Second submission from Jonathan Nevill to the Commonwealth Fisheries Review 2012

The document below is a copy of a chapter from a recent book. It forms my second submission to the fisheries review. It contains important information and arguments supporting the recommendations and conclusions of my first submission.

Australian fisheries management: opportunities for reform

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Abstract:
This chapter looks in overview at key management challenges for both Commonwealth (Federal) and State fisheries management agencies in Australia. The chapter is based on a recent book examining these issues in some detail (Nevill 2010). This chapter, like the book, explores the idea that poor fisheries management - and the economic and ecological damage which follows - is largely the result of management failures to implement important strategies to account for uncertainty. The two most important of these strategies are the precautionary principle and the ecosystem approach. After investigating the implementation of these strategies in Australian fisheries case studies, I conclude that, in spite of strong policy rhetoric, implementation is often weak or superficial. However, the case study of the southern ocean krill fishery, managed by the Commission for the Conservation of Antarctic Marine Living Resources, provides an important exception. Other case studies examined in detail in the book include the Western Rock Lobster fishery, the Northern Prawn fishery, the Orange Roughy fishery, and South Australia's abalone fishery.

The central conclusion of the chapter (explained in more detail in the book) is that steps should be taken to bring about radical change in the cultures which operate within fisheries agencies. This could be achieved, I argue, by replacing fisheries management agencies with agencies charged with managing marine biodiversity assets. This finding reinforces recommendations made in recent years by several prominent scientists for fundamental and far-reaching changes to the administration of marine fisheries worldwide. In essence, management agencies must be re-focused on the objective of protecting the marine ecosystems which underpin commercial production, rather than simply regulating the harvest of individual species.

Key words: precautionary principle, ecosystem approach, fishery management, destructive fishing practices, CCAMLR, policy, implementation failure, overfishing, marine governance.

Introduction:
Fishery scientists provide advice to fishery managers. Fishery managers (within a governance framework created by national statute, international law, common law, and culture) provide and enforce the nation's controls over fishers. Controls include both restrictions and incentives, and operate within the culture of various groups, as well as the prevailing national and international legal and economic framework.

Uncertainty is a fundamental and unavoidable aspect of fisheries management. The most basic scientific advice concerns the size of species stocks, and the effects on those stocks of harvesting pressures. In addition, assessments need to be made of the continuing ability of

the ocean's wider ecosystems to support individual populations. The impacts on the ecosystems themselves, including component species of no direct commercial interest, should also be monitored.

Uncertainty in fisheries management stems mainly from seven sources:

1. imperfect understanding of the *oceanographic drivers* of ecosystem function and species behaviour, reproduction and growth within ecosystems;
2. imperfect understanding of *species-specific biology*, including growth rates and drivers, and movement patterns driven in part by feeding and reproduction;
3. imperfect understanding of the *behaviour of species within ecosystems*;
4. stemming from the above and from the practical limitations involved in expressing biological processes in mathematical form – imperfect predictive *models* of species biology and ecosystem function (incorporating the effects of fishing on ecosystems – including bycatch, habitat damage, and the impact of discarding);
5. errors created by inaccurate or insufficient *sampling for stock and other empirical data,* which seeks to support understanding of the size, movement, growth, mortality and genetic diversity of stocks of fishery target and bycatch species, and to provide oceanographic and ecosystem-related information;
6. systematic but poorly-appreciated *bias in scientific advice and managerial decisions* resulting from the cultures in which these groups operate; and
7. imperfect prediction of *fisher behaviour*, including movement, fishing effectiveness, and ecosystem damage (primarily from gear damage, bycatch and discards).

A significant part of fishery science attempts to understand uncertainty, and to minimise it (or estimate its bounds) where possible. Where uncertainty cannot be eliminated (and this is always the case in capture fisheries) its implications for management decisions need to be understood and taken into account. Powerful tools exist for the management of uncertainty, and two of these tools, the precautionary principle and the ecosystem approach, are examined in detail in a book published in 2010 *Overfishing under regulation: the application of the precautionary principle and the ecosystem approach in Australian fisheries management*. In some ways this chapter summarizes the essential findings of this book, and the book will be cited in the discussion below. A detailed discussion of uncertainty and its implications for fisheries management is contained in Nevill (2010) chapter 6.

Many fisheries *policies* (both in Australia and elsewhere) are evidence-based, sensible and practical; however unless these policies are conscientiously *implemented*, they do no good at all. Where such policies are focused on long-term benefits, they often have short term penalties, and these penalties tend to fall particularly on fishers, for example, whose boats are heavily mortgaged. Naturally such people will place considerable pressure on fisheries managers, and if managers are weak, or if the culture of the fisheries agency condones incompetence or corruption, the end result is that important policies carrying long-term benefits will not be properly implemented. This applies particularly to the two policies already mentioned (Nevill 2010 chapters 7-16). Where failures eventuate, as they often do in fisheries management, the inherent uncertainties provide managers with the necessary excuses.

This chapter focuses particularly on implementation issues in three important elements of Australian fisheries policy. In this chapter I argue that: (a) the Commonwealth's strategic fishery accreditation program's integrity is compromised on a number of fronts; (b) fisheries management agencies generally display strong commitment to the precautionary principle in policy, however implementation of the principle within management programs is sometimes weak and ineffective; and (c) destructive fishing practices in Australia are not being effectively addressed, in spite of an impending international phase-out deadline. I speculate that the underlying cause of the identified problems probably lies primarily with the organizational cultures within fisheries management agencies; cultures essentially focused on harvesting. Such cultures could be changed if fisheries agencies could follow the path already trodden by government agencies responsible for terrestrial biodiversity which, a century ago, were focused on the promotion of hunting and the management of game. The

Commission for the Conservation of Antarctic Living Marine Resources (CCAMLR) provides a model for such a metamorphosis.

Management of the marine environment: Australian policy:

Australia has espoused several progressive policies relating to conservation of the marine environment, and has received international recognition on this account. For example:

- Australia was one of the first nations to adopt bioregional ocean planning (Commonwealth of Australia 1998);
- Australia is committed, at least on paper, to the establishment of a comprehensive, adequate and representative national network of marine protected areas;
- All export fisheries undergo periodic reviews under the provisions of Commonwealth legislation, using a process which appears to be transparent and accountable;
- Australian fisheries legislation *requires* application of the precautionary principle;
- Australia is committed to phasing-out destructive fishing practices by 2012;
- An Australian fishery was the first world-wide to achieve Marine Stewardship Council certification (the western rock lobster fishery in Western Australia).

Australia's scientific capability in marine matters is also highly regarded internationally: the work that the CSIRO is currently doing in areas such as ecosystem-based modelling, and the ecological risk assessment of fisheries, is leading-edge in a global sense. However, in day-to-day fisheries management, the case studies examined in my investigation demonstrate some important problems in program implementation. These problems pertain to three of the above policies:

1. the Commonwealth's strategic fishery assessment program;
2. application of the precautionary principle; and
3. the scheduled phase-out of destructive fishing practices.

In order to provide a short and readable account, the examples presented below are discussed only in overview. Details on these examples, as well as a discussion of many more examples, are provided in Nevill (2010). Examination of the management frameworks of individual fisheries is time consuming, and of course the findings of the book (as discussed here) must be tempered by the small number of case studies examined:

Regional	Southern ocean krill fishery (CCAMLR)
Commonwealth	Orange roughy fishery
Commonwealth	Northern prawn fishery
State (SA)	Abalone fishery South Australia (South Australia)
State (WA)	Western rock lobster fishery (Western Australia).

The Commonwealth's strategic fishery accreditation program

Under the provisions of the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999*, (the EPBC Act) every export fishery, and every Commonwealth fishery, must be assessed against designated 'sustainability guidelines'. Fisheries are accredited for a period of 5 years, usually on conditions aimed at promoting continual improvement (Nevill 2010 chapters 11-14).

This section examines three questions:

1. Are the guidelines adequate?
2. Is the level of documentation contained in the accreditation reports adequate?
3. Does the accreditation result adequately reflect the environmental issues of the fishery?

Are the guidelines adequate?

The Commonwealth's 28 guidelines were published for stakeholder comment in 1999, and finalised in 2000. While there were some improvements in the 2000 version, mostly related to minor points of definition, the final guidelines lost important features relating to auditability – in other words the final version was vague and general where the draft version had been clear and definite. Consider one example:

> Draft guideline 3.1 (1999)
> The fishery *shall* be subject to institutional arrangements that are in accordance with Australian laws and standards and *which give effect to the principles of international agreements relating to the conservation and sustainable use of marine living resources, including the precautionary approach to management* [emphasis added].

This draft guideline has two clear elements: (a) rules must be obeyed, and (b) the principles of international agreements must be applied.

> Final guideline 3.1 (2000)
> *The management regime must comply with any relevant international or regional management regime to which Australia is a party.* Compliance with the international or regional regime does not mean Australia cannot place upon the management of the Australian component of the fishery management controls that are more stringent than those required through the international or regional regime [emphasis added].

This guideline has only one clear element: rules must be obeyed. The rest of the guideline re-states the obvious.

Both versions basically state that 'rules must be obeyed' – which really should go without saying. However the first version quite precisely *requires* the application of the precautionary approach – and other important principles. This requirement is entirely lost in the final version. See Nevill (2010: chapter 7) for a discussion of the difference between the precautionary principle and the precautionary approach.

An examination of the other 27 guidelines provides several other important examples of the removal of critical elements, and the removal of clarity on which auditability depends (Nevill 2010 Appendix 3).

Is the level of documentation adequate?
Consider the example of information provided by the *South East Scalefish and Shark Fishery* (SESSF) re-accreditation report on the deepwater trawl fishery for orange roughy (AFMA 2006b). Although Australia was required (under an Australian / New Zealand Memorandum of Understanding) to send observers on each vessel operating on the South Tasman Rise in 1998-99, and these observers were required to collect information on trawl bycatch, the AFMA report contains *no* information on their bycatch results. Coral bycatch was a critical issue for the fishery at the time. In fact, no orange roughy bycatch reports are referenced or summarised in the AFMA report. In other words, no information was provided on an issue critical to the focus of the assessment (Nevill 2010 chapter 12).

Consider the example of the Northern Prawn Fishery re-accreditation report (AFMA 2008). Although bycatch impacts are a critical issue for the fishery, the AFMA report entirely failed to reference or summarise reports detailing temporal and spatial variation in bycatch/catch ratios – vital information in relation to developing bycatch reduction strategies (Nevill 2010 chapter 11).

Does the accreditation result adequately reflect the environmental issues of the fishery?
Consider the example of the SESSF accreditation report (AFMA 2002) particularly as it related to the orange roughy component of that fishery.

At the time the AFMA report was prepared, all but one of Australia's orange roughy stocks were in severe decline. However, AFMA provided false and misleading information in the

report which had the effect of under-playing this crisis (see below). Moreover, the information which was presented in the report demonstrated that the orange roughy fishery met only 3 of the 28 Commonwealth sustainability guidelines. Many of the 'missing' guidelines were simply not addressed. Turning to another important issue, AFMA failed to produce information on the extent of trawler damage to orange roughy habitats in this report. Much of this damage was severe and effectively irreparable. The trawl fishery presented a major threat to deepsea coral habitats, and possibly to the ecological viability of orange roughy populations (Nevill 2010 chapter 12).

However, in accrediting the fishery, the minister responsible for the EPBC Act (at that time David Kemp) provided a brief statement which had no foundation within the information provided by the AFMA report:

> "I am satisfied that AFMA has provided a report that adequately addresses the current and likely impacts of activities taken in accordance with the management plan…
>
> I am satisfied that actions taken in accordance with the management plan are unlikely to have unacceptable or unsustainable impacts on the environment in a Commonwealth marine area.
>
> I am also satisfied that [the fishery] is unlikely to be detrimental to the survival or conservation status of any taxon, or threaten any relevant ecosystem, to which the fishery relates." (Kemp, 2003)

Three years later, after further population declines, the orange roughy became the first commercial fish listed under Australian threatened species legislation (Nevill 2010 chapter 12).

In summary, the Commonwealth's fishery assessment guidelines are, in several cases, weak and vague. In the case studies examined, the level of documentation in accrediation reports was inadequate, and the results of the accrediation process did not adequately reflect the key issues facing the fisheries.

Application of the precautionary principle

Commonwealth fisheries legislation *requires* the application of the precautionary principle. Many definitions of the precautionary principle exist. A general statement of the principle is:

> *Where there is the threat of serious or irreversible harm, lack of scientific certainty should not deter action by decision-makers to prevent or mitigate such harm*.

The principle contains two key elements: the possibility of serious harm, and the existence of uncertainty. Both these elements are common-place in fisheries management. The principle also reverses the onus of proof. Where formerly decision makers assumed that no action need be taken until the likelihood of damage was clearly identified or demonstrated, under the precautionary principle an activity proponent needs to demonstrate that harm will not occur, or is very unlikely to occur (Preston 2006).

Australia committed itself to apply the precautionary approach to natural resource management in 1982 through endorsement of an important resolution of the United Nations General Assembly, the *World Charter for Nature*. This commitment was later reinforced by Australia's support for the *FAO Code of Conduct for Responsible Fisheries*, as well as the *UN Fish Stocks Agreement*, both documents dating from 1995 (Nevill 2010 chapter 5).

Commonwealth fisheries legislation was amended in 1997 – fifteen years after the initial commitment – to require application of the precautionary principle to Commonwealth fisheries.

Annex II of the UN Fish Stocks Agreement (UNFSA) provides guidelines on the application of the precautionary approach. According to the Annex, the fishing mortality equivalent to that which would produce maximum sustainable yield (Fmsy) should be used as a limit reference point not as a target reference point – thus departing from traditional fisheries management practice over much of the twentieth century.

The UNFSA is widely viewed as providing appropriate advice for the management of single stocks, in addition to migratory or straddling stocks, and this view is shared by the Government of Australia (Commonwealth of Australia 2006).

At the South Tasman Rise, AFMA initially used 20%B_O (B_O: unfished biomass) as a limit reference point for the orange roughy fishery – in apparent violation of responsibilities under the UNFSA, which would have seen a limit of approximately 50% B_O. AFMA made no attempt to demonstrate that their lower limit reference point complied with the UNFSA guideline. When this limit point was breached, AFMA abandoned the reference point, and allowed fishing to continue (Nevill 2010 chapter 12) – in clear violation of its responsibilities under the UNFSA and the legal requirement to apply the precautionary principle.

In AFMA policy statements it is not uncommon to find endorsement of the precautionary principle (as perhaps should be expected, given the statutory background). However evidence, such as the South Tasman Rise example above, indicates that this commitment does not go beyond rhetoric. Another striking example of such evidence is provided by the following:

AFMA, in an accreditation report provided to the minister responsible for the *Environmental Protection and Biodiversity Conservation Act 1999* (AFMA 2002:184), in discussing setting orange roughy total allowable catch (TAC) limits, stated that:

> ..*"current TACs for the southern and eastern sectors are considered precautionary using the best available scientific advice and have a good chance of meeting the recovery strategy."*

The TACs referred to were 1600 tonne for the eastern stock and 420 tonne for the southern stock.

The relevant CSIRO stock assessment (Wayte & Bax 2002) had been commissioned by AFMA, and had recommended a total allowable catch of zero for the eastern stock and zero for the southern stock. The stock assessment report had also pointed out that there was no chance of either stock meeting the recovery strategy.

AFMA's statement, in a such critical document, is misleading. Other examples can be found showing AFMA made little or no attempt to apply the precautionary principle in operational management situations which, by law, required its application (Nevill 2010 chapters 11 & 12).

Destructive fishing practices in Australia

In 1995, on endorsement of the *FAO Code of Conduct for Responsible Fisheries*, Australia committed itself to phase out destructive fishing practices – although here no deadline was set. Many destructive fishing practices existed at that time within Australian jurisdictions – and today some of these practices continue under both Commonwealth and State regulation.

Australian fisheries management agencies were slow to take any action on the commitment. For example, after endorsing the Code of Conduct, no action was taken by any Australian agency to halt the practice of shark finning until 2000, and it was not until 2005 that this practice was prohibited within all Australian fisheries.

AFMA took no action until late 2006 to protect deepsea ecosystems from the effects of bottom trawling, other than the establishment of small exclusion areas, such as the Tasman Seamounts Reserve (1999), or the St Helens Hill exclusion zone. Even when a temporary ban on bottom trawling below 700 m was put in place, the orange roughy fishery (probably the most damaging fishery) was exempted. Orange roughy frequent deepsea coral habitats,

and the fishery for this species has a well-documented history of the destruction of corals and associated habitats (Gianni 2004, Koslow 2007, Nevill 2010 appendix 4).

In 2002, through the United Nations *Johannesburg Implementation Statement*, Australia committed itself to a deadline – 2012 – to phase out destructive fishing practices.

Destructive fishing practices which continue under regulation in Australia include (in my view):

1. Commercial fisheries with excessive bycatch, such as prawn trawling and gillnetting;
2. Bottom trawling over vulnerable habitats – a precautionary approach would see a blanket ban on bottom trawling except in areas which had been studied and assessed as suitable (following the European Union example);
3. Serial overfishing of stocks and substocks (Shaw 2008), with attendant ecosystem effects and likely lost of biodiversity at the genetic level (Allendorf et al. 2008, Hauser et al. 2002);
4. Beach seining – due to the high mortality rate of juveniles;
5. Recreational activities such as gillnetting (still permitted in Tasmania and WA) and spearfishing on SCUBA (still permitted in Victoria, WA and Tasmania) or spearfishing at night.

So far, no Australian fisheries management agency, State or Commonwealth, has prepared a policy or program to chart a course to meeting the 2012 phase-out deadline.

Forward planning is essential to provide a period of say 5 to 10 years over which commercial operations, now legitimately using certain destructive fishing practices, can be phased out without undue hardship to the fishers. Compensation packages will nevertheless remain necessary in some circumstances, and governments need to budget accordingly.

implementation problems: a summary:

The general conclusion of this discussion, based largely on limited case studies of Australian fisheries, is that progressive policies are in place, but effective implementation is not. Failure to implement core government policies may be widespread within natural resource management agencies, in Australia and world-wide. According to former US attorney Richard Sutherland:

> [M]y primary emotion when recalling the past 20 years of environmental law is one of profound disappointment. This disappointment is due to the continuing failure of federal agencies and officials to do a better job of implementing and enforcing our environmental laws… [G]overnment is all too often the environment's worst enemy. Agencies and officials charged with implementing and enforcing our environmental laws frequently fail to do so. They miss statutory deadlines, water down strict legal requirements, or simply refuse to use their enforcement powers, even when faced with blatant violations of the law… [T]he current situation, where laws are implemented, if at all, only half-heartedly… fosters cynicism and serves to undermine faith in our system of law.[1].

Acknowledging the dependence of some of my findings on limited case studies, I conclude, on the basis of the discussion above (with the support of the more detailed analysis in Nevill 2010) that:

1. The Commonwealth's strategic fishery accreditation program's integrity is seriously compromised on several fronts;
2. Fisheries management agencies generally display support for the precautionary principle in policies, but avoid applying it in practice; and
3. Destructive fishing practices in Australia are not being effectively addressed, in spite of an impending international phase-out deadline.

As and aside, similar problems of implementation failure may be found in completely different aspects of natural resource management in Australia: for example relating to freshwater protected area policy, where important commitments dating back 3 decades have not been implemented (Kingsford & Nevill 2006) and groundwater policy where important commitments made within the national water reform framework in 1996 had not been implemented by 2009 (Nevill 2010). The Commonwealth Government's recent draft national biodiversity strategy was constructed in a way which would make performance auditing impossible (Arthington et al. 2009).

An explanation of continuing fisheries management failures:

In my view these failures should not be unexpected from organizational cultures focussed on fishing, rather than on the protection and management of the ecosystems which produce the fish. Marine ecosystems also provide other important ecosystem services, but the protection of these services invariably falls outside the responsibility of government fishery management agencies.

The activities of fisheries management agencies get little real scrutiny from conservationists or fishers with a long-term perspective. Forests, for example, are much more visible, and damage easily recognisable, compared with habitats below the surface of the sea – and consequently attract the attention of conservation lobby groups. The case studies referred to above show a disregard of modern management approaches both in Commonwealth and State fisheries. Senior managers tend, perhaps, to see themselves as working for the fishers rather than the taxpayer. This 'client capture' of the agencies was reinforced a decade or so ago when fishers were asked to pay for management and research costs – substantial amounts of money.

Academic scientists tend to censor themselves. While the Fisheries Research and Development Corporation (FRDC) is not the only source of external funding for research scientists, it is a major player, handling over $24m in grants each year. Under FRDC guidelines, research grants go preferentially to scientists partnering with the fishing industry. While this makes sense in ensuring research has practical outcomes, it also puts pressure on scientists to suppress public criticism relating to the industry's environmental damage or lack of sustainability.

Organisational cultures are strongly influenced by the primary focus of the organization, and that focus is contained in the organization's name and its charter. The culture is also influenced by the disciplinary mix of the professional staff, as well as the extent to which the organizational culture has been 'captured' by its clients' interests. This last point is in turn influenced by the strength or weakness of senior management.

On the issue of organisational charter and name, consider the changes in statutory focus which took place over a century in Victoria, Australia. In 1890 the Victorian Parliament passed two new statutes, the *Game Act 1890* – to promote and manage the hunting of game, and the *Fisheries Act 1890* – to promote and manage fisheries. The Game Act underwent two major revisions, the last in 1958. During this period, commercial harvesting of game gradually disappeared (although small industries survive in other Australian States, for example relating to kangaroos and shearwaters). Seventeen years later, the *Game Act 1958* was replaced by the *Wildlife Act 1975,* with the new statute having a strong focus on wildlife conservation.

In the terrestrial environment, the initial focus on harvesting was transformed into a focus on conservation. This metamorphosis did not occur in the marine environment. The Victorian Fisheries Act again underwent two major revisions to1958, and thirty-seven years later the *Fisheries Act 1958* was replaced by the *Fisheries Act 1995.* Although the new Act acknowledged the need for sustainable harvests, the essential focus of the statute remained unchanged.

This metamorphosis which created such a change of attitude regarding land-based wildlife was also reflected in the way government departments were named over the decades. At the

close of the nineteenth century, the colonies of Victoria and South Australia each created a *Department of Fisheries and Game* to control and promote these activities. The Victorian Department, many decades later, was replaced by two departments: a *Department of National Parks and Wildlife,* and a *Department of Fisheries.* These departments, years later, were subsumed by the creation of larger departments – fisheries into the *Department of Primary Industries,* and wildlife into the *Department of Conservation, Forests and Lands,* which later became the current *Department of Sustainability and the Environment*. As an aside, the term 'wildlife' in Australia is almost never used in respect to aquatic fish or crustaceans, although they are 'life' and they are 'wild'.

Immediate action by fisheries management agencies: a personal view:

Looking past the management case studies which I examined, there are four important areas where day-to-day management is out of step with Australia's responsibilities under international agreements, especially the *Convention on Biological Diversity 1992* and the *Code of Conduct for Responsible Fisheries 1995*. Practices, and to some extent policies which are out-of-date (and which fly in the face of both the precautionary principle and the ecosystem approach) continue to be widely applied in both Commonwealth and State fisheries (and, incidentally, in many other nations around the world).

The first is to set annual catch limits, as was the practice decades ago, on the relative size (heath) of the fishable populations of the targeted fish species – essentially ignoring the ramifications of removing large numbers of that particular species from their ecosystem. This practice continues in spite of scientific advances in identifying the 'ecological risk' of different fisheries. My recommendation is that, where a fishery is identified as 'low ecological risk' catch limits should be set to aim to protect 75% of the spawning (adult) population from harvesting. This would leave the bulk of the population to fulfil its role in the ecosystem (and to ensure supply for next year's harvest). However, where a fishery is identified as 'high ecological risk' the aim should be to protect 90% of the spawning population from fishing pressure.

If this recommendation was followed, total catch levels (and thus total fisher income) would be reduced in the short term – however the reality is that current fishing levels generally speaking are far too high, and are both damaging marine ecosystems and placing the long-term livelihood of fishers at risk - witness the current difficulties of the Western Rock Lobster fishery in Western Australia (Nevill 2010 chapter 14). With appropriate industry restructure (under government assistance) individual fisher income need not decline. However in the medium to long term, when populations rebuild, a small number of fishers would be able to gradually increase their harvests on the strength of healthy marine ecosystems. The final outcome would be fewer fishers earning more, with more income stability. That's win-win in the long term, provided political strength to overcome the short term financial impacts.

The second point relates to bottom trawling. Dragging a trawl across a deep sea coral habitat can destroy an intricate, beautiful and complex ecosystem which has taken a thousand years to develop (Nevill 2010 appendix 4). There are shallow-water habitats, such as sponge gardens, seagrass and non-reef coral, which are also highly vulnerable to trawl damage. Yet there are many areas where bottom habitats are not particularly vulnerable, and recover quickly. A true precautionary approach would be to prohibit *all* bottom trawling *except* where studies have mapped areas resilient to trawl damage. This approach is already used in parts of the European Union, and closer to home is used by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) in its management of southern ocean fisheries. Immediate action is required by Australian fisheries management agencies to phase-in this approach.

Third, Australia, in endorsing the outcomes statement from the *United Nations World Summit on Sustainable Development* (Johannesburg 2002) made a commitment to phase out destructive fishing practices by 2012. However no Australian fisheries agency has addressed the issue. When queried, agency staff state that destructive practices have already been phased out – a blank statement without justification. Around Australia trawl and gillnet fisheries continue to kill huge quantities of bycatch and discards – including some extremely vulnerable animals – such as sawfish, sharks, rays, seabirds and turtles. Breeding

aggregations continue to be targeted, including vulnerable species such as swordfish and orange roughy. Beach seining continues to kill large numbers of juvenile fish. Spearfishing on SCUBA (except in New South Wales and Queensland) and night spearfishing are still permitted, in the face of massive destruction of vulnerable shallow-reef populations by recreational fishing (Nevill 2010 appendix 6). This situation indicates a cavalier regard for both Australia's international obligations, as well as simple common sense. A national approach to the phase-out of destructive fishing practices from Australian waters is required, and this should be coordinated by the Commonwealth Department of Agriculture, Fisheries and Forestry (DAFF).

Fourth, Australia's annual 'status reports' use the outdated MSY/MEY single-stock-based definition of overfishing – flying in the face of both precaution and ecosystem protection (MEY is 'maximum economic yield'). If managers are really committed to the protection of ecosystems, then the definition of overfishing *must* reflect the impact of the fishery on the ecosystem. In my view, overfishing should be assessed against the ecological risk of the fishery, with initial benchmarks based on the reference points which I suggest above. As we gain a better understanding of the effects of fisheries on ecosystems, and as better data becomes available, this simple approach should be complemented by a small suite of 'overfishing' benchmarks which take account of impacts on the age structures of impacted populations, habitat condition (especially where affected by bottom trawling), and evolutionary impacts on heavily fished populations (Francis et al. (2007). Again, a national approach to developing a new definition of 'overfishing' (along with associated reference points and benchmarks) should be the responsibility of the Commonwealth Department of Agriculture, Fisheries and Forestry.

Conclusion

The concerns I have expressed above are shared by many within the marine science community. The coming decades may see changes in line with Earle & Laffoley's (2006) call that "we must place biodiversity conservation at the center of ocean governance". The work of Pitcher & Pauly (2001) support this call in arguing that the proper goal for fisheries management should not be catch optimisation or sustainable harvests, but ecosystem rebuilding. Mangel & Levin (2005) recommend that community ecology should be the basic science for fisheries.

Pikitch et al. (2004) recommend that "the framework of fishery management must be broadened to include environmental effects, food web interactions and the impacts of fishing on ecosystems". Worm et al. (2007) emphasize "that the protection and restoration of biodiversity must be a cornerstone of any rational management regime." Walker & Salt (2006) argue that protecting ecosystem resilience should be the primary goal of natural resource management.

The conclusion I reach is that fisheries management agencies need to be replaced with asset management agencies, focused on the protection of marine biodiversity assets – and the maintenance of the ecosystem services which they produce – not least of which, of course, is the production of food. While acknowledging that marine biodiversity assets are affected by human activities well outside the purview of today's fishery management agencies, the development of such asset management agencies would be totally in line with emerging concepts of integrated coastal management.

The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) provides a model for the metamorphosis I recommend here.

Although the concept of ecosystem management has been under discussion for the best part of a century (Nevill 2010 chapter 8), in many ways the birthplace of the concept as applied to the marine environment lies with the creation of CCAMLR. The concept of ecosystem based management appeared for the first time in a major international agreement in 1980. The *Convention on the Conservation of Antarctic Marine Living Resources 1980* Article II(3) defined three "principles of conservation", of which the second and third principles identify the need for harvesting management to (a) protect entire ecosystems, and (b) take a cautious approach to ecological risk, particularly with regard to 'irreversible' effects.

The boundaries of the Convention were – appropriately – defined by the approximate location of the Antarctic Polar Front (the Antarctic Convergence) which provides a rough natural boundary for the Antarctic large marine ecosystem. CCAMLR and its activities are discussed in more detail in Nevill (2010 chapter 10).

The Commission has devoted much time and effort into applying the precautionary and ecosystem approaches, and has been widely recognised as a global leader in sustainable fisheries (Mooney-Seus & Rosenberg 2007a, 2007b; FAO 2005). My study of a fishery managed by CCAMLR stands in marked contrast to the studies of other Australian fisheries (Nevill 2010 chapter 10). In my mind the essential differences driving the success of CCAMLR (compared to the failures of traditional fisheries management agencies) is the organisation's charter for ecosystem protection. If Australia, and the world, are to achieve true sustainability in fisheries management, it is essential to change the focus of fisheries management agencies from stock management to ecosystem protection.

Peer review and acknowledgements:

This chapter was reviewed by Dr Alan Lymbery (Murdoch University) to whom I owe thanks for critical comment and constructive suggestions. The views expressed in this chapter are sometimes controversial, and remain my own.

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Endnotes:

[1] Richard Sutherland was an environmental attorney and head of the Sierra Club Legal Defense Fund. Quoted in Chasan (2000).