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Productivity Commission—
Inquiry into regulation of the Australian marine fisheries and aquaculture sectors

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Introduction

The Commonwealth has direct jurisdictional responsibility for a number of fisheries, mostly in Commonwealth waters. Day-to-day management of Commonwealth fisheries is the responsibility of the Australian Fisheries Management Authority (AFMA). The Department of Agriculture and Water Resources (DAWR) is responsible for fisheries policy development that seeks to ensure more sustainable, productive, internationally competitive and profitable Australian fishing and aquaculture industries. DAWR develops policies and initiatives that promote better resource management practices, innovation, self-reliance and improved access to international markets. DAWR is also involved in biosecurity measures to safeguard Australia's animal and plant health status to maintain overseas markets and protect the economy and environment.

DAWR's submission is focussed on issues that have a national character and where it has particular responsibility or knowledge. Issues covered include:

- resource sharing and allocation between sectors;
- the interaction of jurisdictional regulatory structures between the Commonwealth and the states including fisheries arrangements under the Offshore Constitutional Settlement (OCS);
- regulation of the marine environment; and
- the Commonwealth's role in support of the aquaculture sector.

Where the department has specific knowledge the submission also responds to some matters raised by the Productivity Commission's issues paper to this Inquiry. This includes:

- application of the precautionary principle; and
- impacts of climate change on fisheries.

Additional information, prepared by the Australian Bureau of Agricultural and Resource Economics and Sciences is provided in Attachment A to this submission.

Summary of Australian Fisheries Management

Australia's fishing industry is small by international and regional standards. The Australian Fishing Zone (AFZ) is the third largest Exclusive Economic Zone (EEZ) in the world, covering approximately nine million square kilometres. Despite this large EEZ, limited nutrient runoff and lack of large river flows, combined with the absence of substantial upwellings of cold nutrient-rich water mean that Australia's commercial catch tonnage ranks 60th in the world and represents 0.2 per cent of the world's total wild capture fisheries of 90 million tonnes. At the same time, Australian waters support a highly diverse array of over 4000 marine species, many of which are endemic and are part of globally significant marine ecosystems, such as the Great Barrier Reef. This marine resource is shared between commercial fisheries (wild catch and aquaculture), recreational fishing and Indigenous fishing.

In 2013-14 the gross value of Australian fisheries and aquaculture production was $2.5 billion, of this, the commercial wild capture fishing industry had an estimated total production value of $1.5 billion, with the Commonwealth-managed part of the production valued at $338 million.

Australia's commercial fishing and aquaculture industry employs around 14 000 people (8 000 directly and 6 000 indirectly).[1]

Over the last decade the volume of wild capture seafood produced in Australia has declined steadily from 230 000 tonnes per year in 2003-04 to around 150 000 tonnes by 2013-14[2]. A reduction in catch limits, reduced profitability in some parts of the industry (from higher input costs and changes in exchange rates) and competition from imported product have all played a role in the reduced wild capture production.

Australian exports in 2013-14 were estimated to be $1.3 billion[2]. Most of the species exported are high per unit value species, such as abalone, rock lobster, tooth fish and southern bluefin tuna. The component of the wild catch that is not exported is largely targeted at the fresh fish market. In order to meet the domestic seafood demand, particularly at the lower cost end of the market, Australia is a net importer of seafood by volume. It has been estimated that around 70 per cent of the edible seafood Australia consumes (by weight) is imported, with the main origins being Asia and New Zealand (Ruello 2011).[3]

Participation in the Australian industry is fragmented. The Australian commercial seafood industry comprises a large number of small, often family-owned companies and a smaller number of larger businesses, a few of which are subsidiary companies of publicly listed parent/holding companies. Most fisheries are characterised by limited/closed entry due to the resource being fully allocated and entry requiring the acquisition of existing rights. The larger, more profitable fisheries often have oligopoly structures with only limited competition between operators. These larger fisheries often display characteristics which include single boats fishing on behalf of multiple quota holders or through informal cooperative arrangements such as in the southern bluefin tuna industry where industry participants work together on aspects of the supply chain, such as sourcing feed stock and wild harvesting juvenile tuna.

The last comprehensive National Recreational and Indigenous Fishing Survey was undertaken in 2000-01. That survey estimated the number of recreational fishers in 2000 (defined as the number of people who fished at least once in the previous year), at around 3.5 million with an estimated annual expenditure within the sector at around $1.85 billion[2]. At the same time, the National Recreational and Indigenous Fishing Survey[4] estimated that 186 200 Indigenous people (excluding those living in the Torres Strait) participated in non-commercial fishing during the survey year. Most Indigenous catches (70 per cent) were taken from inshore and coastal waters, reflecting the distribution of key target species. In common with the commercial sector, a large part of the economic activity is generated outside of the capital cities.

The marine environment is a multi-purpose shared resource with cultural, conservation, scientific, recreational and commercial value. The utilisation of Australia's fisheries resources

[1] Australian Bureau of Agricultural and Resource Economics and Sciences, unpublished data, 2015.
[2] Source: Savage, J & Hobsbawn, P 2015, *Australian fisheries and aquaculture statistics 2014, Fisheries Research and Development Corporation project 2014/245*. ABARES, Canberra, December.
[3] Ruello, NV 2011, *A study of the composition, value and utilisation of imported seafood in Australia: project final report,* Ruello & Associates Pty Ltd for the Fisheries Research and Development Corporation, Canberra.
[4] Henry, G.W., Lyle, J.M., 2003. *The National Recreational and Indigenous Fishing Survey*. NSW Fisheries Final Report Series No. 48. For FRDC project 99/158. Australian Government Department of Agriculture, Fisheries and Forestry, Canberra.

are regulated to ensure the sustainability of a renewable, but limited, natural resource that would otherwise be vulnerable to over exploitation.

Fisheries management also operates in an area where data can be limited. Data is frequently best where fishing occurs and data collection is affordable. Against this background fisheries managers have adopted a high level of collaborative or even co-management with industry. A risk based approach is also frequently adopted with higher levels of oversight or precaution applied where data is poorer, stock levels lower or interaction with no target species or part of the environment is higher.

Fisheries responsibilities are shared between the Commonwealth and the states/Northern Territory (NT) resulting in a high level of complexity for a relatively small fishery. Offshore Constitutional Settlement (OCS) arrangements were intended to simplify the management of fish species. However many species straddle jurisdictional boundaries, species distribution changes and stocks are incidentally or otherwise caught by both Commonwealth authorised fishers and state/NT fishers with the result that fisheries management remains complex.

Australia's marine fisheries are regulated by eight jurisdictions based on agreements made by the Commonwealth and states/NT under the OCS. The OCS is an agreement between the Commonwealth and the states/NT that determines the jurisdictional responsibility for managing the seas and seabeds within Australia coastal waters, territorial sea and EEZ. The OCS provides for the states/NT to exercise jurisdiction over fish stocks from the coast to the 3 nautical mile (nm) limit, while the Commonwealth exercises jurisdiction from 3 nm to 200 nm at the edge of the Australia's EEZ. The OCS operates under these parameters unless an agreement between the parties determines otherwise. To date, 59 such agreements under the OCS have been concluded between the Commonwealth and the states and territories.

Fisheries management objectives and the tools used for fisheries management also vary between jurisdictions. For example Commonwealth fisheries management is focussed on maximising economic return to the community and is almost exclusively output management based through quotas. While in some states social and regional development objectives may be pursued through fisheries management and management is frequently by input controls. There are reasons for these differences but managing shared resources across jurisdictions through OCS arrangements is complicated by the differences.

The Commonwealth and states/NT have and continue to harmonise rules used to manage fish stocks. This is aimed at improving outcomes for fishers, the environment and the Australian community. These issues are explored in more detail below.

As wild capture fisheries are using a public resource, fisheries management is under environmental scrutiny. All Commonwealth fisheries and state/NT fisheries, where the commercial wild catch fishery is engaged in export, are subject to environmental assessment and approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This Act is administered by the Australian Government Department of the Environment. In the marine environment availability of comprehensive environmental data can be uncommon and expensive to collect. Environmental considerations in fisheries can consequently be precautionary and conservative and evolving as more information becomes available, often as a result of the act of fishing. As environmental regulation is most commonly in a different organisation to the fisheries manager this regulation can be perceived as burdensome and contributing to commercial uncertainty.

Australian fisheries are also subject to numerous international treaties, including the United Nations Law of the Sea and the United Nations Fish Stocks Agreement, as well as a range of internationally recognised voluntary arrangements. Several fisheries managed by the Commonwealth target species that migrate or straddle international waters. These fisheries are oversighted by the relevant treaty-based regional fisheries management organisations which establish member agreed regulations for the sustainable management of fish stocks and protection of the environment in specified regional fisheries. International obligations are given effect to via domestic fisheries management arrangements for example through quotas or gear restrictions for environmental reasons.

Fisheries Resource Optimisation

Resource Sharing

Fish stocks are a public resource and governments manage them in a way that seeks an optimal community benefit from their utilisation.

The nature of the marine environment means that fisheries management is often reliant on imperfect and limited information. The Commonwealth seeks to ensure that fisheries are managed at an acceptable level of risk irrespective of the level of knowledge. As such, the Commonwealth employs a universal risk management approach, whereby exploitation levels are reduced as uncertainty around stock status increases. The better the information the more certain fisheries managers can be that the estimated sustainable take is accurate. At more limited information levels or as the information becomes less relevant, for example over time, the less certain fisheries managers can be about the accuracy of the estimated sustainable take. To minimise risk, fisheries managers apply a precautionary approach, whereby the catch is set at a lower level than the estimated sustainable take. In Commonwealth fisheries prescribed discount factors are used as the information becomes less relevant and or less precise.

Scientific studies, and data gathering and monitoring are generally high cost inputs to fisheries management. The cost of obtaining a certain level of knowledge of the fishery is generally traded-off or balanced against the returns the additional catch can generate for fishers. For example in a low value fishery, catches will remain precautionary with supporting fishery research at low levels, to better match the management costs to the business environment for that fishery. Whereas fishers in high value fisheries may seek to improve the precision of estimates around the sustainable catch, particularly if there is a potential for increases in allocated catches, where potential increased profits would outweigh the cost of research.

The *Fisheries Management Act 1991* (FM Act), under which Commonwealth fisheries are managed, includes in its objectives optimising the net economic return to the community. In the absence of well-defined and agreed shares between different sectors, such as between commercial and recreational or Commonwealth and state fishers, the sustainable management of the resource may be compromised with competing sectors potentially fishing in a way that may lead to the fishery being over-exploited. Appropriate resource sharing arrangements can also enhance regulatory certainty and improve equity for resource users, in addition to providing a sound framework for enhancing the sustainability of our marine environment.

The Commonwealth manages its fisheries in accordance with the *Commonwealth Harvest Strategy Policy 2007* which requires that all significant sources of fishing mortality be accounted for when determining the sustainable level of fishing effort for a particular fish stock. A 2005

Ministerial Direction requires AFMA to stop overfishing in all Commonwealth fisheries and recover overfished stocks to levels that will ensure their long term sustainability and productivity. AFMA was also directed to: set the exploitation rate of target stocks so as not to exceed the maximum sustainable yield; cease targeted fishing of any stock that have been reduced below 20 per cent of pre-fished levels; and, implement individual transferable quotas unless it is not cost effective or otherwise detrimental to the fishery.

The recreational fishing catch of most commercial species managed in Commonwealth fisheries is relatively limited and can in most instances be accounted for by including a set aside in the determination of the total allowable catch (TAC) approximating the recreational fishing mortality. This allows the fishery managers to focus their efforts on the main source of mortality, commercial fishing. However, the recreational take of some game fishing species, such as striped marlin, has increased to be a significant proportion of the fishing mortality of these stocks in Australian waters. The Commonwealth Harvest Strategy Policy requires that all significant sources of mortality should be taken into account in any allocation process. However, monitoring and accurately measuring recreational catch can be an expensive undertaking notwithstanding relying on the most up-to-date methodologies.

There are a range of complexities when considering fisheries resource sharing amongst sectors. These include limited data (especially in relation to the recreational sector); mixed jurisdictional responsibilities for particular species; often conflicting interests across different stakeholder groups and sometimes divergent views within some of these groups; budgetary constraints; and for some fish stocks, conservation concerns and international considerations. Assessing the claims of recreational fishers' representative bodies to a share of the total resource is generally made on economic and social grounds. Comparing the economic benefits of recreational fishing with commercial fishing is complex, and robust recreational data is costly to collect. The social benefit claims potentially add another layer of complexity.

A requirement to manage and potentially cap the level of recreational catch on the basis of quota allocation would not only involve issues of compliance, but there would be significant logistical and cost implications. DAWR is examining options for reliably estimating the annual recreational catch of southern bluefin tuna in Australian waters.

Formal resource allocations, including to the recreational sector, would increase certainty around the proportion of fish available to each sector. However, formal allocations beyond the commercial sector are likely to increase the cost and complexity of management. The recreational sector is normally managed by bag and/or boat, and seasonal and spatial closures. Management of recreational catch by quota is relatively rare due to the logistical and practical challenges that it involves, particularly around monitoring, reporting and compliance.

The most appropriate resource sharing model for any fishery or marine species will depend on the biological, economic and any other legislated objectives for the fishery and each sector therein. Consideration should also be given to the cultural, legal, regulatory and institutional framework of the particular fishery. Importantly the selected model also has to be realistic so that it can be implemented and managed effectively.

Valuation techniques for different marine activities and establishment of common objectives for resource use are also important in developing best-practice resource sharing arrangements within Australian waters.

Any reconfiguration of resource sharing approaches would need to consider the costs of monitoring, data collection and compliance which could be considerable.

Indigenous and Cultural Fishing

Fishing is a traditional and cultural activity for many Aboriginals and Torres Strait Islanders and connects Indigenous people to their country. Fish are important to Indigenous people for a variety of reasons including nutrition, cultural, ceremonial and social events. Sharing fish is important socially and communally. Fish catches are shared among the family, extended family and others who are not able to fish for themselves, such as the elderly. Indigenous communities also use fish to barter.

Addressing the matter of traditional and customary fishing is complex, involving the intersection of Commonwealth legislation relating to native title and relevant state/NT legislation. Current fishing laws generally do not distinguish between Indigenous fishing and recreational or commercial fishing. Indigenous fishers are generally required to conduct their fishing activities according to the rules in place for the broader recreational and commercial fishing sectors[5]. Determining how Indigenous fishing fits into modern fisheries management in a landscape of high technology commercial and recreational fishing, while maintaining sustainability and maximum benefit from the resource is difficult.

In places like the Torres Strait, Indigenous fishing is well established in both regulation and resource use. In this region, Indigenous and customary fishing is defined in the *Torres Strait Treaty 1978* between Australia and Papua New Guinea. The Treaty clarifies sovereignty and maritime boundaries in the area between the two countries and underpins the protection of the livelihood of traditional inhabitants. In the Australian area of jurisdiction, traditional fishing and the commercial fisheries are managed by the Torres Strait Protected Zone Joint Authority (PZJA). The PZJA, established under the *Torres Strait Fisheries Act 1984*, comprises the Federal and Queensland Ministers responsible for fisheries and the Chair of the Torres Strait Regional Authority. Traditional inhabitants sit on Torres Strait fisheries advisory and consultative forums to ensure the development of fisheries management policies consider traditional livelihoods. Customary take within commercial fisheries in the Torres Strait is incorporated as part of overall catch allocations and limits. There are measures in these fisheries focused on size and bag limits that aim to sustainably manage customary take.

Traditional fishing rights have been further defined in the recent Akiba High Court decision. In the matter of Akiba on behalf of the Torres Strait Regional Seas Claim Group v Commonwealth [2013] 33 (Akiba), the High Court unanimously held that Commonwealth and Queensland legislation prohibiting taking fish for commercial purposes did not extinguish the native title right of certain Torres Strait communities to take resources from defined areas.

Commercial Fisheries Regulation

Offshore Constitutional Settlement Agreements

The OCS provided for the Commonwealth and the States/NT to make agreements that passed management responsibility for particular fisheries exclusively to the Commonwealth, relevant

[5] Henry, G.W., Lyle, J.M., 2003. *The National Recreational and Indigenous Fishing Survey*. NSW Fisheries Final Report Series No. 48. For FRDC project 99/158. Australian Government Department of Agriculture, Fisheries and Forestry, Canberra.

States/NT or to a Joint Authority. OCS agreements have the practical objective of providing a sound legal and administrative basis for a functional approach under which a particular fishery can be regulated by one authority under one set of laws, without being limited by default jurisdictional lines.

The agreements negotiated under the OCS define fisheries variously: in spatial terms; by technology or method of capture; and by the species caught. Jurisdictional responsibility for the 'fishery', as defined by these characteristics, could be vested in either the Commonwealth, a state or the NT; or under a Joint Authority. A Joint Authority is an agreement whereby a fishery is managed jointly by the Australian Government and one or more states or territories under the laws of a single (Commonwealth, or state or territory) jurisdiction.

A set of principles was used to ensure the agreements emphasised conservation, efficiency (of management and commerce) and the species based management principle (one species to one jurisdiction). Additional Information relating to catch limits and bycatch management arrangements, for all states, with the exception of New South Wales, are detailed in a similar number of associated memoranda of understandings (MoUs).

The Offshore Constitutional Settlement arrangements provide a flexible approach to achieving with single jurisdictional responsibility for fish stocks. If Australia's fish stocks are to be managed by eight authorities then the OCS arrangements arguably represent a sensible solution to a complex problem.

Given fisheries and fish species cannot be wholly divided and separated by spatial or fishing method definitions there will be a need for jurisdictions to work together to minimise the challenges of overlapping responsibilities. Harmonisation of regulatory frameworks between jurisdictions has the potential to reduce regulatory burden and uncertainty associated with shared stocks.

Number of OCS Agreements

There are currently 59 OCSs in place that determine jurisdictional responsibilities between the Commonwealth and States/NT (see Table 1). The 59 agreements provide arrangements for 177 species of fish, using 20 different fishing methods in 27 defined areas. At present, there are four Joint Authorities, including the Torres Strait Protected Zone (TSPZ), consisting of the Commonwealth and one or more state/NT. All the fisheries managed by these Joint Authorities are managed under state law, except for the Torres Strait. The PZJA is responsible for the management of all fisheries in the TSPZ. The TSPZ is defined in the Torres Strait Treaty which was ratified in 1985 between Australia and Papua New Guinea and fisheries are managed under Commonwealth legislation (*Torres Strait Fisheries Act 1984*).

The Commonwealth and states/NT have developed agreements that provide different approaches in dealing with the relative complexity of the OCS agreements. In the majority of cases the Commonwealth and the states/NT established 5 or 6 agreements, with Tasmania and Victoria making 8 and 10 agreements, respectively. A different approach was taken with NSW where 18 agreements were developed.

By pursuing fewer agreements the language in the agreements must inevitably be more complex and in certain instances, require the use of exclusions. Having a larger number of agreements has allowed for simpler and clearer language.

Table 1: State by state breakdown of OCS agreements statistics by number[6]

	No. OCS arrangements	Areas	Taxa	Methods
New South Wales	18	3	42	7
Tasmania	8	4	93	11
Victoria	10	2	81	9
Western Australia	5	10	35	15
Northern Territory	5	2	29	5
Queensland	6	4	37	6
South Australia	6	2	88	4
TOTAL	59	27	177	20

Fisheries Objectives between Jurisdictions

There are markedly different fisheries management objectives in fisheries legislation across jurisdictions. While most fisheries management legislation in Australia (Commonwealth and state/NT) contain a number of objectives, these are generally not arranged hierarchically. This means that decision makers are expected to pursue these objectives simultaneously, with trade-offs between them as necessary. The Commonwealth generally applies economic and biological objectives to its fisheries. In general, state/NT fisheries have an additional focus on social objectives, including in relation to recreational fishing. At the same time, fisheries legislation in all jurisdictions includes references to sustainable development. In most, but not all fisheries legislation, this is specified as ecologically sustainable development. Occasionally an additional reference to the precautionary principle or to the benefit of both present and future generations is included.

The variation in objectives may in part be a consequence of the structural differences between the characteristics of the fisheries, e.g. Commonwealth fisheries are often off-shore and in deep water, while state/NT fisheries are generally located close to shore and have a greater interaction with other users of the resource, such as recreational fisheries, and may operate on a smaller scale.

The different objectives can make harmonising legislation and management approaches between jurisdictions challenging. An instance of this is the different objectives of the *Fisheries Management Act 1994* (NSW) and the FM Act (Commonwealth). The former includes objectives such as "provide social and economic benefits for the wider community of New South Wales" and an objective on sharing resources between different users, whereas the Commonwealth legislation refers to "maximising the net economic return to the Australian community" and has no reference to social benefits.

[6] Australian Bureau of Agricultural and Resource Economics and Sciences

Fisheries Management across Jurisdictions

To meet the objectives of relevant fisheries legislation, managers need to develop management plans or arrangements to control fishing activity and ultimately the catch of the target species. Methods of controlling fishing activity fall into two main categories, input controls (restrictions on fishing efficiency) and output controls (catch limits) (Attachment A).

Commonwealth fisheries have moved predominately to output controls in accordance with a ministerial direction in 2005 (under section 91 of the *Fisheries Administration Act 1991*) The direction included a requirement to adopt output controls in the form of individual transferable quotas (ITQs) where practical. In Commonwealth fisheries, input controls, such as gear restrictions, are used to manage bycatch and other ecological related issues. The Northern Prawn Fishery is one of the few Commonwealth fisheries that uses input controls where it was considered that significant annual seasonal variability in abundance, for exogenous reasons, made it impractical to manage the fishery by quota setting.

Fisheries under the control of the states/NT more often rely on input controls through restrictions to the number or type of fishing vessels, the amount or type of fishing gear, or the areas or periods where fishing can take place. Some of the higher value stocks under state jurisdiction, such as the Western and Southern Rock Lobster fisheries are managed using output controls.

The different objectives and economic performance of a fishery influences the management arrangements employed to control fishing activity within it. For example, managing fisheries by output controls can involve higher management and compliance costs than those managed by input controls. This is primarily due to the need for regular stock assessments that are often data intensive and the need to monitor and record catches more accurately. Using output controls in a high value fishery may be easier to justify economically as the cost of stock assessments can be lower compared to the annual returns from the fishery. Having a good understanding of the biomass dynamics of the fishery potentially allows it be fished at a higher intensity without increasing the risk to long term sustainably of the stock. Input controls on the other hand may be appropriate where the costs to implement output controls would place a disproportionally high burden on the fishery affecting its profitability.

A major concern in fisheries managed by input control is 'effort creep'. Where a fisher is not limited in the amount of fish that he/she may catch but only in the manner of catching, there is a clear incentive to change those things that can lead to more effective or efficient fishing. If over time catch levels steadily rise, it is likely that the regulator will need to impose stricter input controls to reduce catch levels. *The Review of Commonwealth Fisheries: Legislation, Policy and Management*, December 2012 (Fisheries Management Review) noted that "management by effort controls (generally on fishing gear) inevitably focuses industry attention on unregulated inputs and perpetuates a *race to fish*".

While valid arguments can be found for using either input or output controls in a particular fishery, having different jurisdictions using different approaches on a single stock is not optimal for the economic or environmental performance of the fishery involving straddling stocks. Where the Commonwealth seeks to manage stocks by quota, and the state/NT by input/effort measures, there is a high likelihood that the Commonwealth-managed fishers will be required to bear a disproportionate part of any adjustment given there can be no agreed quota sharing

across the jurisdictions. For example, as the Commonwealth has regard to the TAC based on a stock assessment, if the state catch rises (with unchanged effort controls) and the TAC remains constant, the allocation to Commonwealth fishers must fall.

The operation of OCS agreements could be improved by harmonising the management arrangements and control rules used to manage fish stocks. This would also further improve outcomes for fishers, the environment and the Australian community. While conflicts between fishing operations exist both within and between jurisdictions, it is more pronounced and more difficult to solve between jurisdictions when fisheries objectives and management arrangements differ significantly.

The Fisheries Management Review noted that it is "generally recognised that management arrangements for shared stocks across Australia are inconsistent and inefficient, and that this has an impact on the sustainability of fish stocks and fishing operations in the region."

Application of OCS Arrangements

A fundamental principle in developing the OCS arrangements was the desire to limit, where possible, subdividing a single fish stock between two or more jurisdictions. However, the current agreements do not always provide sole responsibility for a particular fish stock to a single jurisdiction.

Where Commonwealth and state/NT spatially overlap, measures will be adopted in each fishery in order to avoid or limit incidental catch of species managed by the other jurisdiction. However, in many cases, incidental bycatch of species managed by another jurisdiction may be unavoidable. A simple requirement to discard such catches is wasteful but may be necessary as a management tool to avoid encouraging the targeting of such 'bycatch', especially if the species are commercially valuable. Fisheries managers seek to minimise discarding through a range of measures both because of the waste and the risk to the sustainability of the stock.

An example of this effect is on the Eastern school whiting stock. Eastern school whiting ranges from Queensland through to Victoria but is fished primarily by Commonwealth and New South Wales fishers. Commonwealth fishers who operate under quota allocations have been subject to uncertainty about the value of their fishing rights as the catch taken by New South Wales, Victorian and Queensland fishers has ranged from 55 per cent in 2000 to 73 per cent in 2011 of the overall TAC. This meant that the allocation to Commonwealth operators was reduced by about 300 tonnes between 2000 and 2011, despite the TAC remaining relatively stable at 1 400 tonnes[7]. The increasing take of state fishers reduced the Commonwealth fishers' allocation and consequently the value of their statutory fishing rights.

Although the OCS agreements have historically divided the management responsibilities on the basis of the target species, the increasing focus on ecosystem-based management as part of fisheries management has complicated the jurisdictional boundaries and led to some unforeseen issues. For example, AFMA's efforts to address fishery impacts on Australian sea lions in the Southern and Eastern Scalefish and Shark Fishery included a shift from gill nets to hooks. This has raised concerns from South Australia relating to impacts on the South

[7] Status of Key Australian Fish Stocks 2004

Australian Snapper fishery from increased levels of snapper bycatch in the Commonwealth fishery due to this change in technology.

Multiple jurisdictional arrangements can also lead to complexities in licensing and fishing operations, even when targeting the same species. For example, fishers off the New South Wales south coast wanting to fish for a particular species may be required to hold several licences. They may also have different requirements on the fishing gear they use depending on which licence they are fishing under at the time, despite targeting the same species.

In addition, to enable a jurisdiction to clearly determine the take from the fishery under its management, fishers may only be allowed to undertake single jurisdictional trips. This may be required, for example, to avoid the possibility of fish caught in one jurisdictional area where a quota exists being reported as being caught in another jurisdictional area where no quota exists. This means a fisher with both a Commonwealth and New South Wales licence to catch flathead, when fishing under the Commonwealth licence, may not fish in New South Wales waters (inside 3 nm) and *vice versa*. The fisher may be required to travel past productive fishing grounds, even when they also have rights to catch the species within that area under a state licence. As the flathead in both jurisdictions comes from the same stock, where the fish is taken should not have implications for the sustainability of the stock.

There are also questions of whether the jurisdictional separation of stocks creates barriers to the efficient and cost effective extraction of the resources. Under an OCS agreement between the Commonwealth and South Australia, South Australia has responsibility for the management of sardines from the coast to the 200 nm limit of Australia's EEZ. The Commonwealth's Small Pelagic Fishery (SPF), which targets small pelagic species, including sardines on Australia's east coast, operates throughout most Australian southern waters, including off South Australia. However, Commonwealth fishers in the SPF cannot take sardines in the area defined by the South Australian sardine fishery, although a small bycatch can be authorised. South Australia manages the sardine fishery under output controls, i.e. catch limits. This means a Commonwealth fisher in the SPF must travel past schools of sardines that may be abundant in the area or discard them if accidently taken. South Australian sardine fishers face a similar prospect if catching small pelagic species that fall under the jurisdiction of the Commonwealth. Despite South Australian and Commonwealth fishery both being quota managed there is no quota trading nor dual endorsement of boats which might allow a single boat to fish in both fisheries simultaneously.

OCS Reform

While the first OCS agreements were negotiated in 1986, the majority were settled during the mid-1990s under a set of guiding principles (Table 2). These principles were to ensure an emphasis on conservation, efficiency (of management and commerce) and the species based management principle (single jurisdiction management of a stock). The Commonwealth and states/NT have since worked to identify and amend OCS agreements that have had an adverse impact on effective regulation or that have created unnecessary burden for fishers. Although these negotiations have been difficult and protracted, there has been some success in resolving some long standing issues, most recently in New South Wales and Western Australia. Negotiations are also underway to reform the three joint authorities in Western Australia, the Northern Territory and Queensland. Working towards reform of joint authorities to provide for

single authority management is a commitment given as part of the Australian Government's Northern Australian White Paper.

Table 2 Principles guiding Revision of the OCS Agreements (agreed December 1993)[8]

- *Ensure through proper conservation and management measures, that living resources of the Australian fishing zone are not endangered by over-exploitation.*
- *Achieve the optimum utilisation of the living resources of the Australian fishing zone.*
- *Avoid, as far as possible, subdividing a single stock under different jurisdictions (to be called the 'species based management principle').*
- *Achieve (as a preference) single agency management of fisheries as opposed to Joint Authorities which add another layer of consultation and operate less rapidly.*
- *Include Memoranda of Understandings (MOUs) to ensure reciprocal licensing data transfer and the application of uniform arrangements where appropriate.*
- *Seek to preserve the flexibility of the fleet to move within a fishery according to changes in the seasonal or geographic distribution of resources.*
- *Avoid discriminating against fishers solely on the basis of State of residence.*
- *Avoid restrictions which represent an impediment to trade between States.*
- *Set boundaries which seek to maximise the potential to develop efficient catching, processing and marketing sectors (subject to resources conservation considerations)*
- *Take account of administrative law including principles of natural justice with respect to the introduction of measures to regulate fisheries.*
- *Seek to achieve a broad based species approach to OCS agreements with respect to bycatch. This is consistent with the ANZFAC resolution for ecologically sustainable development principles*
- *Minimise the number of boundaries and the cost of administration and enforcement.*

The Fisheries Management Review recommended that the Productivity Commission review the OCS provisions with a view to streamlining the arrangements between Commonwealth and States to improve fisheries management and environmental outcomes. The Review further suggested that such changes might also require restructuring within the fishing industry to allow fisheries from different jurisdictions to integrate under a single management regime and to ensure appropriate levels of fishing effort would be applied across fisheries.

The DAWR paper titled *OCS Strategy for Taking Fisheries into the Future – Strategic Direction for Offshore Constitutional Settlement Arrangements in Australia's Fisheries* (2002) outlined the extant OCS agreements and proposed changes to introduce ecosystem based management,

[8] ANAO (1996) Commonwealth Fisheries Management; Australian Fisheries Management Authority. The Auditor General, Performance Audit Report No. 32. Australian Government Publishing Service.

integrated oceans management and simplification by instituting Fisheries Management Councils similar to the model used in the Unites States of America.

In April 2003, DAWR also released a discussion paper '*Strategic policy directions for Offshore Constitutional Settlement and other arrangements for fisheries between the Commonwealth, states and territories*". This document provides a comprehensive analysis of the historical background and institutional and legal basis for the current OCS agreements. The paper also examines how other advanced federal systems of government have managed the regulation of marine fisheries. There is an examination of the *emerging strategic policy considerations*: ecosystem-based fisheries management; ecologically sustainable ocean use including regional marine planning; and resource sharing and management of Commonwealth-managed fisheries. The report noted that considerable work had already been taken in relation to: bycatch mitigation; indicators of ecologically sustainable development in fisheries; and conduct of strategic environment assessments. While all these policy considerations remain relevant, the two which are a current focus for the department are resource sharing in Commonwealth waters and the review and update of Commonwealth bycatch policy and the introduction of bycatch policy guidelines.

In the 2003 discussion paper, under the section entitled 'alternative approach', two possible approaches to address concerns about the extant OCS agreements were identified: **iterative** – progressive incremental changes to progressively address areas of concern but within the existing framework of agreements; and **evolutionary** – design, development and implementation of an '*enhanced benchmark framework for management*' not constrained within the current MOUs. The paper also provides 10 guiding principles for either approach.

Later in 2003, the Australian Fisheries Management Forum agreed to a set of principles for fisheries management arrangements which are reflected in DAWR's 2005 'how to' paper entitled *Offshore Constitutional Settlement (OCS) Fisheries Arrangements: Management Principles and Legislative Guidelines*. This paper identified a number of principles to guide cooperation across jurisdictions in the development and implementation of complementary management arrangements. These principles included four overarching principles; a further five related to target species; six principles for managing bycatch and by-product species; four principles for managing baitfish resources; two principles for managing impact of fishing on marine ecosystems and, finally, one principle on data sharing. This document then examined the legislative basis for the different forms of agreements in place at the time and instructions for creating new agreements and amending or terminating existing agreements.

These papers were substantially informed by a then Bureau of Resource Sciences (BRS) research paper entitled *OCS Arrangements for Fisheries – Part 1 & 2* which analysed the various arrangements in considerable detail and proposed a series of technical and drafting amendments to simplify arrangements, while also concluding that the model was inherently complex and not easily changed.

Further work was carried out by the members of the Australian Fisheries Management Forum as they continued to identify issues and priorities for corrective action while also looking for new approaches that might provide a wider level of improvement. The states/NT and the Commonwealth have been engaged in an almost continuous discussion, at both a principles and practical level, on ways to improve the framework of OCS agreements. At the same time,

governments continue to negotiate bilaterally to solve specific issues around fisheries, fishing practices and fish species.

A pragmatic approach to potentially reducing the operational complexity while maintaining current OCS agreements may be through the increasing harmonisation of management, scientific and compliance processes across jurisdictions. Harmonising science and management processes of shared stocks could also improve outcomes for fishers and the environment. One approach would be for all jurisdictions to implement standard harvest strategies, bycatch arrangements, monitoring requirements and compliance operations. The standards would need to provide sufficient flexibility to respond to an individual fishery's circumstances, while providing for a more seamless cooperative approach between jurisdictions and fisheries. This could also enable jurisdictions to pool limited fisheries management and research resources.

A Fisheries Research and Development Corporation (FRDC) research report titled *National Guidelines to Develop Fishery Harvest Strategies*[9], considered options to develop a national framework to support a consistent and more harmonised approach to harvest strategy development across Australian fisheries jurisdictions. The Commonwealth's Harvest Strategy Policy and the 2005 Ministerial Direction has taken the Commonwealth further down a pathway of quantitatively based decision rules, individual tradeable quotas, requirements for ongoing stock assessments, an explicit commitment to ecologically sustainable development and a requirement for maximising the net economic returns to the Australian community. A high level harmonisation of fisheries management would not be possible without a substantial change in policy and practice by one or more jurisdictions.

In addition, work is well advanced on an FRDC project to compile national reporting on the status and sustainability of Australian wild capture fish stocks through the *Status of Key Australian Fish Stocks Reports*. These reports cover 68 wild-caught species, comprising 238 separate stocks, and contributed to around 85 per cent of the annual catch and 90 per cent of the value of Australian wild capture fisheries in 2012–13. Another FRDC sponsored project is looking at national standards for fisheries science.

Operation of the Quota market

Management of most Commonwealth fisheries is underpinned by a rights based participation arrangement which involves the use of statutory fishing rights (SFRs) in the form of ITQs or individual transferable effort limits (ITEs). Fishers are able to temporarily or permanently trade entitlements to fish in particular fisheries. The entitlements include quota amounts for fish species, entitlements to operate in a fishery, or rights to use particular gear. Theoretically, this arrangement allows market forces to operate, enabling the movement of rights to more efficient operators which maximises overall economic returns.

AFMA monitors and collects information on permanent and temporary rights trading for compliance purposes, but does not collect information on the specifics of these transactions, particularly on the price of traded units. AFMA maintains public registers showing quota ownership.

[9] National Guidelines to Develop Fishery Harvest Strategies. FRDC Project No. 2010/061, 2014

Participants in the industry sometimes suggest that the quota market is not operating effectively with quota underutilised and not traded. These commentators point to the absence of publicly available price information as a factor. Analysis undertaken by Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) indicates the quota market may be operating more effectively than currently believed, and that there is little indication of market distorting concentration in quota ownership (Attachment A).

Industry participants have also suggested that quota holders lack motivation to enter the market due to costs, lack of trading platforms or a lack of knowledge of the market. If this is occurring for a significant number of quota holders, it follows that TAC limits may not be met, despite scientific information indicating that these limits are sustainable and there is sufficient market demand for these species.

However, there are a number of reasons which can be postulated as to why quota limits might not be met. For example, some quota holders may prefer to stop fishing when they approach their individual limits, rather than take the risk of exceeding their catch holdings and possible prosecution, or being obliged to buy additional quota from the market to cover their additional catch. In some cases, quota trading late in a season can be expensive due to scarcity, and costs may exceed the economic returns available to fishers. In other cases, despite capacity to fish and availability of target species, market conditions may act as a disincentive to target certain species–this could be due to lack of demand or low market prices or uncertainty caused by price variability.

Similarly, where quota rights to multiple species are held by an operator, fishers may concentrate on more lucrative species. Cases may also exist, where the location of parts of the fishery may render it uneconomic at current prices and costs to fish with the boats available in Australia. The total size of the fishery may also be insufficient to warrant substantial new capital investment to change the economics of the fishery to a particular fisher. In other words, there may be a number of economic reasons why individual quota holders choose not to fully utilise their quota.

Co-management Arrangements

Co-management can be described as an arrangement where responsibilities and obligations for sustainable fisheries management are negotiated, shared and delegated between government, industry and other stakeholders[10].

Co-management at various levels has been explored as a means to reduce the compliance burden associated with traditional fisheries management approaches. From a regulatory perspective, co-management also offers the potential to lower costs through sharing management responsibilities and associated fishery management services. Where it is used, co-management is generally at some point along a continuum of management models that range beyond command and control and consultation to collaboration and/or delegated functions[11].

A 2007 report by the FRDC identified a number of essential and necessary pre-conditions which need to be met by industry to successfully implement co-management[12] (see Table 3). Later

[10] *Co-management in Commonwealth fisheries*, FRDC, 2015
[11] *Co-management in Commonwealth fisheries*, FRDC, 2015
[12] *A framework for fisheries co-management in Australia*, Draft Interim Report, FRDC, 2007

trials of co-management in three Commonwealth fisheries corroborated that these pre-conditions are necessary for co-management[13].

Table 3: Essential and necessary preconditions for fisheries co-management (Source: FRDC, 2007)

Essential preconditions	Clear objectives established by the authorities who establish a receptive culture for discussing co-management
	A fishing industry (sector) that is sufficiently motivated and cohesive, with representatives willing to champion the 'co-management cause', is financially viable, has appropriate organisational and administrative arrangements established, and possesses or has access to a range of knowledge and skills
	Consistently good working relationships among and between the authorities and the relevant fishing industry, with established and effective communication, administrative and conflict resolution systems and procedures
	A solid legislative and legal foundation for operations
	No social/community conflict associated with the fishery
Necessary preconditions	Appropriate levels of support for co-management obtained by the authorities
	Similar economic interests in the fishery among industry representatives
	Examples of cooperative working relationships, such as those formalised in Codes of Practice and Environmental Management Systems
	Clear and established property rights system
	A well-defined and researched fishery

One of the essential pre-conditions identified by the FRDC study is an absence of social or community conflict. However, new social/community conflicts can quickly arise in fisheries. This is because fisheries are a multi-value resource, where the interests of different groups (such as recreational fishers versus commercial fishers, or community groups versus commercial fishers) or individuals within the same group are often different. The perceptions of risk of fishers are sometimes significantly at variance with those of environmental non-government organisations and this can lead to conflict.

AFMA worked with three Commonwealth fishery groups between 2008 and 2011 to explore the potential for implementing a co-management approach in the management of Commonwealth

[13] *Co-management in Commonwealth fisheries*, FRDC, 2015

fisheries. The project involved trials with varying functions to test the capacity of the fishing industry and government to adopt co-management arrangements. The trials provided on-ground testing of the work undertaken by the FRDC's working group on the co-management initiative, published in 2008. The trial fishery groups included the majority of fishers operating out of the port of Lakes Entrance in Victoria, supported by the Lakes Entrance Fisherman's Cooperative Society Limited; the Great Australian Bight Fishing Industry Association Inc.; and the Northern Prawn Fishery Industry Pty Ltd.[14]

The trials of co-management showed improvements in a number of areas, but did not always realise the savings expected by industry. The effort needed to support some aspects of collaboration (such as in ports) would also be costly to maintain. One of the trial groups met few of the pre-conditions for successful co-management and was unable to develop co-management to a level that would endure and bring any significant benefit, whereas two other groups showed more capacity.

The report found that there is capacity within competent fishery organisations that widely represent the industry to engage in co-management and there are benefits in adopting such an approach. It also concluded under co-management that commercial fisher organisations can expect to play a more hands-on role in fisheries management services and decision-making ranging from greater collaboration in the fisheries management processes through to full provision of fisheries management services. Among other things, this project found that to make co-management a reality, fishery organisations needed to be adequately supported by their membership in terms of resourcing and fisher commitment. Fishers also needed to understand the benefits of representation and its role in implementing successful co-management.

The report noted that the general public is often represented by non-government organisations in the fisheries management process. These groups include conservation, recreational and sport fishing and Indigenous interests. Under co-management, maintaining transparency and access to the management process and demonstrating sustainability would have to become an increased focus for industry. The report also noted that Australian fisheries are disparate and unique in many respects so there is unlikely to be a 'one size fits all' formula for co-management in Australian fisheries. While the FRDC report recommends the further exploration of co-management, the results of the trials show that even during relatively short, government-funded trials, challenges can emerge.

The Fisheries Management Review noted that while much had been written on the benefits of co-management in fisheries, "it has not got a lot of traction in reality". Noting that the capacity of each fishery and its circumstances were disparate, the review suggested that to move co-management forward various conditions should be met: "where there is a clear desire by commercial fishers to develop a substantive co-management practice, it would need to be in the context of clear direction from government and with advice, implementation and oversight from AFMA".

[14] *Co-management in Commonwealth fisheries*, FRDC, 2015

Environmental regulation

Environmental Objectives

The concept of ecologically sustainable development has been widely adopted in legislation to manage Australia's natural resources (in both state/NT and Commonwealth legislation). In addition, specific environmental objectives are included in legislation to ensure that environmental concerns are considered as part of broader decision-making or to protect certain aspects of the natural environment.

Fisheries interact with environmental regulation at multiple government levels. Environmental regulation affecting fisheries includes local planning, state planning and environmental legislation, and national environmental legislation. At the Commonwealth level, the key legislative instrument is the EPBC Act, administered by the Australian Government Department of the Environment. There are three different environmental approval processes under the EPBC Act for Commonwealth managed fisheries – Part 10 approvals (strategic assessments of management arrangements for each fishery), Part 13 approvals (linked to listed threatened species) and Part 13A approvals (export approvals, including for species under the Convention on International Trade in Endangered Species (CITES)).

The complementary fisheries and environmental management arrangements have had a significant impact on the environmental outcomes for fisheries, particularly in Commonwealth fisheries. However, stakeholders often raise issues about perceived increases in regulatory burden due to the interaction of the EPBC Act and the FM Act and the potential duplication of fisheries environmental approval processes.

Independent Reviews of the EPBC Act

A number of options to streamline fisheries environmental approvals have been raised during previous reviews of Commonwealth legislation in this area. These suggestions have centred on the interaction of the EPBC Act with the FM Act, and have focused on options for reducing regulatory burden.

The Australian Environment Act – Report of the Independent Review of the Environment Protection and Biodiversity Conservation Act 1999, October 2009 (the Hawke Review) recommended that the EPBC Act be amended so that the fishery provisions under Parts 10, 13 and 13A are streamlined into a single strategic assessment framework for Commonwealth and State and Territory-managed fisheries to deliver a single assessment and approval process. However, it should be noted that the fisheries assessment provisions serve different functions under the EPBC Act such as covering strategic assessments, protection of listed threatened species and regulation of wildlife trade. Integrating these approval processes would require careful consideration to work in practice, as each approval process is triggered by different causes.

The Fisheries Management Review similarly considered interaction of the Commonwealth fisheries Acts with the EPBC Act and the workability of existing arrangements. While the Review recognised the role the EPBC Act has had in encouraging fisheries managers to address ecological matters beyond the objectives specified in the fisheries Acts, there is a perception that this has come at a cost. In particular, the apparent 'double jeopardy' with separate fisheries and environmental assessments going over much of the same ground and in some respects, the

Department of the Environment taking on at least part of the role that should be the responsibility of fishery managers.

In considering how the fisheries and EPBC Acts might better relate to one another to achieve a seamless but effective integration of fisheries and environmental requirements, the Fisheries Management Review proposed a number of changes to the FM Act, including revising the overall fisheries governance framework. The Review recommended accrediting AFMA's processes for managing fisheries under the EPBC Act, rather than for there to be separate assessments. The governance framework advocated by the Review included amending the objectives of the FM Act to explicitly require addressing harvest strategies, bycatch and discards, and ecosystem impacts in formulating fisheries management plans. The Review also recommended that fisheries management plans should incorporate key performance indicators and provide detail of the management parameters for the fishery to provide greater transparency, accountability and scope for meaningful public consultation processes. It was also recommended that appropriate capacity should be provided for the Minister(s) to audit, and direct where appropriate, management plans to ensure that fisheries and environmental matters are being appropriately addressed.

Precautionary Principle

In its *Marine Aquaculture and Fisheries Issues Paper*, the Productivity Commission asked whether the Precautionary Principle was adequately defined and consistently applied within the context of Australian fisheries.

Consideration of the Precautionary Principle has been incorporated in Australian environmental and resource management legislation, as well as in a number of international treaties and agreements to which Australia is party. The most widely cited version is the Rio Definition, developed at the 1992 United Nations Conference on Environment and Development. It states:

'In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.'

The use of the Precautionary Principle in Commonwealth fisheries has been previously examined by the Productivity Commission. A case study of precaution in fisheries management, focusing on AFMA's decision making and legal precedents was included in a staff working paper published by the Productivity Commission titled *Precaution and the Precautionary Principle: two Australian case studies*, Annette Weier and Paul Loke (September 2007).

The FM Act has since been amended to include a specific reference to the Precautionary Principle in its objectives, however most of the findings of the paper are still applicable. In particular, a series of legal cases (including both appeals to the Administrative Appeals Tribunal and appeals to higher courts) established the validity of utilising precautionary approaches in fisheries in situations where the threshold for the Precautionary Principle had not been met.

AFMA is required under the FM Act to manage Commonwealth fisheries in an ecologically sustainable manner (according to the principles of ESD), which includes avoiding the risks of fisheries collapse and expensive structural adjustment. Fisheries can collapse well before there

is a threat of the target species being fished to the point of extinction – optimal fisheries management means fishing for maximum sustainable yield, ensuring that the fishery maintains its population at an appropriate level. The study found that the Precautionary Principle had relatively little influence in AFMA's decision making, as there was a requirement to manage risks before the threshold of 'serious or irreversible damage' was reached.

Climate Change

Climate change is likely to affect Australia's fishing industry, through rising water temperatures, changing currents and acidification of the ocean. General warming is changing the distribution and abundance of species targeted by marine fisheries, and can change the location of suitable environments for aquaculture species[15].

Climate change poses both challenges and opportunities for Australia's wild fisheries and aquaculture sectors and impacts will vary according to changes in the regional environment: south-east fisheries are most likely to be affected by changes in water temperature, northern fisheries by changes in precipitation, and western fisheries by changes in the Leeuwin Current.

A report by CSIRO, *Implications of Climate Change for Australian Fisheries and Aquaculture: A Preliminary Assessment*, indicates that there may be new opportunities for some wild fisheries where tropical species shift southward. There will also be many challenges, such as that faced by the Tasmanian salmon aquaculture industry due to Atlantic salmon being cultivated close to their upper thermal limits of optimal growth. Nevertheless, the report also highlights that there is potential for adaptation measures to be employed by the industry.

Effective, precautionary and adaptive management of commercial fish species may be able to identify these changes early and adjust fisheries management arrangements accordingly. Targeted research is also used to help industry adapt to climate change and create opportunities for growth in the sectors. The FRDC, AFMA, and the CSIRO have undertaken research in this area.

Adjustment may be required to current spatial boundaries and temporal closures in declared fisheries with impacts on statutory fishing rights if species distribution and range change significantly. This may have implications for OCS and resource sharing arrangements across jurisdictions, particularly where arrangements were negotiated taking account of fisheries of predominantly state or Commonwealth interest.

Aquaculture regulation

The Australian Government recognises that domestic aquaculture production has the potential to significantly expand to help meet the growing demand for seafood both nationally and internationally.

[15] Hobday and Poloczanska (2010) *Fisheries and Aquaculture*. In C.J. Stokes & S. M. Howden (Eds.) *Adapting agriculture to climate change: Preparing Australian agriculture, forestry and fisheries for the future* (pp. 205-228). Melbourne: CSIRO Publishing

Aquaculture in a global context

The World Bank[16] reports that aquaculture will continue to fill the growing supply-demand gap in the face of this rapidly expanding global seafood demand and the more limited scope to expand wild capture fisheries. In 2013, the share of aquaculture in global fisheries production was 43 per cent[17] and OECD-FAO[18] estimates that by 2024 the share of aquaculture will increase to almost half (49 per cent) of global production.

While the overall growth in global aquaculture production remains relatively strong, aquaculture output in many developed countries, most notably the United States of America, Spain, France, Italy, Japan and the Republic of Korea, has fallen in recent years[19]. Conversely, aquaculture production has continued to grow strongly in developing countries. Today around 88 per cent of world edible aquaculture production is supplied from the Asian region, with China being the single largest aquaculture producer[20].

Australia's aquaculture industry

Although Australia's wild catch fisheries production annual tonnage declined by 36 per cent from 2004-05 to 2013-14, during the same period aquaculture production increased by 56 per cent[7]. In 2013-14, aquaculture accounted for 40 per cent of the gross value of Australia's fisheries production, worth approximately $1 billion[21].

Australia's aquaculture industry is relatively small by global comparison, accounting for less than one per cent of the estimated US$138 billion global value of aquaculture production in 2012. However, Australia's strength is in producing safe, sustainable, high quality and high-value products such as oysters, salmon, tuna and prawns.

Aquaculture is particularly significant for many regional economies in Australia and is a key growth industry in Tasmania and South Australia where 74 per cent of Australia's aquaculture production value can be attributed[8].

Aquaculture operations are regulated by local, state, NT and Australian governments. Governments regulate for a number of reasons including marine and coastal management, environmental management, land use planning, land tenure, and quarantine and translocation. The state/NT governments have primary responsibility for regulating most of the day-to-day aspects of aquaculture. However, the Australian Government also plays an important role in supporting aquaculture through national programmes for research, quarantine, aquatic animal health, export food safety, environmental management and market access and trade. Responsibility for environmental regulation, including the approval of new aquaculture developments and ongoing monitoring and compliance, is shared between state/NT

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[16] World Bank, 2014, *Fish to 2030: Prospects for Fisheries and Aquaculture; Agriculture and Environmental Services Discussion Paper 03; World Bank Report Number 83177-GLB*. The World Bank, Washington D.C.
[17] FAO 2014a, *Fishery and aquaculture statistics 2012*, Food and Agriculture Organization of the United Nations, Rome, available at ftp://ftp.fao.org/FI/CDrom/CD_yearbook_2012/navigation/index_content_aquaculture_e.htm.
[18] OECD–FAO 2015, *Agricultural Outlook 2015*, OECD Publishing, Paris, available at: dx.doi.org/10.1787/agr_outlook-2015-en
[19] FAO 2014b, *The state of world fisheries and aquaculture 2014*, Food and Agriculture Organization of the United Nations, Rome, available at fao.org/3/a–i3720e.pdf.
[20] ABARES, 2016, *Agricultural commodities: March quarter 2016*. Australian Government Department of Agriculture and Water Resources
[21] ABARES, 2015, *Australian fisheries and aquaculture statistics 2014*. Australian Government Department of Agriculture and Water Resources

governments and the Australian Government Department of the Environment. The Great Barrier Reef Marine Park Authority has regulatory authority over aquaculture projects that are located within or adjacent to the Great Barrier Reef Marine Park or discharge aquaculture waste directly into the Great Barrier Reef Marine Park.

The Australian Government, through the DAWR primarily deals with aquaculture issues that fall outside or cross over with those that are the responsibility of the states/NT, such as biosecurity, veterinary medicines and chemical regulation and providing a national coordination role to encourage consistency in practices across jurisdictions.

One of the actions identified in the White Paper on Developing Northern Australia is to devolve aquaculture management in Commonwealth waters to the states and NT. DAWR is responsible for implementing this action which will be a key component of the national aquaculture strategy to be released in 2016.

Development of a National Aquaculture Strategy

In June 2014, the government released a National Aquaculture Statement, which was developed by DAWR in consultation with the National Aquaculture Council and state/NT governments. The Statement recognises the contribution that aquaculture makes to the Australian economy and regional development, and demonstrates the commitment of the Australian, state and territory governments to the growth of an efficient, innovative and sustainable domestic aquaculture industry.

DAWR is currently developing a national aquaculture strategy which will:

- support and complement the National Aquaculture Statement;
- articulate a national vision and priorities for Australian aquaculture and describe, at a high level, what government and industry can do to support that vision;
- identify at a national level opportunities and challenges facing the Australian aquaculture industry, and how industry can overcome and capitalise on these; and
- identify a number of agreed, achievable actions that should be undertaken by government and/or industry to support the growth of a strong, competitive, resilient, profitable and ecologically sustainable aquaculture industry.

DAWR is currently developing the strategy in consultation with industry and governments and plans to have a draft strategy by mid-2016. DAWR has consulted a range of stakeholders, including state and territory governments, peak bodies, individual operators, environmental non-government organisations and research bodies on the national aquaculture strategy.

Some of the issues identified by stakeholders include:

- management arrangements and complex and duplicative regulatory requirements;
- difficulties in gaining access to agricultural chemicals and veterinary medicines;
- biosecurity and the risks associated with ballast water, biofouling and imported seafood products;
- communications and the need to educate the Australian public about the credentials of the Australian aquaculture industry;
- infrastructure (or lack thereof), particularly in regional or remote locations and across northern Australia;

- research, development and extension (RD&E) and the success of the research development corporation (RDC) and cooperative research centre (CRC) models for RD&E; and,
- aquaculture in Commonwealth waters and the lack of a clear regulatory framework for interested proponents (see below).

The strategy will consider these issues (and others raised during ongoing consultation) and seek agreement from the state/NT Governments, and industry, to a range of actions to encourage the growth of an innovative, sustainable and efficient aquaculture industry.

Aquaculture in Commonwealth Waters

As previously mentioned, the White Paper on Developing Northern Australia included a commitment to devolve the management of aquaculture in Commonwealth waters to the states and territories.

DAWR understands that the technology for offshore and exposed aquaculture is available and is being used in various locations internationally. This technology could allow Australian aquaculture operators to establish operations in Commonwealth waters in the medium term.

There is currently no specific legislation relating to the management of aquaculture in Commonwealth waters. However, aspects of the activity, such as the removal of fish from an aquaculture facility, are potentially regulated under the FM Act. While state/NT laws could be drafted to include Commonwealth waters adjacent within their jurisdiction, the current drafting of the FM Act may preclude the concurrent application of such laws, to the extent that they deal with matters covered by the FM Act.

As noted in the Productivity Commission's *Marine Aquaculture and Fisheries Issues Paper*, aquaculture currently occurs in state/NT waters under state/NT laws and using state/NT arrangements. While the Commonwealth Government agrees that a regulatory framework is required for Commonwealth waters, establishing Commonwealth regulation could add a layer of unnecessary regulation.

The Australian Government could explore amending legislation to remove any limits on the application of state/NT laws for aquaculture in Commonwealth waters adjacent to their jurisdiction. This would leave the way clear for the other jurisdictions to amend the area of application of their aquaculture legislation to include Commonwealth waters and to therefore manage the activity across the entire Exclusive Economic Zone adjacent to their jurisdiction.

Australian Government
Department of Agriculture and Water Resources
ABARES

Attachment A

ABARES input to the Department of Agriculture and Water Resources submission

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Summary

In December 2015 the Productivity Commission was requested by the Treasurer to enquire into the regulatory burden imposed on the Australian marine fisheries and aquaculture sectors. In making a submission to the inquiry, the Australian Government Department of Agriculture and Water Resources requested that ABARES provide summary information about the Australian fishing sector, with a particular focus on Commonwealth fisheries and the context within which they are regulated. The information provided in this report is designed to meet that request.

This report provides some key data on the Australian fishing industry, with a particular focus on Commonwealth fisheries, and provides a discussion of the reasons why the fishing industry needs regulation to avoid over capitalisation and over exploitation. In line with the experience of Commonwealth fisheries and with the inquiry's terms of reference, it also focuses on wildcaught fisheries to the exclusion of aquaculture. It also provides a summary of the regulatory options available to Government, in particular the different aspects of input and output control managed fisheries. Other aspects covered are management costs and cost recovery. Some contemporary issues facing Commonwealth fishery management, namely how well quota markets are operating in allocating effort across Commonwealth quota managed fisheries, and the degree to which quota remains unused at the end of the fishing season are also discussed.

Key facts about Australia's fishing industry

- The gross value of production (GVP) of wildcaught fisheries and aquaculture has risen slightly in real terms since 2009–10 to reach a value of $2.5 billion in 2013–14, of which $1.5 billion was wildcaught. The fishing sector is small compared with other agricultural sectors, including the crops sector (which had a GVP of $28.4 billion in 2013–14) and livestock ($51.2 billion).
- Australia produced 233 000 tonnes (0.14 per cent of total world production) in 2013–14, indicating that Australia is a very small producer on the global stage. However, export earnings were $1.4 billion in the sector in 2014–15, indicating that around half of production, by value, is exported annually.
- Employment in the fisheries and aquaculture industry has fallen from the 20 000 persons employed in the early 2000s to approximately 10 000 persons in 2013–14.
- There are at least 2 069 fishing vessels in Australia that are currently registered with the Australian Maritime Safety Authority (AMSA), although some boats less than 24 metres are not required to register. According to the register the average size of fishing vessels is 16 metres with 63 per cent of vessels between 12 and 19 metres. Queensland and Western Australia have the largest number of vessels, with 700 and 353 vessels registered respectively. Other States have between 100 and 300 registered vessels each.
- Labour or crew costs comprise the most significant component of total cash costs of fishing enterprises. A share payment system is typically used to remunerate labour with skippers and other crew generally receiving a proportion of total gross sales from a vessel's catch. The next largest cost item is fuel. The contribution to costs from fuel varies according to the type of fishing operation. Trawl fisheries have a higher proportion of fuel costs in total operating cash costs because of the fuel intensity of trawl operations when compared to other types of fishing techniques.
- A large portion of management costs are recovered from fishers with the absolute level of management costs recovered generally related to the size of the fishery being managed.

The Commonwealth trawl sector and Gillnet, Hook and Trap sector of the SESSF, the Northern Prawn Fishery (NPF) and the Eastern Tuna and Billfish fishery incur amongst the highest management costs of Commonwealth fisheries and exhibit similar trends in management costs over time. In these fisheries management costs in 2013–14 are significantly lower than in 2001–02, but the cost per active vessel is higher. In general management costs remained steady both in total and per active vessel until the Securing our Fishing Future structural adjustment package in 2006–07. Because many boats left these fisheries, the cost per boat increased substantially, however since then total management costs have declined substantially, reversing much of the per boat increase.

- The profitability of fisheries varies but are likely to be affected by the management controls in place at the time of fishing. ABARES analysis of key Commonwealth fisheries indicates that fishery profitability generally increased following the introduction of output controls and a reduction in effort levels after the Securing our Fishing Future structural adjustment package of 2006 was implemented. Other management arrangements since the adjustment package have also influenced returns. Survey results indicate that the rate of return earned on capital invested in fisheries is frequently at attractive levels.

Regulation of fisheries, targets and controls

- Open access fisheries are characterised as being "rivalrous" and "non-excludable" common property resources. Once a fish is caught it is not available to another fisher to catch and no fisher can exclude another fisher from entering the fishery. In this sense no single fisher has exclusive right to the stock. As a result unregulated fisheries have a propensity to be overfished and progressively overcapitalised.
- In regulating fisheries, managers need to set management targets. Since the 1950s the target of achieving a biomass level that leads to the maximum sustainable yield being harvested from the available fishery biomass, the B_{MSY} target, has been extensively used in the management of fisheries. In economic terms, this target is consistent with a target that aims to maximise fishery revenue. More recently an explicit economic target, the B_{MEY} target, has been adopted in many fisheries, particularly in Commonwealth fisheries. This target seeks to maximise profits from the fishery and targets a catch structure that allows the biomass to reach a level that leads to a maximum economic yield being extracted from the fishery. This yield is the one that maximises the difference between harvest revenue and costs. The likelihood of reaching an adopted target is improved by the development of a harvest strategy, which sets out the direction of fishery management, through decision rules, when the target is not being achieved.
- The B_{MEY} target offers a number of benefits, including: less waste of resources as resources not needed in fisheries flow to more productive uses in the economy; economically resilient fisheries that are less likely to require future tax payer funded restructuring packages; biologically resilient fisheries that are unlikely to be pushed toward limit reference points; and positive downstream economic impacts in fishing communities, as profits are invested and business diversify into other areas.
- For fisheries to reach maximum economic yield, effort or catch must be restricted. Fisheries' managers have two broad categories of control for this purpose:
  - **input controls**: the aim of these controls is to prevent catch and effort from expanding to points where overfishing is occurring by placing restrictions on fishing gear, limiting the number of vessels operating in a fishery, setting the number of days the fishery is open or controlling any other type of fishery input. Total allowable inputs in the fishery are usually split among operators through a system of individual transferable effort units.

- **output controls**: the aim of these controls is also to limit catch and effort, but do so by restricting the size of the catch. Setting a total allowable catch (TAC) can help achieve maximum economic yield — once the predetermined catch level has been reached, the fishery is closed. TAC systems usually split the TAC among operators through a system of individual transferable quotas (ITQs). Output controls are generally preferred to input controls as it caps catch directly and avoids the effort creep problem, that is, the increased use of unregulated inputs by fishers to increase catch beyond the level intended by the control of regulated inputs.

- Output controls are more prevalent in Commonwealth, non-prawn fisheries, whereas catch limits in state fisheries are applied mostly to shellfish, molluscs and crustaceans and applied more rarely to finfish.

Management costs and cost recovery

- Management costs vary significantly between fisheries, mainly a result of the complex and differing interactions that fishers have with the environment and the complexity of the fishery being managed. For example, in multi species fisheries with fishing occurring across extensive grounds higher costs of management usually prevail than for single species fisheries in well delineated and specific grounds. Management cost are also affected by the type of control adopted with output controlled fisheries typically incurring higher management costs than input controlled fisheries.

- State and territory governments fund fisheries management activities in a variety of ways. Victoria and South Australia pursue cost recovery for fisheries management services based on broader cost recovery policy or guidelines not dissimilar from the *Australian Government Cost Recovery Guidelines*. Western Australia, Queensland, New South Wales, the Northern Territory and Tasmania have no formal cost recovery policies for fisheries. Western Australia, Queensland and New South Wales' arrangements have an aspect of providing returns to the community for exploiting their resources, such as a fee structure based on the 'value of the access right' or through management charges proportional to shares held in managed fisheries. The cost recovery framework for Commonwealth fisheries applies cost recovery on an activity basis, consistent with the *Australian Government Cost Recovery Guidelines.*

Quota markets, quota distribution and latency

- Transaction costs are an important consideration when establishing quota markets. High transaction costs can be an impediment to the flow of quota amongst fishers and contribute to high levels of quota latency. High transaction costs result from low liquidity, leading to little available quota "on the market" at a given time. High transaction costs also result from poor information as most transactions are private, and also from social factors.

- AFMA registry data shows some key targeted stocks are extensively leased and that there has been an increasing proportion of quota leased over time for these stocks, indicating transaction costs may not be high and inhibiting trade. Notably stocks with a greater number of clients either holding or leasing tend to have a greater proportion leased, illustrating the importance of liquidity. Preliminary analysis suggest that quota leasing activity is leading to greater use by more efficient fishers, and that concentration of quota ownership or holding does not appear to be occurring. Foer example, major targeted stocks in the SESSF have demonstrated an increasing proportion of quota leased over time.

- Some output controlled stocks are fished below their TAC limit – a phenomenon known as quota latency. An examination of major targeted species in the Southern and Eastern Scalefish and Shark Fishery (SESSF), for which output controls have been in place for some

time, indicates species vary in the extent of quota latency. It is sometimes difficult to isolate the reason for a high level of latency. In many cases it is the result of a mismatch between the TAC setting and the level of catch that maximises economic yield. Latency may also result from changes in the market, or arise from the introduction of new management arrangements that change fisher behaviour.

- Accumulation of unused quota is unlikely to be a concern. One hypothesis is that quota owners retain unused quota in the hope of capital gains, however any such gains would be received even if the quota was leased out. Another hypothesis is that large quota holders restrict the fishing of a species to increase stock abundance (and reduce per unit fishing costs) and increase prices, however this is unlikely to yield gains if the TAC is aligned with the objective of MEY, which is intended to produce these same gains. If fishers are finding it profitable to increase abundance and prices by restricting catch, then the problem of latency is likely to stem from a TAC setting which is too high, and not insufficient catch.

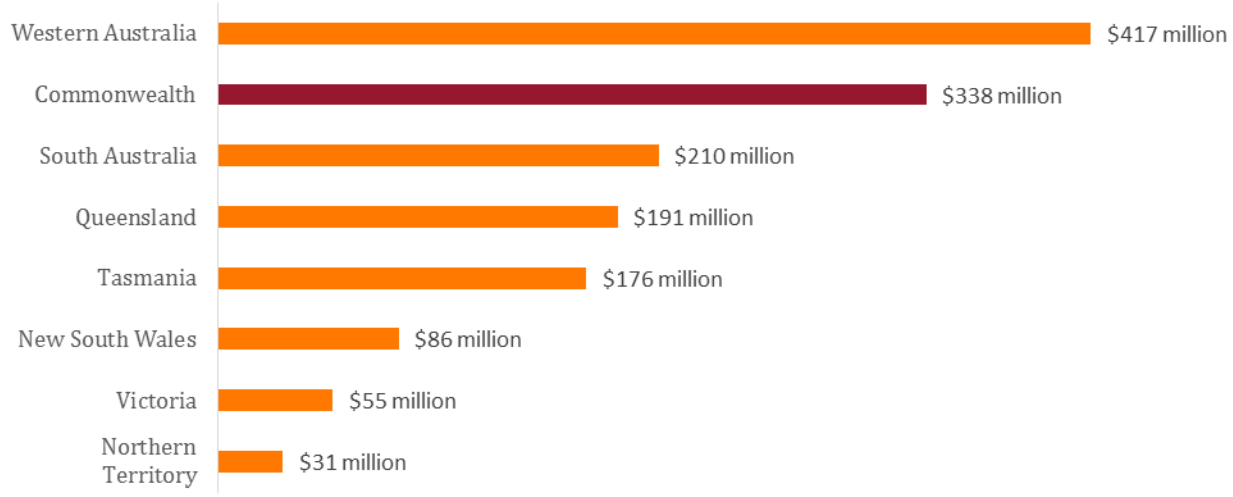
1 Introduction

Australia has one of the largest marine domains in the world, covering an area larger than the Australian mainland. Australian fisheries also have a reputation for being well managed, and as a result most of the stocks commercially fished in Australian waters are classified as not overfished and not subject to overfishing (Flood et al 2014). Maintaining and improving on this position is dependent on the maintenance of effective management frameworks and regulation. The challenge is to design fishery management systems and regulation that account for the multi-jurisdictional nature of Australian fisheries, their geographical spread, and the range of species harvested. Other considerations in designing effective management and regulatory frameworks are related to the cross sectoral nature of the fisheries: for example, Australia has a long history of Indigenous, commercial and recreational fishing (including charter fishing) in its waters and each sector has a competing claim to the use of fish stocks. Fisheries also are part of and interact with larger marine ecosystems, and managing the impacts of fishing on the marine environment is also a social concern.

In the 2013–14 financial year, wildcaught fisheries contributed 61 per cent ($1.5 billion) of the total value of Australia's fisheries production ($2.5 billion) and produced more than 150 000 tonnes (t) of seafood, for local, domestic and export markets. The production from the wild catch sector is diverse; it includes scallops, prawns, crabs, squid, coastal fish such as whiting and flathead, reef fish such as Coral Trout, oceanic tuna and billfish. The fisheries that supply our seafood operate in estuaries and bays, across the continental shelf to oceanic waters and, in some cases, on the high seas. The fisheries and the wild fish stocks on which they are based are managed by eight jurisdictions. In general, the states and the Northern Territory manage fisheries that extend from the coast to a distance of 3 nautical miles, and the Commonwealth manages fisheries that extend from 3 nautical miles to the 200 nautical mile limit of the Australian Fishing Zone.

Commonwealth fisheries account for around 14 per cent of total Australian fisheries and aquaculture production and 22 per cent of wildcaught production (Figure 1). Commonwealth fisheries are generally managed using output controls applying a harvest strategy framework and some complimentary input controls to meet the economic and biological objective of maximising economic returns to the Australian community within the context of maintaining sustainable biological stocks (DAFF 2007). In contrast, States and Territory fisheries use a mix of input and output controls and increasing use of formal harvest strategies (Chapter 4).

Figure 1: Contribution to gross value of wildcatch fisheries production by jurisdiction, 2013–14



Source: Savage and Hobsbawn 2015

The differences in management approaches naturally raise questions in regard to cost effectiveness of alternative approaches to management, impact on characteristics and composition of fleets, and regional socio-economic impacts. Fisheries require clear objectives and means to achieve these objectives to avoid overexploitation and issues of excess fishing capacity. This report provides an overview of Australia's fishing industry, commentary on why fisheries require regulatory based management and the types of management controls available. The focus is on the management of commercially targeted species, although the nature of marine ecosystems means these stocks are not managed in isolation. The report also discusses some key characteristics of Commonwealth fisheries, including the cost of management and the recovery of costs from industry and the quota market and its operation.

2 Key economic characteristics of Australian fisheries

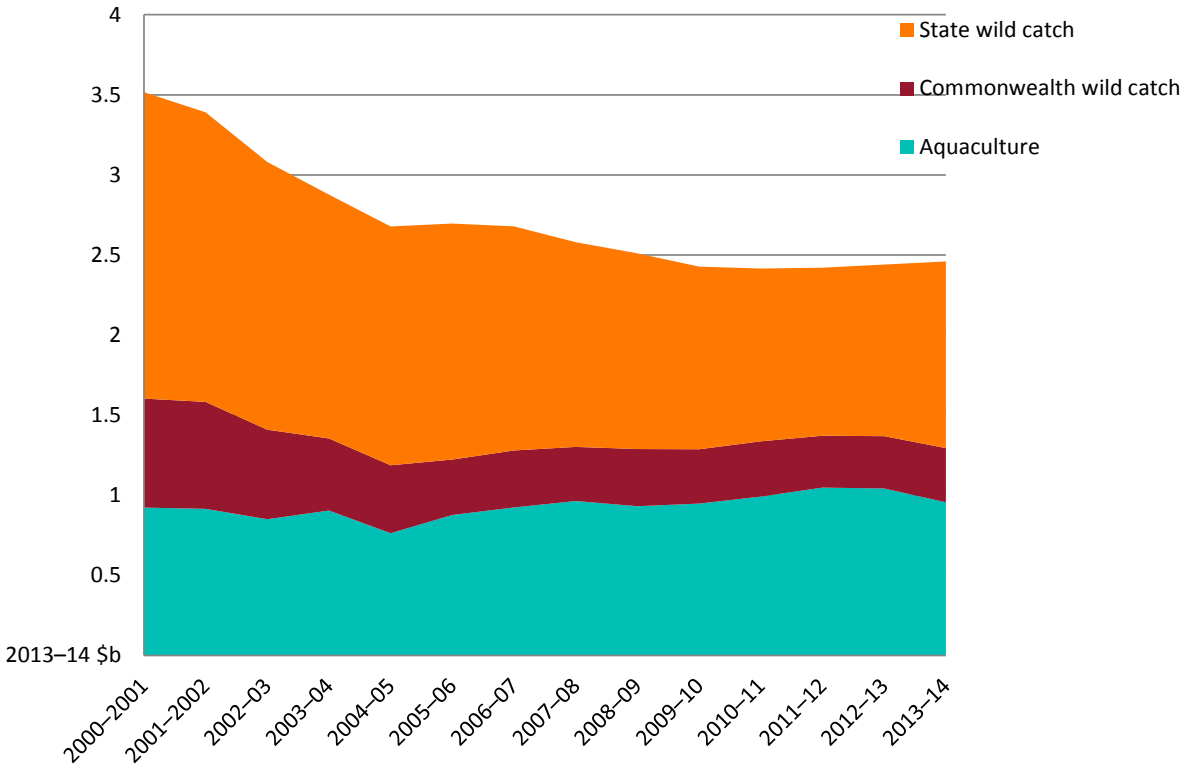
ABARES has produced annual fisheries production and trade data since 1991 in the *Australian fisheries and aquaculture statistics* report series. ABARES has also undertaken economic surveys of key Commonwealth fisheries since the early 1990s. The data collected as part of these surveys are used to assess the financial performance of operators in the fishery and the economic performance of the fishery as a whole. The data allow for observations to be made about the physical inputs and cost structures of the different Commonwealth fisheries surveyed.

The information presented in this section is sourced from these series.

Production

Australia produced $2.5 billion worth of fisheries and aquaculture products in 2013–14 (Savage & Hobsbawn 2015). Fisheries GVP has risen slightly in real terms since 2009–10 after a period of decline between 2000–01 and 2009-10. Fisheries GVP is small when compared with other agricultural sectors. In 2013–14 the crops sector had a GVP of $28.4 billion and livestock a GVP of $51.2 billion (ABARES 2015). The relative size of fisheries to the other agricultural industries has remained relatively constant over time.

Figure 2 Gross Value of Production of fisheries and aquaculture



Source: ABARES

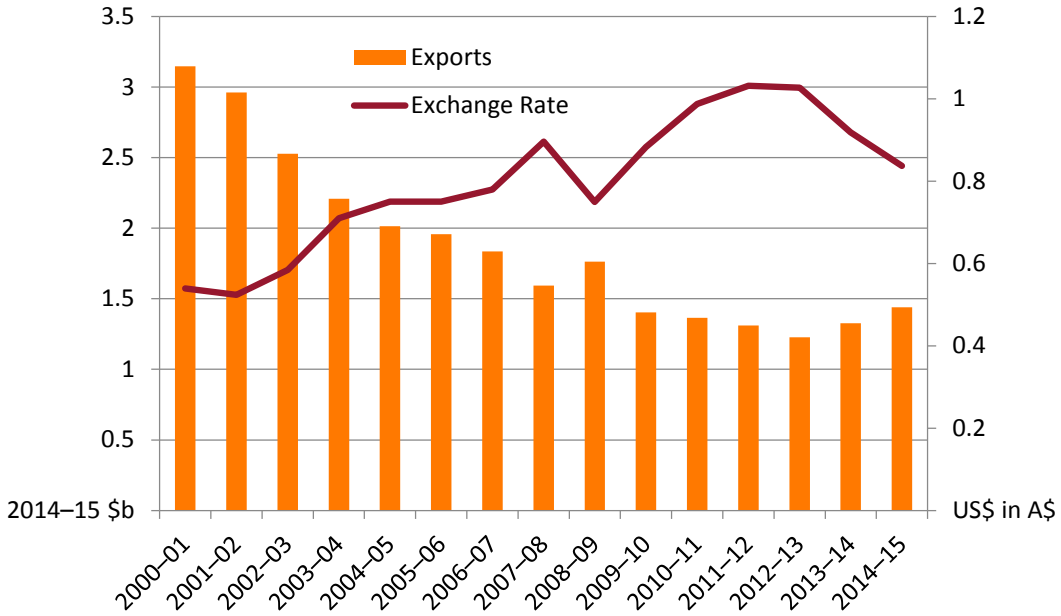
World production of fisheries and aquaculture products was 163 million tonnes in 2013 (FAO 2014). Australia produced 232 635 tonnes (0.14 per cent) of this indicating that Australia is a very small producer on the global stage.

Exports

In 2014–15 Australia exported $1.44 billion of fisheries and aquaculture products. Fisheries exports are small when compared to exports of other agricultural sectors with exports of products from crops $21.7 billion and livestock $21.9 billion. However the export shares of production for fisheries, crops, and livestock are quite significant and at similar levels to each other, with around half of production, by value, exported.

In real terms the value of fisheries and aquaculture exports have fallen significantly since the turn of the century, with only a slight recovery from 2012–13 to 2014–15. Fisheries and aquaculture exports are quite sensitive to currency fluctuations with the rising Australian dollar causing the export decline from 2008–09 to 2012–13, the subsequent depreciation in the Australian dollar has provided support to exports since then. Australia exported 35 304 tonnes of edible fisheries products in 2012–13.

Figure 3 Exports of fisheries and aquaculture products

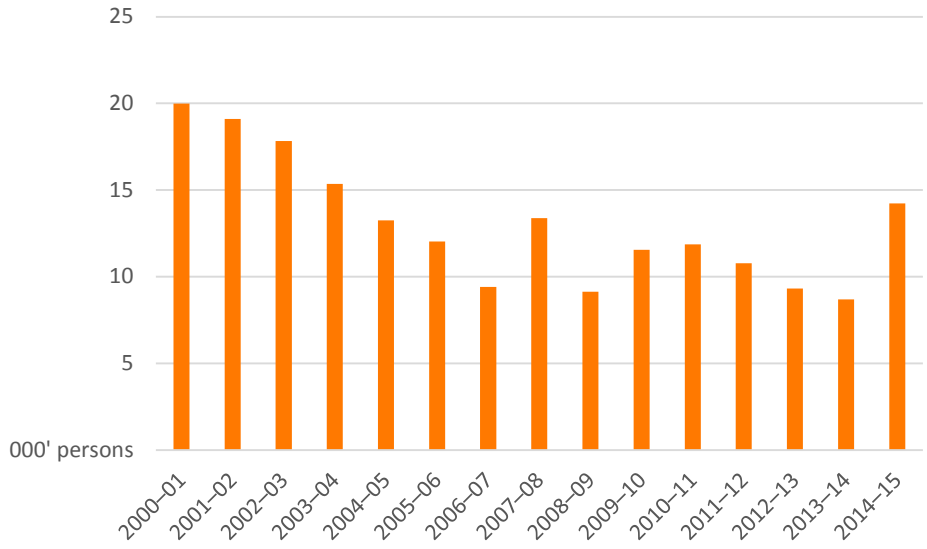


Source: ABS

Employment

Employment in the fisheries and aquaculture industry has fallen from the 20,000 persons employed level at the turn of the century to around 10,000 persons over the past few years (ABS 2015). This coincides with the falls in production and exports over the same period.

Figure 4 Employment in fisheries and aquaculture



Source: ABS 2015

Vessels

ABARES reports on the active number of vessels in Commonwealth fisheries in its yearly status reports, but does not explicitly collect data on the number of fishing vessels (whether state or Commonwealth jurisdictions) as there are limited available data on vessels currently engaged in commercial fishing. The largest publicly available dataset of vessels in Australia is the Australian Maritime Safety Authority's general register of vessels (Australian General Register). This dataset contains details of the length of vessel, vessel type, home port and year of registration. The main weakness of the dataset is that only vessels in excess of 24 metres in length and operating in Australian waters are required by law to be registered (among other requirements); vessels less than 24 metres may be registered, but are not generally required to be registered unless certain conditions prevail. As many fishing vessels are below 24 metres in length this dataset may not be a complete representation of Australia's fishing fleet.

ABARES has vessel data for a number of commonwealth fisheries which ABARES surveys. This details year built and length among other things and can be used in some instances to compare with the AMSA register data. This small dataset contains records for 236 vessels in the fisheries surveyed for 2014–15.

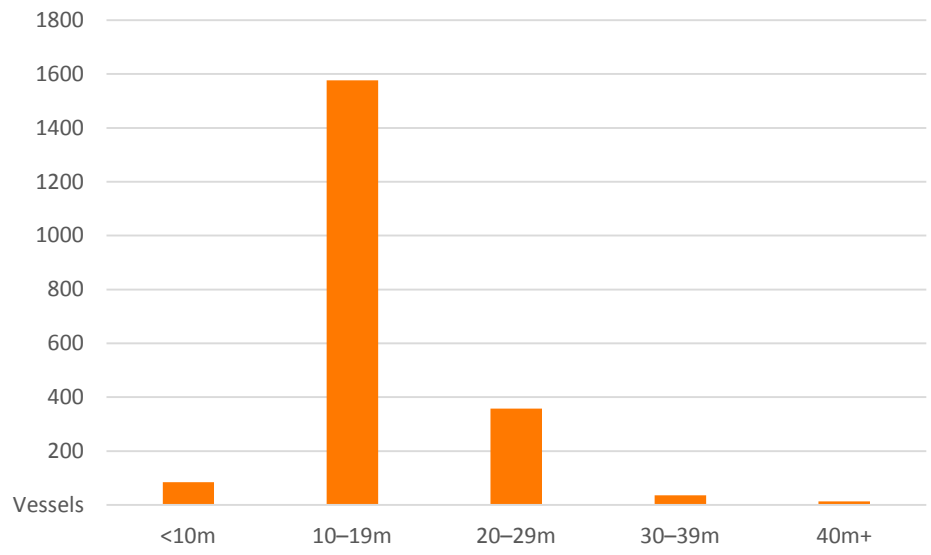
The AMSA register (last updated in February 2016) states that there are approximately 2069 registered fishing vessels in Australia. This includes recreational (charter and game) fishing vessels. As noted above, vessels under 24 metres are not always required to register, and so the data may not be representative. Similarly whether registered boats are actually engaged in any commercial fishing is unclear as boats may be registered as a fishing boat but not engage in fishing.

Size of Vessels

According to the AMSA register the average size of fishing vessels is 16 metres with 63 per cent of vessels between 12 and 19 metres (Figure 5). However the average size will be upwardly biased due to the absent vessels with length below 24 metres. The Commonwealth fishery data

has an average size of 19 metres, reflecting the more difficult operational conditions in Commonwealth fisheries and the different mix of species caught and fishing techniques applied in comparison with State fisheries.

Figure 5 Average size of fishing vessels

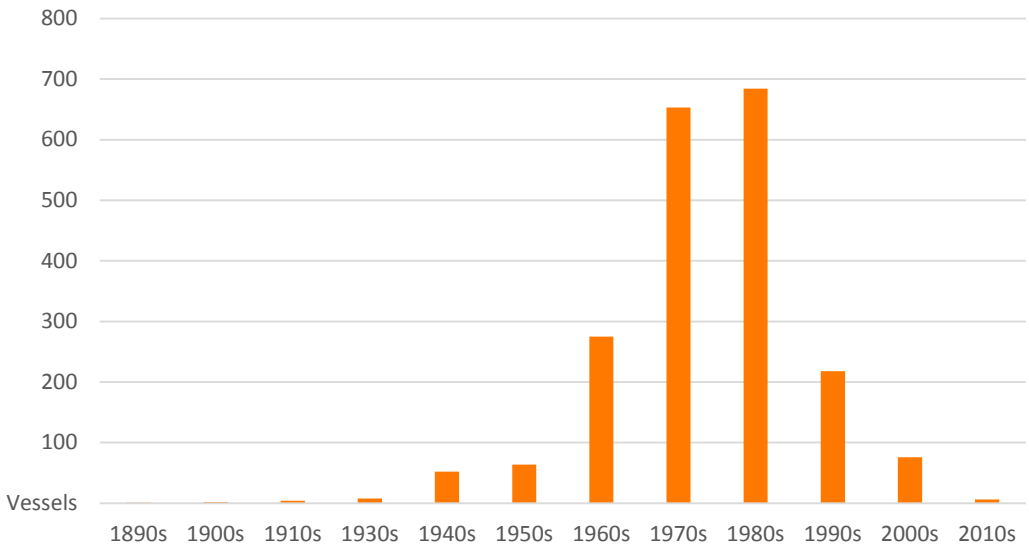


Source: AMSA

Age of Vessels

The average year of registration is 1977 with the years of greatest number of registered ships being 1979 and 1980 (Figure 6). Year of registration can be used as a proxy for boat construction/age and indicates that many boats entered the fleet in the late 1970s and early 1980s. This may be partially explained by the introduction of the Ship Construction Bounty Act in 1975 which subsidised certain types of ship construction from 1975 to 1990. The Commonwealth fishery survey data has an average year of construction of 1987.

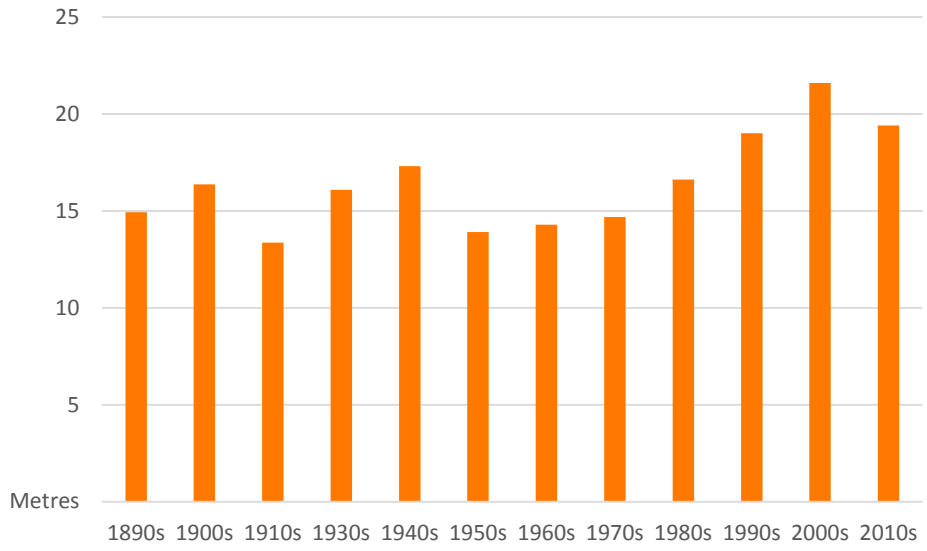
Figure 6 Year of registration of fishing vessels



Source: AMSA

One observable trend is that newer registered/constructed vessels seem to be of greater length on average (Figure 7).

Figure 7 Average length of fishing vessels by decade of registration

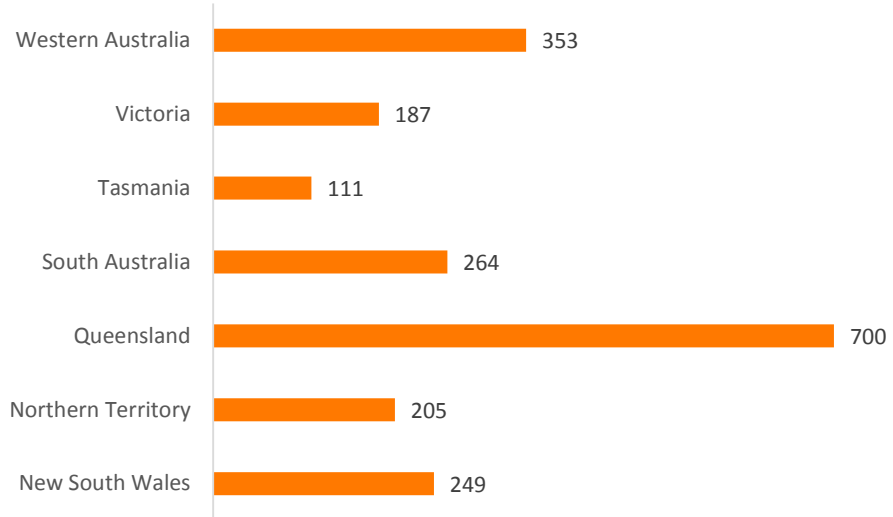


Source: AMSA

Vessel Location

The reliability of the register with respect to location of fishing vessels is unclear with a number of key fishing ports not appearing to have any boats registered. Boats fishing from these ports may be absent from the register entirely or registered with a home port elsewhere (Figure 8). Queensland and Western Australia have the largest number of vessels. This is consistent with the types of fishing that occur in these States, for example rock lobster fishing which utilises a greater number of smaller boats than other forms of fishing such as trawling.

Figure 8 Vessel location by registered port



Source: AMSA

Labour

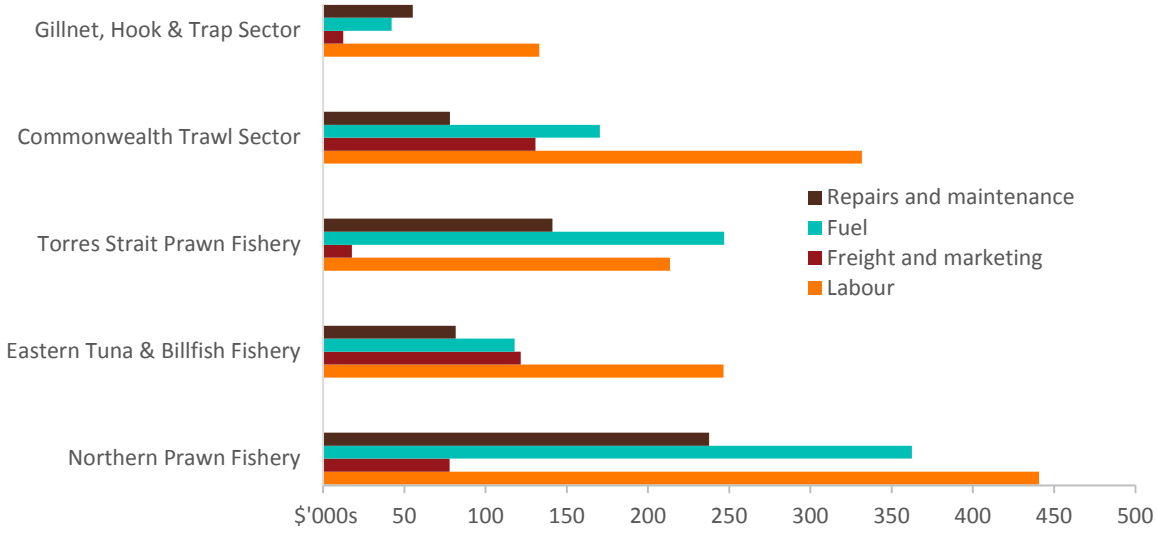
ABARES surveys of Commonwealth fisheries show that labour or crew costs comprise the most significant component of total cash costs (Table 1; Figure 9). Other major cost items, in order of contribution to total cash costs, are fuel, repairs and maintenance, and freight and marketing.

Table 1 Labour costs as a percentage of total cash costs for selected Commonwealth fisheries/sectors — average vessel

Fishery	2011–12	2012–13
	% costs	% of costs
Torres Strait Prawn Fishery	30	na
Northern Prawn Fishery	28	na
Eastern Tuna and Billfish Fishery	28	27
Commonwealth Trawl Sector	35	33
Gillnet Hook and Trap Sector	36	36

Source: ABARES surveys Note: Percentages are calculated from average fishery financial performance reported in the Australian fisheries economic indicator report (formerly the Australian fisheries surveys report). Average fishery financial performance reflects profit and loss statement for the (weighted) average boat for all business activities, including operation in other fisheries during the survey period. na is not available

Figure 9 Major costs of the average vessel in Commonwealth Fisheries 2011–12



Source: ABARES surveys

The main form of remuneration are share payments, with skippers and other crew receiving a proportion of total gross sales from a vessel's catch. The range of tasks crews undertake and the number of crew used for a fishing trip is variable, and depends on the type of vessel being used, the duration of the fishing trip and the species being targeted.

Fuel

Fuel is a major cost for fishing businesses. In major Commonwealth fisheries fuel costs range from 12 per cent to 34 per cent. Trawl fisheries have higher fuel costs than other fisheries (Table 2; Figure 9).

Table 2 Fuel cost as a percentage of total cash costs for selected Commonwealth fisheries/sectors

Fishery	2011–12	2012–13
	% costs	% of costs
Torres Strait Prawn Fishery	34	na
Northern Prawn Fishery	27	na
Eastern Tuna and Billfish Fishery	13	15
Commonwealth Trawl Sector	18	19
Gillnet Hook and Trap Sector	11	12

na Not available. Note: Percentages are calculated from average fishery financial performance reported in the Australian fisheries economic indicator report (formerly the Australian fisheries surveys report). Average fishery financial performance reflects profit and loss statement for the (weighted) average boat for all business activities, including operation in other fisheries during the survey period. Source: ABARES surveys

Fishers are entitled to a rebate on their fuel expense under the Energy Grants Credit Scheme. For claims made since early January 2006, the rebate is approximately 38 cents per litre. When calculating NER as described later in this chapter, ABARES includes this foregone excise in costs.

Gear

Vessel gear is dependent on the type of fishing methods used and current management arrangements of the fishery in which the vessel is operating. Table 3 shows the primary fishing methods and controls for the ABARES surveyed Commonwealth fisheries.

Table 3: Primary fishing methods and controls for surveyed Commonwealth fisheries

Fishery	Primary fishing method	Current controls
Northern Prawn	Otter Trawl	Limited entry to the fishery Individual transferable effort units Gear restrictions Bycatch restrictions A system of seasonal and spatial closures
Torres Strait Prawn	Otter Trawl	Total allowable effort on fishing nights Individual transferable effort units Limited entry Gear restrictions Vessel length restrictions Spatial and temporal closures
Eastern Tuna and Billfish	Pelagic longlines and minor-longlines	Gear restrictions Closed areas ITQs, school shark/gummy shark catch ratio restriction
Gillnet Hook and Trap	Demersal gillnet and a variety of line methods	Total allowable catch for key species Limited entry Gear restrictions Area closures
Commonwealth Trawl Sector	Otter trawl and Danish-seine	Total allowable catch Limited entry Gear restrictions Area closures

Each of the fisheries are subject to gear restrictions amongst other controls. Restrictions are placed on vessel gear to manage escapement from the fishery and can include mesh size on nets, depth settings, number of hooks used, length of head and foot ropes, and the number and size of traps.

Gear restrictions can be used to limit the amount caught in the fishery, but can also protect other non-target species, marine environments and prevent fishers catching juvenile species. Vessel operators would need to ensure that different gear requirements are met, before choosing to operate across multiple fishery jurisdictions.

Economic performance of fisheries

ABARES survey reports provide indicators that give a picture of economic performance in the fishery and assist in informing management of the fishery. Some key influences on the economic performance of fisheries are described below.

Input and output prices - Input prices include the price paid for costs associated with the fishery business, such as fuel. Output prices are the prices received for landed catch. Together the input and output prices give indications of the terms of trade fishers are subject to in their operating environment.

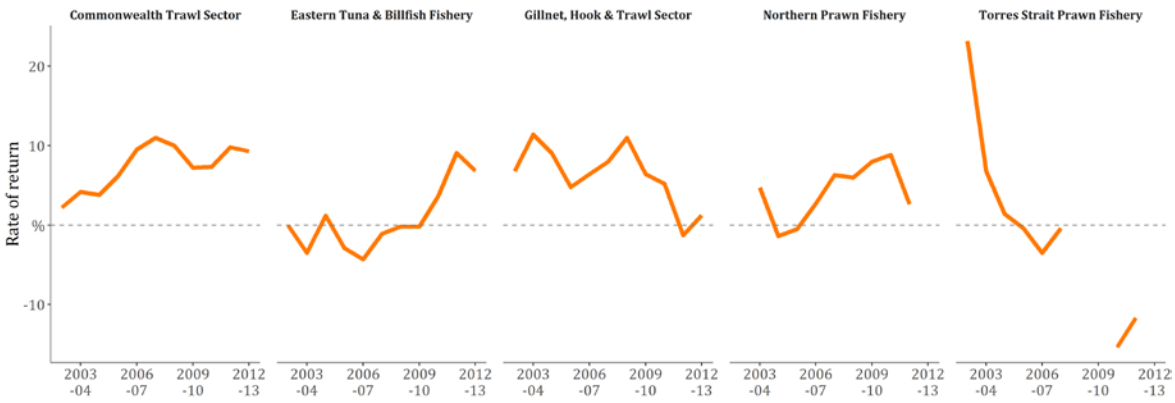
Productivity - Productivity reflects the ability of fishers to convert inputs into outputs. Productivity improvements can be made in response to factors such as adverse market conditions (increasing input costs or competition), changes to management conditions or changes to fishers' technology choices.

Management arrangements - Management arrangements are the type of controls placed on the fishery including setting of TACs, gear and effort restrictions, the tradability of rights within the fishery, and seasonal or temporal closures within the fishery. Management arrangements necessarily incur management costs — a proportion of which are recovered from fishers under cost recovery arrangements — to ensure the fishery continues operating. Management arrangements are key to ensuring that the potential economic returns to a fishery are not dissipated through a 'race to fish'.

Two key measures of economic performance include rate of return on capital, which is a financial performance measure and relevant to a fisher's decision to operate in a fishery, and net economic returns (NER), which is the key measure of fishery level economic performance.

Rate of return on capital measures the financial profit at full equity as a percentage of total capital (including quota and licence value) for the average boat in a fishery. Figure 10 provides the rate of return for boats operating in the five Commonwealth fisheries that ABARES surveys. For the major fisheries that ABARES surveys the rate of return to capital has been variable. Part of this variation reflects the differing level of risk of operating in different fisheries.

Figure 10 Rate of return at full equity for Commonwealth Fisheries



Source: ABARES

The NER are the returns earnt from a fishery's operation across a financial year. This is calculated as economic returns after all costs across the fleet have been met, including fuel (with excise), crew costs, repairs, the opportunity cost of family and owner labour, depreciation, the full cost of managing fisheries and the opportunity cost of capital. Different levels of NER have different economic interpretations:

- **a zero NER** implies normal returns: fishers have recovered all their costs and made a normal rate of return on their deployment of labour and capital to the fishery; the costs of managing the fishery have been fully recovered; management has not been successful in preventing the dissipation of potential economic rents.
- **a negative NER** means more resources are used in the fishery than are generated by fishing.
- **a positive NER** indicates that management arrangements have been successful in capturing a portion of the potential economic returns available, consistent with the management objective of pursuing economic efficiency through targeting maximum economic yield.

Figure 11 to Figure 15 show the trend of NER from 2000–01 to the most recent year of survey. Significant changes in management or events in the fishery are included in the figures. The NER trends across the fisheries are variable, with all experiencing negative NER at some point since 2000. Four of the fisheries were targeted in the Securing Our Fishing Future buyback package - the ETBF, CTS, GHT and NPF. Figure 11 to Figure 15 show the reduction in number of concessions or vessels directly after the buy-back period (2006–07). NER performance since the buyback has been varied, with the CTS, ETBF and NPF achieving positive NER and the GHT returning to negative NER. Where NER has improved changes can be linked to fishery level cost decreases associated with reductions in vessel numbers as well as other factors, such as positive impacts from environmental and stock variation, market conditions, previous management changes and changing levels of management costs (Vieira et al, 2010).

Figure 11 Net economic returns 2000–01 to 2012–13, Torres Strait Prawn Fishery

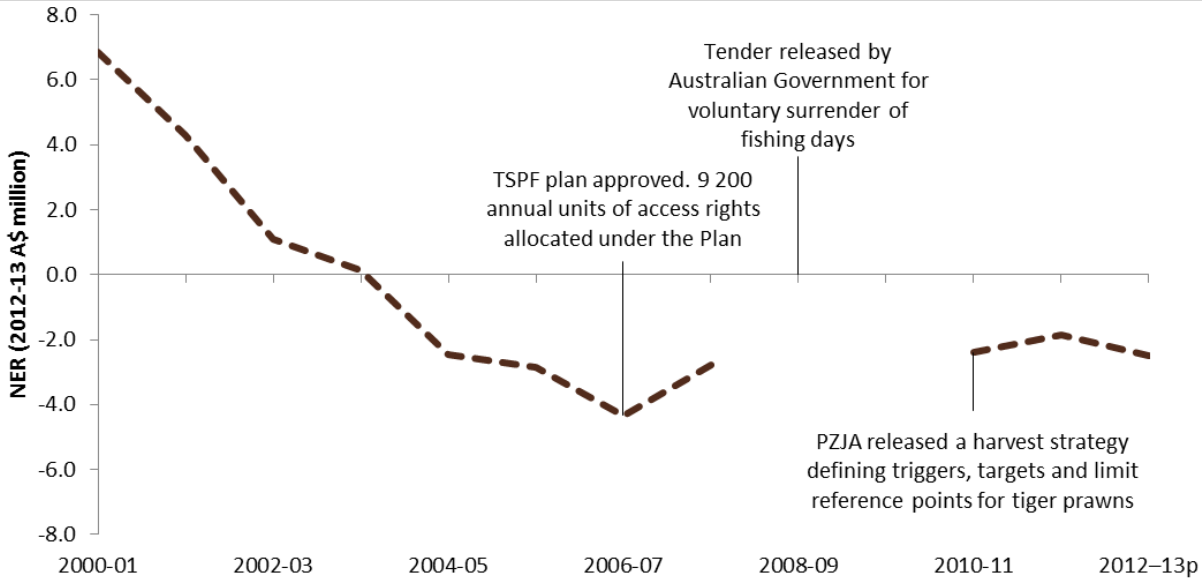


Figure 12 Net economic returns 2000–01 to 2012–13, Eastern Tuna and Billfish Fishery

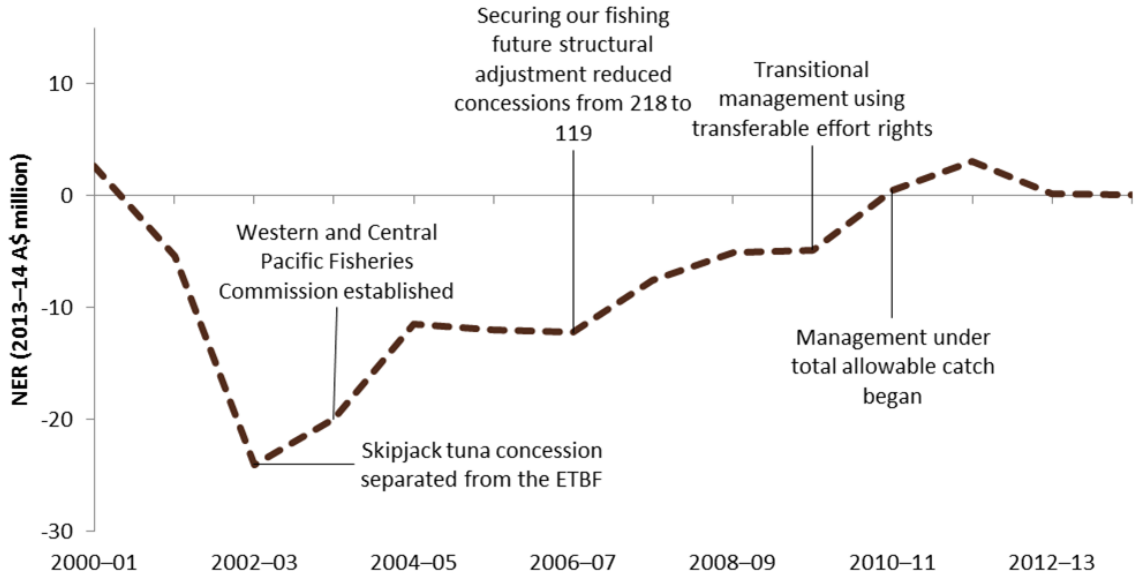


Figure 13 Net economic returns 2000–01 to 2013–14, Commonwealth Trawl Fishery

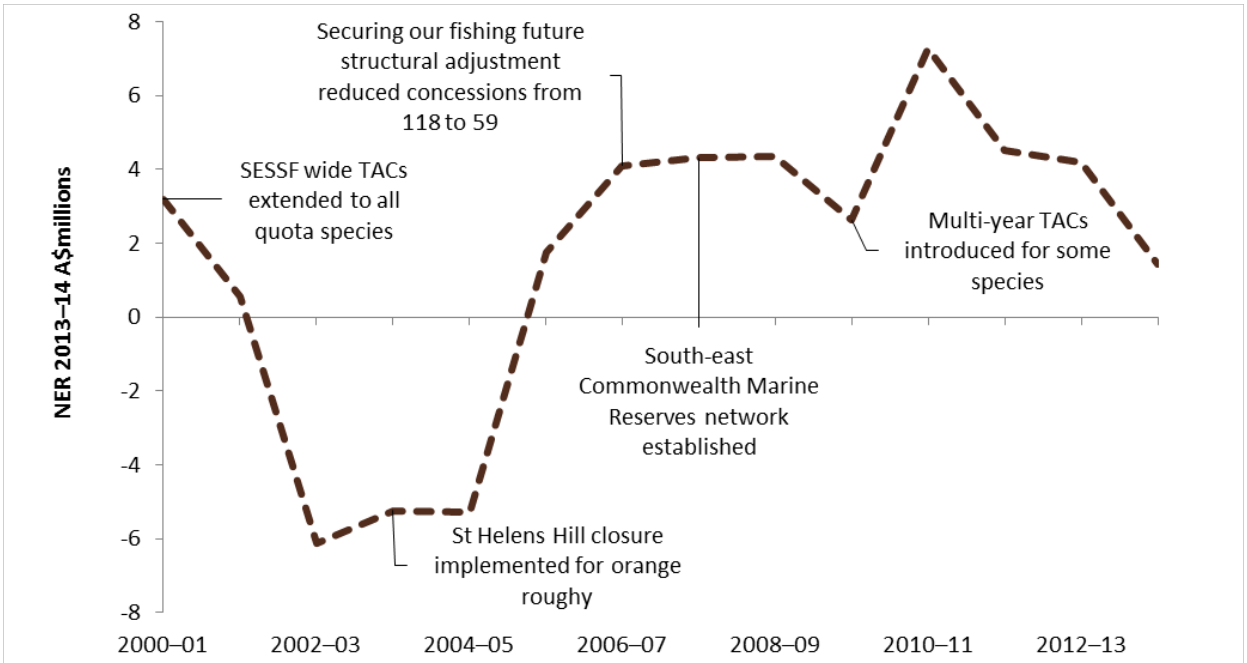


Figure 14 Net economic returns 2000–01 to 2013–14, Gillnet Hook and Trap

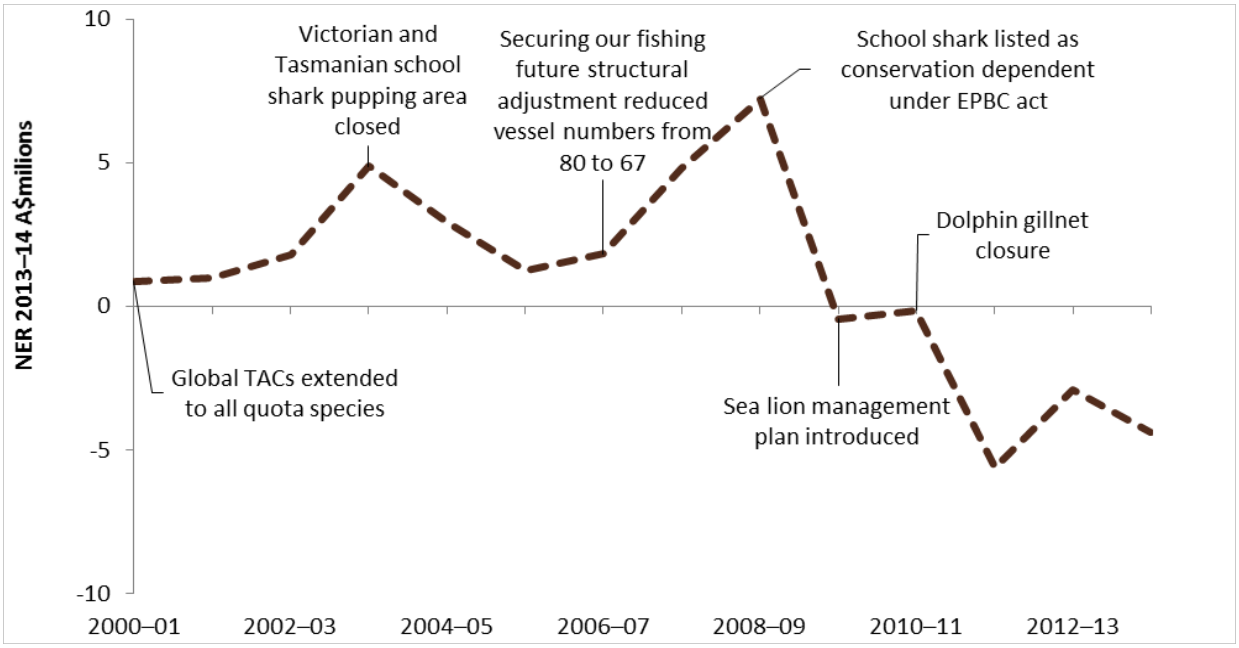
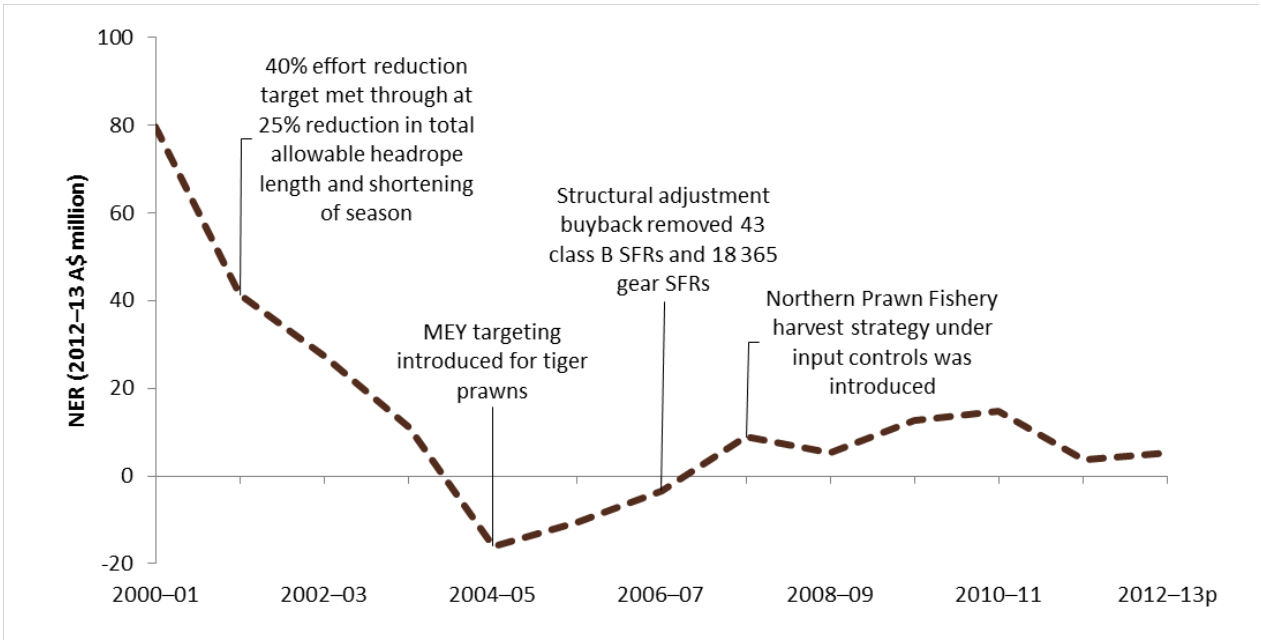


Figure 15 Net economic returns 2000–01 to 2012–13, Northern Prawn Fishery



3 The nature of fisheries resources and role of a regulatory framework

In unregulated fisheries fishers are likely to overfish targeted fish stocks and progressively overcapitalise the industry. This is because under open access, fish stocks have the characteristics of being "rivalrous" and "non-excludable". In the fishery context, rivalrous implies that once a fish is caught it is not available to another fisher to catch. In the same context, "non–excludable" implies that no fisher can exclude another fisher from entering the fishery. In this sense the fishery is a common property, belonging to all with no single fisher having exclusive right to the stock.

Under open access, the features of "rivalrous" and "non-excludable" imply a lack of property rights over fish stocks and hence a "race to fish" develops where each fisher who enters the fishery seeks to catch as fast as possible, in the knowledge that fishing later will incur a higher cost as stocks are depleted. Fishers will enter the fishery as long as the costs of doing so are covered by the expected revenue from selling fish. However, with each additional fisher the costs of fishing increases as stocks are fished down and marginal revenue earnt decreases as more fish are placed on the market. Fishing continues until the unit price from fishing just equals the unit average cost of the catch. At this point all available resource rents from exploiting the fishery are dissipated.

An additional problem with the open access fisheries is that once fisheries have become overcapitalised, that is too much labour and too many boats to make the fishery economically viable, it is difficult for fishers to leave the fishery. Vessels are long term investments, and once fishing vessels are geared up it is costly to adjust gear configuration to operate in another fishery. Also once a fishery has developed a work force that is excessive to its needs it is costly for people to move to other industries through retraining. For these reasons open access fisheries often result in calls for government assistance, including licence buybacks.

In recognition of the issues with open access, and the difficulty in restructuring fisheries once they have become unviable, governments have long realised that regulation of fisheries is required. Regulation has typically focused on making fisheries excludable, by introducing limited entry licencing arrangements, and controlling effort and or harvest to ensure sustainability and that fisheries are profitable and economically resilient. In contemporary fishery management additional regulations are introduced to control the adverse impacts of fisheries on bycatch, stocks that are undergoing rebuilding and the marine environment. These controls can generally be characterised into input and output controls and are used extensively in the management of Australian fisheries. Box 1 provides some detail about the development path of a significant and key Commonwealth fishery, the Commonwealth Trawl Sector of the SESSF.

Fishery biomass targets

A large aspect of fisheries management is about ensuring effort levels in a fishery do not put fishery resources at risk of excessive depletion, and that fisheries remain biologically and economically sustainable. To be effective in this task fisheries managers must set objectives that ensure sustainability of the stock and ensure that the stock management targets are consistent with those objectives.

The open access equilibrium

Fisheries in Australia were allowed to develop in the early 1900s with minimal management (Harrison 2008). By the 1950s it was being realised internationally, and in Australia, that fisheries resources could readily be depleted if too much effort was applied and economists and biologists started thinking about the issue of how to manage fish stocks that are available to all for exploitation, but owned by none. The common property nature of fisheries resources was discussed in Gordon (1954), an influential paper that explored the economic theory applying to common property resources, and in particular fisheries. In that paper it is shown that the open access equilibrium (B_{OAE}) is a natural equilibrium point in an unmanaged fishery. At this point there is no further profit incentive to enter the fishery, as all marginal profit gains from entering the fishery have been exploited. If more effort is applied to the fishery beyond the B_{OAE} equilibrium, economic losses are incurred, that is the marginal cost of any additional effort applied will be in excess of the marginal revenue gained.

From an economic perspective the B_{OAE} equilibrium is wastefulness to the economy, as it results in all available resource rents available from the fishery being dissipated. Further, the economy has scarce labour and capital resources, and it is best to use those scarce resources in their most productive use. The B_{OAE} equilibrium leads to too many of these resources applied to fisheries, and hence missed opportunities in other parts of the economy. Moreover, fishers only earn normal rates of return from operating at this level and zero resource rents are generated from the use of the resource. A feature of this equilibrium is that cost of fishing is higher than it needs to be, because fish stocks are too thin, and fish prices are lower than they could be, because too much harvest are reaching markets. In addition there will be a "race to fish", as fishers recognise that any foregone catch will readily be taken by another fisher as the resource is common property with no fisher having property entitlement to the fish stock. As a result the fishery gravitates to a point where too many vessels are chasing too few fish, with no single fisher able to make a viable livelihood from the fishery.

In an unmanaged fishery it is unlikely that the annual catch taken will be consistent with achieving a sustainable yield, that is, the economic outcome is likely to be inconsistent with maintaining a level of catch that is sustainable. As a result, the fishery is likely to face the prospect of seeing fish stock reduce to levels that put the stock at risk of collapse. If open access is a desired target then fishery managers need to ensure that the open access biomass target is on the yield curve and sustainable.

The maximum sustainable yield (B_{MSY}) target

At B_{MSY} the maximal level of biological yield from the stock can be taken year after year without affecting the stock size. For most species the stock size at B_{MSY} involves some level of resource rents being earnt by fishers. These resource rents ultimately flow to other areas of the economy for productive use. Hence from a resource allocation perspective the B_{MSY} target is a preferred to the B_{OAE} target. Moreover, assuming that fishers are price takers, at the B_{MSY} target industry revenues are maximised, as the fishing yield is at its maximum sustainable potential.

The maximum economic yield (B_{MEY}) target

The B_{MEY} target is pursued in the management of Commonwealth fisheries. Part of the reason is that for most stocks the B_{MEY} target occurs at thicker levels of fish stocks than B_{MSY} implying that this target provides a higher buffer against unintentional overfishing and/or fish stock collapse. The main reason however, is that the B_{MEY} target results in the highest level of returns that are possible from a fishery and is consistent with the fishery improving its economic efficiency over

time. At B_{MEY} there is a maximum difference between fishery revenues and costs, and the fishery is at its optimum scale. In this sense it is a target that achieves an optimal allocation of resources and one that captures all available resource rents. Moreover, resources not required for fishing are able to leave the industry and flow to other areas of the economy where they will earn higher returns. Some challenges in implementing this target are that it is moves with changes in prices and costs.

How does the B_{MEY} target maximise net economic returns to the Commonwealth from the management of Commonwealth fisheries?

One of the legislative objectives for Commonwealth fisheries that AFMA is required to pursue is to "Maximise net economic returns to the Australian community from the management of Australian fisheries." Pursuing the B_{MEY} target ensures that resource rents generated through the fishery are at their maximum potential. The other major feature of the B_{MEY} target is that this target is consistent with making the best use of available inputs, including the economy's scarce labour and capital inputs.

The benefits that the Australian community derive are:

- No dissipation of available resource rents;
- Economically resilient fisheries that are unlikely to require future tax payer funded restructuring packages;
- Biologically resilient fisheries as the stock levels are managed under higher levels with the B_{MEY} target compared to the B_{MSY} and B_{OAE} equilibrium.
- The release of resources from the fishery sector, mainly labour and capital, then used in other parts of the economy.
- Positive downstream economic impacts in fishing communities, as profits are invested and business diversify into other areas, for example farming and tourism.

The role of harvest strategies

A harvest strategy provides a means through which the management objective can be actively pursued. The main advantage of having a harvest strategy in place is that it contains the pre–agreed management actions that need to be taken in specific circumstances, and in this sense management actions become more predictable and transparent for fishers. The strategy usually states the objective and the management actions required to meet that objective. For Commonwealth fisheries DAFF (2007) states that stocks are required to be maintained at sustainable levels and that the economic returns from managing these stocks is to be at the maximum sustainable level. A harvest strategy exists for each of the Commonwealth managed fisheries, with the approach taken in each varying in accordance with the type of stock being managed and the fishery specific issues faced. The Commonwealth Harvest Strategy Policy and its associated guidelines were developed in 2007 and were reviewed in 2013 (DAFF 2013).

National guidelines for developing harvest strategies in Australian fisheries were published in 2014 (Sloan et al 2014). The development of these guidelines was supported by the Australian Fisheries Management Forum (AFMF) and the Fisheries Research and Development Corporation (FRDC) to encourage some level of consistency in the development of harvest strategies across Australian fishing jurisdictions. The guidelines set out a number of principles for the development of harvest strategies:

- Defined operational objectives for the fishery;
- Indicators of fishery performance related to the objectives;
- Reference points for performance indicators;
- A statement defining acceptable levels of risk to meeting objectives;
- A monitoring strategy to collect relevant data to assess fishery performance;
- A process for conducting assessment of fishery performance relative to objectives; and
- Decision rules that control the intensity of fishing activity and/or catch.

Harvest strategies have been adopted by a few, mainly developed, countries to assist in the management of their fisheries, such as Canada, Iceland and New Zealand. Harvest strategies are generally a requirement for certification in the Marine Stewardship Council program (Sloan et al 2014).

In Australia harvest strategies have been established for Commonwealth fisheries in line with the Commonwealth Fisheries Harvest Policy (DAFF 2007). The operational objective is to achieve maximum economic yield. There is significant research effort that assists Commonwealth fisheries to meet the operational target, most of which is conducted through Resource Assessment Groups established to assist AFMA in its management fisheries.

Box 1 Management of the Commonwealth Trawl Sector, early 1900s to 2016

The fishery now known as the Commonwealth Trawl Sector of the SESSF demonstrates the consequences of inadequate controls since it began in the early 1900's. Diminished stock levels were already apparent by the 1940s when declining flathead catch led to expansion into jackass morwong and redfish. In the virtual absence of management restrictions, the Danish-seine fleet based in New South Wales expanded southwards to waters off Victoria in the 1950s. A shift towards trawling technology led to an expansion to deeper and more southerly waters during the 1970s.

By the early 1980s, the New South Wales fleet had increased to 130 vessels, almost double the number in 1970.

Before 1985 there was a limit on the number of trawlers over 32 m long permitted to enter the fishery, but there were no regulations controlling the number of smaller vessels. Despite the introduction of several management measures aimed at limiting fleet expansion, both fishing capacity and effort continued to increase. The discovery and development of the deepwater orange roughy fishery in the late 1980s led to large expansions in effort, with 26 000 tonnes and 40 000 tonnes of orange roughy caught in 1989 and 1990 respectively. These catch levels were unsustainable and the stock soon became overfished, with the biomass falling below the level associated with maximum sustainable yield.

TACs began to be implemented in the late 1980s and early 1990s, particularly for stocks that had become overfished, including eastern gemfish and orange roughy but in general catch was not constrained and continued to reflect an open access equilibrium including a doubling of trawl hours between 1992 and 2004. As such in 2006 many valuable species, including gemfish, orange roughy, flathead and pink ling were considered overfished.

About 140 vessels were active in the trawl sector in 1991, and although vessel numbers declined after the introduction of quotas the fishery was still considered to be overcapitalised. During 1997, an Australian Government-funded structural adjustment scheme removed 27 (of 108) permits from the fishery. This failed to improve economic returns even as GVP increased, and net economic returns in the period 2000 to 2005 were negative. Further government funded structural adjustment through the Securing our Fishing Future structural adjustment package in 2006 removed about half of the concessions in the SESS. It is unclear whether the history of buyouts has led unprofitable boats to expect a further opportunity in the future, and remain in the fishery when they otherwise would not have done so.

Concurrent with the introduction of the Securing out Fishing Future structural adjustment, the new Commonwealth Harvest Strategy Policy–including the objective of maximum economic yield–was introduced in 2007, and TACs were reduced. As a result, fishing effort and GVP also substantially reduced, but net economic returns became and have remained positive up to the most recent ABARES estimates for 2013–14.

Source: Derived from Morison et al 2007, Skirtun and Green 2015 and Newton et al 2007

The status of commonwealth fish stocks

Since 1992, ABARES has reported on the status of key commercial fish stocks in Commonwealth fisheries. Status assessments consider whether the size of a fish stock is adequate to sustain the stock above the level which would be considered overfished (biomass status) and whether current catch levels allow the stock to remain in that state (fishing mortality status).

The number of stocks classified as not overfished and/or not subject to overfishing has increased since reporting to this resolution began in 2004 (Patterson et. al. 2015). In 2015, of the 92 stocks across 21 fisheries, 66 were classified as not overfished, 77 classified as not subject to overfishing and of these, 63 stocks were both not subject to overfishing and not overfished. There remain 12 stocks classified as overfished and 2 of these stocks were also subject to overfishing. Overall, this demonstrates a general improvement in the current state of the Commonwealth key commercial stocks. The status reports also detail some of the broader impacts of fishing on the environment, including fishery assessments under the EPBC Act, ecological risk assessments and the level of interaction with protected species. There are clear examples of the effectiveness of management in minimising interactions with bycatch.

Bycatch management in Commonwealth Fisheries

Some fisheries are highly targeted in nature and exhibit minimal interaction with non-target species. Other fisheries are less targeted in nature and interact with non-target species as a matter of course.

In Commonwealth fisheries, bycatch is generally considered to be the species that physically interact with fishing vessels and/or fishing gear which are not retained for sale. The overarching drivers for the management of bycatch in Commonwealth fisheries come from the Fisheries Management Act 1991 (FM Act) and Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and the Commonwealth Policy on Fisheries Bycatch 2000.

Implementation of the direction contained within the above legislative instruments takes the form of fishery specific Bycatch and Discarding Workplans. These plans are developed by AFMA in consultation with industry and research partners to find practical and affordable solutions to minimising bycatch and the discarding of target species. Workplans focus on ‘high risk’ bycatch and threatened, endangered and protected species as identified though the ecological risk assessment process.

Since 2001, AFMA has been refining the ERA/ecological risk management process (ERM) process in pursuit of broader ecosystem-based fisheries management goals. Within this system, the ERAs help to prioritise research, data collection, monitoring needs and management actions for fisheries while the ERM framework provides a framework to guide the management response to risk. There are currently 10 Bycatch and Discarding Workplans for Commonwealth fisheries which are accessible through AFMA's website.

4 Types of controls used in Australian fisheries

For fisheries to reach maximum economic yield, fishing must be restricted. Fisheries' managers have two categories of control for this purpose:

- **input controls** — the aim of these controls is to prevent catch and effort from expanding to the open access equilibrium–that is overfishing–by placing restrictions on fishing gear, limiting the number of vessels operating in a fishery, setting the number of days the fishery is open or controlling any other type of fishery input.
- **output controls** — the aim of these controls is also to limit catch and effort, but do so by restricting the size of the catch. Setting a total allowable catch (TAC) can help achieve maximum economic yield — once the predetermined catch level has been reached, the fishery is closed. TAC systems usually split the TAC among operators through a system of individual transferable quotas (ITQs). Although size limits are also a form of output control, this report takes "output controls" to refer to catch limits.

Australian fisheries operate under both input and output controls and, in practice, often use a combination of the two. Output controls are more prevalent in Commonwealth, non-prawn fisheries, whereas catch limits in state fisheries are applied mostly to shellfish, molluscs and crustaceans and applied more rarely to finfish. This may be because the former species are less likely to be co-caught or harvested with other target species, and thus biomass targets are easier to develop.

A summary of controls across Australian jurisdictions is in Table 4.

Table 4 Types of controls used for the management of target species across Australian fishing jurisdictions

Jurisdiction	Input and output controls
Commonwealth	11 of 22 Commonwealth fisheries use ITQs (with complimentary input controls) and another three use either non-tradeable quota or TACs. ITQ fisheries account for nearly 60 per cent of GVP in Commonwealth fisheries, with almost all of the remainder accounted for by prawn fisheries using input controls including limits on gear, fishing days, vessel numbers and seasonal and spatial closures.
New South Wales	Abalone, lobster, red urchin, ocean trapped and line (northern zone) spanner crab are limited under total allowable commercial catch (TACC). Other species are input controlled
Victoria	Abalone, lobster, scallop, giant crab managed under TACC, other species managed under size and gear restrictions
Queensland	Tropical rock lobster, Spanish mackerel, stout whiting and harvest fisheries (coral, beche-de-mer or trochus) managed under catch limits. Effort limits used for most trawl species
Western Australia	West Coast Rock lobster, abalone, crabs, pearl oysters and some finfish including mackerel, pink snapper and pilchards are managed under quota. Other species use effort controls, but with a target total catch.
Tasmania	Lobster, abalone, scallops and other shellfish are managed largely under total allowable catch. Scalefish are largely managed under input controls except for banded morwong.
Northern Territory	The Demersal Fishery, which accounts for most of the Territory's catch, is operated under total allowable catch, as is the pearl oyster fishery.

Input controls

Input controls generally have a lower on-going cost of implementation than output controls as targets need not be developed for every species or in response to changing stock levels, and because they are relatively easy to monitor. This is particularly desirable when a species stock is highly variable from year to year. Like output controls individual effort units can be allocated to fishers so that effort can flow to the most efficient fishers.

However, input controls frequently allow overfishing as fishers increase their catch through other inputs if profitable to do so. This practice is known as "effort creep", where fishers increasingly use unregulated inputs in a bid to augment the regulated inputs and increase their fishing power. This alternative mix of inputs may be less economically efficient than what they would have done otherwise and may mean that the benefits of allowing transferrable effort units are not captured, as additional catch can be achieved through increasing the use of unregulated inputs rather than purchasing effort rights. As a result of effort creep input controls need to be frequently adjusted to maintain the fishery at the chosen target catch level, leading to increased management costs.

Although input controls can be used as a method of achieving MEY, input controls also can address other issues, and are thus are also used in fisheries that target MEY through output controls. An example is spatial closures to protect species reproduction, for instance preventing fishers from taking stock in shark pup grounds. Other examples are gear and spatial restrictions

designed to protect other species (for instance sea lions, dolphins and seals) or prevent ecosystem damage (limits on trawling). Examples of input controls and their associated purposes are in Table 5.

Inputs controls designed to meet other objectives may prevent fishers using the most efficient mix of inputs, and, in the case of gear or boat size restrictions, exploiting any available economies of scale. The variety of input controls is large, and the costs and benefits vary by fishery, area and stock, and cannot easily be summarised.

Table 5 Examples of input controls

Examples of Input controls	Reason
Effort restrictions (on fishing days, number of vessels, number of lines/hooks/seine shots etc)	Restricting total effort to restrict output
Gear restrictions (net length, boat size, mandatory devices etc)	Limits the amount that can be caught Protect other marine species and habitats Prevent the catching of juvenile or undersized fish
Seasonal and spatial closures	Limits effort and can protect the reproductive cycle of species Provide protection to other species and to marine habitats Limits disruption to some local communities (for example in the Torres Strait)

Output controls

Output controls directly limit the amount that can be caught, thus directly addressing the problem of overfishing and solving the problem of 'effort creep' associated with input controls and catching beyond target levels. This is the main reason they are preferred over input controls. The limited TAC is usually, and most efficiently, distributed as individual tradable quotas (ITQs) which can be bought, sold or leased on a quota market. When the quota restriction is binding, economic theory suggests that this will lead quota to be allocated to the fishers who can use it most efficiently. Output controls work best in high value single species fisheries with stable abundance. If there is good information about fish stocks, fishing costs, revenues and production relationships, landings and discarding then the efficiency of ITQ management is enhanced. Effective enforcement is also important (Rose 2002).

As with input controls, a number of problems also exist with the implementation of output controls in some fisheries.

One is the difficulty in setting TACs for species where stock levels can vary significantly year to year. An example of this is prawn species, which are relatively short lived and can reproduce rapidly when conditions are right. In this instance stock levels would need to be estimated and appropriate TACs determined yearly if output controls were used. The impracticality and high cost of this has meant that the two Commonwealth prawn fisheries–the Northern Prawn Fishery (NPF) and the Torres Strait Prawn Fishery (TSPF)–operate under input controls, although in the former case the potential of an ITQ regime is reinvestigated regularly.

Another complication occurs in multi-species fisheries, where fish of several species may be co-caught. In this instance, a fisher must have quota sufficient for both the species targeted, and

any other species that might be caught. Approaches to address this have been considered both by theoretical means of setting TACs in multispecies fisheries (Pascoe et al 2015) and can also be mitigated by other management initiatives. The latter includes a reconciliation period in which fishers can seek quota for inadvertent catches over quota, and overcatch allowances where a fisher can "borrow" from their quota in the following year.

Lastly, a TAC system may increase management costs (whether recovered from fishers or paid by government) because of the process of setting and monitoring TACs. This can potentially require collection of data on stock levels, the development of bioeconomic models and a robust system of engagement and review to set TACs. In practice AFMA often chooses to set targets by a proxy, by pursuing a biomass target 20 per cent higher than that deemed required for maximum sustainable yield (usually 0.40 of unfished biomass). This reduces management costs, but may lead to targets that are misaligned with the MEY objective, or are inconsistent in a multi species fishery.

Output controls need appropriately set targets to succeed in reaching maximum economic yield. A target that is set too high may result in lower economic returns and potentially overfishing. A target set too low will result in foregone economic opportunities. As these risks are asymmetric–the potential cost of overfishing is much higher than foregoing profitable catch–managers may choose to err on the side of caution where there is uncertainty.

The effectiveness of the quota market in allocating quota is also limited by the transaction costs of the market. When these are high, the market may not allocate quota efficiently, or can change the structure of the market at the expense of some participants. Whilst there are strong anecdotal concerns about the quota market, empirical evidence suggests it is working more effectively than anecdotal evidence would suggest, and may be improving over time.

Table 6 Comparison of input and output controls

Output controls			
Individual transferable quotas (ITQs)			
	Advantages	**Disadvantages**	**Comments**
ITQs are shares of a Total Allowable Catch (TAC), and can be bought, sold or leased temporarily.	Provides individual fishers with a share of the TAC which can be used an asset Quota markets can allocate quota to fishers that are more efficient. Costs are minimised for a particular level of catch and returns are maximised.	TACs are difficult to set when stock levels are volatile Can be complicated in multi species fisheries when different species with separate quota are co-caught. Potentially produces uncertainty, inhibiting investment and planning decisions Ongoing management, monitoring and compliance may be costly	Implementing a TAC system requires appropriately set TACs to be effective, and this can be complex. Spatial controls and gear restrictions may be needed to protect other aspects of the environment, for instance other marine species such as sea lions.
Input controls			
	Advantages	**Disadvantages**	**Comments**
Examples of input controls include: limited number of fishers boat size restrictions gear restrictions (for example limits on the size of nets or number of hooks that can be used) Individual transferable effort units.	Management costs, including target setting, monitoring and compliance may be lower, particularly where stock levels are volatile Unlikely to be any management induced highgrading and/or discarding as fishers have no incentive to maximise the average quality of a limited catch. Some effort restrictions (for instance fishing days) can be traded	There is a strong incentive for fishers to compete to maximise their catch resulting in overcapacity and a reduction in overall returns. Fishers will substitute unrestricted inputs for restricted inputs which pushes up the cost of fishing. This 'effort creep' forces managers to periodically adjust input control and can lead to inefficient production techniques. Costs associated with initial allocation of transferable effort units if these are adopted.	Prevents fishers from using the least cost combination of inputs for a given level of catch. Almost always involves some level of effort creep. Rather than the community benefiting from improved fishing techniques, gear controls are frequently adjusted to limit the amount of effective effort applied in a fishery. Can be successful in fisheries where no input substitution is possible. May be appropriate in small fisheries where the costs of implementing and maintaining a system of output controls may not be feasible.

Resource allocation

The Commonwealth government solely or jointly manages around 21 fisheries of economic importance, comprising over 90 fish stocks or species assemblages. Jointly managed stocks refer to those managed by the Commonwealth in partnership with the states/Northern Territory, and shared international stocks managed by regional fisheries management organisations (RFMOs). At the domestic level, a number of these fisheries and stocks are shared between Commonwealth and state fishers and other extractive resource users, including the recreational, charter boat and indigenous customary sectors.

The focus of this section is on domestic fish stocks either managed solely by the Commonwealth or by the Commonwealth in partnership with the states/Northern Territory or other domestic fisheries management organisations (such as the Protected Zone Joint Authority). Regulation and management, including resource sharing, of stocks managed by RFMOs may present different issues.

Resource allocation frameworks are increasingly being proposed for inclusion in, or formalised into, fisheries management strategies and relevant legislation (see, for example, Western Australian Department of Fisheries 2012; MRAG Asia Pacific 2014). At the Commonwealth–state fisheries management level, resource allocation frameworks exist in the form of Offshore Constitutional Settlement arrangements, whereby shared resources are managed across jurisdictional boundaries using a variety of mechanisms. Organisations such as the Torres Strait Protected Zone Joint Authority are responsible for the management and allocation of commercial and traditional fisheries and stocks shared by Australia and Papua New Guinea.

There are a number of examples where possible inequity in resource allocation and associated management costs appears to exist between Commonwealth- and state-managed fisheries resources (Box 2).

Box 2 Commonwealth management of the eastern school whiting stock

Quotas for economically important stocks in Commonwealth fisheries are set through a variety of stock assessment processes that produce recommended biological catches (RBCs). Estimates of discards, state catches and other sources of fishing mortality (including recreational catch, where available), are deducted from these RBCs to provide quota in the form of total allowable catches (TACs). These TACs are apportioned to Commonwealth fishers based on the number of statutory fishing rights (SFRs) they hold.

AFMA, through its resource assessment groups, sets RBCs and TACs for the eastern school whiting stock, which is shared between Commonwealth and state fishers. A large proportion of the costs of stock assessment and quota setting processes are cost-recovered from Commonwealth SFR holders. State-based fishers also pay levies to fish the stock, but these levies do not directly contribute to the cost of the Commonwealth management of the stock.

Part of the difficulty with this scenario is that the Commonwealth's primary management mechanism for this and other economically important stocks is output controls in the form of TACs, whereas many of the states manage shared stocks using input controls. Application of the Commonwealth Fisheries Harvest Strategy results in Commonwealth quota being reduced based on the level of state catches (i.e. state catch and other sources of mortality are deducted from the RBC to produce the Commonwealth TAC). As well as obvious equity issues around the costs of stock assessment and management, this may also result in uncertainty for Commonwealth fishers around future quota allocations and may discourage investment in the fishery or their business.

In 2004, the Australian Government developed a framework for making resource sharing decisions in Commonwealth fisheries, consisting of: a set of guiding principles; a consultation process; and a Memorandum of Understanding (MOU) between the Australian Government and the states/Northern Territory. This framework was applied in the Western Tuna and Billfish Fishery and Eastern Tuna and Billfish Fishery to establish rights of access to a negotiated share of the resource for the commercial and recreational sectors. An important lesson that arose from this process was the need for timely and targeted data on which to base sound resource sharing decisions. This is of particular importance for the recreational fishing sector where, in some jurisdictions, data collection has been ad hoc and the sector faces difficulties in supporting claims to their share of the resource.

While exploitation of the same stocks by the Commonwealth and recreational sectors is relatively rare when compared to the number of stocks shared by recreational and state-based fisheries, there are a number of examples where increasing recreational catches need to be considered in the sustainable management of stocks (for example, for Southern Bluefin Tuna; SBT). Attempts are being made to account for the recreational take of SBT in line with a commitment by Australia in its capacity as a member of the Commission for the Conservation of Southern Bluefin Tuna to develop methods to account for all sources of mortality to this stock, including recreational fishing, by 2018 (see Moore et al. 2015).

Recreational fishing in Australia is managed by the states and territories, with relevant jurisdictional legislation extending to the management of recreational fisheries in adjacent Commonwealth waters. Importantly, recreational fisheries are managed using a combination of input (for example gear restrictions) and output (for example bag limits) controls. However, in the absence of total quota for the recreational sector, there is generally no relationship between the objective of output controls used in recreational and commercial (particularly Commonwealth) fisheries.

Ideally, stocks should be managed at a biological level using a consistent set of input and/or output controls (or a least easy translation between them), but current arrangements between the Commonwealth and the states (including state/territory management of the recreational fishing sector) may not allow this to occur. Data paucity often prohibits this occurring in any meaningful and equitable way, particularly when considering allocation for the recreational sector.

This complexity can create perverse outcomes by limiting the ability for shared stocks to be managed at the appropriate biological or economic target (e.g. MSY or MEY), and may undermine the objectives of relevant (but different) legislation or policy under which the stock is managed.

High management costs for some Commonwealth fisheries may prohibit undertaking assessments of risk around particular exploitation rates or estimates of biomass for certain stocks. While many Commonwealth fisheries are relatively data rich when compared to state-managed and recreational fisheries, a lack of funding for more comprehensive science (for example exploration of sensitivities and risks) may prohibit certain fisheries from achieving the desired biological and economic targets. This may also exacerbate equity issues whereby marginal improvements in certainty, resulting in moving closer to the management target (and providing better returns for fishers) may be negated by the additional cost. Historically, there are examples where the costs of managing certain fisheries may have exceeded the value of the fishery itself. If other users of a particular stock are not subject to the same management controls as those who are responsible for paying for all or part of the management of the resource, perverse outcomes may arise whereby there is a disincentive to invest in better knowledge.

Equity issues may be confounded because there are no formal arrangements for cost recovery from non-Commonwealth resource users (including from state fisheries or recreational fisheries) to support data collection, research, stock assessment and overall management of Commonwealth-managed stocks for which the Commonwealth is a key beneficiary.

Some examples of possible resource allocation issues are provided in Table 7.

Table 7 Possible resource allocation issues

Resource allocation issue	Examples of key stocks affected
Stocks shared between Commonwealth (output [quota] managed) and state (predominantly input control-managed) fisheries	Eastern redfish Blue eye trevalla Eastern school whiting Flathead (predominantly tiger) Jackass morwong Pink ling Silver trevally Small pelagics
Non-quota stocks shared by both Commonwealth and state fisheries	Snapper
Stock shared between the Commonwealth and recreational fishing sectors	Southern bluefin tuna Striped marlin Albacore Yellowfin tuna Gummy and school shark Blue-eye trevalla (minimal take but likely to be increasing) Pink ling (minimal take but likely to be increasing)

As well as the possibility of direct competition for these resources between Commonwealth, state and recreational fisheries, there may also be 'indirect' resource allocation conflicts that arise when a particular sector values a stock that is regarded as biologically important for a more desirable target stock. A recent example of this is the concern by parts of the recreational fishing sector that exploitation of small pelagic stocks may influence availability and abundance of target species, for example tunas and marlins.

Biological risks and problems with overfished stocks

When shared stocks are managed using different mechanisms (i.e. input versus output controls) the ability to constrain total mortality to an acceptable level that will allow a particular stock to rebuild is made more complex. Commonwealth stocks that are classified as overfished (generally below the proxy limit reference point of 20 per cent of unfished biomass) are subject to rebuilding strategies that aim to rebuild stocks to above the limit reference point. Once stocks are above the limit reference point, harvest control rules allow for exploitation rates that should allow the stock to rebuild towards the target reference point.

For stocks shared between Commonwealth, state and other resource users, constraining total mortality to levels that support the objectives of the rebuilding strategies can be challenging. Currently, there are few, if any, formal mechanisms by which resource users other than the Commonwealth are responsible for meeting the objectives of rebuilding strategies.

Data issues

Data paucity is a key challenge for addressing resource allocation questions. Equitable, efficient and sustainable resource allocation requires consideration of biological, social and economic aspects of resource use. Estimates of the total catch by different sectors and the economic and social value are required, but can be difficult and costly to obtain (see, for example, Georgeson et al. 2015, Moore et al. 2015).

5 Management costs in Commonwealth fisheries

From an economic perspective, the costs of management include two components

- The explicit cost of management; in the Commonwealth the activates undertaken by AFMA
- The degree to which any foregone efficiencies caused by management rules exceeds the benefits (environmental and economic) of the intervention.

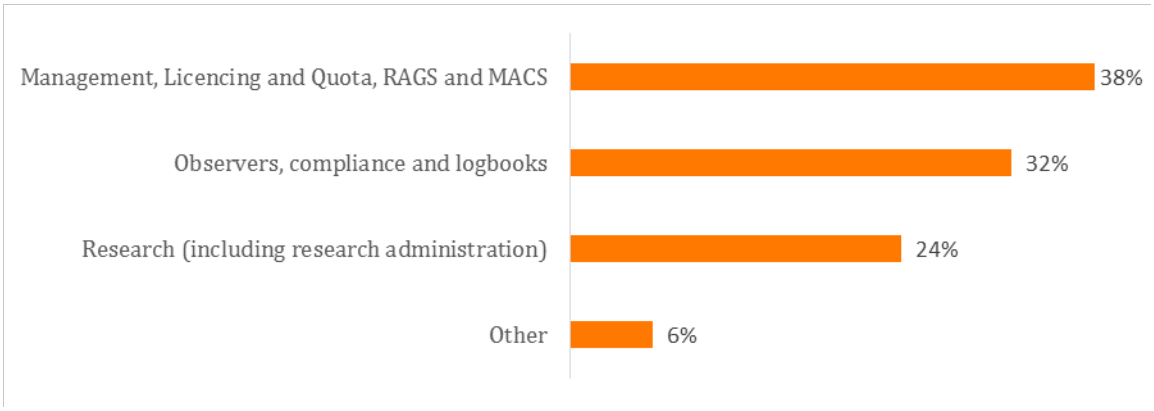
The latter, if it exists, is difficult to estimate. This chapter discusses the former alone.

Explicit management costs are related to the management requirements for each fishery, including the need to observe the fishery and ensure compliance in order to achieve the objectives of fishing at MEY and other environmental objectives.

Management costs by Commonwealth fishery

Management levy costs vary between Commonwealth fisheries. Across all fisheries, formulating and enforcing management controls accounted for 70 per cent of the cost recovered AFMA budget in 2013–14 (Figure 16). Subsequently the nature of the management methods required and used play a large role in determining the size of explicit management costs. Although other factors, including co-management arrangements can also play a major role, the complexity of a fishery's management and the required management methods play a major role along with its size in determining the magnitude of management costs.

Figure 16 AFMA Cost recovery budget 2014–15



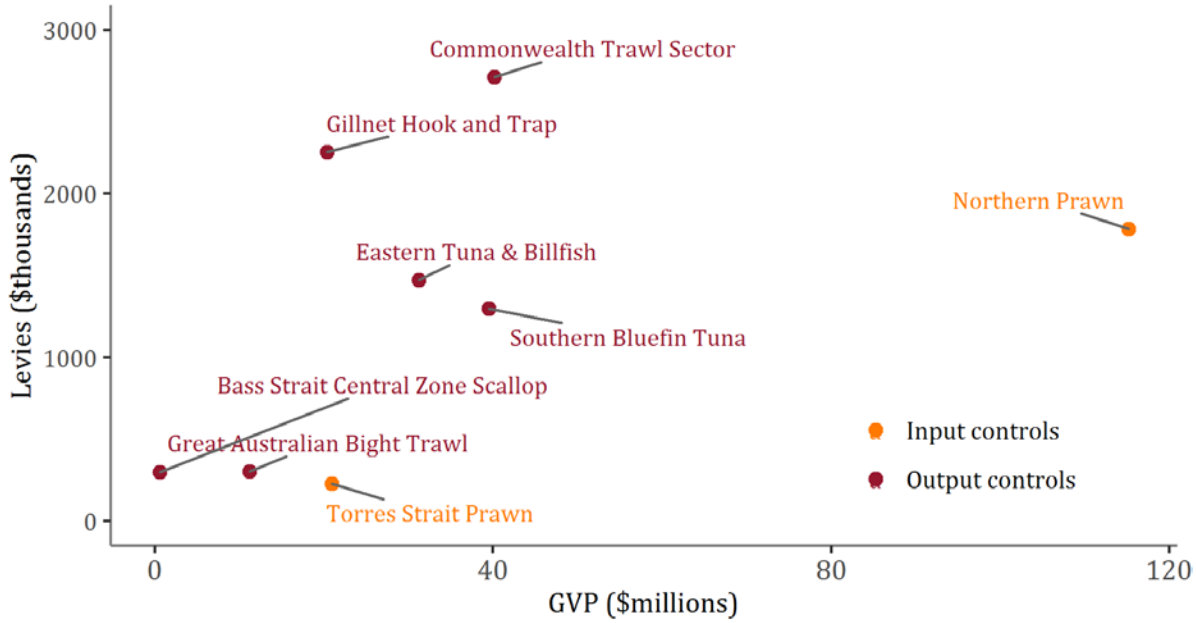
Source: AFMA 2014.

For instance in 2013–14, the Commonwealth Trawl Sector, which covers nearly 30 separate stocks, has AFMA management costs twice as high as the Southern Bluefin Tuna fishery despite each fishery having a similar GVP (Figure 17; Table 8). Although this is partially explained by the latter's international co-management, which shares costs, which consists of a single stock, the complexity of managing many, as opposed to one stock likely also plays a role.

The two Commonwealth prawn fisheries, which have fewer (in less diverse stocks) and are managed under simpler input controls, appear to have lower levy costs than output controlled fisheries when allowing for GVP size. Notably in 2013–14:

- compared to the Northern Prawn Fishery, (which also has some comanagement) the Commonwealth Trawl Sector required 11 times as much expenditure on licencing and quota management ($186 000 against $17 000), and 58 times as much expenditure on logbooks ($139 000 against $2 000), reflecting the greater financial management costs required to manage and enforce output controls and quota, and the costs of managing a complex multispecies fishery with a larger and more diverse fleet.
- compared to the Torres Strait Prawn fishery, which was of a similar GVP, the multi species, output controlled Gillnet, Hook and Trap Sector required 13 times as much expenditure on logbooks ($73 000 against $6 000).

Figure 17 GVP and AFMA management costs for Commonwealth fisheries for which GVP data is available–2013–14



Source: AFMA 2014, Savage and Hobsbawn 2015. Note: Eastern Tuna and Bill fish and Southern Bluefin Tuna share some management costs internationally. The Great Australian Bight Trawl, Torres Strait Prawn and Northern Prawn have some costs co-managed with other Australian jurisdictions, or are budgeted elsewhere.

Other factors, including share management arrangements with other jurisdictions and where a fishery is in its management cycle–for instance whether new management plans are being developed–may also influence variation in costs over time, and the need to manage interactions with the broader ecosystem, as with the Gillnet, Hook and Trap Sector will also increase costs, as discussed later. Relative costs may also appear high when GVP experiences strong declines over a short period, as in the case of the Bass Strait Central Zone Scallop Fishery in 2013–14 (Table 8).

Table 8 Relative size of management costs in selected Commonwealth Fisheries

Fishery	AFMA management costs as a percentage of GVP
Northern Prawn Fishery	2%
Torres Strait Prawn Fishery	3%
Great Australian Bight Trawl Sector	3%
Southern Bluefin Tuna Fishery	4%
Eastern Tuna and Billfish Fishery	5%
Commonwealth Trawl Sector	7%
Gillnet, Hook and Trap Sector	16%
Bass Strait Central Zone Scallop Fishery	60%

Note: Other fisheries excluded as GVP estimates are unavailable
Source: Patterson et al 2015

Trends

The Commonwealth trawl sector and Gillnet, Hook and Trap sector of the SESSF, the Northern Prawn Fishery (NPF) and the Eastern Tuna and Billfish fishery incur amongst the highest management costs of Commonwealth fisheries and exhibit similar trends in management costs over time, as shown in Figure 18 to Figure 21). In all cases total management costs are significantly lower than in 2001–02, but the cost per active vessel is higher. In general management costs remained steady both in total and per active vessel until the Securing our Fishing Future structural adjustment package in 2006–07. Because many boats left these fisheries, the cost per boat increased substantially, however since then total management costs have declined substantially, reversing much of the per boat increase. The 2006–07 financial year also saw the introduction of the Commonwealth Harvest Strategy Policy and the policy guidelines, along with AFMA's desire to ease the burden on remaining fishers, which may have contributed to this fall.

The exception to this pattern is the Gillnet, Hook and Trap Sector. Whilst total costs fell following 2006–07 some of this fall was reversed in 2009–10, and costs have remained steady since. This is likely the result of increased observation and other costs associated with measures to reduce adverse effects on other marine species, including sea lions and seals.

Figure 18 Management costs in the Commonwealth Trawl Sector 2001–02 to 2013–14

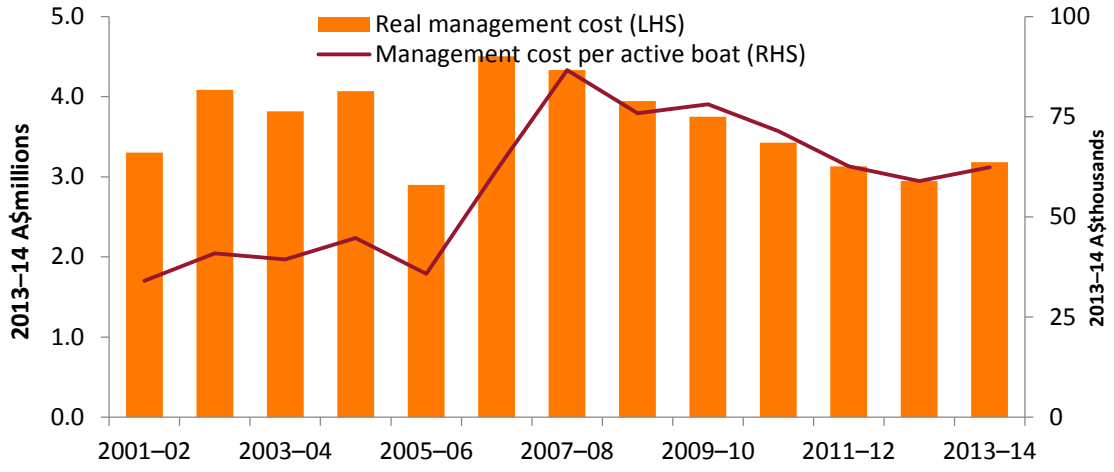


Figure 19 Management costs in the Gillnet Hook and Trap Sector 2001–02 to 2013–14

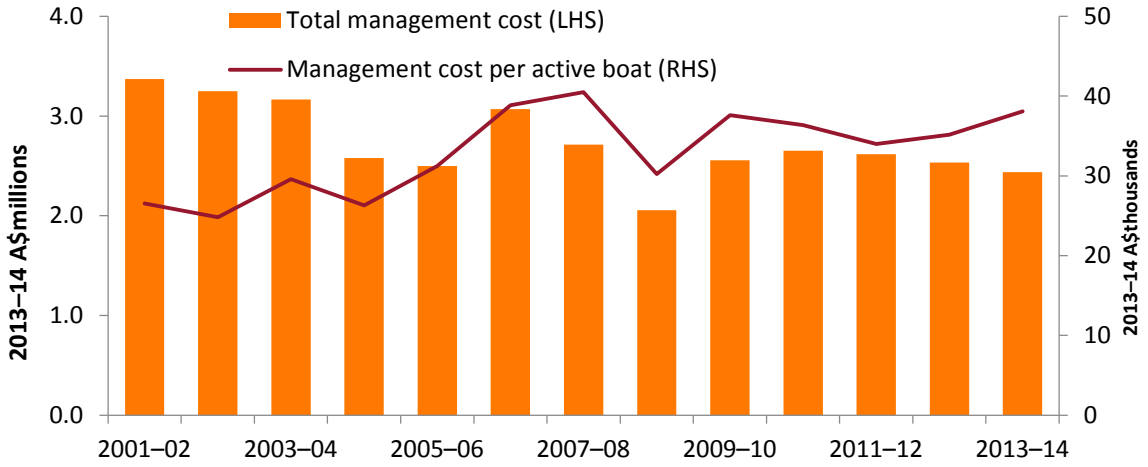


Figure 20 Management costs in the Eastern Tuna and Billfish Fishery 2001–02 to 2013–14

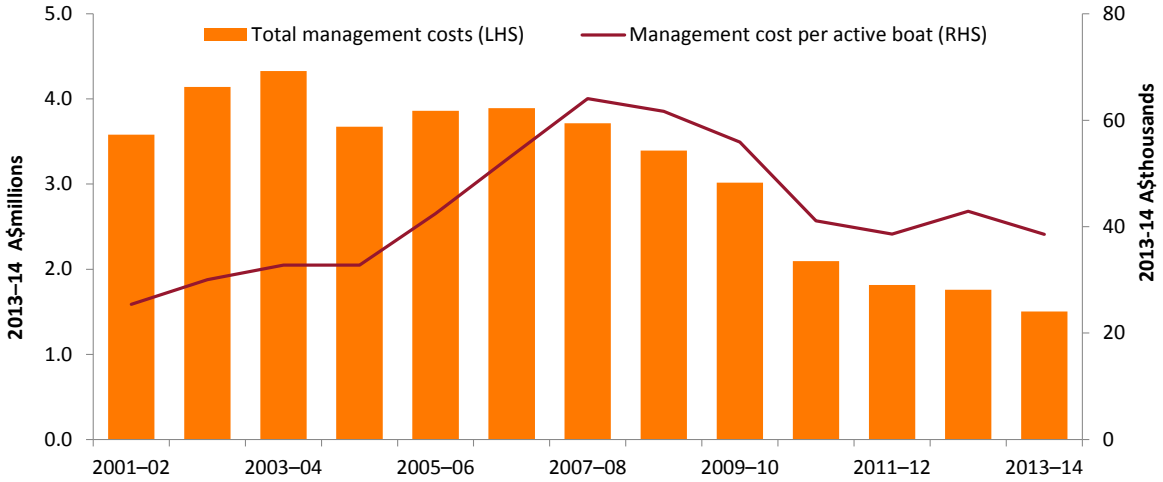
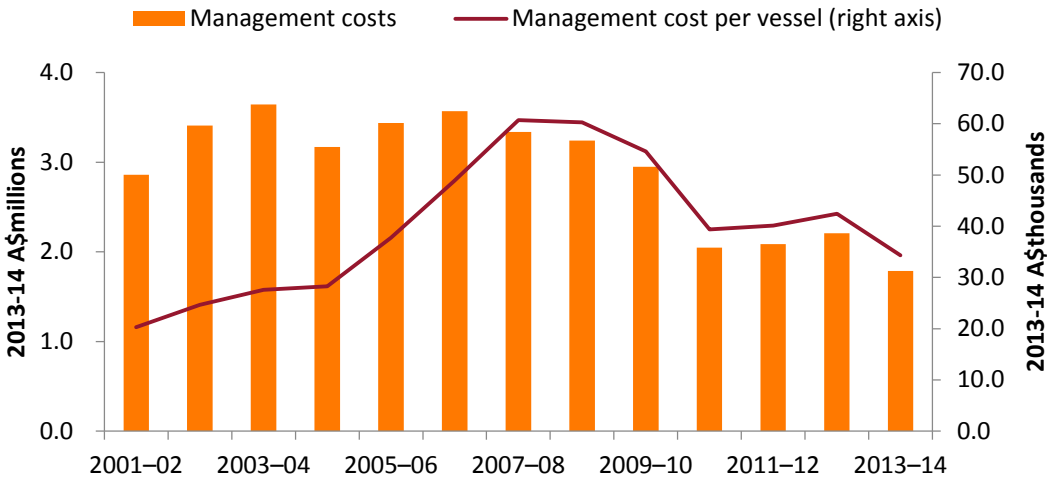


Figure 21 Management costs in the Northern Prawn Fishery 2001–02 to 2013–14



The Heard and McDonald Island Fishery also incurs sizeable management costs, but is not surveyed by ABARES and cannot have its GVP reported for reasons of confidentiality. In 2013–14 management costs were $790 000, a considerable fall from $1.5 million in 2009–10, but higher than the $367 000 recorded in 2001–02. The Macquarie Island Fishery, for which data is also scarce, has increased management costs from $73 000 in 2001–02 to $295 000 in 2013–14. Neither fishery was part of the Securing our Fishing Future Structural Adjustment.

6 Cost recovery in Australian fisheries

Because a large part fisheries management is a service provided to the fishing industry, government often seek to recover these costs from fishers. This section outlines cost recovery in Commonwealth and State fisheries in Australia, and the rationale behind them.

Cost recovery in Australian fisheries has been a policy issue for over 20 years. The *Fisheries Licenses Levy Bill 1984* enabled levies on boats in Commonwealth fisheries to fund fisheries management (Haynes & Brown 1985). Levies were then introduced in the Northern Prawn and Southern Bluefin Tuna fisheries, two major Commonwealth fisheries. Full cost recovery was not pursued at that time, and the levies recovered less than half of the management costs in these fisheries (Haynes et al 1986). Cost recovery in fisheries has since been revisited a number of times (Commonwealth of Australia 1989; Industry Commission 1992; AFMA 1994).

State and territory fisheries

State and territory governments fund fisheries management activities in a variety of ways (Table 9). Victoria and South Australia pursue cost recovery for fisheries management services based on broader cost recovery policy or guidelines not dissimilar from the *Australian Government Cost Recovery Guidelines* (Department of Treasury and Finance Victoria 2010; Primary Industries and Resources South Australia 2010).

In 2010, Western Australia moved from cost recovery to simply charging fishers access fees. Access fees in each fishery are set at 5.75 per cent of the fishery's gross value of production (GVP). Individual fishers' fees are proportional to the entitlement they hold in that fishery. In fisheries where effort is regulated only through the number of licences available, each fisher pays the same amount, and where different licence holders have different entitlements, their fees vary in proportion to that entitlement. These arrangements are intended to give the community an appropriate return for a degree of exclusive access to the fishery's resources (Department of Fisheries Western Australia 2012). It has been suggested that this approach has reduced administration costs, and some argue that collecting a uniform percentage of the GVP in each fishery is more equitable. Also, because the funding available for managing each fishery is not constrained by negotiated cost recovery arrangements, managers have significant flexibility to respond to issues as they emerge, such as fish disease outbreaks (Ben Fraser pers. comm.). This policy has an element of cost recovery because the fees collected are only spent on fisheries management. However, by divorcing the government goods and services used and the access fees charged, the approach does not follow the principles of cost recovery. It is not clear how differences between the amount collected and the costs of fisheries management are reconciled.

Queensland, New South Wales, the Northern Territory and Tasmania have no formal cost recovery policies for fisheries. Queensland's and New South Wales' arrangements have an aspect of providing returns to the community for exploiting their resources, such as a fee structure based on the 'value of the access right' or through management charges proportional to shares held in managed fisheries (Stevens et al 2012). However, as these fees or the value of access rights are not explicitly linked with the costs of providing those services, they are not considered cost recovery.

Table 9 Charging frameworks in state and territory fisheries

Jurisdiction	Charging frameworks
Victoria	Cost recovery
South Australia	Cost recovery
Western Australia	Access fees used to recover a fixed proportion of the gross value of production
Queensland	No formal cost recovery policy across fisheries, fees based on the 'value of the access right' and a fee for services
New South Wales	No formal cost recovery policy across fisheries, management charge based on a small 'community contribution' and in proportion to the shares held in share-managed fisheries, aquaculture subject to full cost recovery for administration costs. Cost recovery being considered by the Ministerial Fisheries Advisory Council as of early 2016.
Northern Territory	No formal cost recovery policy across fisheries, some fees collected
Tasmania	No formal cost recovery policy across fisheries, some fees collected

Sources: NSW Trade and Investment 2011; Stevens et al 2012

Commonwealth fisheries

AFMA's Cost Recovery Implementation Statement (CRIS) (2010) established a cost recovery framework for Commonwealth fisheries that applies cost recovery on an activity basis, consistent with the *Australian Government Cost Recovery Guidelines* (DFA 2014). Activities are grouped by characteristics and objectives defined by the purpose of the activity, who it is provided to and who creates the need for the activity.). AFMA is currently considering a replacement draft to be implemented from July 2016 (AFMA 2016). The activities identified in the proposed draft on this basis are outlined in Table 10, indicating how each is recovered from industry and funded by taxpayers.

Table 10 Activity group structure for the draft cost recovery impact statement 2016

Activity group	Industry ($m)	Taxpayer ($m)	Total
Management of domestic commercial fisheries	4.6	2.2	4.8
Management of traditional, Indigenous and non-commercial fisheries	0	2.1	2.1
Input into defining international treaty standards and developing regulation	0	2	2
Policy	0.5	2.5	3
Domestic fisheries compliance enforcement	0	3.4	3.4
Foreign fisheries compliance enforcement and outreach	0	7.3	7.3
Data collection and management	4.9	0.9	5.8
Research	2.4	1	3.4
Licensing/registration and revenue collection	1.6	0	1.6
Total	14	21.5	35.5

Source: AFMA 2016

Differences between budgeted and actual recoverable costs in one year are acquitted in the next year. While annual variability in fisheries management costs attributed to the community are absorbed by the general tax base, variability in costs for industry-funded activities is concentrated among commercial fishers. Industry equalisation accounts (IEAs), which are special accounts under the *Financial Management and Accountability Act 1997,* have been used by other agencies to mitigate the effect of variability, but have not been used for Commonwealth fisheries. For example, the National Residue Survey operates under full cost recovery and maintains IEAs for 10 commodity projects at 20 per cent to 80 per cent of the following year's program expenditure. This is because seasonality and fluctuations in volumes and values of products can affect the costs recovered (DAFF 2008). These IEAs are commonly managed in coordination with industry. These types of arrangements may not be preferred if stakeholders believe they are better placed than government to manage variability in costs over time.

The cost recovery guidelines also indicate the importance of identifying who creates the need for government activities. Identifying who creates the need for fisheries management activities may be partly resolved by asking: 'would the non-existence of a particular group eliminate the need for the AFMA activity in question?' (Cox 2000). However, answering this question is not simple because of the shared nature of fish stocks and other marine resources where multiple social and economic values create competing needs.

A baseline set of expected management outcomes could help determine who creates the need for government activities, and thus who they are provided to. For example, if it is determined that the community should expect a level of bycatch from fishing activities that is not excessive, the management activities ensuring this outcome will be required to avoid lower community welfare. This is different to providing a service to the community as a whole. The costs of these activities would then be properly attributable to fishers.

As users of fish stocks, recreational fishers create the need for some fisheries management services. Therefore, it may be deemed appropriate for them to contribute to fisheries management expenses. However, for the purposes of cost recovery there is not a narrow identifiable group of recreational fishers, which precludes their inclusion in the cost recovery framework for Commonwealth fisheries.

How to determine financial liability in these cases is not covered by the cost recovery guidelines. There is some indication that the costs of complying with increased community expectations about responsible stewardship of marine environments are being attributed to fishers. For example, increases in Southern and Eastern Scalefish and Shark Fishery levies between 2010–11 and 2011–12 have been attributed to 'research and monitoring costs associated with interactions with protected species' (Commonwealth of Australia 2011).

Using levies to collect 96 per cent of AFMA's recoverable costs reflects the nature of fisheries management services. Fees are appropriate where government goods and services are supplied to particular users in measurable quantities. For example, fees are charged when AFMA grants fishers particular concessions, which is included in the licensing/registration and revenue collection activity group. However, levies are generally used to recover AFMA costs. This is because many of the services provided are indivisible. For example, once a harvest strategy is developed for a fishery, all participants in that fishery 'consume' it.

Where fees are not appropriate, a levy base needs to be identified that suitably reflects how different fishers create the need for the activity. The efficiency and equity-based arguments for cost recovery have greater merit the more closely aligned charges are with the government

goods and services provided. The explanatory statement to Fishing Levy Regulations 2011 (Commonwealth of Australia 2011) provides some insight into how this is done, and the issues different fisheries face to determine individuals' levy liabilities.

> The levy system in the Coral Sea Fishery reflects the fishery's diverse sectors. These include the aquarium fish sector, the lobster and/or trochus sectors, the line and trap sector, the trawl and trap sector, and the sea cucumber sector. A two-tier system is used to collect levies. The Tier 1 amount reflects the management costs incurred across all sectors of the fishery, including salaries, travel, logbook processing, data management, licensing and compliance costs. The Tier 2 component reflects the observer costs associated with different sectors of the fishery.

In the Eastern Tuna and Billfish Fishery, the levy system is designed to account for there being both fixed and variable costs in fisheries management. The fixed costs of managing the fishery are collected through Tier 1 of the levy. This amount is payable on a per boat statutory fishing right (SFR) basis. The fisheries management costs that vary with fishing effort are collected through Tier 2 of the levy, which is based on a per quota SFR basis. The levy amount per quota SFR is different for each quota species, where more quota SFR on more valuable stocks attract higher levies.

The diversity of arrangements across Commonwealth fisheries demonstrates the difficulties associated with attributing fisheries management costs to individual fishers. In some fisheries, the link between cost drivers and levies and fees is not immediately clear. If the costs of fisheries management cannot be adequately attributed to individual users, levies may be set to satisfy other objectives. One option may be to set quota SFR-based levies in multi-species fisheries relative to species' market values, which demonstrates how 'within a given fishery the quantum of each fisher's total levy is proportional to a measure of that fisher's beneficial interest in the fishery' (AFMA 2010). An alternative approach could be sharing management costs equally among concession holders where no such apportioning of the levy base sufficiently reflects individual fishers' use of fisheries management services. This represents some divergence from the objective of relating charges to the costs attributable to different users, but compromise may be needed given the complexities of cost recovery for fisheries management services.

7 Quota markets and quota distribution across fishers

The success of output controls is dependent on setting a fishery level catch target that is consistent with maximising economic returns from the fishery, and allowing the rights to this TAC to flow between fishers through the use of ITQs. Theoretically, when transaction costs of trading quota are minimal it does not matter what the starting allocation of quota is across owners, the rights will gravitate to the most efficient operators of the fishery, that is, to those fishers that can best use the quota for generating economic returns. However, Coase (1960) notes that transaction costs usually matter, raising the issue of how best to address their effect on quota trading. This section assesses the current state of quota distribution in quota managed Commonwealth fisheries, and discusses how efficient this distribution is, and how transaction costs potentially influence this distribution.

As discussed in Chapter 4, ITQs have become a common method of controlling catch in Commonwealth fisheries. For many Commonwealth fisheries output controls (total allowable catch) and some forms of input controls (effort limits) are enforced by statutory fishing rights. These rights give individual fishers a legally enforceable property right to a share of the total allowable catch each year. These rights are valuable assets that can be traded or leased amongst fishers, and used as collateral in obtaining finance from lending institutions. The tradability of rights allows the industry to flexibly adjust to changed operating conditions and take advantage of operating at higher or lower economies of scale. Trading can be temporary or permanent. A temporary trade is when a fisher leases their quota, or a part thereof, to another fisher who will use it for that fishing season — leasing of quota is only possible for one season at a time. A permanent trade is when a fisher sells their quota to another fisher who may hold it or sell it in perpetuity.

In the absence of transaction costs — the cost of effecting sales or leases of quota between purchasing and selling agents — the ability to trade quota will mean it will be allocated by market mechanisms to the most efficient fishers. This is because the more efficient fishers, whom are able to catch a given amount of fish at lower cost (assuming output quota), will be prepared to pay a greater amount than less efficient fishers who incur greater costs. As such, less efficient fishers will find it more profitable to sell or lease quota to the more efficient fishers (perhaps through intermediaries. This should, in aggregate, lead to greater efficiency in the fishery.

Some quota markets in Commonwealth Fisheries may have characteristics that can inhibit this process. These include:

- Low liquidity–there is little available quota “on the market” at a given time, meaning the act of buying or selling takes time, and finding buyers/sellers is difficult
- High transaction costs–as a result of low liquidity, it is very costly to buy or sell quota.
- Poor information–as most transactions are private, fishers have little sense of the market price of quota, and pursuing quotes from numerous potential buyers and sellers is costly
- Social factors–Commonwealth fisheries are relatively small and highly personalised, and fishers often are reluctant to trade quota on personal grounds

An attempt to address these concerns through a centralised exchange for trading of quota, run by the Australian Fisheries Management Authority (AFMA) was unsuccessful, and after a trial period the centralised exchange was discontinued. Market brokers also play a role in reducing transaction costs, but many of the problems listed remain.

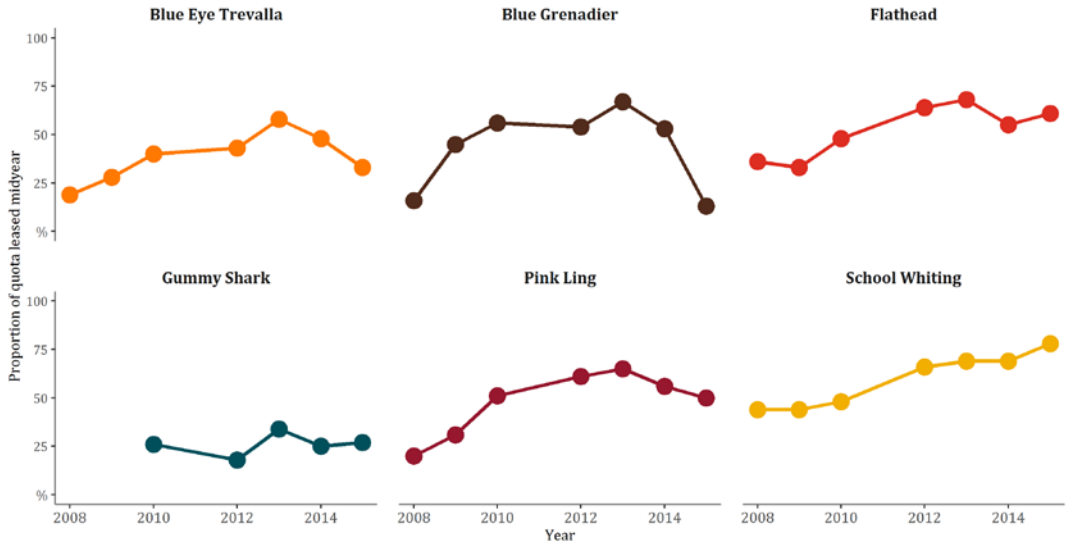
AFMA registry data shows some stocks are extensively leased, for instance over two thirds of Flathead and Pink Ling quota (both major targeted species) was held by someone other than the owner in December 2015. Notably stocks with a greater number of clients either holding or leasing tended to have a greater proportion leased, illustrating the important of liquidity (Figure 22). This indicates that the quota market is succeeding in reallocating the use of quota, at least on a temporary basis.

Figure 22: Proportion leased in selected Commonwealth fisheries

Source: Derived from AFMA data by ABARES Note: Some leasing may be between entities controlled by the same person or persons.

Major targeted stocks in the SESSF have demonstrated an increasing proportion of quota leased over time (Figure 23). This may indicated the transactions costs of the quota market are reducing over time as fishers become more acquainted with it. This suggests the efficacy of the quota market may improve over time without management changes.

Figure 23: Proportion leased for selected SESSF stocks over time



Source: Derived from AFMA data by ABARES Note: Data unavailable for 2010. Data is for early July for all years except 2009, which is early June. Some leasing activity may be between entities controlled by the same person or persons.

AFMA has responsibility for monitoring the use of quota during the course of the fishing season. Holders have the capacity to retain a small proportion (10 per cent) of uncaught quota each season to use the following season. This is known as "undercatch". Potentially this provides an alternative to leasing out unused quota on the market, however there is little evidence this is altering market behaviour, as uncaught quota is usually in excess of this amount.

Concentration of ownership of Commonwealth quota

There are no restrictions on the quantity of quota a single owner can hold. This raises the question of whether management through ITQs in Commonwealth fisheries is leading to concentration of quota in a handful of owners.

It is not possible to state if a given level of concentration is "too high". If some vessels or firms are genuinely more efficient, then quota may be concentrated amongst them has they purchase or lease it. This would both increase efficiency in the fishery and provide greater returns to those no longer fishing, as they presumably found the sale or lease price greater than the returns they could have received by using it.

Some fisheries are likely to be more efficient with greater concentration, for instance where there are large economies of scale because of the technology used, for instance stocks that require on board processing maintain quality. Other fisheries may be more efficient at lower levels of concentration because there are few economies of scale, for example hand gathered or trapped stocks like lobster, where a larger operation would be more encumbered in movement.

The most tangible concern about concentration is if it leads to monopoly power that could distort the quota market. Should ownership become too concentrated when the use of the quota is still spread widely (for instance if capital constrained fishers need to sell quota to reduce debt whilst still leasing it), quota holders may be able to extract economic rents (higher than efficient market prices) by exercising their monopoly power. The existence of market power can reduce the benefits of an ITQ market (Rose 2002).

Preliminary analysis presented below suggests that quota leasing activity is leading to greater use by more efficient fishers, and that concentration does not appear to be occurring. Although there are little data available on the exchange and prices of quota, AFMA produces a register, updated monthly, on the owners and holders of tradable SFRs in Commonwealth Fisheries. When an entity owns quota, whether or not they have leased it out that season, they are said to be the owner of the quota. When an entity is in possession of quota for a season, whether by leasing in or owning without leasing out, they are said to be the holder of the quota.

It is important to note that the owners and holders are often legal persons or partnerships rather than natural persons or individuals. A given person may hold or own, in part or in full, quota attributed under several different names. As such, it is theoretically possible that a quota may appear to have dispersed ownership, despite being largely owned by entities controlled by a single person or firm. They may have incentive to split their holding if, for instance, managers impose an absolute limit on an individual holder's overcatch rights. If splitting a holding allows an entity to accumulate total overcatch rights that are greater than the absolute limit a single holder can access, and if the benefit of greater overcatch rights outweighs any additional administrative cost, then division into separate entities may occur. As such, a given stocks' concentration measures must be considered with such stock specific incentives in mind.

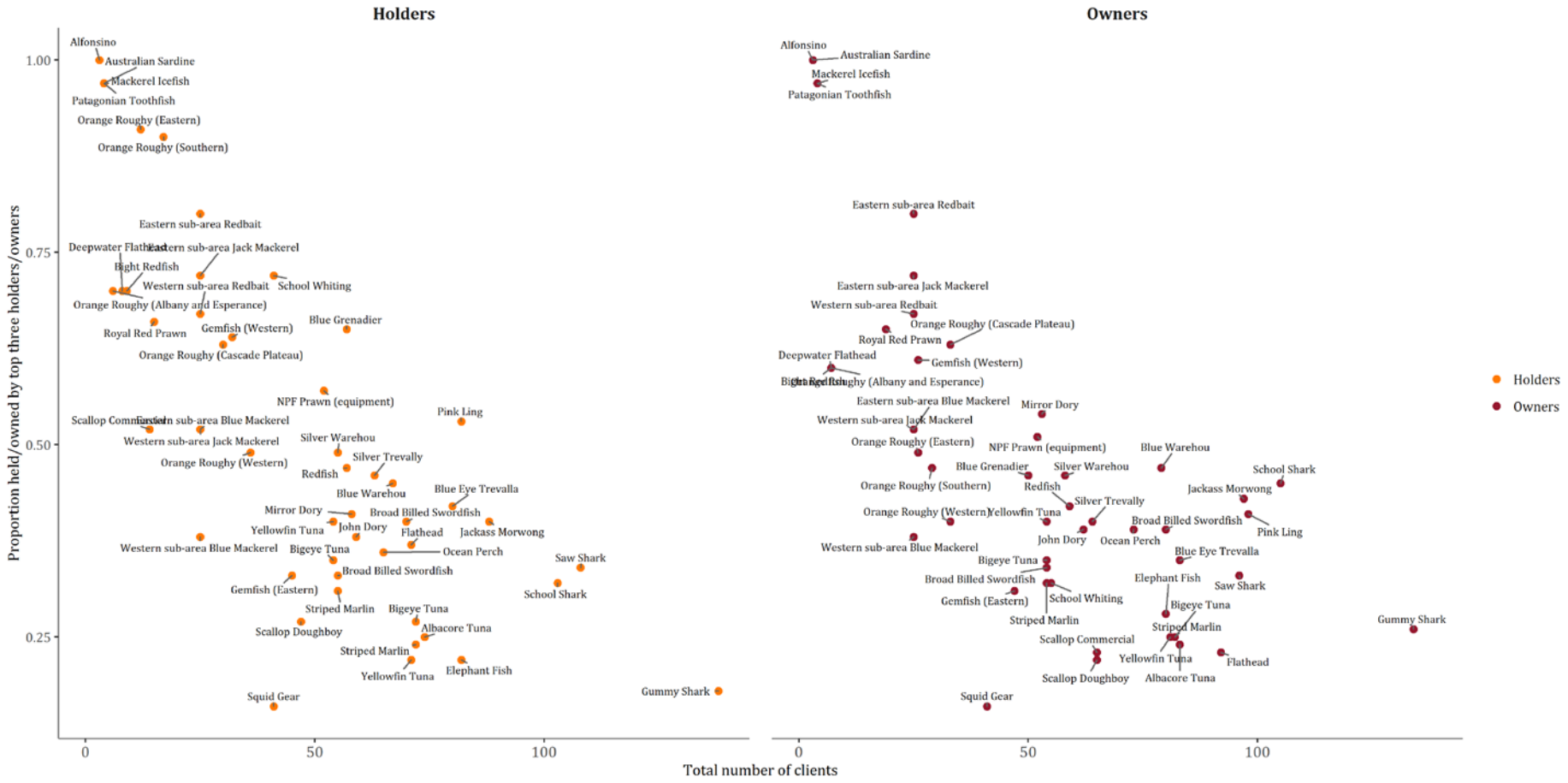
This section covers four measures of concentration

- Gini coefficients (where the population is all owners/holders of quota)
- Herfindahl Indices
- The proportion owned/held by the largest owner/holder
- The proportion owned/held by the largest three owners/holders

Whilst all four are reported for completeness, in general ABARES believes the largest three owners/holders measure is the preferred measure. The Gini coefficient (usually used for income concentration) and Herfindahl indices (usually used for revenue concentration in an industry), whilst widely used in economics, are not easy to interpret or summarise succinctly, particularly for non-economists and have not traditionally been used in this context. Additionally the Gini Coefficient is sensitive to the population size, which here is the number of owners/holders at a given time. The addition of another owner with a nominal amount of quota increases the Gini estimation of inequality, whilst not increasing the amount held by large owners and holders. Many fisheries have a "long tail" of small holders who are not active in the fishery, and whom retain small amounts of quota for reasons other than direct participation in the fishery.

Concentration varies amongst fish stocks, and can be much higher for some than others. In general however concentration is greater when the number of clients (owners or holders of quota) is lower–if only because there are less clients to share the quota between (Figure 24), but also because the economies of scale available in the fishery encourage fewer, larger operators. Concentration measures for selected high value stocks managed under ITQs are in Table 11.

Figure 24: Concentration and number of clients for stocks in Commonwealth Fisheries



Source: Derived from AFMA data by ABARES Note: Southern Bluefin Tuna not shown because divided quota holdings make determining true concentration difficult.

Table 11: Concentration measures for selected stocks as of 2nd December 2015

Stock	Herfindahl Index	Gini Coefficient	Proportion owned by top owner	Proportion owned by top three owners	No. of Owners	GVP 2013–14 ($m)
Swordfish (ETBF)	0.09	0.72	0.26	0.39	80	$7.2
Blue Eye Trevalla	0.07	0.78	0.18	0.35	83	$3.3
Blue Grenadier	0.11	0.81	0.21	0.46	50	$6.4
Flathead	0.04	0.71	0.11	0.23	92	$13.6[a]
Gummy Shark	0.04	0.77	0.12	0.26	134	$13.5
Pink Ling	0.08	0.83	0.16	0.41	98	$4.3
Southern Bluefin Tuna	0.04	0.73	0.09	0.22	89	$39.5
Yellowfin Tuna (ETBF)	0.04	0.68	0.13	0.25	54	$14.4

Source: Derived from AFMA data by ABARES **a** includes deepwater flathead

Trends in concentration

When ABARES calculated measures over the period 2008 to 2015, none of the stock exhibited a trend towards greater or less concentration. Concentration in ownership has remained steady, whilst concentration in holding has varied for a small number of stocks. Notably this variation has occurred in stocks which anecdotally are prone to changing operating conditions (such as Blue Grenadier, which is exposed to competition from New Zealand and subject to the availability of appropriate factory vessels that can process the fish to retain quality and price). This suggests that fishers who lease these stocks are not inclined to buy the quota permanently, because they only fish the stock when conditions are favourable.

The lack of a trend towards greater concentration suggest the contention that greater concentration over time is inevitable in a quota market is unsupported based on available data.

Large non fishing owners

Were ownership becoming concentrated amongst a few owners who were leasing them out rather than using them directly, the concentration of quota amongst owners would be usually greater than concentration amongst holders. This does not appear to be the case. For most stocks under most measures, including almost all stocks outside the Southern and Eastern Scalefish and Shark Sector (SESSF), the difference in concentration is close to zero, indicating the market is neither increasing nor reducing concentration. Of the remainder, concentration is more likely to be greater in holding than ownership, including most of the major targeted species in the SESSF (Table 12). This implies a dispersed ownership is inclined to lease their quota to a smaller number of efficient fishers, rather than an exercise of market power.

The sole examples of greater concentration in ownership than holding are Mirror Dory, a minor by product species, School Shark, which is allocated an incidental catch quota, and Gummy Shark–the major targeted species of the Gillnet, Hook and Trap sector of the SESSF. Gummy shark quota has been the subject of concerns raised by stakeholders, however the degree of greater concentration in ownership is minor, and the absolute measures of concentration are low, indicating these concerns may be unfounded.

Table 12: Difference between concentration measures for ownership compared to holding of quota of selected fish stocks

Notably more concentrated in holding than ownership					
difference in concentration by….	**Gini coefficient**	**Herfindahl index**	**Proportion held/owned by top holder/owner**	**Proportion held/owned by top 3 holders/owners**	**GVP (2013–14 fishing season)**
Blue Eye Trevalla	-0.03	-0.03	-8%	-7%	$3.3 million
Blue Grenadier	-0.06	-0.11	-21%	-19%	$6.4 million
Flathead	-0.06	-0.04	-9%	-14%	$13.6 million [a]
Pink Ling	-0.01	-0.05	-9%	-12%	$4.3 million
Eastern School Whiting	-0.15	-0.2	-31%	-40%	$2.0 million
Notably more concentrated in ownership than holding					
difference in concentration by….	**Gini coefficient**	**Herfindahl index**	**Proportion held/owned by top holder/owner**	**Proportion held/owned by top 3 holders/owners**	**GVP (2013–14 fishing season)**
Gummy Shark	0.04	0.01	5%	8%	$13.5 million
Mirror Dory	0.06	0.08	13%	13%	$0.6 million
School Shark [b]	0.03	0.02	4%	13%	$1.8 million

Source: Derived from AFMA data by ABARES Note: For all four measures a higher number indicates higher concentration, so in the table a positive number indicates higher measured concentration in ownership rather than holding **a** Includes deepwater flathead **b** Incidental catch allowance only a includes deepwater flathead

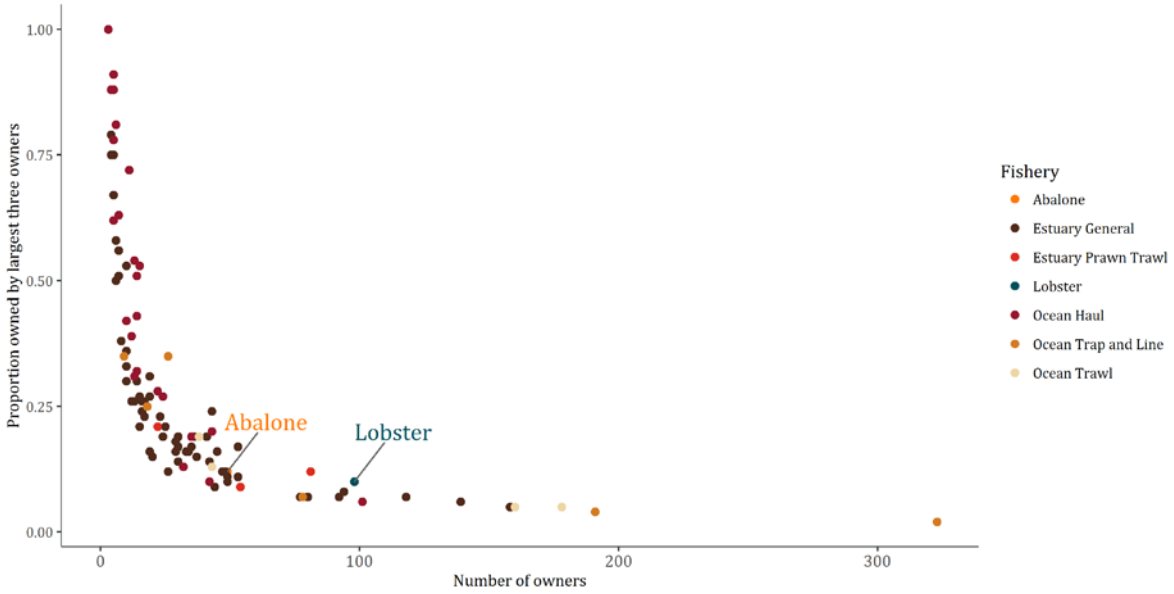
The higher tendency towards greater concentration amongst holders than owners suggests that the leasing market is allowing a smaller number of efficient fishers to use the available quota, however a few points are uncertain, and there may be little data to investigate these:

- Would the difference be greater if the quota market was more liquid, and had lower transaction costs?
- If the leasing vessels are required to lease quota year after year, rather than using a long term lease, is this creating a transaction cost that would be avoided were they able to buy the quota?
- Does concentration amongst holders, or efficient vessels, lead to monopsony, or buying power, which can suppress the price of quota?

Concentration in state fisheries

Of the state authorities, only New South Wales publishes a register for share managed fisheries on the Internet, and then only for ownership, however some similar patterns are apparent, including the propensity for larger fisheries with more participants to be less concentrated (Figure 25). Notably the high value stocks of abalone and lobster ($10 million and $4 million respectively in 2013–14) have relatively low concentration, with 12 and 10 per cent of total quota held by the largest three owners. This is likely because the methods of gathering do not present an opportunity to exploit economies of scale. As such, concentration in NSW share managed fisheries likely reflects a move towards an efficient distribution of quota.

Figure 25 Concentration in NSW share managed stocks (January 2016)



Source: Derived from NSW DPI 2016 by ABARES

8 Latency

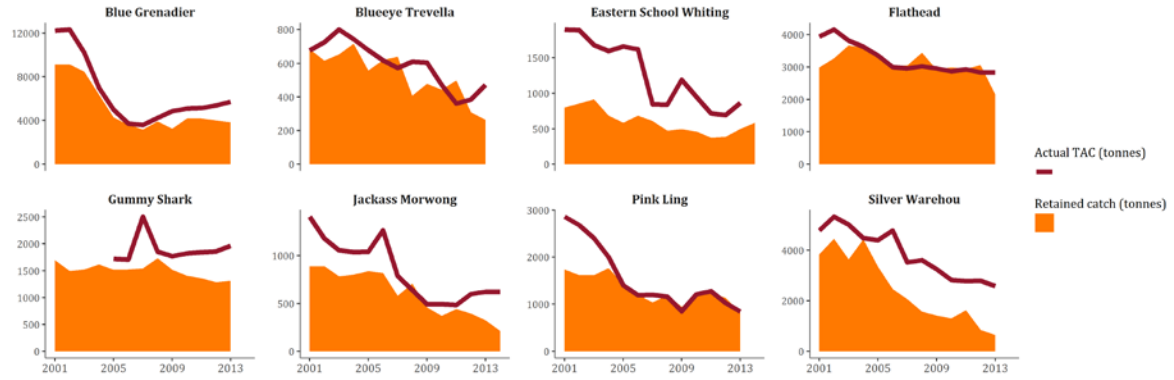
There has been concern amongst some stakeholders that market barriers to trading quota are contributing to the current observed high level of quota latency–the proportion of quota that is left uncaught each season–in some stocks.

An examination of major targeted species in the SESSF, for which output controls have been in place for some time, indicates species vary in the extent of latency and how it varies over time (Figure 26). Some species, such as Flathead and Pink Ling exhibit very little latency. Others, including Blue Grenadier, Silver Warehou and Gummy Shark have seen latency increase over time, but there are plausible reasons for this to have occurred regardless of the operations of the quota market. For instance

- Blue Grenadier–A species subject to competition by frozen imports from New Zealand, where catch allowances have increased in recent years, reducing prices and incentives to catch the stock.
- Silver Warehou–A species primarily used for fish cakes, a product that has declined in popularity in recent years, reducing incentives to fish
- Gummy shark–Management interventions to protect other marine species (sea lions and dolphins) by closing fishing grounds off South Australia have increased costs for many fishers by requiring them to steam further to alternative fishing grounds, and may have rendered filling their quota unprofitable

Other species which are not actively pursued by fishers may exhibit high latency, but this is unlikely to be reflective of any effect the ownership structure is on fisher's collective decision making or ability to seek quota on the market.

Figure 26 Landed catch and TAC for key species caught in the SESSF



Accumulation of unused quota is unlikely to be a concern. One hypothesis is that quota owners retain unused quota in the hope of capital gains, however any such gains would be received even if the quota was leased out. Another hypothesis is that large quota holders restrict the fishing of a species to increase stock abundance (and reduce per unit fishing costs) and increase prices, however this is unlikely to yield gains if the TAC is aligned with the objective of MEY, which is intended to produce these same gains. If fishers are finding it profitable to increase abundance and prices by restricting catch, then the problem of latency is likely to stem from a TAC setting which is too high, and not insufficient catch.

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