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IMAS
INSTITUTE FOR MARINE AND ANTARCTIC STUDIES

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4 May 2012

House of Representatives Standing Committee on Agriculture, Resources, Fisheries, and Forestry
PO Box 6021
Parliament House
Canberra ACT 2600



Email: arff.reps@aph.gov.au

Dear Madam/Sir

**Re: House of Representatives Standing Committee inquiry into fisheries and aquaculture science**

Appended please find our submission to the above inquiry. The Institute for Marine and Antarctic Studies (IMAS) acknowledges the support of the National Centre for Marine Conservation and Resource Sustainability (NCMCRS) at the Australian Maritime College (AMC) for their comments and contributions to this report, especially in the section on aquatic animal health.

Please refer any further enquiries to the Director of IMAS's Fisheries, Aquaculture, and Coasts Centre, Prof Colin Buxton at

Yours sincerely

Prof Mike Coffin
Executive Director

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IMAS INSTITUTE FOR MARINE AND ANTARCTIC STUDIES

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**House Of Representatives Standing Committee Inquiry Into Fisheries And Aquaculture Science**

**Institute for Marine and Antarctic Studies (IMAS), University of Tasmania**

The Institute for Marine and Antarctic Studies (IMAS), University of Tasmania, welcomes the opportunity to provide input to the House of Representatives Standing Committee inquiry into fisheries and aquaculture science. IMAS has an extensive seafood research program, with approximately fifty staff involved in research on production capability.

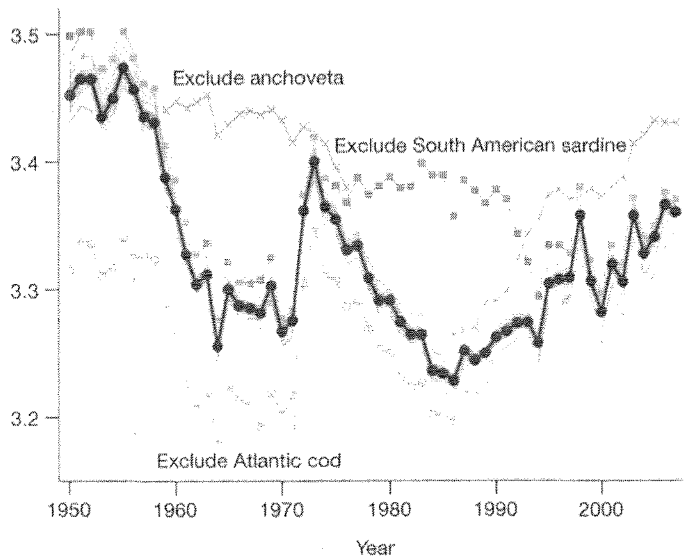
The context for the Standing Committee's inquiry is around the *"exceptional pressure... being placed on global fish stocks. According to the Food and Agricultural Organisation's 2010 report on the State of World Fisheries and Aquaculture, wild fisheries production has reached a plateau that will not increase until the world's fish stocks are more effectively managed. Meanwhile, aquaculture is fulfilling demand in place of wild fisheries."*

This submission addresses two general issues before commenting specifically on the key areas of interest: (i) the interpretation of trends in production; and (ii) the meaning of sustainability.

***Fisheries Production***

The Standing Committee should be cautious of trends in global fisheries catch as these are commonly used incorrectly to infer trends in the status of fish stocks or the potential for future production. This is for the following reasons:

a) Global catch is highly influenced by changes in a small number of high volume fisheries. The most influential are the fisheries for Atlantic cod, anchoveta, and South American sardine (Branch et al, 2010). Production from these three fisheries is not representative of trends in fisheries globally.




*The influence of Atlantic cod, anchoveta, and South American sardine on the mean trophic level of global fisheries production (heavy line). Our view of world fisheries is strongly influenced by few larger fisheries, so aggregate data tend to give little guidance on potential for seafood production (Branch et al, 2010).*

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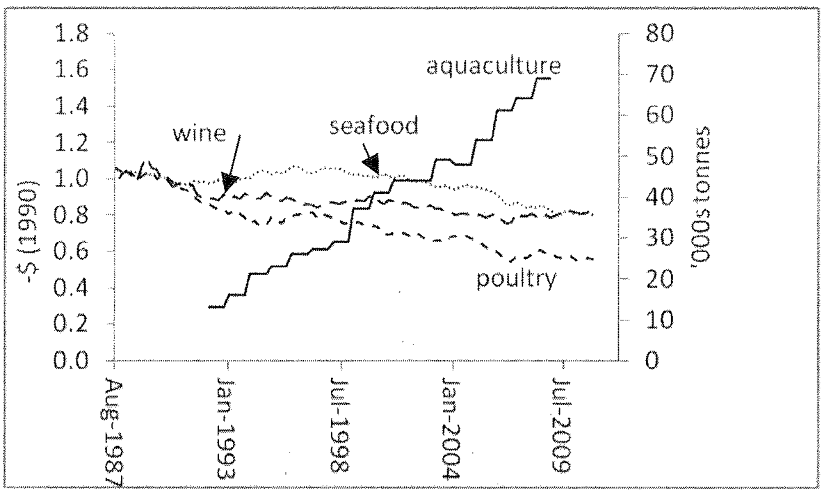
b) The real price of seafood has been declining globally and in Australia for the last two decades. It should come as no surprise that wild fisheries production is stable when it operates in a business environment where supply is increasing (through aquaculture) and price decreasing. The Australian Bureau of Statistics (ABS) tracks prices of 39 categories of food, and seafood is one of the few with substantial price declines since 1990. The price decline of seafood has resulted from increased supply, both through greater trade and also through domestic aquaculture production. The price trend has been similar to wine, where declining price has also slowed growth in production.

Stability of wild total catch is widely interpreted to mean that the opportunity for producing food from wild harvests has reached its peak. This ignores the economic drivers of catch and the fact that many Australian fisheries have reduced catch over the last few decades in response to declining prices.

A case study of the effect of falling prices: a Royal Commission in 1915 called for the creation of a Tasmanian fish canning industry due to the high price of imported canned fish. This led to a canning industry for Australian salmon, which has now closed due to a decline in prices of farmed fish and imported canned Alaskan salmon. Australian salmon is now rarely harvested for human consumption despite high stock abundance.




*Change in real price (standardised by CPI1990) of Australian food categories with largest declines in price since 1990. Declines in price would be expected given increases in supply through aquaculture and trade. Increases in supply from wild fisheries would not be expected in this operating environment.*

c) No scientific assessments of Australian fisheries rely on catch as a performance measure to infer stock abundance or status. For example, catches are commonly reduced in Australian fisheries using quota management systems where the objective is to reduce long run catch in order to maximise economic yield. The mistake of using catch to infer the abundance of fish is widespread, with the most notorious application being researchers who predicted the collapse of global fisheries by 2048 (Worm et al, 2006). Several papers followed shortly thereafter explaining that such use of catch data was misleading, and that more scientific approaches were required to assess the health of global fisheries (Worm et al, 2009; Branch et al, 2011). Despite this, Worm et al (2006) continues to be widely cited, and the Standing Committee will likely receive submissions influenced by that paper.

d) Abundances of fish stocks can be affected by fisheries management and also environmental processes. There is a widespread tendency to ascribe all stock declines to fishing harvests. However, environmental changes in primary productivity can also have a profound effect on abundance, and the Standing Committee's terms of reference sensibly reflect this.

***Fisheries sustainability, overfishing and optimal performance***

Extractive use is a variable threat to biodiversity and ecosystem function in almost all areas of the coast that are open to recreational or commercial fishing, dredging, mining, and other newer uses such as energy generation and desalinization (Beeton et al, 2012). However, fishing does not necessarily pose a threat to biodiversity where it is well managed and conducted at an appropriate scale.

The term "fisheries sustainability" is widely used but has many different interpretations. In fisheries science, "sustainability" means stability. Consequently, many fished stocks are both overfished and sustainable (e.g., small sub-populations of abalone in NE Tasmania; Tarbath and Gardner, 2011). All Australian fisheries are biologically sustainable. However, many Australian fisheries are not economically sustainable, as evidenced by the closure of many fisheries in the past.

Overfishing is a different concept to sustainability, and definitions vary between jurisdictions. A process to unify reporting is underway through the Australian Fisheries Status Reporting project, which involves the IMAS Fisheries Program (through the Fisheries Research and Development Corporation (FRDC)). This project is reviewing the status of all major Australian fisheries and defines overfishing as:

*"Recruitment overfished: the spawning stock biomass has been reduced through catch, so that average recruitment levels are reduced."*

This means that any reduction in the number of juvenile fish caused by fishing implies overfishing and is thus unacceptable because it leads to lower productivity. It is incorrect to assume that a fish stock classified as overfished is a conservation concern. The mistake here is that "overfishing" relates to production and means that the harvests are not as great as they could be otherwise. This is an economic problem, not a conservation concern.

Optimal fisheries performance is a more ambitious target for fisheries management than sustainability and the prevention of overfishing. It means the delivery of the maximum sustainable benefit from the resource.

Based on current assessments, all Australian fisheries are sustainable, but some are classified as overfished, and few are managed to optimise performance. For example, school shark is assessed as being sustainable. but conservation dependent, overfished, and clearly not performing in terms of optimal benefit to the community. Other examples are orange roughy and southern bluefin tuna.

The gap between current use and best use has been estimated for sustainable Australian fisheries at $415 million per year or 36%-46% (FRDC Resource Working Group, 2009). Globally, this performance gap is estimated at $50 billion per year (Kelleher et al, 2009).

The major challenge for Australian fisheries research is to close this performance gap and achieve harvesting that approximates optimal fisheries performance.

***The relationship between scientific knowledge of fish species, ecosystems, biodiversity and fish stock sustainability***

The management of fisheries harvests in all Australian jurisdictions involves a hierarchy of decision making with protection of ecosystem and biodiversity placed above sustainable economic performance of fisheries.

*At the single species level*: Most marine species harvested in Tasmania are exploited at low levels as minor fisheries. In these species, the level of scientific knowledge tends to be limited to biological information used for setting regulations that protect reproduction. This prevents overfishing, but does not provide abundance data to enable fishery performance to be optimised.

Annual assessments of abundance and fishery performance are conducted for higher value fisheries such as abalone, rock lobsters, giant crab, and scallop. These enable greater management of harvest and are generally information rich. Nonetheless, management of all these fisheries is limited by the extent of scientific knowledge. For example, the black lip abalone fishery is Australia's largest seafood industry by market capitalization of traded shares (~$1.7 billion), yet growth information is not yet available for more than half of the fishery.

*Biodiversity*: Management of biodiversity is informed through two distinct processes. Direct reporting occurs through mandatory protected species interaction reporting, bycatch monitoring, and byproduct data. This is augmented with expert risk assessment processes that are applied differently (inconsistently) between jurisdictions.

Fisheries management generally operates by comparing performance against limit or target reference points. Scientific knowledge is not commonly used to develop ecosystem and biodiversity indicators. Examples include limits on protected species entanglements and total biomass limits. There has been a long history of Marine Protected Area (MPA) monitoring in Tasmania, but to date the results of this monitoring have not been used in setting performance measures for protecting ecosystems or biodiversity.

Reference points used in fisheries management drive a fishery towards targets. These should reflect the societal objective for fisheries management, such as creating economic yield, or employment, or providing seafood to consumers. However, consistency between jurisdictions is lacking, as it is even between fisheries within jurisdictions. This aspect of Australian fisheries management requires greater involvement at the legislative level. There are essentially three alternate, competing choices when setting objectives for fisheries:

*employment vs catch vs economic rent*

(more on this below under Governance)

***Fishery management and biosecurity***

*The calculation and monitoring of stock size, sustainable yield and bycatch, as well as related data collection*

Harvest optimisation requires bio-economic models of the stock. These determine the effect of alternative catch limits and rules on the economic and biological outcomes of fisheries. Generally, biological sustainability is straightforward to achieve, but optimising economic benefits is more complex and requires bioeconomic models. These models are either developed or being developed for some of Australia's largest fisheries, including southern rock lobster, western rock lobster, bluefin tuna, northern prawn, and abalone.

Bycatch monitoring is conducted on many of the larger fisheries through continuous monitoring (eg, with observers in rock lobster), but single period data collection is possible with smaller fisheries (eg, the Tasmanian gill net fishery).

Reporting of byproduct is known to be poor in some Tasmanian fisheries by comparison of research sampling data with fisher reported data.

*The effects of climate change, especially relating to species dispersion, stock levels, and impacts on fishing communities*

Fisheries vary inherently, and appear to be adapting to climate change. However, there are vulnerabilities in management decision-making, eg, if we use stock models that assume growth will remain constant through time.

The first national fishery case study on climate change impacts on a fishery was conducted by IMAS for the Department of Climate Change (DCC), using data from the east coast Tasmanian rock lobster fishery (Pecl et al, 2009). Other case studies are underway on snapper, blue grenadier, abalone. and rock lobster through a national project with leadership shared by IMAS and the South Australian Research and Development Institute (SARDI).

Identification of impacts tends to require sophisticated modeling, and is thus mainly available to larger fisheries. Stock level impacts include changes to larval dispersal and growth. Ecosystem processes examined include change in the predator/prey suite (eg, octopus predation of lobster) and change in ecosystem productivity (eg, through expansion of urchin barrens).

Climate change impacts on fishing communities in Tasmania are being assessed through economic and social research. The coastal town of St Helens, Tasmania, is being studied in detail as lobster harvests decline, but urchin processing increases, in the region.

*Pest and disease management and mitigation**

Tasmania's most significant disease risk is abalone viral ganglioneuritis (AVG), which has reduced catch across large areas of the Victorian fishery. An extensive research and mitigation strategy is in place, and this has established a framework for dealing with diseases in other fisheries.

The University of Tasmania has been the Australian leader in aquatic animal health research, focusing on disease management in aquaculture, in particular farmed Atlantic salmon (in particular Amoebic Gill Disease and yersiniosis) and ranched Southern Bluefin Tuna (in particular parasitic diseases related to blood fluke infection). Diseases can significantly affect aquaculture production, not only through mortalities, but also through treatment cost and loss in growth. For example, Amoebic Gill Disease accounts for up to 20% of Atlantic salmon production costs. Some diseases and parasites have a potential to spread from farmed to wild fish (or vice versa). Biosecurity and disease management and mitigation are essential for sustainable aquaculture. The National Centre for Marine Conservation and Resource Sustainability (NCMCRS) at the Australian Maritime College (AMC) and the Tasmanian Government's Fish Health Unit (FHU) conduct research on disease management, including vaccine development and treatment. The basic science underpinning this research, including biology of the pathogens, parasite life cycles, epidemiology of diseases, and host immune responses, are also addressed. NCMCRS's world experts have made several breakthroughs, and NCMCRS hosts reference laboratories for Amoebic Gill Disease and tuna diseases.

Currently all aquaculture research (including research on pest and disease management and mitigation) has to be supported by the aquaculture industry (eg, cash contributions to Australian Research Council (ARC) Linkage proposals, industry support for FRDC proposals, industry support for Cooperative Research Centre (CRC) proposals). While this ensures uptake of results and access to samples, it means that most research is reactive and addresses only immediate industry concerns. There is not much interest in long term strategic projects, and it is becoming increasingly hard to attract industry support for longer term projects.

*Aquatic Animal Health research capability at the University of Tasmania includes the AMC's National Centre for Marine Conservation and Resource Sustainability (NCMCRS), IMAS, and the Fish Health Unit (FHU) within the Tasmanian DPIPWE Animal Health Laboratories .

*Minimising risks to human health*

Human health risks relate to both safe food handling processes and marine toxins. A monitoring program is underway in Tasmania for shellfish toxins, both for assurance of safe domestic consumption and to meet export requirements for abalone. Shellfish harvesting is commonly suspended in some areas as a consequence of this program.

*Minimising risks to the natural environment*

While many advocate the importance of MPAs for protecting biodiversity from the threat of fishing, conserving biodiversity is best achieved by identifying and removing the specific threat (Kearney et al, 2012). For example, risk of drowning of the threatened Australian sealion is best mitigated by preventing the use of gear that leads to drowning, rather than using MPAs in small areas to exclude unrelated activities like abalone diving.

Small MPAs have a role as scientific reference sites and can assist research on managing environmental risk of fishing (research scale MPAs are too small to influence catch across the wider system). Management of biodiversity risk across the broader marine ecosystem is then done through fisheries management including controls on total catch and gear.

*Cooperation among Australian governments*

Approaches differ substantially between jurisdictions. Consistent performance measures are lacking in many cases for shared stocks (eg, the level of egg production that would be considered of concern). More significantly, management objectives vary between regions. For example, Commonwealth fisheries are managed for economic efficiency where employment is minimised, while the creation of employment is a policy objective of many state fisheries.

***Research, development and applied science of aquaculture***

*Transitioning from wild fisheries to aquaculture in individual species*

The development of new species for aquaculture is the main area for aquaculture research activity at IMAS. Current new-species aquaculture research is mainly on rock lobster, although we have also been involved with research on bluefin tuna, yellowtail kingfish, striped trumpeter, banded morwong, flounder, and abalone.

The species selected for research to develop new aquaculture industries are luxury seafood products, and the objective of the research is to develop new industries, rather than primarily to provide increased seafood to consumers. This is consistent with wild fisheries research at IMAS, where the objective is to increase profitability of producers and contribute to gross state product through the creation of efficient export industries.

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Striped trumpeter was successfully developed through to viable pilot scale commercial aquaculture production. It was intended to provide an alternative species for salmon culture if warming water affected production, and remains a feasible mitigation strategy for the salmon industry.

Most of Australia's aquaculture production occurs in Tasmania through established industries for Atlantic salmon and oysters. IMAS initiated these industries and remains involved in their continued growth.

*Improving sustainability and lifecycle management practices and outcomes*

Issues identified for Tasmanian aquaculture and the subject of research at UTAS include the management of:

- ecosystem impacts of escaped salmon;
- benthic habitats beneath salmon farms;
- nutrient flows through estuary systems from salmon farms;
- carrying capacity and estuary impacts from oyster farming;
- management of estuary flows and impacts on oyster farmers from upstream users;
- whole of catchment intergrated monitoring to examine connectivity between all coastal activity including aquaculture (INFORMD);
- sustainability of farmed fish feed (fish oil and fish meal replacement in fish feed); and
- health of salmon and trout.

***Governance arrangements relating to fisheries and aquaculture, including the implications for sustainability and industry development;***

*Aquaculture*
Tasmanian aquaculture legislation deals with the allocation of sites and the requirements for aquaculture operations to manage impacts. Tasmanian legislation has functioned to allow the orderly expansion of the Tasmanian aquaculture industry. The ability of the Tasmanian legislation to enable orderly access to sites has been a significant contributing factor to the greater development of aquaculture in Tasmanian than in other states.

*Fisheries*

Differing objectives of legislation dealing with fisheries in Australian jurisdictions affect management choices and levels of production. The lack of clarity in legislative objectives means that targets for fisheries assessed by IMAS are usually decided by the commercial fishing industry, researchers, or State Government employees. This does not guarantee optimal societal outcomes for these community owned resources.

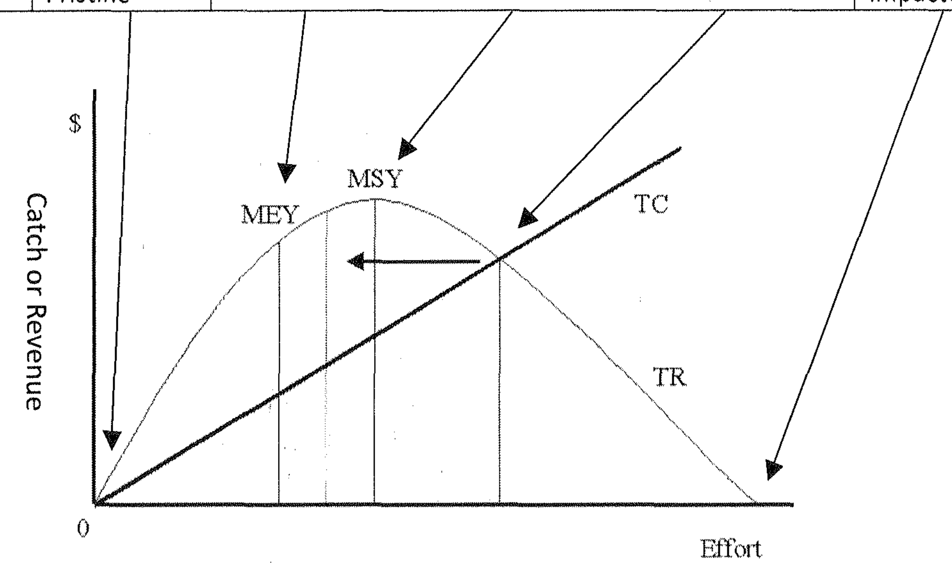
IMAS has research underway contrasting Australian fisheries legislation. The clearest legislative objectives are in the Commonwealth where fisheries target maximum economic yield (to producers) through the use of quotas and other rules (*"maximising the net economic returns to the Australian community from the management of Australian* *fisheries"*, Part 1, 3c Fisheries Management Act 1991). This objective means that the catch is kept lower than it would be if the objective were to provide the maximum sustainable supply of seafood to the Australian community.

In other fisheries, such as the Tasmanian abalone fishery, the objective is to target maximum sustainable catch. This means economic yield will be less than it could be if managed by the objectives of Commonwealth legislation.

The debate around what objectives we want from our fisheries is well developed in some countries. New Zealand fisheries have a defined goal of managing for maximum sustainable yield, while the recent review of the Magnuson-Stevens Fishery Conservation and Management Act in the United States emphasized employment and social benefits.

**What do we want from community owned fishery resources? These high level choices would appropriately be made by legislators representing the community.**

| | | | | | |
|---|---|---|---|---|---|
| **Economic and Social** | Non-extractive benefits only (eg, tourism in MPAs) | Highest economic rent from the resource | Greatest supply of seafood to consumers, lowest price of seafood | Greatest employment, and other inputs (eg, fuel, supplies) | Economic loss |
| **Stock** | Natural | | | | Depleted |
| **Ecosystem** | Pristine | | | | Impacted |




*Fisheries legislators have alternate options in defining objectives for fisheries. This plot illustrates sustainable catches as a function of the effort allowed by regulators, plus the increase in fishing cost (TC) as effort increases. In the Tasmanian abalone fishery, managers target the peak catch, which is termed the maximum sustainable yield (MSY). A different objective is applied in the Tasmanian rock lobster fishery, where catch is reduced below MSY to target maximum economic yield (MEY). MEY is the point where the gap between total revenue (TR) and total cost (TC) is greatest. It is not possible to simultaneously target maximum sustainable catch, maximum economic yield, and maximum employment.*

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***Current initiatives and responses to the above matters by state, territory and Australian governments***

The development of bioeconomic model capacity has been critical to improving performance of our larger fisheries. This process is one of the main themes of the Australian Seafood CRC, in which IMAS plays a leading role.

Bioeconomic models enable managers to simulate the economic and ecological effects of different harvest decisions, such as higher / lower catches or size limits. This has led to large changes in some fisheries. For example, modelling led to catch reduction in the Tasmanian lobster fishery by 27.5% since 2010. In turn, this led to an increase in lease price, from $9/kg in 2011 to $25/kg in 2012. The market value of quota units responded by increasing by $8000 per unit over the same period ($22,000 to $30,000), which equates to a rise in market capitalisation of the entire pool of quota units of $84 million.

Resource allocation between different parts of the community remains a complex and poorly resolved issue in Australian fisheries. The main stakeholder groups are:

- non-extractive users (eg, eco-tourism divers);
- seafood consumers;
- recreational fishers;
- traditional fishers; and
- commercial fishers.

IMAS is involved in research on allocation between recreational and commercial fisheries, but legislation is needed to facilitate efficient reallocation. For example, market based instruments have been developed elsewhere to create efficient allocations.

***Other Related Matters***

*The recovery of economic rents from fishing to the community*

All of Australia's largest fisheries are managed to provide economic yield to the fishing industry by restricting catches and access to the fishery. This generates wealth for the individuals who were given the entitlements, which is capitalized in the asset value of entitlements. There has been substantial debate in the United States about the recovery of some of this economic yield to the community that owns the resource (Macinko and Bromley, 2002); however. this has not occurred with Australian legislation.

Individuals can generate income from owning entitlements, which are then leased to other firms to catch the fish. This is only possible because the catch and access are constrained by regulation. These economic rents are most apparent in tradable quota systems where the value of the units is a function of the rent received.

The economic rent from fisheries resources is comparable to the super-profit which is topical in mining. A portion of this rent is returned to the community in all other Australian scarce resources (eg, forestry royalties, mining royalties, land tax on rental property, radio bandwidth auctions).

There is inconsistent treatment of the economic rent from Australian fisheries resources. In most cases, it is retained by the owner of the entitlement (and potentially subject to company tax). In rare cases, such as the Tasmanian abalone fishery, a levy is paid to the State.

*The use of market based instruments*

Most of Australia's large fisheries use individual tradable quota systems (ITQs) to restrict catch, promote efficient allocation of inputs, and provide economic incentives for conservative management. The many unresolved issues around these include:

- In most cases the quota markets function poorly because trading price is not readily accessible. The same issue was resolved in Australian water trading through government initiated on-line trading systems.
- The use of rights-based incentives for conservative management is undermined when the security of rights is weak. For example, governments commonly weaken the ability of ITQs to promote conservative management by reallocating catch away from commercial fishers to MPAs.
- The outcomes of ITQs are not always well articulated with government objectives. For example, ITQs are used to contract the fleet (less regional employment) and reduce seafood supply to consumers, which conflicts with objectives of some state legislation.

*Role of Marine Protected Areas (MPAs) in managing fisheries productivity*

The benefit of the spillover effect is frequently used to promote MPAs and has been suggested to provide a net improvement for a fishery. Current IMAS research shows that MPAs are beneficial only when the fishery is highly depleted, commonly where traditional fisheries management controls are absent. The researchers concluded that MPAs do not provide a spillover benefit to fisheries that are well managed (Buxton et al, in prep).

*Role of Marine Protected Areas (MPAs) in marine biodiversity conservation*

The absence of properly identified mechanisms to adequately protect the marine environment remains a major shortcoming in Australia's commitment to biodiversity conservation. The current commitment to a National Representative System of Marine Protected Areas (NRSMPA) falls short of providing adequate protection against the suite of existing and potential threats even though areas are designated as being 'protected'. Actions taken under the NRSMPA are disproportionately concentrated on regulating fishing, including the closing of areas in so-called sanctuary zones to all types of fishing. Adequate measures for the proper conservation of these areas and/or the protection of marine biodiversity more generally are not being provided and in most cases threats are not even adequately described and evaluated (Kearney et al, 2012).

In those cases where fishing is a threatening process, the most effective mitigation strategy is to regulate fishing gear design and effort. There are 446 species of threatened fauna listed under the EPBC Act, with 74 of these living in marine habitats. Fishing is a possible threatening process to 40 listed species (9% of the 446 listed species). These are mainly albatross (18 species) and turtles (6 species) captured as bycatch. Thirty three of the 40 threatened species potentially impacted by fishing move large distances (>100 km) and cannot be protected by no-fishing MPAs. In all cases where fishing is a threatening process, the risk is through a single fishery gear type. Mitigation is best addressed by regulation of these specific fisheries.

*Need for strategic approach in fisheries and aquaculture research*

There is an urgent need for strategic research funding for aquaculture research, at least some of it should be committed to research addressing long term issues including new species for aquaculture, biosecurity and disease management and potential impacts of aquaculture.

*Options for expansion of seafood production*

The Standing Committee focuses on the expansion of aquaculture to increase production. Aquaculture will drive most future growth in production, but other opportunities include:

- *Recovery of over-exploited stocks and higher exploitation of under-exploited species.* An over-fished stock is by definition less productive than a stock that is well managed. At the other extreme, many fish stocks are harvested, but at low level due to low demand (eg, pike, mullet species, barracouta, bearded cod, albacore tuna, and flounder)
- *Harvest of unexploited stocks.* Many stocks of fish aren't included in Australian fisheries statistics because they are not targeted. Only 9 of the 470 fish species in Tasmania are fished to a level that warrants inclusion in fishery assessments. Some unexploited fish have large biomass, such as myctophids, which could support harvests several times the current global catch, but are not economically viable for harvest under current conditions.
- *Increasing yield from fully exploited stocks.* Harvests can be increased in stocks classed as fully exploited through changes in management rules. For example, production was increased by 15% in the "fully exploited" Tasmanian abalone fishery through spatial management. Modelling of regional size limits in the Tasmanian lobster fishery has shown that production could be increased by a greater amount.

- *Human consumption of reduction and feed fisheries.* Species such as pilchards and mackerel were once harvested for human consumption, but price has fallen so that these industries are now only viable at high volume for animal feed production.
- *Increase in recovery.* Much of the landed harvest is discarded waste. Some of this could be recovered for human consumption (eg, roe) or could be used as input for animal feed production.
- *Enhancement.* Enhancement involves the addition of habitat or animals to increase production. This is mainly conducted for freshwater angling, but there are Australian marine fishery examples, including abalone in Western Australia, sea cucumbers in the Northern Territory, and rock lobster translocation in Tasmania.

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