of assessment. For both fisheries, owner-operators are now the smallest participating group by size. In both the **Abalone** and **Rock Lobster** fisheries approximately three-quarters of all participants are active in the lease market. This includes as lesees or lessors, for both entitlements and quota units.<br><br>In the **Scalefish** fishery, high levels of inactivated licenses indicate the low barriers to entry into the fishery. This is supported by the finding that market values for Scalefish Fishing License A or B are as low $5,000, with limited demand for leasing.<br><br>Similarly, for the **Giant Crab** and **Scallop** fisheries the barriers to entry are low, and market prices for quota units are low or negligible. In all of these cases this is reflected by the small economic “size (quota or license market capitalisation, see section 2.1.2) of these fisheries.<br><br>In contrast, entry into the **Commercial Dive** fishery is increasingly limited by the rising license value (reported as $20,000 per license in 2016 and rising to $50,000 in 2017) as demand and beach prices for urchins and other targeted species increase. |
| **What factors explain this result?** | Declines in the level of participation by owner-operators, relative to the level of lease-dependency, in the **Abalone** and **Rock Lobster** fisheries is expected in Individual Transferable Quota (ITQ) systems and indicates that the market for quota units is functioning. |

| | |
|---|---|
| | Low levels of activation of **Scalefish** and **Scallop** licenses are likely to be caused by market constraints and the availability of harvestable fish (Scallop in particular), reducing the opportunity and associated economic and social benefits to fishers from participation. |



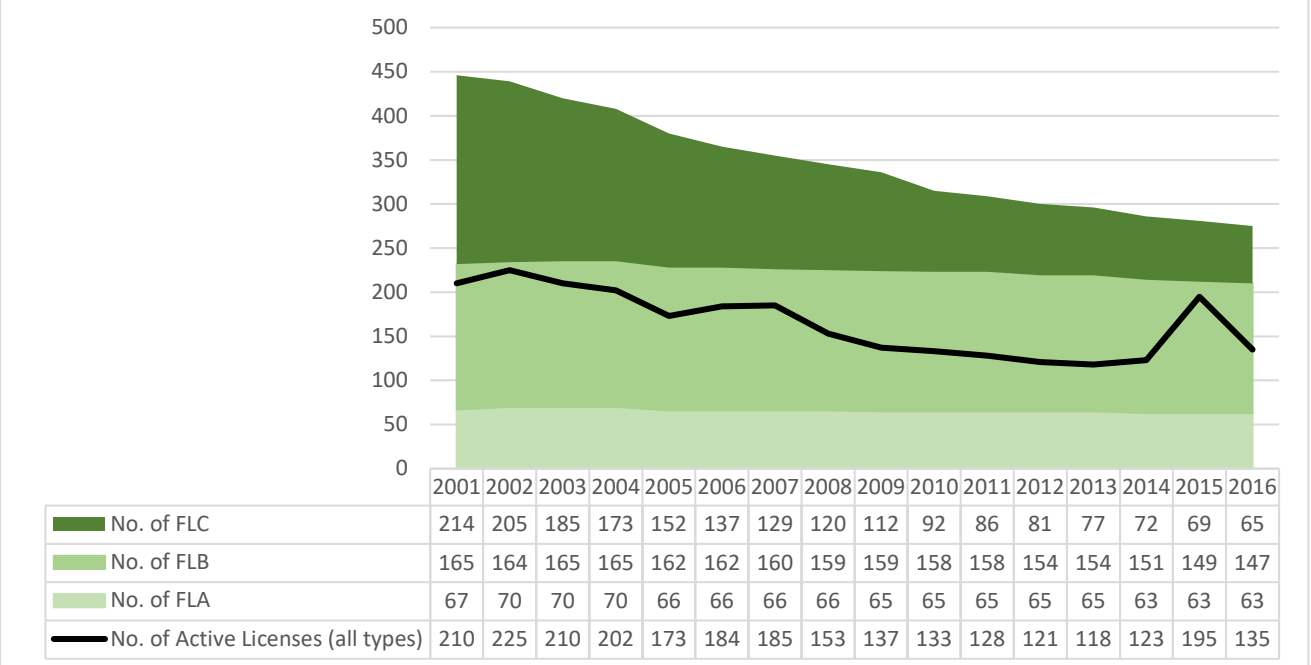

| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|
| Type 1 Own neither quota or entitlement (Full Leasee) | 16 | 18 | 18 | 17 | 17 | 19 | 21 | 23 | 23 |
| Type 2 Own entitlement but lease in quota (Part Leasee) | 49 | 46 | 44 | 41 | 39 | 39 | 37 | 39 | 36 |
| Type 3 Own quota but no entitlement (Part Leasee) | 50 | 48 | 49 | 54 | 56 | 52 | 55 | 50 | 50 |
| Type 4 Own both quota and entitlement (Owner-Operator) | 33 | 30 | 29 | 25 | 25 | 21 | 19 | 17 | 17 |

**Figure 21.** Proportion of divers in the Abalone Fishery by type across time. *Sources:* DPIPWE - refer Table B.1. (Appendix B) for data sources.




| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Quota Redistributor (Fishers/processors who lease in and re-lease) | 46 | 51 | 44 | 44 | 46 | 53 | 58 | 78 | 73 | 62 | 84 | 86 | 66 | 71 | 55 | 46 |
| Lease Dependent (Part or Full Lessee Fisher) | 85 | 76 | 91 | 89 | 90 | 72 | 77 | 69 | 81 | 84 | 70 | 58 | 75 | 67 | 76 | 78 |
| Investor | 69 | 85 | 84 | 85 | 85 | 103 | 107 | 112 | 87 | 79 | 92 | 111 | 112 | 109 | 111 | 113 |
| Independent Fisher (Owner-Operator) | 52 | 44 | 33 | 33 | 35 | 34 | 20 | 11 | 16 | 23 | 16 | 15 | 13 | 10 | 22 | 24 |
| Income Supplementer (Fishers who also lease out part of their quota) | 38 | 31 | 35 | 37 | 36 | 31 | 31 | 24 | 37 | 45 | 31 | 23 | 26 | 35 | 27 | 28 |

**Figure 22.** Proportion of participants in the Rock Lobster fishery by type across time. This analysis excludes a number of participants due to lack of data on type of participation. *Sources:* DPIPWE - refer Table B.1. (Appendix B) for data sources.




| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. of FLC | 214 | 205 | 185 | 173 | 152 | 137 | 129 | 120 | 112 | 92 | 86 | 81 | 77 | 72 | 69 | 65 |
| No. of FLB | 165 | 164 | 165 | 165 | 162 | 162 | 160 | 159 | 159 | 158 | 158 | 154 | 154 | 151 | 149 | 147 |
| No. of FLA | 67 | 70 | 70 | 70 | 66 | 66 | 66 | 66 | 65 | 65 | 65 | 65 | 65 | 63 | 63 | 63 |
| No. of Active Licenses (all types) | 210 | 225 | 210 | 202 | 173 | 184 | 185 | 153 | 137 | 133 | 128 | 121 | 118 | 123 | 195 | 135 |

**Figure 23.** Number of Scalefish Licenses actively fished relative to total number of available licenses. *Source:* Moore, Lyle et al. (2018).

### 2.4.3. Levels of catch sold into Tasmanian markets

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|---|---|
| **How is the *level of catch sold locally* defined and measured?** | Data on levels of local purchase and consumption of fish commercially harvested in Tasmania is not available.<br><br>The comparative availability of **Abalone** and **Rock Lobster** product can be inferred by comparing the value of sales to local markets with those to interstate and international markets.<br><br>The real availability of **Scallops** to local consumers can be obtained from landings data, as the majority of Tasmanian-caught scallops are processed and consumed in Tasmania. However, this is likely to be an over-estimate due to unknown volumes being shipped to Melbourne markets. Measures of volume of Scallop product are by whole weight (i.e. shell and other inedible parts included), in contrast to measures of other seafood product which are of edible portions only. Approximately 33% of the reported weight of Scallop product is edible.<br><br>The real availability of species caught within the **Scalefish fishery** (the majority of which are sold into local markets) to local consumers can be inferred from the total annual catch (volume) of this fishery minus catch of species that are known to be predominantly sold into markets outside Tasmania or mainly harvested for bait (Australian salmon, wrasse, banded morwong, garfish, calamari and arrow squid). |
| **Why is this measure important?** | One benefit to the community from resource industries is through the provision of product. The first step in establishing if the Tasmanian community receives any benefit from locally-caught seafood is to measure the volume of catch sold into Tasmania. A second step, not undertaken here, would be to assess if there is any consumer surplus from being able to access Tasmanian seafood. This is a possible research need because it is plausible that there is no consumer surplus for local Tasmanian seafood because product is readily imported and exported. That is, consumers in Tasmania may have no greater access or welfare from Tasmanian seafood than consumers interstate or overseas.<br><br>Species such as Flathead and Striped trumpeter may have some cultural value to Tasmanian consumers due to their local iconic status and their traditional consumption at key festive occasions. |
| **What does this analysis show?** | Production data for Tasmanian commercial fisheries indicates that in 2015-16 4,680 tonnes of locally-caught seafood was landed in Tasmania. Approximately 3,048 tonnes was exported to markets and consumers in other State of Australia or overseas.<br><br>Seafood consumption per person in Australia is estimated to be 14.5 kilograms per year. This suggests that the 1,632 tonnes of locally-caught seafood that is not exported is able to meet 22% of Tasmania's seafood consumption needs, or 3.1kg of the 14.5kg per person annual level of consumption. The remaining 78% of local seafood consumption needs are likely to be met by farmed and imported seafood product, or seafood caught recreationally. |

| | |
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| | The majority of **Abalone** and **Rock Lobster** product is sold interstate and overseas. Sales to local (Tasmanian) markets were less than 1% of **Abalone** and 13% of **Rock Lobster** in 2015/16.<br><br>Availability of **Scalefish fishery** products to local consumers has decreased from 2000/01 to 2015/16 due to the decline in catch by more than 60% across this period.<br><br>The majority of **Scallops** landed in Tasmania are consumed locally, sold as a premium fresh product or processed for pies. However the volume of scallop landed by fishers licensed in the Tasmanian fishery has ranged from approximately 4,000 tonnes in 2006-07 to zero in 2009-10 or catches of 744 tonnes in 2015-16, due to variable recruitment into the fishery and its effect on the availability of harvestable scallops. |
| **What factors explain this result?** | The availability of Tasmanian caught fish to Tasmanian consumers is influenced by a variety of factors, including lower average income levels and the lack of willingness of local retailers and consumers to pay the equivalent price paid by interstate and overseas markets and consumers. Declining trends in the availability to local consumers of **Scalefish fishery** products can also be accounted for by declining biomass, changing consumer preferences resulting in a decline in demand for some species, and competition with recreational fishers. |

**Table 4.** Total tonnage of seafood produced by Tasmanian commercial fisheries estimated to be available to local consumers in 2015/16. *Known to be an over estimate due to tanking of product locally before export. **Edible portion assumed to be 33% of whole weight landed, which was 744t. *Sources:* Tas Agri-Food Scorecard 2015/16 (DPIPWE 2017); ABARES (2016).

| **Seafood product** | **Tonnes (t)** |
|---|---|
| Barracouta | 1.4 |
| Boarfish | 0.7 |
| Cod | 1.3 |
| Flathead | 81.9 |
| Flounder | 3.3 |
| Gurnard | 2.7 |
| Leatherjacket | 2.6 |
| Ling | 0.1 |
| Jackass morwong | 1.6 |
| Mullet | 0.2 |
| Trevally | 3.6 |
| Bastard trumpeter | 6.4 |
| Striped trumpeter | 12.3 |
| Warehou | 8.0 |
| Whiting | 26.0 |
| Shark | 15.9 |
| Rock lobster* | 330.0 |
| Abalone* | 1.0 |
| Scallops** | 245.5 |
| Octopus | 84.5 |
| Squids | 298.2 |
| **Total** | **1126.7** |
| ***Total production (includes exported products)*** | ***4,180.2*** |

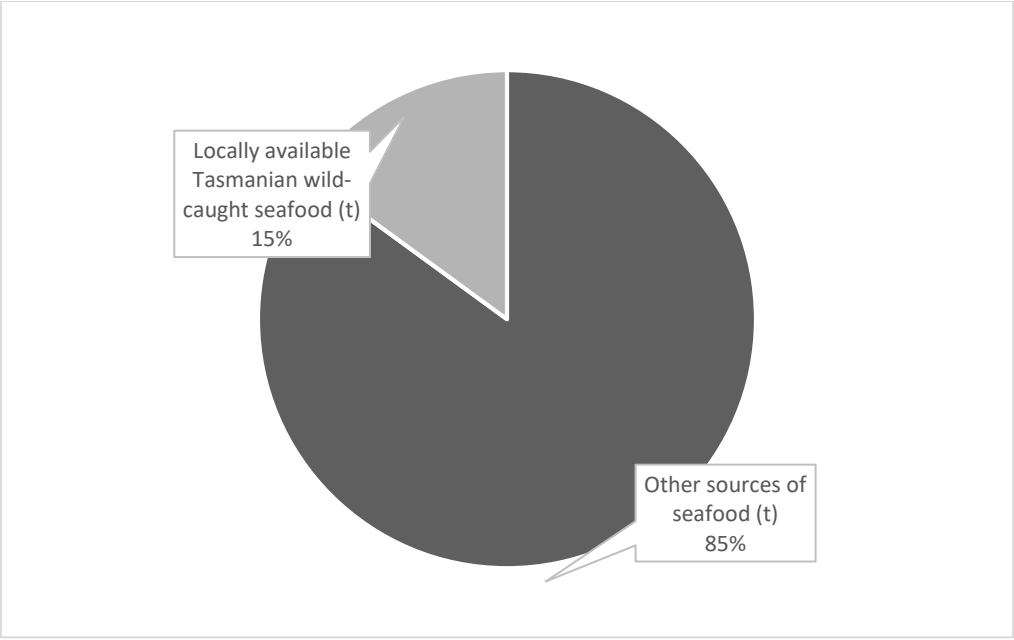


**Figure 24.** Proportion of total annual Tasmanian seafood consumption needs that is met by locally-available locally wild-caught seafood products. Assumes seafood consumption per capita per year at national average of 14.5kg. Sources: Tas Agri-Food Scorecard 2015/16 (DPIPWE 2017); ABS and ABARES export data (Department of Agriculture 2015, ABARES 2016).

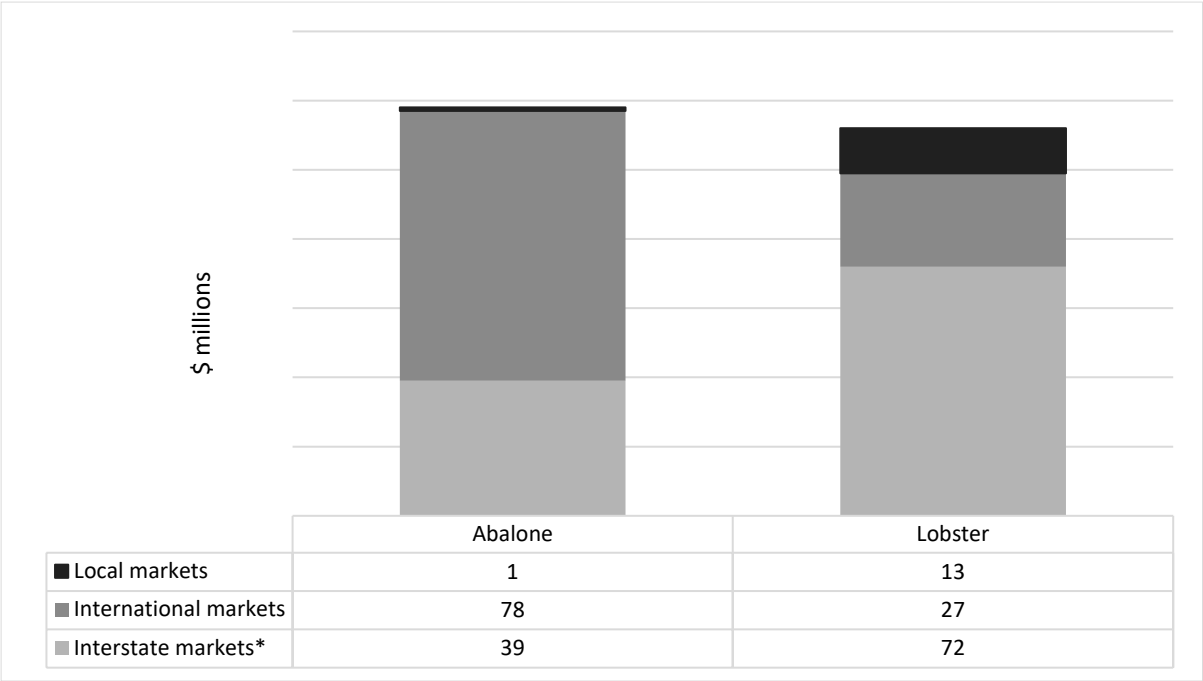


**Figure 25.** Tasmanian Abalone and Rock Lobster sales by location of market in 2015-16 *Includes interstate wholesale markets from which product exported to international markets. *Sources:* Tas Agri-Food Scorecard 2015/16 (DPIPWE 2017); ABS and ABARES export data (Department of Agriculture 2015, ABARES 2016).

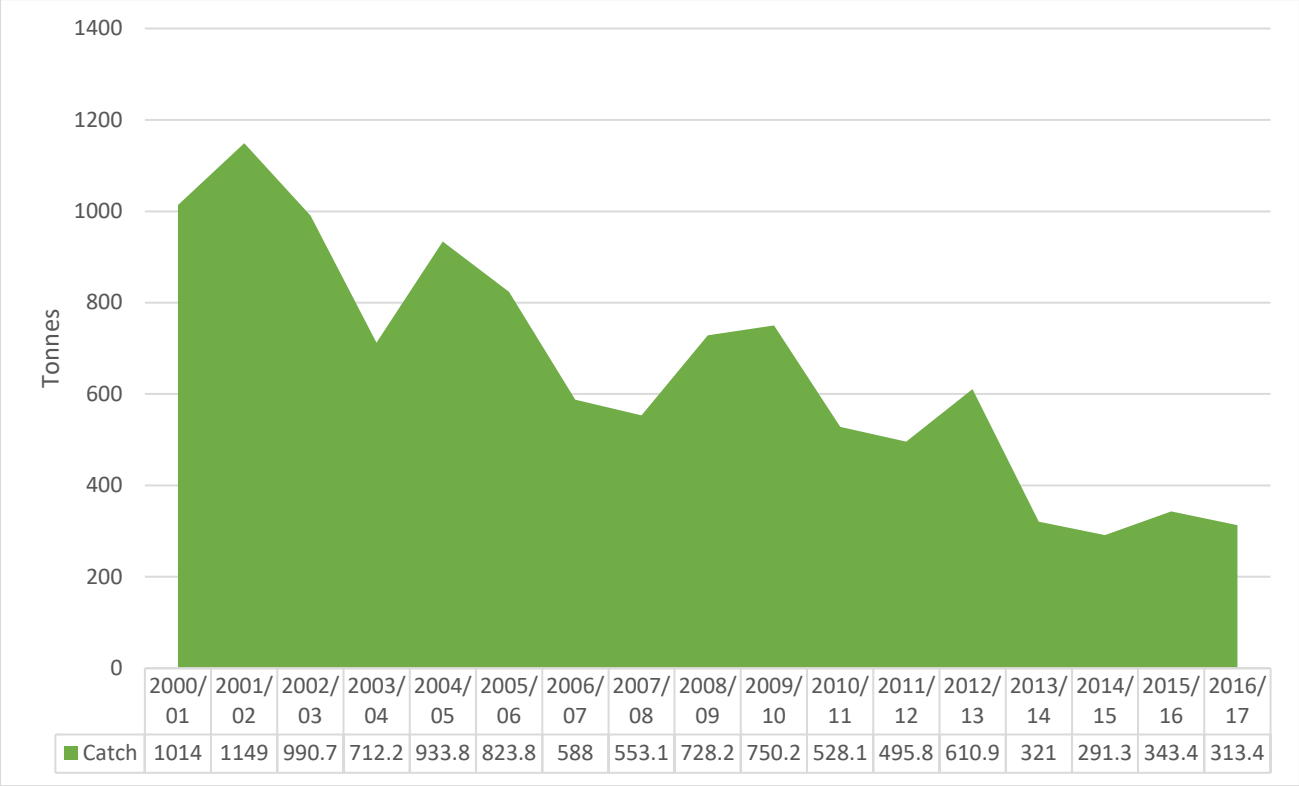


**Figure 26.**Trend in commercial catch of Tasmanian Scalefish Fishery (all species). Note this volume includes catches of species sold to interstate markets (i.e. not consumed in Tasmania). This is estimated to be approximately 50% of the total volume landed in 2015/16. *Source:* Moore, Lyle et al. (2018).

# 3. RECREATIONAL FISHERIES

## 3.1. Participation in recreational fishing

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| **How is participation in recreational fishing defined and measured?** | Participation in recreational fishing is measured by the number of Tasmanian residents who fished at least once a year.<br><br>In Tasmania data on recreational fishing participation is collected through a general population telephone survey.<br><br>A further measure of recreational fishing participation is the level of avidity, or frequency of participation with a year. Numbers of participants combined with levels of avidity generates a measure of total annual Fisher Days.<br><br>Participation is not a measure of catch (released or landed) but a measure of effort. |
| **Why is the level of participation important?** | Participation levels in recreational fishing is an indicator of the extent to which members of the Tasmanian community have the opportunity to recreationally fish, as provided through fisheries management arrangements. It also an indirect indicator of the level of amenity values and social benefits gained by recreational fishers arising from participation.<br><br>Measuring levels of recreational fisher avidity provides a profile of the population of recreational fishers, and the associated levels of use of marine resources and amenity values derived by different categories of fishers.<br><br>Estimating the total number of Fisher Days annually provides a measure of whether recreational fishing amenity is increasing or decreasing, and whether associated changes in effort have implications for the sustainability of the targeted fish species. |
| **What does this analysis show?** | Overall, the number of Tasmanian residents who recreationally fish, and the number of days they participate in fishing each year, is declining.<br><br>The number of Tasmanian residents who participated in recreational fishing (all types, inclusive of **Abalone** and **Scallop** diving, **Rock lobster** and **Scalefish** fishing) decreased by approximately 20% from 2000/01 to 2012/13. Similarly, the total yearly number of Fisher Days declined by approximately 30% across the same time.<br><br>In 2012/13 the majority of Tasmanian residents who recreationally fished did so for fewer than 5 days each year. A small proportion of avid fishers (20%) accounted for 55% of the total effort.<br><br>The number of recreational fishers participating in the **Abalone** fishery decreased by approximately 35% from 2002/03 to 2016/17. The decline in Fisher Days per year has been even more significant (64%), indicating that the decline is more attributable to lower levels of annual fishing effort (avidity) by fishers.<br><br>In contrast, the number of recreational fishers participating in the **Rock Lobster fishery** has remained steady across the period 2002/03 to 2016/17. |

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| | The number of Fisher Days per year has declined by 20% across this period, indicating a decline in levels of fishing effort (avidity) by participants as numbers of people participating in recreational fishing for Rock lobster has remained constant.<br><br>Levels of participation in recreational diving for **Scallops** have declined significantly due the closure of significant beds. The D'Entrecasteaux Channel, which historically accounts for 95% of the recreational fishery, is managed as a separate scallop fishing area. The Channel has been effectively closed since 2011 to allow stocks to recover. |
| **What factors explain this result?** | Levels of participation in recreational fishing is affected by a variety of factors, including:<br>• Changes in preferences and motivations of recreational fishers for recreational activity<br>• Cost of fishing<br>• Availability of discretionary time to participate in recreational activities generally<br>• Declines in abundance and therefore catch rates of species targeted by recreational fishers<br>• Seasonal and spatial closures due to disease outbreaks and harmful algal blooms |

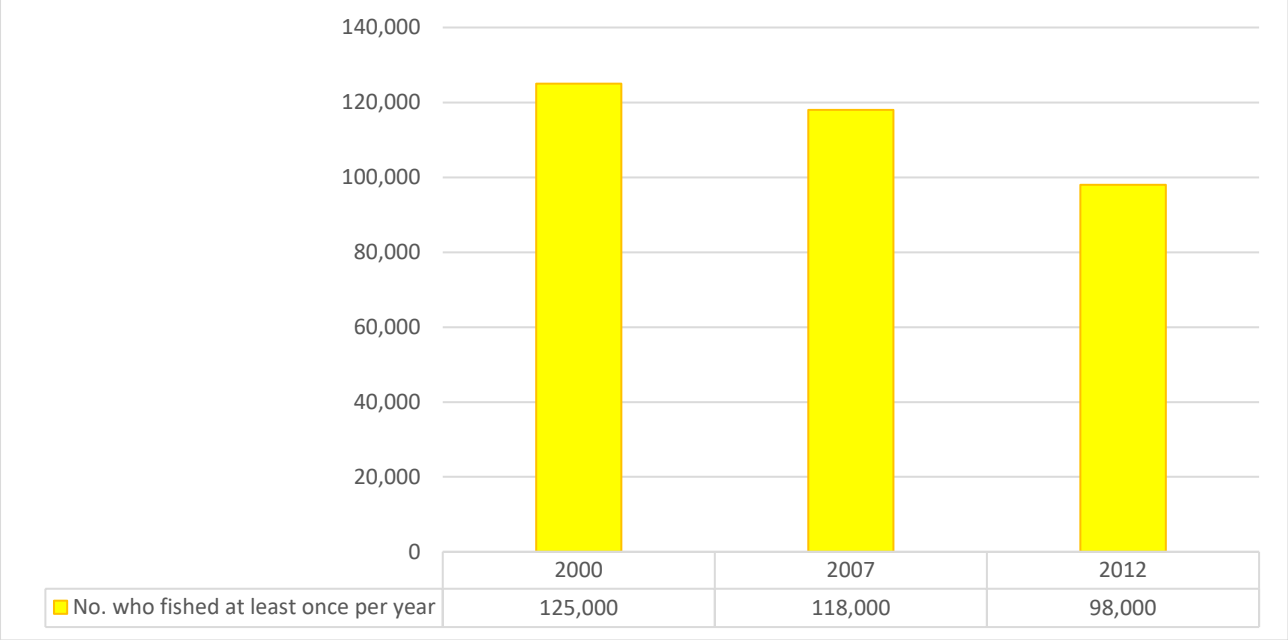



**Figure 27.** Levels of participation in Recreational Fishing (coastal and marine – all types) in Tasmania. *Source:* Lyle, Stark et al. (2014).

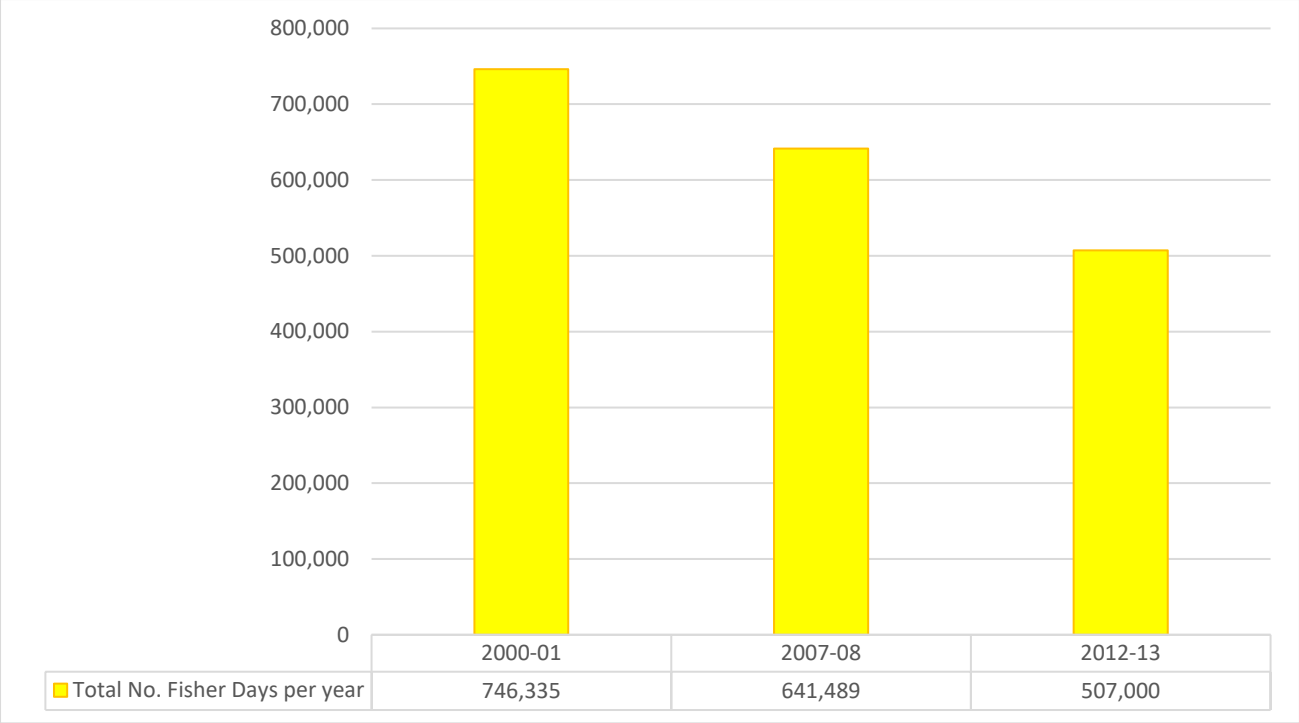



**Figure 28.** Number of Fisher Days per year of Recreational Fishing (coastal and marine – all types) in Tasmania. *Source:* Lyle, Stark et al. (2014).

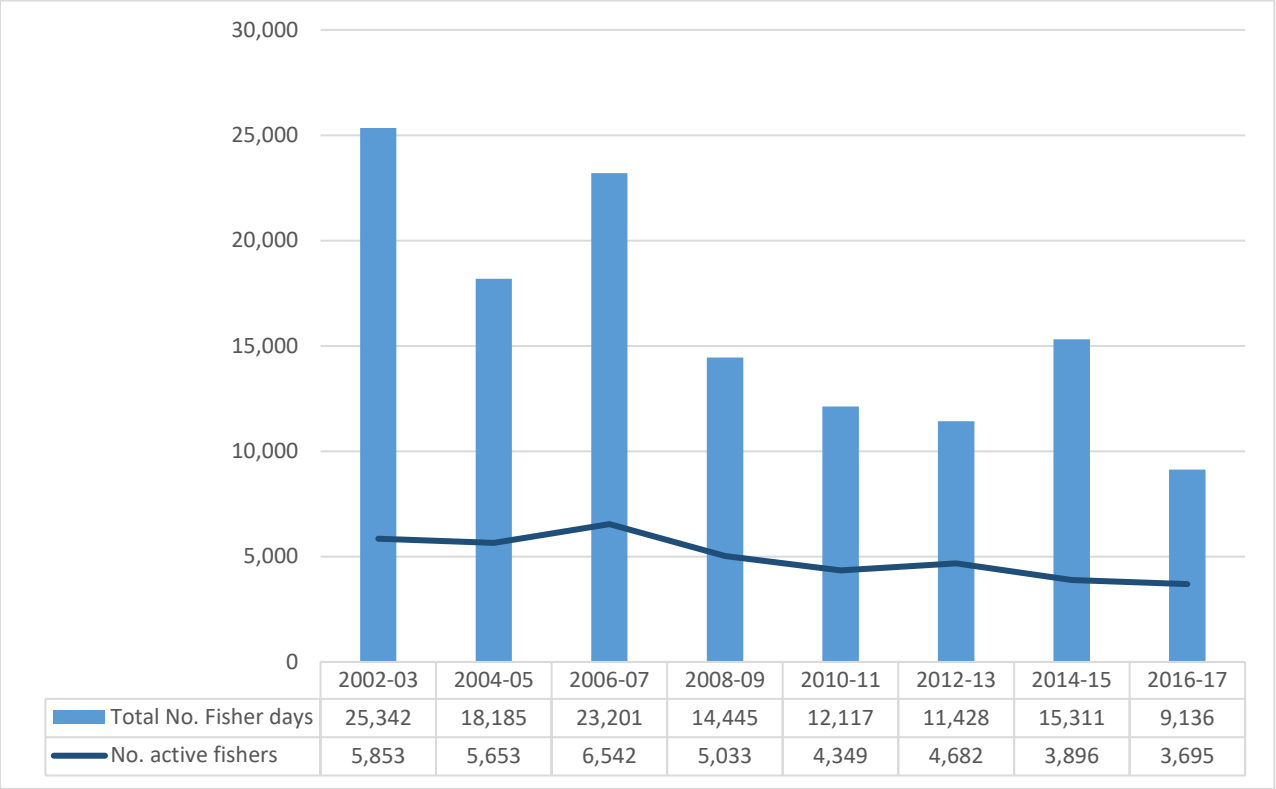
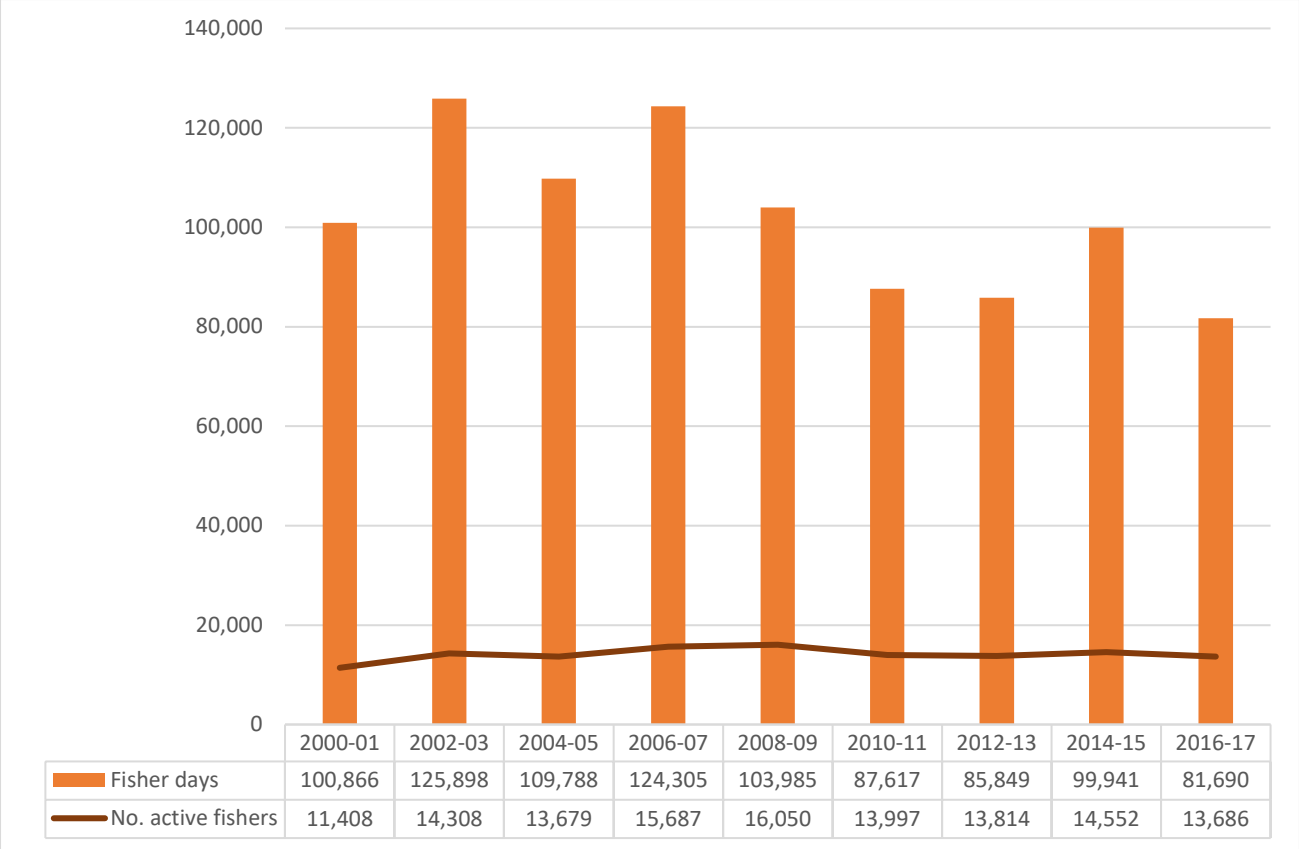



**Figure 29.** Number of Fisher Days and active fishers per year participating in the Tasmanian Abalone Fishery. *Source:* Lyle and Tracey (2014, 2016, 2016, 2017).




| | 2000-01 | 2002-03 | 2004-05 | 2006-07 | 2008-09 | 2010-11 | 2012-13 | 2014-15 | 2016-17 |
|---|---|---|---|---|---|---|---|---|---|
| Fisher days | 100,866 | 125,898 | 109,788 | 124,305 | 103,985 | 87,617 | 85,849 | 99,941 | 81,690 |
| No. active fishers | 11,408 | 14,308 | 13,679 | 15,687 | 16,050 | 13,997 | 13,814 | 14,552 | 13,686 |

**Figure 30.** Number of Fisher Days and active fishers per year participating in the Tasmanian Rock Lobster Fishery. *Sources:* Lyle and Tracey (2014, 2016, 2016, 2017)

## 1.2. Quality of recreational fishing experience

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| **How is *quality of recreational fishing experience* defined and measured?** | Quality of recreational fishing experience varies by individual fisher, and is dependent on their motivations for participating in recreational fishing. Quality of fishing is measured as "utility" in fisheries economics and can be compared with economic yield in commercial fisheries.<br><br>For the majority of Tasmanian recreational fishers, non-catch motives relating to relaxation, socialising and the environment are important (Lyle, Stark et al. 2014). However, motivations for participation in Tasmania's **Abalone** and **Rock Lobster** fisheries are considered to be largely consumptive (that is, fishing for a feed).<br><br>For the purposes of this assessment of quality of **Abalone** and **Rock Lobster** recreational fishing, quality is measured using recreational strike rate as a proxy for fisher satisfaction or quality of recreational experience, based on the catchability of the targeted species (for example, proportion of active Fishers with a greater than zero annual catch). There is a need to quantitatively assess recreational fishing satisfaction across a range of targeted species by obtaining measures of utility through survey techniques because a recreational fisher may feel satisfied even without catching any fish. |
| **Why is this measure important?** | Individual dive or season harvest levels can be used to infer levels of fisher satisfaction or quality of recreational experience for fisheries where motivations are predominantly consumptive in orientation. They are direct measures of the provision of seafood for local consumption by recreational fishers and their communities.<br><br>These estimates also reveal how equitably the distribution of the total recreational catch is shared across all participating fishers. |
| **What does this analysis show?** | Between 17-21% of all dives by recreational **Abalone** fishers result in no (zero) harvest of abalone, and therefore no or limited fisher satisfaction or quality of recreational experience (Figure 31). This proportion appears to be remaining stable across the period 2012-13 to 2016-17. The large majority of dives do result in the catch of at least one Abalone, with the largest proportion of dives resulting in the catch of between 1-9 Abalone. This indicates that divers are not motivated or able to catch the daily harvest limit of 10 in the majority of dives.<br><br>The proportion of recreational fishers targeting **Rock Lobster** in 2016-17 who harvested no (zero) lobster in the fishing season was 14% (Figure 32). This proportion has declined since 2012-14 and 2014-15, when it was 20%, indicating that fisher satisfaction or quality of recreational experience arising from this fishery has increased. This is despite the effect on recreational |

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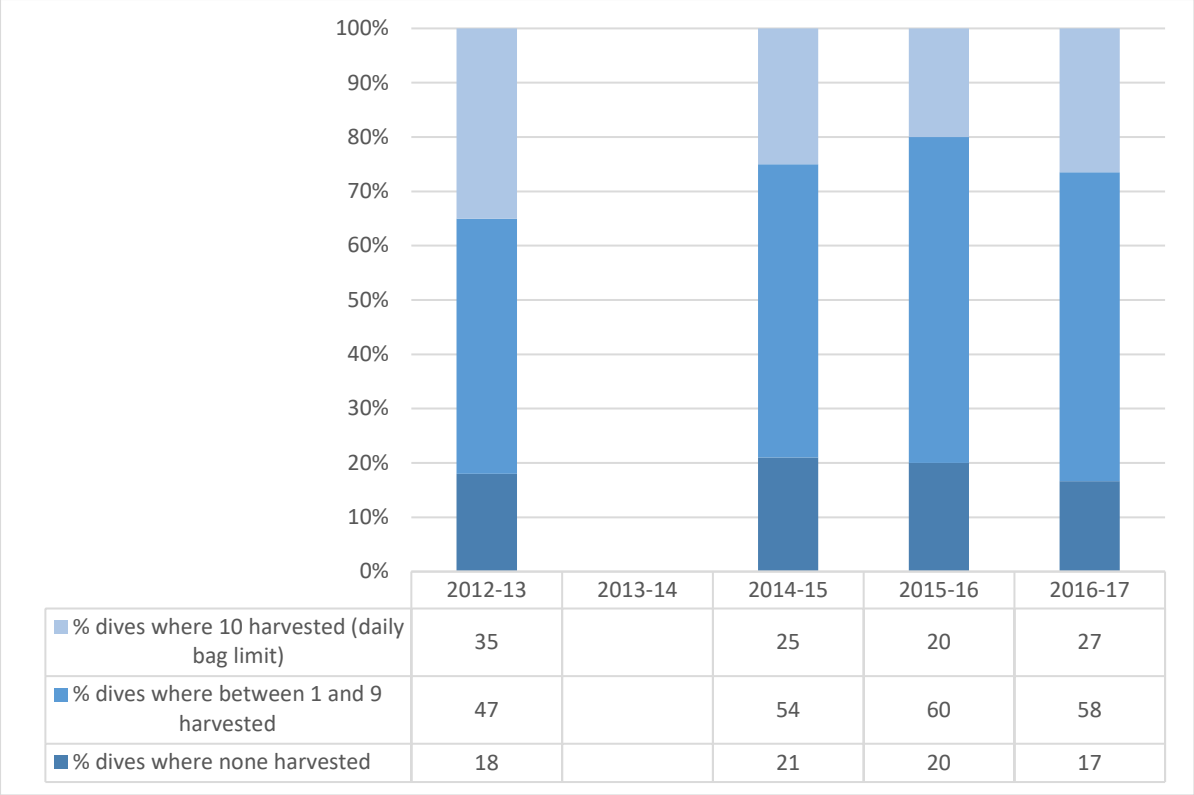
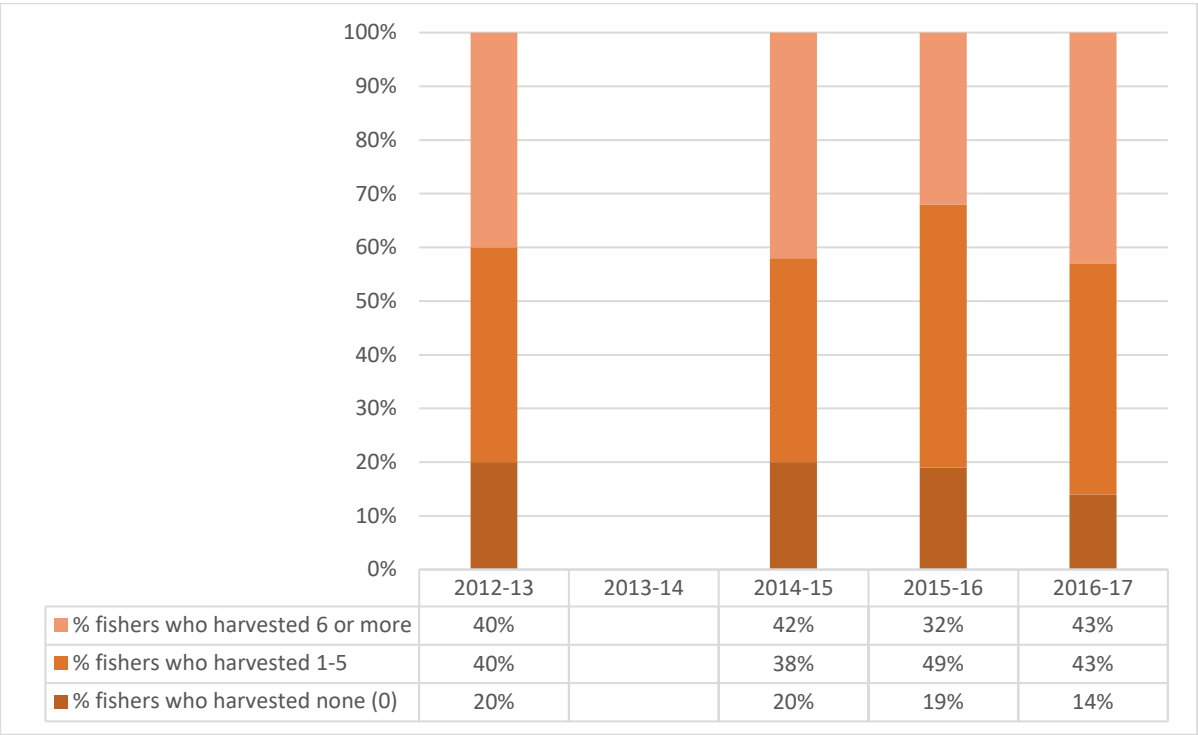
| | catch of the reduction in bag limits and closures on East Coast due to harmful algal blooms (HABS), and of the increase in recreational fisher participation reported in 2016-17.<br><br>In 2016-17, the 6% of recreational fishers who harvested 20 or more Rock lobsters accounted for more than 26% of the total recreational catch, indicating that a small proportion of the recreational fisher population retains a proportionally high share of the resource available to all recreational fishers. However, of this 6% of fishers, proportionally fewer are catching these lobsters on the East Coast of Tasmania compared to historical levels. |
| **What factors explain this result?** | Factors which account for detected levels of individual recreational dives where no **Abalone** are harvested may include:<br><br>• Declining participation in recreational diving for Abalone<br>• Declining stock availability on the East Coast, where recreational Abalone dive effort is concentrated<br>• Changes in preferences and motivations of recreational fishers for recreational activity, leading to lower levels of participation (and, therefore, catch) each year<br><br>Factors which account for detected levels of individual seasonal harvest of **Rock Lobster** by recreational fishers where no catch is recorded, or where individual seasonal harvest levels are lower, may include:<br><br>• Declining participation in recreational fishing for Rock Lobster on the East Coast of Tasmania, where catchability and recreational opportunity has declined. These declines have been caused by seasonal and spatial closures due to disease outbreaks and harmful algal blooms, leading to less frequent participation in a year period (and, therefore, lower annual catch), as well as reductions in bag limits for recreational fishers<br>• In comparison, catchability of Rock Lobsters has increased in other areas, providing increased recreational opportunity and quality of opportunity for recreational fishers |




| | 2012-13 | 2013-14 | 2014-15 | 2015-16 | 2016-17 |
|---|---|---|---|---|---|
| % dives where 10 harvested (daily bag limit) | 35 | | 25 | 20 | 27 |
| % dives where between 1 and 9 harvested | 47 | | 54 | 60 | 58 |
| % dives where none harvested | 18 | | 21 | 20 | 17 |

**Figure 31.** Proportion of all Recreational Abalone Fisher dives in each season by number of Abalone caught in that dive. *Source:* Lyle and Tracey (2014, 2016, 2016, 2017)




| | 2012-13 | 2013-14 | 2014-15 | 2015-16 | 2016-17 |
|---|---|---|---|---|---|
| % fishers who harvested 6 or more | 40% | | 42% | 32% | 43% |
| % fishers who harvested 1-5 | 40% | | 38% | 49% | 43% |
| % fishers who harvested none (0) | 20% | | 20% | 19% | 14% |

**Figure 32.** Proportion of all active Recreational Rock Lobster Fishers by individual annual harvest estimate. *Source:* Lyle and Tracey (2014, 2016, 2016, 2017)

# 4. TASMANIAN ABORIGINAL FISHERIES

## 4.1. Tasmanian Aboriginal Community access and opportunity

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| **How is *access and opportunity* defined and measured?** | Access by members of the Tasmanian Aboriginal community to fish in accordance with their traditions and cultural rights is measured by the existence of fisheries management provisions that enable or constrain such fishing activity.<br><br>Opportunity to catch fish in accordance with cultural traditions and practices has been affected by change in biomass of **Abalone** and **Rock Lobster**. Prior to large-scale reduction by European fishers, these species were harvested by hand in shallow or intertidal water (Cameron 2006, Taylor 2007). This requires populations with biomass close to estimated virgin biomass size (MacDiarmid, Freeman et al. 2013).<br><br>Non-commercial catch of any fish species by members of the Tasmanian Aboriginal community as part of Aboriginal fishing activities is not recorded, and therefore not reported here. |
| **Why are *access and opportunity* important?** | Taking fish from the sea continues within contemporary Aboriginal law and culture in Tasmania. |
| **What does this analysis show?** | Traditional Aboriginal fishing practices are protected under the *Native Title Act 1993.*<br><br>The *LMRMA 1995* provides for Aboriginal activities, including non-commercial fishing, the taking of prescribed fish for the manufacture of artefacts for sale and by the issuing of permits and exemptions. People engaging in Aboriginal activities associated with fish and fishing must be able to prove that they are Aboriginal and that their fishing is an Aboriginal activity. The Act exempts Aboriginal non-commercial fishers from requirements to hold a sea fishing licence but requires that they must comply with all other fisheries rules, including bag and possession limits, size restrictions and seasons.<br><br>Rock lobster pots, set lines, gillnets or unattended rock lobster rings used for Aboriginal activities must be clearly marked with a unique identification code (UIC) and the gear code. The 'Recognition of Aboriginal Fishing Activities and Allotting Unique Identifying Codes under the LMRMA 1995' policy (Tasmanian Government 2017) outlines these provisions.<br><br>There is provision in the Act to issue an exemption or permit for Aboriginal fishing activities that may be contrary to the existing recreational fishing provisions. To obtain these, it is necessary to demonstrate that the fishing activities are associated with Aboriginal cultural or ceremonial activities. |

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| | Catch rates of **Abalone** and **Rock Lobster** on Tasmania's inshore shallow rocky reefs and platforms using traditional harvest methods can be inferred to have declined since European colonisation. The biomass of Rock Lobsters biomass is less than 30% of natural levels in all assessment regions of the state and is less than 15% on the more accessible east coast. These levels affect the ability to conduct traditional cultural hand harvesting. |
| **What factors explain this result?** | Declines in **Rock Lobster** biomass have occurred through fishing. Stock rebuilding is underway but the east coast interim target of 20% natural levels by 2023 will not enable cultural hand harvesting. |

# 5. GLOSSARY OF KEY TERMS

| Term | Definition |
|---|---|
| Common-pool resource | A common-pool resource is a type of good consisting of a natural or human-made resource system (e.g. fishing grounds or stock). This good is commonly-held by society (i.e. all members of that society can potentially derive benefit), and is susceptible to over use. However the size or characteristics (e.g. mobility of fish) makes it costly, but not impossible, to limit access to all who can potentially benefit. |
| Economic benefit | Economic benefits are any benefit received from using a resource. This can include the revenue earned from commercial harvesting of fish or the non-monetary benefit associated with the recreational harvest of fish. These benefits can be gained by an individual person or firm, or by a community or State. |
| Economic rent | Economic rents are "excess returns" above the "normal levels" that are generated in competitive markets. More specifically, a rent is "a return in excess of the resource owner's opportunity cost" (Tollison 1982).<br><br>Economic rent is also referred to as resource rent for natural resources, such as forestry and fishery resources. A fishery is generally thought to be generating resource rent if the average economic returns to capital in the fishery are greater than normal economic returns.<br><br>In a perfectly homogeneous fishery, economic profits would be equivalent to resource rent, as this is the return from the fishery once the full cost of labour, capital and management had been taken into account. However, in fisheries with more heterogeneity in the fleet, some of this profit represent other “rents” such as the return to management, skipper skills or other individual vessel characteristics. Separating this intra-marginal rent from economic returns in order to estimate resource rent is difficult (Coglan and Pascoe 1999) and is usually not undertaken. In practice, most fisheries bioeconomic studies tend to focus on total fishery profit as a proxy for resource rent, and maximizing these profits is assumed equivalent to maximising resource rent (Hoshino et al, 2017).<br><br>In welfare economics, economic rent is any payment made (including imputed value) for non-produced inputs and for assets formed by creating official privilege over natural opportunities (e.g., quota unit ownership). |
| Economic yield | The total economic yield of a commercial fishery is the amount of surplus (or economic profit) available once all costs have been deducted from the sales of landed fish (revenue).<br><br>Costs include both explicit costs (i.e. fuel, bait and boat surveys), and implicit costs (i.e. unpaid labour and capital of licence owners) unlike accounting profit, which does not include these implicit costs. |

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| Market capitalisation | Market capitalisation refers to the total dollar market value of a company's outstanding shares. It is calculated by multiplying a company's shares outstanding by the current market price of one share. The concept of market capitalisation can be applied to the quota or license markets of a commercial fishery, but excludes any measure of real capital (i.e. boats). |
| Royalty | It is a payment made in return for the right to exercise a beneficial privilege or right (e.g. to remove natural resources).<br><br>However, while the term 'Royalty' is used to describe the annual payment by Abalone quota unit holders to the State as specified in the Abalone Deed of Agreement, this payment used by the State Government of Tasmania to support services required for management of the fishery (hence, not a royalty payment). |
| Social benefit | Social benefits includes a broader definition of benefits that an entity derives from a given activity or resource in comparison to economic benefits. The entity can be an individual, group, community or State. Often, the benefits to society are not captured in market-based information. |

# 6. REFERENCES


ABARES (2017) Australian fisheries and aquaculture statistics 2016 (Ed.s Mobsby, D. and A. Koduah) Canberra, December. CC BY 4.0., Fisheries Research and Development Corporation project 2017-095

Anderson, J. L., C. M. Anderson, J. Chu, J. Meredith, F. Asche, G. Sylvia, M. D. Smith, D. Anggraeni, R. Arthur, A. Guttormsen, J. K. McCluney, T. Ward, W. Akpalu, H. Eggert, J. Flores, M. A. Freeman, D. S. Holland, G. Knapp, M. Kobayashi, S. Larkin, K. MacLauchlin, K. Schnier, M. Soboil, S. Tveteras, H. Uchida and D. Valderrama (2015). "The fishery performance indicators: a management tool for triple bottom line outcomes." PLoS One **10**(5): e0122809.

Anderson, L. G. (2008). "The Control of Market Power in ITQ Fisheries." Marine Resource Economcis **Volume 23**: 25–35.

Cameron, P. (2006). "The Companion to Tasmanian History." Aboriginal Life Pre-Invasion Retrieved 6 December, 2017, from http://www.utas.edu.au/library/companion_to_tasmanian_history/A/Aboriginal%20life%20pre-invasion.htm.

Coglan L., Pascoe S. (1999) 'Separating resource rents from intramarginal rents in fisheries' economic survey data'. Agric Resour Econ Rev 28:219–228.

Department of Agriculture (2015). Australia's seafood trade: Updated 2015. Canberra, Department of Agriculture.

DPIF (1994). Policy document and fishery management plan for the Tasmanian scallop fishery [draft] Hobart, Tasmania, Marine Resources Division.

DPIF (1997). Rock Lobster Fishery Policy Document. D. P. I. Fisheries. Hobart, Tasmania.

DPIWE (2000). The Tasmanian Abalone Fishery Revised Policy Paper. W. a. t. E. Dept Primary Industries. Hobart, Tasmania.

DPIPWE (2017). Tasmanian Agri-Food Scorecard 2015-16. Hobart, Tasmania, AgGrowth - Department of Primary Industries, Parks, Water and Environment.

Econsearch (2015). A Best Practice Protocol and Methodology for Economic Data Collection in Australian Fisheries. Adelaide, Australian Seafood Cooperative Research Centre, Fisheries Research and Development Corporation.

Emery, T., K. Hartmann and C. Gardner (2014). Tasmanian Giant Crab Fishery 2013/14. Hobart, Tasmania, Institute for Marine and Antarctic Studies.

Farrell, M. J. (1957). 'The Measurement of Productive Efficiency.' Journal of the Royal Statistical Society, 120: 253-290.

Gardner, C., K. Hartmann and D. Hobday (2012). Tasmanian Rock Lobster Fishery Assessment 2011-12. Hobart, Tasmania, IMAS, University of Tasmania.

Hoshino, E., Pascoe, S., Hutton, T. , Kompas,T., Yamazaki, S. (2018) 'Estimating maximum economic yield in multispecies fisheries: a review.' Rev Fish Biol Fisheries 28: 261. https://doi.org/10.1007/s11160-017-9508-8

Kompas, T., R. Q. Grafton, N. Che and P. Gooday (2009) Development of methods and information to support the assessment of economic performance in Commonwealth fisheries. ABARES Report to the Fisheries Research and Development Corporation, Canberra, February.

Lyle, J., K. E. Starkand S. R. Tracey (2014). 2012-13 Survey of Recreational Fishing in Tasmania. Hobart, Tasmania, IMAS, University of Tasmania.

Lyle, J. and S. Tracey (2014). Tasmanian Recreational Rock Lobster and Abalone Fisheries: 2012-13 fishing season. Hobart, IMAS, University of Tasmania.

Lyle, J. M. and S. R. Tracey (2016). Tasmanian Recreational Rock Lobster and Abalone Fisheries: 2014-15 fishing season. Hobart, IMAS, University of Tasmania.

Lyle, J. and S. Tracey (2016). Tasmanian Recreational Rock Lobster and Abalone Fisheries: 2015-16 fishing season. Hobart, IMAS, University of Tasmania.

Lyle, J. and S. Tracey (2017). Tasmanian Recreational Rock Lobster and Abalone Fisheries: 2016-17 fishing season. Hobart, IMAS, University of Tasmania.

MacDiarmid, A. B., D. Freeman and S. Kelly (2013). "Rock lobster biology and ecology: contributions to understanding through the Leigh Marine Laboratory 1962–2012." New Zealand Journal of Marine and Freshwater Research **47**(3): 313-333.

Moore, B., J. Lyle and K. Hartmann (2018). Tasmanian Scalefish Fishery Assessment 2016/17. Hobart, Institute for Marine and Antarctic Studies (IMAS).

Mundy, C. and H. Jones (2017). Tasmanian Abalone Fishery Assessment 2016. Hobart, Tasmania, IMAS, University of Tasmania.

Tasmanian Government (2017). Recognition of Aboriginal Fishing Activities and Allotting Unique Identifying Codes under the Living Marine Resources Management Act 1995. P. Department of Primary Industries, Water and Environment. Hobart, Tasmania, Tasmanian Government.

Taylor, R. (2007). "The polemics of eating fish in Tasmania: the historical evidence revisited." Aboriginal History **31**: 26pp.

Tollison, R. D. (1982). “Rent seeking: a survey”. *Kyklos* **35**: 575-602. doi:10.1111/j.1467-6435.1982.tb00174.x

Triantafillos, L., K. Brooks, J. Schirmer and S. Pascoe (2014). Managing the social dimension of fishing: Part 1 Introduction to social objectives and indicators in fisheries management. FRDC Project 2010-040 - Final Report. Adelaide, Primary Industries and Regions SA, Fisheries and Aquaculture 57.

TSIC (2017). Seafood Industry Workforce Profile: May 2017. Report prepared by Stern and Associates. Hobart, Tasmanian Seafood Industry Council.

van Putten, I., K. G. Hamon and C. Gardner (2011). "Network analysis of a rock lobster quota lease market." Fisheries Research **107**(1-3): 122-130.

Ziegler, P. E. (2012). "Fishing tactics and fleet structure of the small-scale coastal scalefish fishery in Tasmania, Australia." Fisheries Research **134-136**(Supplement C): 52-63.

# APPENDIX A: Objectives for Fisheries Management

The *Living Marine Resources Management Act 1995* sets out the objectives for the sustainable management of living marine resources in Tasmania and provides the framework for developing and implementing management arrangements for each of the State's fisheries.

The objectives of the legislation are provided in Section 7 and Schedule 1 of the Act and are consistent with the objectives of the resource management planning system of Tasmania (Table 1).

**Table A.1: Objectives of the *Living Marine Resources Management Act 1995***

**7. Purpose and objectives**

(1) The purpose of this Act is to achieve sustainable development of living marine resources having regard to the need to –

a) increase the community's understanding of the integrity of the ecosystem upon which fisheries depend; and
b) provide and maintain sustainability of living marine resources; and
c) take account of the community's needs in respect of living marine resources; and
d) take account of the community's interests in living marine resources.

(2) A person must perform any function or exercise any power under this Act in a manner which furthers the objective of resource management.

**SCHEDULE 1 - Objectives of the Resource Management and Planning System of Tasmania**

1. The objectives of the resource management and planning system of Tasmania are –

a) to promote the sustainable development of natural and physical resources and the maintenance of ecological processes and genetic diversity; and
b) to provide for the fair, orderly and sustainable use and development of air, land and water; and
c) to encourage public involvement in resource management and planning; and
d) to facilitate economic development in accordance with the objectives set out in paragraphs (a), (b) and (c); and
e) to promote the sharing of responsibility for resource management and planning between the different spheres of Government, the community and industry in the State.

2. In clause 1(a), ***sustainable development*** means managing the use, development and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic and cultural well-being and for their health and safety while –

a) sustaining the potential of natural and physical resources to meet the reasonably foreseeable needs of future generations; and
b) safeguarding the life-supporting capacity of air, water, soil and ecosystems; and
c) avoiding, remedying or mitigating any adverse effects of activities on the environment.

# APPENDIX B: Indicators, data sources, and calculations

**Table B.1. Data sources, requirements, calculations and assumptions**

| INDICATOR | Data source | Calculations | Assumptions and caveats |
|---|---|---|---|
| ***Commercial fisheries*** | | | |
| 2.1.1 Economic Yield (Abalone) | Beach price and catch data obtained from DPIPWE (FILMS) / IMAS database. Rates paid to divers to collect abalone are not recorded by DPIPWE so were obtained from quota brokers and processors. | Economic yield (EY) = (catch x beach price) – ((catch x harvest cost) + licence payment)) | Nominal beach price used and inflation is not taken into account.<br><br>The cost for harvest is determined by a market rate for divers, which averaged $7 per kg (2000-2014) and $7.5 per kg (2015 and 2016).<br><br>Assumes that government costs of management, research, compliance and crown prosecutor are fully covered by licence fees so that royalties are fully available to support services to the community unrelated to the abalone fishery. |
| 2.1.1 Economic Yield (Rock Lobster) | Quota lease prices are not currently recorded in the DPIPWE (FILMS) / IMAS database, but has been obtained from quota brokers and processors. | EY that flows to private holders of quota units = quota lease price ($/kg) x catch | Fishers who lease quota cover their fishing costs, including the opportunity cost of the capital in their vessel and their labour. The difference between these costs and the beach price can thus be used to lease quota. Quota lease price is used as a proxy for yield. Average value of lease price was used and is not representative of entire quota market with modest variation between trades. |
| 2.1.2 Economic "size" (quota or license market capitalisation) | Quota sale prices are not currently recorded in the DPIPWE (FILMS) / IMAS database, but have been obtained from quota brokers. | Quota market capitalisation = quota sale price x No. quota units in the fishery | Economic "size" measured as quota market capitalisation excludes the value of capital items. Average value of annual quota price was used and is not representative of entire quota market with modest variation between trades. |

| INDICATOR | Data source | Calculations | Assumptions and caveats |
|---|---|---|---|
| | License sale and lease prices are not currently recorded in the DPIPWE (FILMS) / IMAS database, but have been obtained from quota brokers and from industry participants. | License market capitalisation = license sale price x No. licenses in the fishery | Abalone - Assumed 3500 units in the fishery. Public component is based on reported and estimated royalty payments. The market capitalisation of the public component is estimated by scaling against the capitalisation of the private component.<br><br>Rock Lobster – Assumed 10507 units in the fishery.<br><br>License market price data was extracted from the prices of "packages" that included Fishing Boat Licenses, in many cases. The price of FBLs was estimated based on anecdotal reports from brokers and industry participants, and then subtracted from the "package" price to obtain an estimate of license sale price. |
| 2.2.2 Efficiency of production | | Efficiency = Economic yield (i.e. based on lease price, see section 2.1.1) as a percentage of total revenue (i.e. GVP) | EV/GVP ratio as a proxy for efficiency is potentially unreliable because economic yield and total revenue can be affected by beach price, which is influenced by exchange rate.<br><br>Other indicators of fishing capacity, such as engine power/size, gross tonnage of boat that may be more useful for other fisheries (e.g. scallop). |
| 2.3.1 Private and public distribution of yield (Abalone) | Reported royalty payments were provided by DPIPWE.<br><br>Formulas for calculating royalties are outlined in the Old and New Deeds. | Public economic yield = Royalty payments (reported where available, otherwise estimated) | Assumes 80% of the quota units held in the Tasmanian abalone fishery are held under the New Deed.<br><br>Assumes that government costs of management, research, compliance and crown prosecutor are fully covered by licence fees so that royalties are fully available to support services to the community unrelated to the abalone fishery. |

| INDICATOR | Data source | Calculations | Assumptions and caveats |
|---|---|---|---|
| 2.3.2 Distributions across industry participants by type | Ownership of entitlements and quota units as well as harvesting data is obtained from the DPIPWE (FILMS) / IMAS database | Harvesters = >0 catch in a year<br><br>Investors = 0 catch in a year | |
| 2.3.3 Regional distribution of economic benefits | Quota holders' resident state as registered is obtained from DPIPWE (FILMS) / IMAS database. | | Residency or location of quota unit holding entities is measured by determining the postcode (if within Australia) or country from the following: Mailing address for Individuals and Family Trust entities; and by state/territory or country recorded for companies as listed against their Australian Business Number (ABN) or international parent company.<br><br>Note that some quota holders are registered in multiple states, leading to double counting of quota held (between 1.6% and 5.3% depending on year). In some cases the postcode or state information was missing from the database. |
| 2.4.2 Fisher livelihoods – opportunities and constraints (Abalone) | Activation of entitlements, ownership of entitlements and quota units as well as harvesting data is obtained from the DPIPWE (FILMS) / IMAS database | Abalone divers in Tasmania were assigned into four categories.<br><br>Type1: Divers who lease in (do not own) both quota and entitlement<br><br>Type 2: Divers who lease in quota (more than they own or not own at all) but own entitlement (hereafter referred to as Lease Dependent Divers) | Divers/fishers who nominated supervisor (s) do not own the entitlement.<br><br>Year was extracted from entitlement expiry date from the LMM/FILMS database. There was a discrepancy of about 5% in licence numbers due to database inconsistency, however this does not affect the overall trend. |

| INDICATOR | Data source | Calculations | Assumptions and caveats |
|---|---|---|---|
| | | Type 3: Divers who own quota but does not own entitlement<br><br>Type 4: Divers who own both quota and entitlement | |
| 2.4.2 Fisher livelihoods – opportunities and constraints (Rock lobster) | Activation of entitlements, ownership of entitlements and quota units as well as harvesting data is obtained from the DPIPWE (FILMS) / IMAS database | Agent types used for this analysis were based on definitions and queries used by van Putten, Hammon et al (2001). | Harvester are those clients with catch > 0<br><br>Investors are those clients with catch = 0<br><br>Lease dependent fishers are those who lease quota in and do not lease any of their own quota out to other fishers |
| 4.1 Tasmanian Aboriginal community access and opportunity | IMAS rock lobster population model estimates were used for biomass % | | That high catchability in inshore rock platforms is due to population abundance levels close to virgin biomass levels. |

## Further notes

### 2.1.1 Economic yield

Economic yield is the difference between total revenues and total costs of fishing (including the cost of labour and capital) with all inputs valued at their opportunity costs. It is different to accounting yield as it does not include costs to individual such as interest payments. Economic yield is often estimated in fisheries by surveying fishers to determine the cost of harvesting. That approach requires opportunity cost to be estimated by applying an assumed value of unpaid labour and a foregone yield on invested capital.

In this assessment, economic yield is either estimated or revealed using more readily obtainable data. Economic yield for the **Abalone fishery** can be estimated more easily than for most fisheries because the cost for harvest is revealed by a competitive market rate for diving services. This has been very stable over years, is inelastic to catch rate, and recently has averaged $7 per kg (2000-2014) and $7.5 per kg (2015 and 2016).

The licence payment in fisheries is notionally for payment of costs for management, compliance and research. This is an approximation because there is no public reporting of these costs in Tasmania. The economic yield formula used here also does not include public subsidy payments to the abalone fishery, including research funding leverage through FRDC or the University of Tasmania.

In case of the **Rock Lobster fishery**, it's possible to measure trends in economic yield by using revealed lease price paid for access to quota. Lease price is determined in a market between quota holders and fishers. Fishers who lease quota need to cover all their fishing costs, including the opportunity cost of the capital in their vessel and labour. The difference between these costs and the beach price can thus be paid as lease price – the economic yield.

There are limitations in estimating economic yield by either method (i.e. surveying fishers for cost or from lease price). Surveys of cost can be biased due to omitted data or bias in the sample, and they also require significant time and costs to collect data. They involve assumptions about opportunity cost of labour and capital. Lease prices may be affected by factors unrelated to economic yield. For example, fishers may subsidise their lease operations with quota they hold outright, or processors may manipulate the lease price of quota they control with requirements to sell product back to the processor. Nonetheless, trends in lease price through time provide a useful and low-cost indicator of changes in economic yield from the fishery.

### 2.2.2 Efficiency of production

Farrell (1957) proposed that economic efficiency in a firm has two components: technical efficiency and allocative efficiency. Technical efficiency refers to the ability of a firm to produce the maximum outputs from a given set of inputs subject to production technology. Allocative efficiency reflects the ability of a firm to use inputs in optimal proportions e.g. selecting that mix of inputs such as labour and capital that produces a given quantity of output at minimum cost, given their relative prices and the production technology. These two measures are then combined to produce a measure of total economic efficiency.

Economic efficiency in a fishery is commonly measured by mathematical programing technique, using individual firm level input/output data over time and compare them to the feasible production set, which is the set of all input-output combinations that are feasible. Such technique also allows managers to identify the levels of capacity utilization and existence of excess capacity. However, the detailed economic data required for such analysis is not currently available for the Tasmanian fisheries. For this assessment, a proxy for the level of economic efficiency, that is economic yield (i.e. based on lease price, see section 2.1.1) as a percentage of total revenue (i.e. GVP) was used. Changes in the number of active divers or vessels in the fleet are also measured as an indicator fishing capacity.

### 2.3.1 Distribution of public and private economic benefits

The Tasmanian abalone industry is currently governed by two separate Deeds that set out two separate royalty calculations.

Old deed quota units calculate the royalty payment based on the indexed catching cost together with a sliding scale (of increasing resource levy percentage) of beach price. The downward trend of beach prices since 1994 has led to a situation whereby Deed Holders on the Old Deed do not currently pay any royalties to the Tasmanian government. Approximately twenty percent of the 3,500 quota Tasmanian Abalone Quota Units are held on the Old Deed. Recent negotiations between the Old Deed Quota Holders and the Tasmanian Government have resulted in a new royalty fee structure based on 4% of Beach Price under specified conditions.

New Deed Quota Units came into effect in 2003 under Section 99B of the *Living Marine Resource Management Act 1995* (as amended). The royalty paid to the Tasmanian Government is calculated on a formula of 8.125% for the period 2003 to 2016, and 7% for the period of 2016 to 2017 of the average beach price, paid in arrears at the commencement of each new fishing quarter and is locked in for a period of 30 years from commencement (maturing in 2033). Approximately 80% of the quota units held in the Tasmanian abalone fishery are held under the New Deed.

Values for royalties in annual stock assessment reports are drawn from observed income and can differ from royalties calculated from DPIPWE/IMAS database with an 8.125% or 7% beach price applied. Accuracy could be increased by including the annual proportion of quota holders who were on old deeds.

# APPENDIX C: Supplementary Data

## Table C.1. Abalone

| Year | Greenlip | | | Blacklip | | | Total Revenue ($ millions) | Dive rate ($/kg) | Costs ($ millions) | Total Economic Yield ($ millions) | Royalties | | Total Private Economic Yield ($ millions) | Total Public Economic Yield ($ millions)*** | Av. Quota unit sales price ($/unit) | No. of quota units |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Catch (tonnes) | Price* ($/kg) | Revenue ($ millions) | catch (tonnes) | Price* ($/kg) | Revenue ($ millions) | | | | | 80% of Est. Royalty ** ($ millions) | Reported ($ millions) | | | | |
| 2001 | 135 | 47.63 | 6.43 | 2436 | 40.91 | 99.66 | 106.09 | 7.00 | 18.00 | 88.09 | 7.44 | n/a | 80.65 | 7.44 | | 3,500 |
| 2002 | 138 | 48.20 | 6.64 | 2319 | 45.13 | 104.67 | 111.31 | 7.00 | 17.20 | 94.11 | 7.45 | n/a | 86.66 | 7.45 | | 3,500 |
| 2003 | 139 | 42.51 | 5.91 | 2413 | 33.77 | 81.48 | 87.39 | 7.00 | 17.86 | 69.52 | 5.77 | n/a | 63.75 | 5.77 | | 3,500 |
| 2004 | 129 | 41.45 | 5.33 | 2334 | 37.19 | 86.79 | 92.12 | 7.00 | 17.24 | 74.88 | 6.10 | n/a | 68.79 | 6.10 | | 3,500 |
| 2005 | 116 | 44.11 | 5.11 | 2353.53 | 40.61 | 95.57 | 100.68 | 7.00 | 17.29 | 83.40 | 6.65 | n/a | 76.74 | 6.65 | | 3,500 |
| 2006 | 119 | 44.75 | 5.34 | 2351.90 | 43.32 | 101.89 | 107.23 | 7.00 | 17.30 | 89.93 | 7.06 | n/a | 82.87 | 7.06 | | 3,500 |
| 2007 | 107 | 44.05 | 4.71 | 2263.16 | 40.06 | 90.67 | 95.38 | 7.00 | 16.59 | 78.79 | 6.38 | 7.30 | 71.49 | 7.3 | $261,000 | 3,500 |
| 2008 | 121 | 40.95 | 4.95 | 2436.32 | 34.62 | 84.34 | 89.29 | 7.00 | 17.90 | 71.39 | 5.84 | 6.20 | 65.19 | 6.2 | $248,580 | 3,500 |
| 2009 | 119 | 42.83 | 5.09 | 2464.89 | 35.32 | 87.06 | 92.16 | 7.00 | 18.09 | 74.07 | 6.06 | 6.20 | 67.87 | 6.2 | $195,110 | 3,500 |
| 2010 | 128 | 44.82 | 5.76 | 2473.07 | 39.34 | 97.30 | 103.06 | 7.00 | 18.21 | 84.85 | 6.80 | 7.20 | 77.65 | 7.2 | $226,917 | 3,500 |
| 2011 | 118 | 39.10 | 4.61 | 2332.35 | 33.09 | 77.18 | 81.78 | 7.00 | 17.15 | 64.63 | 5.54 | 6.35 | 58.28 | 6.35 | $184,000 | 3,500 |
| 2012 | 131 | 33.98 | 4.46 | 2185.74 | 37.18 | 81.27 | 85.74 | 7.00 | 16.22 | 69.52 | 5.68 | 5.72 | 63.80 | 5.72 | $175,000 | 3,500 |
| 2013 | 126 | 28.83 | 3.63 | 1977.92 | 34.58 | 68.40 | 72.03 | 7.00 | 14.73 | 57.30 | 4.79 | 5.42 | 51.88 | 5.42 | $165,000 | 3,500 |
| 2014 | 125 | 32.24 | 4.02 | 1782.63 | 36.22 | 64.56 | 68.58 | 7.00 | 13.35 | 55.23 | 4.48 | 4.97 | 50.26 | 4.97 | $165,000 | 3,500 |
| 2015 | 134 | 40.95 | 5.47 | 1705.61 | 44.64 | 76.14 | 81.61 | 7.50 | 13.79 | 67.81 | 5.55 | 4.68 | 63.13 | 4.68 | $200,000 | 3,500 |
| 2016 | 134 | 48.19 | 6.46 | 1559.60 | 46.12 | 71.93 | 78.39 | 7.50 | 12.70 | 65.68 | 4.39 | n/a | 61.30 | 4.39 | $250,000 | 3,500 |

* Av annual price by weight

** assuming 80% of the quota units held in the Tasmanian abalone fishery are held under the New Deed.

*** Based on reported royalty payments when figures available, and based on estimated royalties where reported payment not available

## Table C.2. Rock Lobster

| Year | Catch (tonnes) | Averaged annual beach price ($/kg)* | Number of active vessels | No. Quota units | Av. Quota unit lease price ($/kg) | Av. Quota unit sale price ($ '000) |
|---|---|---|---|---|---|---|
| 2000 | 1484 | | 233 | 10507 | 15 | 23 |
| 2001 | 1495 | | 272 | 10507 | 15 | 29 |
| 2002 | 1512 | | 257 | 10507 | 16 | 45 |
| 2003 | 1497 | | 250 | 10507 | 17 | 46 |
| 2004 | 1515 | | 262 | 10507 | 18 | 45 |
| 2005 | 1512 | | 247 | 10507 | 19 | 31 |
| 2006 | 1520 | 35.55 | 237 | 10507 | 20 | 36 |
| 2007 | 1550 | 43.77 | 230 | 10507 | 17.5 | 42 |
| 2008 | 1472 | 46.00 | 234 | 10507 | 16 | 23 |
| 2009 | 1357 | 51.39 | 253 | 10507 | 13 | 20 |
| 2010 | 1225 | 49.91 | 263 | 10507 | 8.5 | 19 |
| 2011 | 1093 | 46.69 | 245 | 10507 | 15.5 | 19 |
| 2012 | 1087 | 57.75 | 227 | 10507 | 30 | 23 |
| 2013 | 1089 | 49.91 | 226 | 10507 | 30 | 30 |
| 2014 | 1056** | 71.71 | 239 | 10507 | 35 | 35 |
| 2015 | 1057** | 85.60 | 227 | 10507 | 45 | 40 |
| 2016 | 1067** | 81.65 | 205 | 10507 | 45 | 60 |

*Based on ABARES financial year data, adjusted for calendar year

** *Errata*: Catch (tonnes) for 2014, 2015 and 16 was initially incorrectly reported as 1484, 1495 and 1512. These volumes have been corrected.