

CSIRO Submission 12/465

Independent review into the legislation governing the Commonwealth's fisheries management system

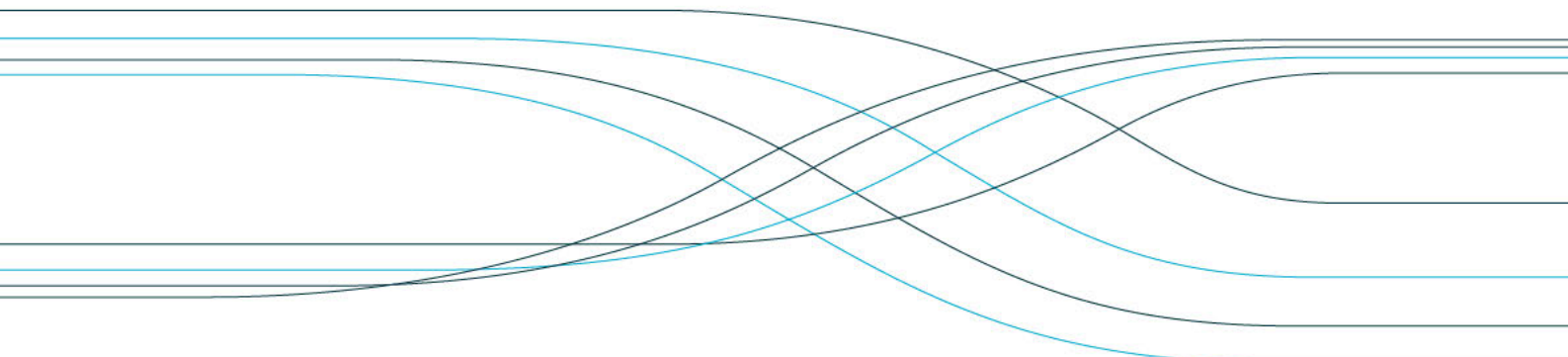
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Acronyms Used

AFMA	Australian Fisheries Management Authority
AIMS	Australian Institute of Marine Science
Bmsy	biomass at maximum sustainable yield
CCR	cost catch risk
CITES	Convention on International Trade in Endangered Species
CRIS	Cost Recovery Impact Statement
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EBFM	ecosystem-based fishery management
EEZ	exclusive economic zone
EPBC	Environment Protection and Biodiversity Conservation (Act)
eNGOs	environmental non government organisations
ERA	ecological risk assessment
ERM	environmental risk management
ESD	ecologically sustainable development
FAO	The Food & Agriculture Organisation of the United Nations
FMA	Fisheries Management Act
FRDC	Fisheries Research & Development Corporation
HSP	Harvest Strategy Policy
IMOS	Integrated Marine Observing System
MACs	management advisory committees
NGO	non government organisation
RAGs	resource assessment groups
RBCC	recommended biological commercial catch
SESSF	Southern and Eastern Scalefish and Shark Fishery
SEWPaC	Department of Sustainability, Environment, Water, Population and Communities
TAC	total allowable catch
TEPs	threatened, endangered and protected species

Executive Summary

Australia's fisheries and aquaculture industries are small by world standards but have a high regional, ecological, and political foot print. By global standards they are regarded as well managed and the Australian model of collaboration across science, management, and industry is regarded as world's best practice. A key strength of the current model is its evidence based with a strong risk management approach that is consistent with the precautionary principle.

Areas that could be improved include clearer guidance on the application of the precautionary principle (which should apply to all users of the marine environment – not just commercial fishers), national agreement on acceptable levels of impact as part of food production, and greater opportunity for community input into the formulation of fishery management plans. There should be periodic independent benchmark reviews of assessments and other key areas of science.

Specifically:

TOR 1

- CSIRO supports the recommendation that clear, direct management arrangements, i.e. through the Fisheries Management Act remain the primary legislative basis for fisheries management.
- There is a need for improved harmonisation with other government legislation, including the Environmental Protection and Biodiversity Conservation Act (EPBC).
- A shift towards ecosystem approaches to fisheries management has broadened the science focus by adding an objective to understand the broader ecological impacts of fishing and improve understanding of the role that biodiversity and ecosystem function might play in supporting fisheries production.
- Australia has well established internationally respected participatory management structures that explicitly involve industry, resource managers, eNGOs and scientists.
- Current opportunities for public comment and NGO/recreational sector participation in the assessment and management advice processes should be more widely communicated and the advice from the RAGs, MACs and Commission made more timely and transparent.
- A formal mechanism for independent peer review of scientific inputs into fishery management could be developed and adopted by the RAGs.

TOR 2

- The precautionary principle is designed to allow for management actions even in the absence of information, and there are many ways in which the precautionary principle is already applied in Commonwealth fisheries management in combination with risk-based approaches. The main issue to address is consistency of application of the principle. This consistency of application should extend to all users of the marine environment.
- Greater clarity is needed on how to apply the precautionary principle in a consistent and reasonable fashion. A set of consistent guidelines for implementation of the precautionary principle in Commonwealth fisheries could be drafted, reviewed, published and implemented as a central part of AFMA's operational guidelines.
- Australia has a global lead in research that underpins the ability to evaluate alternative forms of governance through innovative model frameworks such as Atlantis that enable "whole of system" evaluation of fishery and management plans and arrangements with quantitative prognostic assessments of future outcomes.

TOR 3

- Australia is seen as a world leader in developing effective forms of governance for fisheries.
- Public sector funding for research is flat or decreasing but the costs of and breadth of research are increasing.
- There needs to be an equitable sharing of costs of research across all users of the marine environment and marine resources, including public good funding.
- Rapid shifts in fisheries management from a focus on single target species assessments to a focus on ecosystem-based management places increasing demands on research and management.
- New observation technologies are improving understanding of marine ecosystems in general and some harvested species in particular.
- Recreational fisheries continue to be an important sector in Australia, socially, politically, economically, and environmentally, and there are a number of species taken by both commercial fishers and recreational fishers in Commonwealth waters.
- Governance arrangements for commercial wild caught fisheries generally are well established but challenges in overall governance include resource allocation issues between commercial, recreational, and indigenous sectors, as well as with other marine uses.

Introduction

This submission has been prepared by CSIRO scientists with extensive experience and international recognition in many facets of fisheries research. In addressing these Terms of Reference, CSIRO primarily limits its response to matters with a technical and research focus. Management issues where CSIRO has had direct engagement in the Commonwealth fisheries management system are commented upon as appropriate. A summary of CSIRO's main points in response to the Terms of Reference follows, with supporting references cited in the body of the submission.

Australia's commercial fisheries industries are relatively small by world standards yet have disproportionately large ecological, social, and political footprints. For example, Australian marine fisheries account for 0.2% of global marine fisheries landed tonnage but 2% of marine fisheries landed value (FRDC 2010). Demand for seafood is likely to increase with increasing populations both domestically and in our region, placing additional pressure on sustainable production of seafood. Global landings from capture fisheries are static or declining slightly, while production from aquaculture continues to rise (FAO 2011).

Australia's fisheries jurisdictions have adopted ecosystem-based fishery management (EBFM) as a policy goal, since the mid-2000s. This is consistent with the growing international demand for environmentally sustainable food production. Spatial management and participatory or co-management are also key features of the fishery management system. Our fisheries are considered well managed by global standards. For example, it has been estimated that only 15% of our fisheries are classified as overfished, with an improving trend, compared to 30% globally (FAO 2010, Smith and Webb 2011, Woodhams et al 2011).

This fairly rapid shift in fisheries management over the last decade from a focus on single target species assessments to a focus on ecosystem-based management places increasing demands on research for the provision of management advice. A focus on EBFM requires that fishing impacts on target, bycatch, habitats and ecological communities are considered, with the information demands for EBFM being much higher. As a result Australia has pioneered the development of tiered risk assessments that start with lower cost methods and only increase research costs when a material risk with that approach is shown. Australia is seen as being at the forefront in this area of research (Gallagher et al 2012; Scandol et al 2009; Patrick et al 2009; Pikitch 2012) but the information demands are still formidable and outside the scope of traditional data-rich-based research.

Current challenges to sustainable management are likely to be compounded by long-term changes in the ocean environment which limit the value of past experience and historical patterns. Science has a role in addressing these challenges through advances in ocean observation systems, developing methods to assess data-poor species and fisheries, bio-economic research, 'whole of system' modelling frameworks, and social research into governance systems, including better understanding of human behaviour (Fulton et al 2011).

Australian marine industries (offshore oil and gas, tourism, fishing) were worth in excess of \$44 billion per annum in 2010, having increased from \$38 billion in 2008 (AIMS 2010). Increasing marine uses can lead to tensions between sectors and generate competing priorities for the same areas. Recreational fishing is a major social and economic activity in Australia with up to four million people participating per annum and catches of many species exceeding commercial catches (Henry and Lyle 2001). The recreational fishing sector is managed by the States, but interact with Commonwealth managed fisheries. The growth in marine industries is increasing conflict with other users, including commercial fishers. No arrangements currently exist to provide a forum for identifying integrated strategic marine management or for setting spatial management priorities across multiple sectors.

CSIRO's response to the Terms of Reference

TOR Point 1 Recommend changes to the Acts that clearly establish the Fisheries Management Act 1991 as the lead document in fisheries management, and that all aspects of environmental, economic, and social consideration, and the relevant planning processes required be incorporated into the Acts, in a co-ordinated way.

Key points

- CSIRO supports the recommendation that clear, direct management arrangements, i.e. through the Fisheries Management Act remain the primary legislative basis for fisheries management.
- There is a need for improved harmonisation with other government legislation, including the Environmental Protection and Biodiversity Conservation Act (EPBC).
- A shift towards ecosystem approaches to fisheries management has broadened the science focus by adding an objective to understand the broader ecological impacts of fishing and improve understanding of the role that biodiversity and ecosystem function might play in supporting fisheries production.
- Australia has well established internationally respected participatory management structures that explicitly involve industry, resource managers, eNGOs and scientists.
- Current opportunities for public comment and NGO/recreational sector participation in the assessment and management advice processes should be more widely communicated and the advice from the RAGs, MACs and Commission made more timely and transparent.
- A formal mechanism for independent peer review of scientific inputs into fishery management could be developed and adopted by the RAGs.

Any changes to the Fisheries Management Act (FMA) should lead to improved efficiencies and cost savings, reduced duplication and legislative complexity, and greater clarity around jurisdiction. It is also clear from recent controversies that there is poor community understanding of the processes underpinning fisheries assessment and management and the status of Australian fisheries. However, the need for independent, science-based decision-making should remain enshrined within the FMA.

While the FMA should remain the primary legislative basis for fisheries management, it is important that this be harmonized to the extent possible with other government legislation, including the Environmental Protection and Biodiversity Conservation Act (EPBC). This coordination and harmonisation should occur at a range of levels, from legislation, through policy to the specifics of the methods and tools used to for assessment and management of marine resources and ocean use. There are instances of inefficiencies and duplications in current assessment and review processes that duplicate resources and cause confusion to stakeholders and to public perceptions about natural resource management. Australia is well placed to move towards a much more integrated approach to ocean management, including management of natural resources.

The recent shift towards ecosystem approaches to fisheries management has broadened the science focus towards, on the one hand, understanding the broader ecological impacts of fishing, and on the other to improving understanding of the role that biodiversity and ecosystem function might play in supporting fisheries production. The focus on ecological impacts of fishing in Australia has been driven in part by provisions of the EPBC Act (1999).

The EPBC Act Review in 2009 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. The review also recommended that the Australian Government:

- (1) integrate the Commonwealth Fisheries Harvest Strategy Policy (HSP) framework with the threatened species listing process for marine fish; and
- (2) ensure the HSP biological reference points reflect the biology of the species and its role in ecosystem function rather than standard default settings such as reduction of population.

Science will play a significant role in helping to deliver these recommendations efficiently and effectively. Scientific knowledge of fish species and fish stock sustainability is much greater than for other components of biodiversity and ecosystems. Indeed, much of the information available for biodiversity and ecosystems has been obtained incidentally from fishery monitoring. Cost-effective monitoring strategies and activities such as the Integrated Marine Observing System (IMOS) enhances the information base for biodiversity and understanding of ecological function but require to be maintained over a long period to sustain consistent, structured, long term observations.

Australia has well established participatory fisheries management structures that involve Industry, Resource Managers, eNGOs and scientists explicitly in a process that provides direct, structured pathways to deliver research support into management and policy fora.

CSIRO scientists have been actively engaged in the planning processes, particularly management advisory committees (MACs) and resource assessment groups (RAGs) since their inception when AFMA was established. CSIRO generally supports these processes as an effective means of participatory management leading to improved communication and shared outcomes (Smith et al. 1999, Smith et al. 2001). Processes such as these are also regarded internationally as key components of effective fisheries management. However, these planning and advisory processes are not well understood in the community.

Current opportunities for public comment and NGO/recreational sector participation in the assessment and management advice processes should be more widely communicated and the advice from the RAGs, MACs and Commission made more timely and transparent (noting that this is generally available on the AFMA website). Appropriate public scrutiny of fisheries management activity is highly recommended. Care should be taken at which level this occurs, so as not to undermine processes respected by the international sector. For example, a fishery's harvest strategy (which contains the decision for setting the recommended biological commercial catch (RBCC) should be (and presently is) made available to the public for comment. However, the annual total allowable catch (TAC) setting process (that applies this harvest strategy) could be opened to greater scrutiny to ensure adherence to the approved process, but not subject to formal public comment.

There is value in considering the current representation on MACs and whether bringing conservation and fisheries management together in a single forum might prove useful in developing a broader shared understanding.

One shortcoming of the current processes is the absence of peer review. Currently, within RAGs, there is rigorous internal review of scientific results and assessments but there is no formal process for independent scientific peer review beyond the publication of methods in scientific journals which may lag the actual decisions by several years. This is an important part of the scientific process and provides greater confidence to all involved that the science supporting management decisions is of the highest quality and robustness. A formal mechanism for independent peer review could be developed and adopted by the RAGs. Approaches such as those used in the United States (<http://cufer.rsmas.miami.edu/wordpress/wp-content/uploads/2007/05/p41.pdf>) could be considered for use in Commonwealth fisheries. South Africa also undertakes annual and rigorous peer review of its fishery assessments and harvest strategies. There would be a modest increase in costs but these would be greatly outweighed by the benefits.

It is unclear what is meant by social consideration in the TOR. Social objectives are not explicit in the current FMA other than those encompassed more broadly within the ESD objective. Although explicit social objectives are important for some fisheries such as in the Torres Strait region, the bulk of the Commonwealth fisheries are commercial enterprises (rather than artisanal). Fisheries do have impacts beyond the target species and will continue to do so. What has not been discussed among Australian stakeholders is what level of impacts are 'acceptable' beyond issues such as sustainability of target resources. There is community concern regarding bycatch and discards, and interactions with threatened, endangered and protected species (TEPs). Indeed, interactions with TEPs are likely to increase as the populations of many of these species, particularly marine mammals, continue to recover. What is needed is a national debate on what impacts are acceptable which could inform policies similar to the Harvest Strategy Policy. The current review of the bycatch policy goes some of the way but benchmarks or standards have yet to be articulated. While this is primarily a social debate, science can inform it.

TOR Point 2 Recommend any necessary changes to the Acts that affirm the powers of a Minister to take advice, and make decisions, with the full scope of the precautionary principle available within the Fisheries Management Act 1991, and that same definition of the precautionary principle apply in both the Fisheries Management Act 1991 and the Environment Protection and Biodiversity Conservation Amendment 1999

Key points

- The precautionary principle is designed to allow for management actions even in the absence of information, and there are many ways in which the precautionary principle is already applied in Commonwealth fisheries management in combination with risk-based approaches. The main issue to address is consistency of application of the principle. This consistency of application should extend to all users of the marine environment.
- Greater clarity is needed on how to apply the precautionary principle in a consistent and reasonable fashion. A set of consistent guidelines for implementation of the precautionary principle in Commonwealth fisheries could be drafted, reviewed, published and implemented as a central part of AFMA's operational guidelines.
- Australia has a global lead in research that underpins the ability to evaluate alternative forms of governance through innovative model frameworks such as Atlantis that enable "whole of system" evaluation of fishery and management plans and arrangements with quantitative prognostic assessments of future outcomes.

The intention to apply the precautionary principle is clearly stated in both the FMA and the EPBC Acts, and the same definition is used:

'if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation'

There are many ways in which the precautionary principle is already applied in Commonwealth fisheries management (detailed below). The main issue to address is consistency of application of the principle, both within the issues under the control of the FMA, across other legislation (such as the EPBC Act), and more generally across different users of the marine and terrestrial environment. The marine environment is difficult and costly to observe and study, though the Australian EEZ is relatively well studied by international standards. Nevertheless, there are always major uncertainties that arise in addressing the impacts of fishing, particularly on non-commercial species (bycatch and TEPs) and on marine ecosystems more generally. Overly strict application of the precautionary approach could result in cessation of many human activities in the marine environment, including both commercial and many forms of recreational fishing. A "risk based" approach coupled with a clearer understanding of what constitutes acceptable

impacts and acceptable risks is required. Greater clarity is needed on how to apply the precautionary principle in a consistent and reasonable fashion.

The current activities that give operational effect to the implementation of the precautionary principle in Commonwealth fisheries include:

1. The Harvest Strategy Policy (HSP) explicitly links the outcomes of monitoring and stock assessment with the management response to ensure sustainable fisheries (Smith et al 2008, 2009). Elements of precaution within the HSP include:

- The explicit use of limit and target biomass reference points:
 - The target is well above the often-used international target of biomass at which maximum sustainable yield occurs (B_{MSY}) – often close to 50% of unfished biomass.
 - The limit is at or above 20% of unfished biomass – no targeted fishing is allowed below the limit.
 - Where $B < 15\%$ of the unfished level, conservation dependent status may be assigned with a need for a formal recovery plan.
- The biomass must be above the limit reference point biomass (B_{LIM}) with a 90% probability (thus defining an acceptable level of risk, at least for target species).
- The HSP recommends a tiered approach reflecting uncertainty in stock status and data availability. In the Southern and Eastern Scalefish and Shark Fishery (SESSF) a 'discount factor' is applied at each tier level such that the TAC is reduced as uncertainty in data and/or assessments increases.
- Harvest strategies are formally evaluated using a simulation framework known as management strategy evaluation to check that they meet the requirements of HSP and are sufficiently robust to scientific uncertainty.
- The limit and target reference points used in the HSP are considered conservative by global standards.

2. Ecological risk assessments (ERA) have been undertaken for all AFMA fisheries (Smith et al 2007; Hobday et al 2011; Williams et al 2011). These focus on the impacts of each fishery on bycatch species, TEPs, habitats and marine communities, with over 2000 species and 200 habitats assessed. AFMA has used these as the basis for its Environmental Risk Management strategies for each fishery. The methods adopted by AFMA for ERA are seen as global best practice, with the same methods subsequently adopted in the US, by several regional fishery management organizations, and by CITES. The international Marine Stewardship Council has also adopted the CSIRO/AFMA methods for ERA for its fishery certification program.

3. Spatial management is widely adopted as a key aspect of fishery management to help reduce the impacts of fisheries on marine species and ecosystems. Examples include spatial closures to deepwater trawling to protect orange roughy and deepwater sharks, inshore closures to gillnets to protect Australian sea lions, and upper slope closures to protect gulper sharks and inshore closures to protect key nursery grounds. Such closures are inherently precautionary for relatively sedentary species.

It would be useful to ensure how SEWPaC operationalises the precautionary principle is consistent across the Acts. A set of consistent guidelines for implementation of the precautionary principle in Commonwealth fisheries could be drafted, reviewed, published and implemented as a central part of AFMA's operational guidelines.

Fishing businesses and management will need greater flexibility to operate within a changing climate and climate change is contributing to a need for changes to management and fishing strategies. Changes in fishing season, closed areas, vessel zoning, vessel size, permit sharing, multiple gear types are examples of things that may need to be flexible in future, as species respond to environmental changes.

TOR 3 Consider the need for modernising Commonwealth fisheries resource management legislation and approaches including penalty provisions, licence cancellations, the use of modern technology and co-management. Consideration of cost recovery arrangements will include consideration of the degree to which cost recovery might impact on the management of fisheries including investment in research and stock assessment.

Key points

- Australia is seen as a world leader in developing effective forms of governance for fisheries.
- Public sector funding for research is flat or decreasing but the costs of and breadth of research are increasing.
- There needs to be an equitable sharing of costs of research across all users of the marine environment and marine resources, including public good funding.
- Rapid shift in fisheries management from a focus on single target species assessments to a focus on ecosystem-based management places increasing demands on research and management.
- New observation technologies are improving understanding of marine ecosystems in general and some harvested species in particular..
- Recreational fisheries continue to be an important sector in Australia, socially, politically, economically, and environmentally, and there are a number of species taken by both commercial fishers and recreational fishers in Commonwealth waters.
- Governance arrangements for commercial wild caught fisheries generally are well established but challenges in overall governance include resource allocation issues between commercial, recreational, and indigenous sectors, as well as with other marine uses.

Effective fisheries management benefits from a combination of top down and bottom up governance structures. Australia is seen as a leader in developing effective forms of governance for fisheries, including introduction of limited entry licensing, cost-recovery frameworks, development of formal harvest strategies, adoption of incentive based approaches to harvest regulation, and, particularly, participatory approaches to management (Smith et al. 1999; Hilborn and Kearney 2011). The HSP and ERA/ERM are relatively recent developments and are not reflected in legislation. It is not clear whether aspects of governance arrangements need to be reflected in legislation, or just in policy and procedures. However, key to this decision is the ability to remain flexible while still maintaining science-based decision making.

Fisheries are relatively expensive to study and assess due to the nature of the environment in which they operate. There are twin challenges currently facing fisheries science in Australia within this context. First, public sector funding for research is flat or decreasing but costs of research are increasing with ongoing needs for monitoring and research to reduce uncertainty about future resource dynamics (e.g., because of natural variability combined with increasing pressures on marine ecosystems from climate and other anthropogenic sources) and demand for high standards of scientific evidence to meet society's high environmental expectations. Second, the fairly rapid shift in fisheries management from a focus on single target species assessments to a focus on ecosystem-based management places increasing demands on research. The information demands for the broader approach are much higher, despite development of tiered assessment approaches that start with lower cost approaches and only increase research costs when a material risk with that approach is shown. Finally, the introduction of the Harvest Strategy Policy increased the requirements for ongoing information collection, stock assessments, and other analyses in order to maintain the management of the Commonwealths fisheries. This has led to an increase in assessment and management costs at the same time as resources to achieve this has declined.

Under current cost-recovery arrangements, industry contributes 80% of funding required for monitoring and assessment. However, this funding barely covers the basic monitoring and assessment required to manage Commonwealth fisheries. Additional, but limited funding is also available from FRDC, which funds more strategic research.

Faced with rising expectations and static or diminishing resources, a "cost catch risk" (CCR) approach to investment in monitoring and research provides a possible resolution (Sainsbury 2005, Dowling et al. in press). This involves specifying an acceptable level of impact and risk, and then matching the investment in monitoring and research and the resulting level of uncertainty to the level of precaution needed in the management arrangements to achieve the acceptable risk. The lower the investment and the higher the consequent uncertainty, the more precautionary the management arrangements that will be required. While this is fine in theory, in practice the tradeoffs can be difficult to calculate and expert judgement will usually be required. It is also important to note that there is generally a minimum level of investment below which no risk based decision is possible other than discontinuing the activity (closing the fishery). The nexus between acceptable impacts, acceptable levels of risk, and investment in research and monitoring is central to the operational definition and application of the precautionary principle.

With climate change, baseline of information becomes less valuable in a changing ocean, as it becomes outdated more rapidly compared to an "equilibrium" ocean (Hobday and Poloczanska 2008; Hobday and Evans in press). Thus, ongoing monitoring will be critical in future. Design of cost-effective monitoring remains critical - and must be targeted to address key uncertainties.

Cost-recovery may not be a sufficient industry-research model in a rapidly changing ocean. With observed and projected climate change, fished and unfished species are and will move, abundances will change, and new fishing opportunities will arise as others are lost. New species will also need "research" to inform sustainable fishing - yet in the absence of established fisheries in the new area targeting that species, it is not clear if the cost-recovery model for funding research will be appropriate. Similarly, as species changes lead to declining catch, there will be reduced research capacity to determine if it is climate change, fishing, or other factors causing the decline. Thus, strategic research will be needed that may not fit to the industry priorities, or may be above and beyond the business-as-usual research that is already straining budgets (e.g. stock assessments).

Currently commercial fisheries fund a significant proportion of the research and monitoring costs in the marine environment where impacts arise from a wide range of human activities, including land based sources of pollution, recreational fishing activity, and other users of the marine environment. A broader arrangement for cost sharing could be considered.

It is likely that encounters with some TEP species will increase, even if fishing effort and bycatch controls are constant or improved. This may be due to increased population sizes of TEPs as a result of populations recovering from past exploitation and because some TEPs will be advantaged by a changing climate. Thus, move-on rules, bycatch limits, basket limits, allowed take, may all need to be reconsidered based on updated research.

Thus while the CRIS plays an important role in focussing research and monitoring priorities and delivery of cost-efficient fisheries management, it does reduce the availability of funding for broader marine research, such as ecosystem impacts of fishing and issues of interest to the wider community. There is a need to consider different/complimentary sources of funding for broader applied research on marine ecosystems to address these broader issues.

New observation technologies are improving understanding of marine ecosystems in general and some harvested species in particular. These technologies include hydro-acoustic methods, video monitoring, swath mapping, and sensor platforms, exemplified in the Integrated Marine Observing System (IMOS). Fishers are an active group in the marine environment deploying new technology. Deploying sensors on fishing vessels to collect environmental information is an opportunity that is only just starting to be

explored. New techniques from other science fields, such as genetics and software development, are also being developed to support more cost effective monitoring and processing of environmental data.

Recreational fisheries continue to be an important sector in Australia, socially, politically, economically, and environmentally, and there are a number of species taken by both commercial fishers and recreational fishers in Commonwealth waters. Methods to assess them are generally expensive and less well developed than those applied to commercial fisheries. The last national snapshot of recreational fishing was in 2000 (Henry and Lyle 2001). New cost-effective methods are being developed (e.g., Griffiths et al 2010) but the recreational catch remains highly uncertain for many species, though in some cases it is known to be significant.

Governance arrangements for commercial wild caught fisheries generally are well established but challenges in overall governance include resource allocation issues between commercial, recreational, and indigenous sectors, as well as with other marine uses. Recent focus on fisheries impacts from coastal development (e.g. around Gladstone Harbour) also underscores the interactions of multiple uses of marine environments with fisheries and the need for integrated management across multiple uses. Research is required to develop robust tools to inform such integrated management planning.

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