

Ecosystem-based fisheries management: An Australian perspective

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Abstract – The terms ‘ecosystem-based fisheries management’, ‘ecosystem-based management’ and ‘ecosystem approach to fisheries’ have recently entered the vernacular of fisheries management. Examination of contemporary guidelines and proposals for such an approach illustrates that ecosystem-based fisheries management is, for all intents and purposes, a re-expression of the objectives and processes associated with ecologically sustainable development (and associated international instruments). Since the early 1990’s, all levels of government in Australia have committed themselves to the concept of ecologically sustainable development, and a complex network of policies and laws exist to support this, particularly in natural resource management. One significant outcome of these instruments is the application of environmental impact assessment to the management of fisheries. This has forced extensive deliberation of the ecological impact of fisheries and stimulated the development and application of new research tools. Application of environmental impact assessment to the management of fisheries has been a crucial step for the implementation of ecosystem-based fisheries management in Australia. These assessments are embedded within a range of legal and policy instruments that capture the ecological, economic and social dimensions of fisheries. The scientific challenges associated with many aspects of ecosystem-based fisheries management are very significant, but it is likely that the value-based nature of the underlying environmental issues will continue to dominate the managerial agenda.

Key words: Ecosystem-based management / Fisheries / Australia

Résumé – **Gestion des pêches basée sur les écosystèmes : une perspective australienne.** Les termes « gestion des pêches basée sur l'écosystème », « gestion basée sur l'écosystème » et « l'approche écosystémique des pêches » ont récemment été inclus dans les mots vernaculaires de la gestion des pêches. L'examen des propositions, et des guides actuels pour une telle approche, illustre que la gestion des pêches basée sur l'écosystème est, en toute occasion, une re-expression des objectifs et processus associés au développement écologiquement durable (et aux outils internationaux associés). Depuis le début des années 1990, tous les niveaux de gouvernement en Australie se sont engagés sur le concept du développement écologiquement durable, et un réseau complexe de politiques et de lois existent pour venir à l'appui de cela, particulièrement dans la gestion des ressources naturelles. Un résultat significatif de ces instruments est l'application de l'évaluation de l'impact environnemental, à la gestion des pêches. Ceci a imposé de vastes délibérations sur l'impact écologique des pêches, et stimulé le développement et l'application de nouveaux outils de recherche. L'application de l'évaluation de l'impact environnemental à la gestion des pêches a été une étape cruciale, pour la mise en œuvre de la gestion des pêches basée sur l'écosystème en Australie. Ces évaluations sont, cependant, incluses dans une série d'instruments législatifs et politiques qui englobent les dimensions écologiques, économiques et sociales des pêches. Les défis scientifiques, associés à de nombreux aspects de la gestion des pêches basée sur l'écosystème, sont très significatifs mais il est probable que l'aspect économique, sous-jacent aux questions environnementales, continuera de dominer l'ordre du jour des gestionnaires.

1 Introduction

1.1 Background

Use of the expressions “ecosystem-based management” (EBM) and “ecosystem-based fisheries management” (EBFM) has gathered momentum in recent years. This paper gives a

brief background to the application of these terms and their international and national contexts. It will be argued that, for all intents and purposes, ecosystem-based management is simply a re-expression of the processes and operational mechanisms already developed for the paradigm of (ecologically) sustainable development. Given that ecologically sustainable development is already embedded within the policies, statutes and regulations of all Australian jurisdictions, it is likely that existing legal and policy instruments such as environmental

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assessment will become the key drivers towards the implementation of ecosystem-based fisheries management in Australia. As the procedural requirements of environmental assessment become finalised in all Australian jurisdictions, it is helpful to reflect upon the challenges met and difficulties that lie ahead for ecosystem-based fisheries management. Although this paper gives an international and national context for EBM, this paper focuses upon the unique circumstances of New South Wales (NSW), where environmental assessment of fisheries was required under both Commonwealth and State law.

1.2 Terminology

In 2001, the United Nations Food and Agriculture Organization (FAO) prepared a background paper “Towards Ecosystem-Based Fisheries Management” (FAO 2001) for the Reykjavik Conference on Responsible Fisheries in the Marine Ecosystem (this paper is also available as FAO 2003b). The essential messages of this paper are captured as the 2001 Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem. The paper outlined an agenda for fisheries management that recognises the broader context of fisheries – including the roles of non-target species as well as human behaviour. FAO stated that EBFM “... is not discussing a new concept, rather it is revisiting and re-emphasizing principles and needs that have long been recognized...”. The authors of the background paper made it clear that the principles of EBFM had already been included in the FAO Code of Conduct for Responsible Fisheries (1995). Furthermore, many of these principles had direct linkages back to sustainable development. Examples of these are discussed below.

Following up on this initial background paper, the FAO published operational guidelines for the “Ecosystem Approach to Fisheries” (EAF) (FAO 2003a). In this they defined EAF as “... a way to implement many of the provisions of the [FAO] Code [of Conduct for Responsible Fisheries] and achieve sustainable development in a fisheries context” (FAO 2003a, p. v). This recent FAO document represents a current international consensus on exactly what is EBFM and how it might be achieved.

The FAO booklet provides guidance on how to translate the economic, social and ecological policy goals and aspirations of sustainable development into operational objectives, indicators and performance measures. Such developments are not seen as a replacement for, but rather an extension of, current fisheries management practices that need to be broadened to take into account the biotic, abiotic and human components of ecosystems in which fisheries operate.

The following principles of EBFM are provided (FAO 2003a, p. 15): fisheries should be managed to limit impacts on the ecosystem to the extent possible; ecological relationships between harvested, dependent and associated species should be maintained; management should involve cross-jurisdictional arrangements if required; a precautionary approach should be adopted; and governance arrangements should ensure human and ecosystem well being and equity.

A year prior to the publication of the FAO document, the World Wide Fund for Nature published a non-government organization’s perspective on ecosystem-based management

(Ward et al. 2002). This document also focused upon the operational aspects of EBM but identified the following elements. EBM should: maintain natural structure and function of ecosystems; recognise that human uses and values are central to ecosystem management; base management upon a shared vision of stakeholders; appreciate that ecosystems are dynamic; and, require a commitment to performance monitoring and management.

Importantly, Ward et al. (2002) recognised that social and economic aspects form part of the ecosystems in which fisheries are embedded, and that human uses and values drive the management process. They noted that conservation of the entire system was required, not just individual stocks of target species but also the associated species and their relationships, habitats and ecological processes. The authors emphasised the importance of performance monitoring and suggested that management should be adaptive.

The phrase “ecosystem management” is not new. Lackey (1998b) wrote a critique of the concept and cross-referenced definitions from the early 1990’s, and noted (at p. 23). “These definitions have an unmistakable similarity to traditional definitions of fisheries management, wildlife management, and forest management”. The combination of the words may be new but the definition and interpretation have been around for a long time. The acronyms EBM, EBFM and EAF represent the same essential concept; therefore to simplify this manuscript only “EBFM” will be used.

The parallels between EBFM with sustainable development were recently noted by Garcia (2005) who commented (at p. 189). “The operational framework for EBFM is practically identical to the sustainability indicators’ framework, both from a scientific and decision-making point of view”. This manuscript also outlined important relationships between scientists and managers and used these relationships to illuminate essential issues in contemporary fisheries management.

There are two fundamental aspects of EBFM that will be repeatedly considered in this paper. Firstly, EBFM must include a reference to the management of human activities that have the potential to affect ecosystems, habitats or non-target species. There must be a sense that the management is oriented towards the biophysical systems that underlie fisheries. Management must recognise the uses and values of these systems that are beyond those associated with the harvesting of fish. Secondly, EBFM is a humanistic paradigm. Fisheries management is about people. Policies of EBFM recognise the human role in ecosystems and the human values associated with ecosystems. They have particular regard to equity issues, the rule of law, the rights and obligations of stakeholders and the community at large.

Given the historical legacy of EBFM within international conventions (discussed below) it is not surprising that the essence of EBFM already exists in laws of the Australian Commonwealth and States. This paper will review these instruments with the aim of illustrating what aspects of EBFM already exist in Australia and identifying and attempting to explain the gaps. Before examining the legal and policy frameworks that exist internationally, nationally and in NSW, it is valuable to reiterate that the implementation of

environmental policy is far more difficult and costly than it often initially appears.

Australia has always had quite progressive environmental laws but governments have been, and will always be, challenged to balance private and public interests in complex natural resource management issues (Bonyhady 2002). Progress towards EBFM will be no exception.

2 International environmental instruments

2.1 Background

It is not the purpose of this section to recapitulate international environmental instruments relevant to EBFM, but merely to illustrate that many of the themes of EBFM already exist within international environmental laws ratified by Australia. Such instruments have a very influential role upon domestic law because ratification of international conventions places an obligation on the nation to pass relevant legislation or otherwise conform with these agreements. In many cases, national environmental policies are in step with, or precede, international laws. This short discussion is not exhaustive. Other, more detailed reviews, have been prepared by Turrell (2004), Aqorau (2003) and Cochrane and Doullman (2005).

2.2 UNCLOS

The United Nations Convention on the Law of the Sea 1982 (UNCLOS) was ratified by Australia in October 1994. UNCLOS articulates the rights and duties of nation states with respect to the seas and oceans. Although the convention does not mention EBFM explicitly, several of the articles either have the same intent as EBFM or were directly responsible for future multilateral agreements that have adopted EBFM (see below). Within Part VII, Article 119 (1)(b) states that [fisheries management of States should] "... take into consideration the effects on species associated with or dependent upon harvested species with a view to maintaining or restoring populations of such associated or dependent species...". This is a clear reference to the management of unharvested species. Similar provisions for fisheries operating within exclusive economic zones are made in Part V within Article 61 (4). The only use of the words "ecosystem" or "habitat" is within Article 194 (5), associated with marine pollution, which indicates that states should take the measures necessary to "... protect and preserve rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other forms of marine life".

2.3 The Rio Declaration on Environment and Development

The Rio Declaration on Environment and Development (1992), or Agenda 21, is a key outcome of the UN Conference on Environment and Development. The Declaration contains a series of twenty-seven soft law principles that are at their core, anthropocentric and humanistic and not eco-centric (see Dryzek 1997, p. 157). For example, Principle 1 states "Human

beings are at the centre of concerns for sustainable development". Indeed at least two thirds of the principles are associated with socio-economic and development issues rather than the environment *per se*. The word "ecosystem" only appears in Principle 7, which asserts that "States shall cooperate... to conserve, protect and restore the health and integrity of the Earth's ecosystem". In contrast, there are far more explicit principles recommending the: enactment of effective environmental legislation (Principle 11); adoption of the precautionary principle (Principle 15); internalisation of environmental costs (Principle 16); and, use of environmental impact assessment (Principle 17). Perhaps the most crucial theme of the Rio Declaration is the binding of socio-economic and environmental concerns, captured so clearly in Principle 4: "In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it". This integration was re-affirmed during the World Summit on Sustainable Development in Johannesburg in 2002.

2.4 United Nations Convention on Biological Diversity

The UN Convention on Biological Diversity (CBD) was developed as a specific and practical instrument to implement the principles of Agenda 21. The Convention clearly acknowledges the critical role of ecosystems (defined in Article 2) in biodiversity conservation, particularly with regard to in-situ conservation (Article 8). Article 8 identifies the need for: protected areas (8(a)); compatibility between conservation and sustainable use of components (8(i)); legislation and regulatory provisions for threatened species (8(k)); regulation and management of processes that adversely affect biodiversity (8(l)). Article 10(a) suggests that States "Integrate consideration of the conservation and sustainable use of biological resources into national decision-making", a provision that is supported by other articles associated with research and training (Article 12), public education and awareness (Article 13), impact assessment (Article 14), technical and scientific cooperation (Article 18), and settlement of disputes (Article 27). Turrell (2004) pointed out the phrase "ecosystem approach" was first used in Decision II/8 of the Conference of the Parties (1995 Jakarta) where it was stated that "... the ecosystem approach should be the primary framework of action to be taken under the Convention [on Biological Diversity]".

The Convention is a carefully worded document that integrates the socio-economic values associated with biological diversity with the underlying biological and ecological systems that have created that diversity. Article 7 contains suggestions for the "Identification and Monitoring" of various aspect of biological diversity (including impacts on that diversity, of which fishing could be included) but does not allude to the technical difficulties of such a task. Such monitoring systems are clearly consistent with the performance management systems required within EBFM. As noted below, legislation from the Commonwealth of Australia such as the *Environment Protection and Biodiversity Conservation Act 1999* was enacted as part of Australia's ratification of the Convention. This Act has had significant consequences for fisheries management in Australia.

2.5 FAO Code of Conduct for Responsible Fisheries

The UN Food and Agriculture Organization (FAO) Code of Conduct for Responsible Fisheries (1995) is “soft” international law (or voluntary guidelines) that outlines the principles and operational procedures for sustainable fisheries. Article 2(a) states that the objective of the code is to “establish principles ... for responsible fishing and fisheries activities, taking into account all their relevant biological, technological, economic, social, environmental and commercial aspects”. The Code immediately recognises the importance of aquatic ecosystems in Article 6.1: “States and users of living aquatic resources should conserve aquatic ecosystems”, Article 6.2: “Management measures should not only ensure the conservation of target species but also of species belonging to the same ecosystem or associated with or dependent upon the target species” and 6.8: “All critical fisheries habitats in marine and fresh water ecosystems, such as wetlands, mangroves, reefs, lagoons, nursery and spawning areas, should be protected ...”. Suggestions for fisheries management include appropriate legislative instruments (7.1.1), consultation (7.1.2), compliance (7.1.7), data gathering and management advice (7.4) and adoption of the precautionary approach (7.5). Article 10 recommends mechanisms to integrate fisheries management with coastal area management.

2.6 The UN Fish Stocks Agreement ¹

Although the jurisdictional scope of the UN Fish Stocks Agreement is beyond NSW, the agreement has direct relevance for Commonwealth fisheries and provides essential guidelines for State fisheries management. The Agreement is an extension to, what some considered as, the relatively weak provisions for fisheries within UNCLOS (see Nelson 1999). As expected, the Agreement reflects the increasing emphases on aquatic ecosystems in the preamble “Conscious of the need to avoid adverse impacts on the marine environment, preserve biodiversity, maintain the integrity of marine ecosystems...”, and continues to underline the integration of socio-economic processes and the development of effective managerial institutions. Interestingly, Article 5(d) includes the principle of environmental assessment, i.e., “assess the impacts of fishing, other human activities and environmental factors on target stocks and species belonging to the same ecosystem or associated with or dependent upon the target stocks”.

2.7 Regional fisheries organizations

Part III of the UN Fish Stocks Agreement describes the potential role of regional fisheries management organizations or arrangements for management of shared and straddling fish stocks. One such arrangement in which Australia is a key player is the Convention on the Conservation of Antarctic

Marine Living Resources (CCAMLR 1982), which is the international institution responsible for fisheries management in Antarctic waters. Article II(3)(b) of the Convention states that the Commission for CCAMLR is to adopt the following principle of conservation “maintenance of the ecological relationships between harvested, dependent and related populations of Antarctic marine living resources”. This was a far-sighted provision that pre-dated the wider adoption of “ecosystem-based fisheries management” (also see Constable et al. 2000).

There are many other regional fisheries organizations or agreements to which Australia is a member of, or party to, including the Indian Ocean Tuna Commission and the Commission for the Conservation of Southern Bluefin Tuna, but it is beyond the scope of this paper to consider these. Such arrangements now include at least some recognition of the elements of EBFM. Interested readers should consult Aqorau (2003) for a more extensive consideration of international environmental instruments and their relationship to EBFM.

3 Commonwealth policy and law

3.1 (Ecologically) Sustainable Development

In the early 1980’s, under the then Prime Minister Bob Hawke, Australia was at the forefront of developing policies for “ecologically sustainable development” (ESD). The impetus for this work was the publication of the Report of the World Commission on Environment and Development (or the Brundtland Report, World Commission on Environment and Development, 1987) which, in essence, argued that societal demands for environmental protection and economic development could be reconciled. Much of this policy development occurred through the ESD working groups (including one for fisheries, Anon. 1991). The continued development of policies for the ESD of fisheries was evident by the early 1990’s with a wide range of scientists, principally in government departments and universities undertaking various projects on frameworks and tools to assess ESD. Although the phrase “sustainable development” (SD) was defined and used within the Brundtland Report and Agenda 21, Australia adopted the phrase ESD to emphasize the role of ecological systems within sustainable development.

The Australian National Strategy for Ecologically Sustainable Development was developed and enacted in 1992 (the same year as the Rio Conference). Associated with this strategy was the Intergovernmental Agreement on the Environment (IGAE 1992) that contained national principles of environmental policy including the four principles of ESD (the precautionary principle; intergenerational equity; conservation of biological diversity and ecological integrity; and improved valuation, pricing and incentive mechanisms). ESD was accepted as the basis of natural resource management in Australia and is explicitly or implicitly an objective of State and Commonwealth natural resource agencies. The IGAE is fundamental to understanding ESD (and EBFM) in Australia and there is an explicit recognition that ESD (3.2) “... requires the effective integration of economic and environmental considerations in decision-making processes, in order to improve community well-being and benefit future generations”.

¹ The full title is the “Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the conservation and management of straddling fish stocks and highly migratory fish stocks”.

Consistent with international agreements, ESD in Australia is a humanistic and fundamentally anthropocentric framework.

Given Australia's commitment to, and investment in, ESD (and there is much more to come) it is not surprising that policymakers were quick to note the similarities between ESD and EBFM. The Australian Fisheries Management Forum (AFMF), a consultative group used to co-ordinate national fisheries policy, has recently considered the relationship between EBFM and ESD. In a submission from the AFMF Research Committee, it was noted that "The elements of EBFM are contained within Australia's ESD framework, and so thorough application of that framework would achieve both ecosystem-based management and ESD" (in Smith et al. 2004, p. 9). This comment reflected the earlier remarks by Fletcher (2001, p. 34) who noted that EBFM was a subset of ESD. More recently, Fletcher (2005) suggested that EBFM is the mechanism to implement ESD (in the context of fisheries). In Australia it appears that these terms are, for all intents and purposes, synonymous.

Amendments to Commonwealth legislation accelerated the development and application of the National ESD Reporting Framework, as discussed below.

3.2 Environment Protection and Biodiversity Conservation Act

The Commonwealth *Environment Protection and Biodiversity Conservation Act* (EPBC Act) was introduced in 1999. The Act has, as one of its objects, promotion of ecologically sustainable development through the conservation and ecologically sustainable use of natural resources (Section (s) 3 – Objects of the Act), and thus reflects the ecosystem orientation to natural resource management. In general, the EPBC Act makes it an offence for a person to undertake an action that has the potential to impact significantly on a matter of "national environmental significance", without first obtaining a permit from the Commonwealth Minister for Environment and Heritage. Relevant matters of national environmental significance include: declared World Heritage areas (e.g. the Great Barrier Reef); listed threatened species and ecological communities (discussed below); listed marine species (also discussed below) and the environment of Commonwealth marine areas.

Parts of the Act that relate specifically to fisheries include: the strategic assessment of Commonwealth managed fisheries under Part 10 of the EPBC Act; assessments relating to impacts on protected marine species under Part 13 of the Act; and, assessments for the purpose of export approval under Part 13A of the Act.

Strategic assessment of Commonwealth fisheries is carried out under a set of guidelines ("Guidelines for the Ecologically Sustainable Management of Fisheries") prepared by the Commonwealth Department of the Environment and Heritage. Principle 2 of these guidelines concisely state a goal of EBFM: "Fishing operations should be managed to minimise their impact on the structure, productivity, function and biological diversity of the ecosystem". To achieve this goal, strategies are assessed to ensure that they provide for: fishing in a manner that does not threaten bycatch species, avoiding mortality or injury of threatened species and minimising impacts

on threatened ecological communities and fishing in a manner that minimises impacts on the ecosystem generally (including ecological communities, food chains and the physical environment).

Marine species protected under s 13 of the Act include listed threatened species (Division 1), all cetacean (Division 3) and listed marine species (essentially marine birds, reptiles, mammals, syngnathids and solenostomids, Division 4). Threatened ecological communities are also protected under Division 1. While the relevant parts of the Act do not specifically refer to the protection of ecosystems, the protection of marine species may contribute to the goals of EBFM if they are impacted by fishing. For example, several marine turtles are listed as threatened species, and as a result fishing gears have been modified to reduce impact on these species (Robins et al. 1999).

Amendments to the EPBC Act in January 2002 (incorporating provisions from the *Wildlife Protection (Regulation of Exports and Imports) Act* 1982) require that all wildlife trade operations (including export of fish) obtain an export permit. Australian fisheries that require an export permit for harvested species were required to undergo an environmental assessment by December 2005. Fisheries that fail to be assessed as "demonstrably sustainable" by that date may not be able to export their product. The new Part 13A of the EPBC Act regulates export control for marine species. Export approval requires the minister to be satisfied that the fishing operation will not be detrimental to the taxon's survival or conservation status, nor must it threaten any relevant ecosystem (including habitats and biodiversity). Furthermore, the minister must have regard to: "(a) the significance of the impact of the operation on an ecosystem (for example, an impact on habitat or biodiversity); and (b) the effectiveness of the management arrangements for the operation (including monitoring procedures)" (s 303FN).

Public consultation in fisheries management is required under s 146 (for strategic assessment of Commonwealth fisheries) and s 303FR (public consultation), and the Minister is required to take into account any comments received before making a declaration. Given the consideration of ecosystem-level impacts, incorporation of ESD principles and public consultation, the assessment of fisheries under the EPBC Act is consistent with the aims and principles of EBFM.

3.3 National ESD Reporting Framework

To meet the requirements of ESD as required under the EPBC Act and a range of other fisheries legislation, an ESD reporting framework for Australian Fisheries has been developed (Fletcher et al. 2003). The aim of these guidelines is to provide uniformity in the implementation and assessment of ESD for fisheries at state and national levels. Under the framework, ESD (defined as "Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased") is divided into several sub-components that are grouped according to their contribution to ecological wellbeing (retained species, non-retained species, general ecosystem), human wellbeing (Indigenous wellbeing, local and regional wellbeing) and national social and economic

wellbeing and ability to achieve these outcomes (governance, external drivers).

Subcomponents are further divided, and a risk assessment is performed for each of the lowest level subcomponents. If the risk warrants it, a performance report is prepared for the subcomponent with appropriate objectives, indicators and a statement of the acceptable limits of performance, along with the management actions required to achieve that performance.

Subcomponents that may be considered under the heading of General Ecosystem include: impacts on the biological community (trophic structure), air quality, water quality and substratum (habitat) quality (Fletcher et al. 2003; Fletcher et al. 2005). The framework in its present form lacks detail on appropriate ways to measure these components or assess their performance, and does not specifically address ecosystem structure and function. However, it should be noted that risk assessment and reporting is not restricted to the components listed above; these are simply guidelines that may be adapted by users for different situations. Further development of these guidelines is expected to occur (Fletcher et al. 2003; Fletcher et al. 2005).

In general the guidelines are consistent with the principles of EBFM, and provide an overarching framework for assessment. Progressive use and refinement of the guidelines will undoubtedly provide more specific detail about appropriate performance measures. These guidelines have been used in recent assessments of commercial fisheries in NSW, with slight modifications (see below).

Fletcher (2005) described a hierarchy of concepts in which fishery ESD reporting (as under the National ESD Reporting Framework) is a subset of EBFM. In this scheme, EBFM would involve the assessment and management of all fisheries (commercial and non-commercial) and no-take uses within a designated area, effectively incorporating ESD reports for all fisheries and considering their cumulative effects. The hierarchical scheme provided by Fletcher (2005) also suggested that EBFM was nested within EBM, which was nested in Integrated Oceans Management, which was in turn, nested within ESD. Integrated oceans management is a framework being adopted within Australia's Oceans Policy (see below). Whilst the logical elegance of this hierarchy is to be welcomed, it is unlikely that the authors and editors of numerous policy and scientific documents will be disciplined enough to conform to this terminology when real-world examples are described. The concepts simply have too many interdependencies.

3.4 Australia's Oceans Policy

A major initiative in the 1990's has been the development of Australia's National Oceans Policy (Commonwealth of Australia, 1998). Based on ESD principles, this provided, for the first time, an integrated framework for ecosystem-based planning and management of Australia's exclusive economic zone (EEZ), to be implemented through a regional planning process. The policy embraces the ecosystem approach, and the principles and terminology used to describe this approach are broadly consistent with those presented by World Wide Fund for Nature and the FAO. Fishing is only one of a broad range of human uses of the ocean covered under this policy.

The original policy stated (Vol. 1, p. 10) that "Ecosystem-based oceans planning and management aims to ensure the maintenance of: ecological processes in all ocean areas, including, for example, water and nutrient flows, community structures and food webs, and ecosystem links; marine biological diversity, including the capacity for evolutionary change; and, viable populations of all native marine species in functioning biological communities". A series of regional marine plans are being prepared, the first completed being the South-east Regional Marine Plan (Anon. 2004). The final plan identifies ecosystem-based management as the paradigm that will be used for Australia's EEZ and outlines the necessary steps to implement such a system. Development of the plan included extensive consultation with stakeholders.

The plan indicates a clear commitment to Integrated Oceans Management which "is an approach that recognises that planning and management need to be integrated across sectoral agencies and spheres of government to satisfy the social, economic and ecological objectives of ESD" (Anon. 2004, p. 91). This approach is consistent with the Canadian concept of "integrated management" which is an initiative resulting from Canada's *Oceans Act* (1997). O'Boyle et al. (2005) described a pilot project ESSIM (Eastern Scotian Shelf Integrated Management) which has important parallels with developments in Australia. These include the use of inclusive and hierarchical planning processes to identify objectives, and a commitment to the use of indicators and reference points for performance management. Both of these approaches are features of the National ESD Reporting Framework and the implementation of Australia's Oceans Policy.

Ocean's Policy sets a broad framework for all human activities related to the ocean. With regard to fisheries, the policy provides for impact assessment of Commonwealth fisheries (Vol. 2 p. 10, also see the section on the EPBC Act above), and promotes a range of sustainable fisheries practices including the development of a Commonwealth Bycatch Policy and bycatch action plans for specific fisheries. Also included in the initial plan are steps towards networks of marine parks, improvements to spatial fisheries management, cumulative impact assessment, cross-jurisdictional management and monitoring methods and systems of indicators for monitoring the health of ecosystems (p. 32). The regional marine planning process undertaken by the National Ocean's Office has been an important step towards the ESD of Australia's oceans with a solid commitment to ecosystem-based management. Implementation of the plans, like much environmental policy, will be much more controversial and costly.

4 NSW policy and law

4.1 Background

NSW was one of the first Australian jurisdictions to adopt environmental impact assessment. This approach was codified within the *Environmental Planning and Assessment Act* (1979) (EPA Act) whose principal aim was to provide an improved policy foundation for the development of controls used to regulate the use of land (Thomas 2001). Part 5 of the Act included a general "catch-all" for the assessment of both private and

public projects that may cause significant environmental impact. Key features of the Act are the general definitions of “an activity” which could be subject to provisions within the Act, and open standing provisions that enable any citizen to initiate judicial review of possible breaches of the Act (even by government agencies). Such attributes of the Act enabled legal action that resulted in significant changes to the management of fisheries in NSW, changes consistent with the principles of EBFM.

Examination of the legislative and policy frameworks in NSW will illustrate two important aspects of EBFM in Australia. Firstly, that consideration of the ecological impacts of human activity is extensively provided for in various environmental policies and laws. Secondly, that the social or human side of environmental management is more often associated with rights given to citizens for consultation and legal appeal, rather than “indicators” or other technical approaches.

4.2 Sustainable Fisheries & Tourism Inc. v NSW Minister for Fisheries and another

In 1999, Sustainable Fishing and Tourism Inc. initiated proceedings of judicial review against the NSW Minister for Fisheries (and another) in the NSW Land and Environment Court (106 LGERA 322). The court found that the EPA Act applied also to fisheries and, in essence, an environmental impact statement was required for the issue and renewal of a commercial fishing license in NSW.

After consultation with stakeholders and some deliberation by government, various amendments to both the EPA Act and the *Fisheries Management Act* 1994 (FM Act) were undertaken. Division 5 of Part 5 of the EPA Act now includes provisions for the environmental assessment of fishing activities in NSW. This amendment modifies the environmental assessment regime in the Act, which was designed for land use based assessments, to fit a fisheries context. The changes account for the fact that fisheries are existing and ongoing activities as opposed to new, one-off developments such as buildings or marinas. Of particular note are the: requirement for an environmental impact statement (s 115K); publicity and examination processes for the environmental impact statements (s 115L); parameters for public inquiries (s 115M); provisions relating to threatened species (s 115N); and processes of determination with respect to environmental assessment (s 115O).

Amendments to the FM Act were also made. Part 1A was included to specify the content and purpose of a “fishery management strategy”. These documents are to: describe the fishing activity to be assessed; incorporate any management plans for the fishery; outline regulatory controls to be applied; outline interactions with other fisheries; describe monitoring strategies; and, specify review strategies. Of particular note is clause 7E (e) “include performance indicators to monitor whether the objectives of the strategy (and the management plan) and ecologically sustainable development are being attained”.

The framework with which environmental assessment occurs is described in s 7D (1). “The draft [fishery management] strategy is the basis for environmental assessment under Division 5 of Part 5 of the EPA Act of that activity”. Although

this process is never actually described as strategic environmental assessment in the FM Act or EPA Act, it is clearly assessment of a policy, plan or program, rather than of a particular project (also see Marsden 2002).

The Director-General of Planning NSW issued guidelines for the Environmental impact statement under clause 230 (1) (a) of the *Environmental Planning and Assessment Regulation* 2000. Rather than duplicate the assessment efforts already underway because of the statutory requirements of the Commonwealth, the guidelines from Planning NSW include relevant matters to meet the Commonwealth Benchmarks and Terms of Reference for Environmental Assessment of Fisheries and satisfy Guidelines for the Ecologically Sustainable Management of Fisheries for the purposes of EPBC Act 1999.

4.3 Strategic environmental assessment in NSW

To achieve the post January 2000 statutory requirements of NSW State and Commonwealth legislation, the NSW Department of Primary Industries (formerly NSW Fisheries) is developing a fishery management strategy (FMS) for each major fishing activity. These strategies outline the management goals, objectives, controls and other measures for achieving the objectives, as well as describing performance indicators and monitoring programs that will apply to a particular fishing activity. The FMS contains the “management tools” applying to the fishery, as well as data collection protocols and triggers for the review of the strategy. In NSW, ESD is considered the goal or the “What” and EBFM is the means of achieving ESD in fisheries or the “How”. The NSW framework integrates and develops from the national fisheries ESD research of the 1980’s and 1990’s.

The environmental impact assessment of each fishery is an important tool to assess the current activity and highlight those aspects that need to be addressed in the FMS. It details likely impacts and allows for the consideration of alternative management and mitigation measures when formulating management strategies to ensure, *inter alia*, conservation of coastal biodiversity and ecological processes. The environmental assessment enables the community to review and contribute to the proposed strategy and management regimes. It also informs decision makers of the likely costs and benefits of the strategy and the need for mitigation measures. Examples of completed environmental assessments include (NSW Fisheries 2001, 2002a,b; 2004, available for download from www.dpi.nsw.gov.au).

The term “environment” includes biophysical, economic and social aspects. This definition has much broader scope than simply the assessment of the target species and requires a multitude of issues to be considered in the environmental assessment. For example, within each fishery over twenty components are considered including retained species, bycatch species, bait species, biodiversity, habitat damage, protected and threatened species, species assemblages, species diversity, ecosystem processes, trophic structure, translocation, fish disease, water quality, noise, light, air quality, energy, external factors, economic viability, employment, safety, as well as social issues associated with Indigenous and European heritage.

The environmental assessment tests the sustainability of the proposed level of fishing activity authorised under the proposed fishery management strategy. The assessment considers the cumulative implications of issuing approvals for the designated fishing activity along with interactions and impacts of other fisheries and activities on the resources under assessment.

The consultative process for the environmental impact statement (EIS) is comprehensive and transparent, incorporating a broad cross section of stakeholder groups and the wider community. Several drafts of the FMS are prepared for comment at intervals throughout the process, including a public consultation phase. A Management Advisory Committee of elected endorsement holders in the fishery and other key stakeholders is involved throughout. At various stages input is also sought from individual endorsement holders, Ministerial Advisory Councils on commercial fishing and recreational fishing, Indigenous representatives, the general public, and representatives of industry, environmental, social, academic and non-government organizations, as well government bodies with an interest in the statement.

The consultative process is both time-consuming and costly. The process does, however, attempt to capture the social values associated with the fisheries and provides for transparent and equitable access to decision-making processes. These processes are consistent with the principles of ESD, Agenda 21, the FAO Code of Conduct as well as elements of EBFM.

4.4 Other relevant policies and legislation in NSW

Although the EPA Act and the EPBC Act provided the legislative vehicles for the environmental assessment of fisheries in NSW, there are a multitude of other laws and policies that support the implementation of EBFM. These are briefly considered below.

The NSW FM Act includes extensive provisions for the conservation and protection of non-target species and aquatic habitat. The objects of the Act include (s 3(2)): “(a) to conserve fish stocks and key fish habitats, and (b) to conserve threatened species, populations and ecological communities of fish and marine vegetation”. Provisions are also included to improve the incentive for fishers through share management (Part 3) including various appeal mechanisms, co-operation with other jurisdictions (Part 5), protection of aquatic habitats (Part 7) and threatened species conservation (Part 7A). Section 230 gives the provisions for the Management Advisory Committees, a keystone in the consultative processes used in fisheries management. Other Acts that have direct impact on fisheries and aquatic resource management in NSW are the *Marine Parks Act 1997*, *Threatened Species Conservation Act 1995* and the *Protection of the Environment Operations Act 1997*. Certain administrative decisions made by government agencies are subject to appeal under the provisions within the *Administrative Decisions Tribunal Act 1997*.

Policies associated with EBFM include the NSW Coastal Policy (1997). The primary aim of the policy is to protect the NSW coastline and ensure development is environmentally sensitive. One of its main features is to protect coastal

species and ecosystems for aesthetic, environmental, scientific and economic reasons. In June 2001 the NSW government introduced nine interrelated initiatives that were to help put the policy into operation. Chief among these initiatives is the Comprehensive Coastal Assessment (CCA), whose aim is to provide data and information to assist in strategic planning and decision-making to ensure ESD is achieved for coastal development and other issues (Table 2a-A, p. 85, NSW Government, 2004). Objectives of the CCA include optimising biodiversity conservation, ecological function, developing land and water areas within the limits of natural processes and encouraging diverse, vibrant and sustainable coastal communities. CCA is particularly focused at the regional level. Like the Commonwealth regional marine plans, the outcomes of the CCA will take several years to mature but will provide valuable frameworks and tools for the EBM of coastal systems.

The crucial point to be made from this discussion is that implementation of EBFM is not, and will never be, simply a technical or scientific problem. In NSW, the social dimensions of EBFM are captured within the complex, and no doubt imperfect, network of environmental and administrative laws already operating, as well as other policies being developed under various mechanisms of consultation. If these systems are effective, then developments to fisheries management will occur that reflect the social values associated with marine and coastal ecosystems. These developments will be driven by decisions that are taken by government (at various levels), industries (including commercial fishing) and the citizens at large.

The role of science in ecosystem-based fisheries management is, therefore, more complicated than initially appears. EBFM is not simply a complex scientific problem requiring resolution by ecologists, but a complex management paradigm where the strengths and weaknesses of ecological science need to be better understood. The term “ecosystem” has been criticised by ecologists (Peters 1991) and natural resource managers (Zeide 2001), but the word has gained favour in natural resource law and policy. These issues are discussed in more detail below.

5 Comments on ecological science and EBFM

5.1 Science and EBFM

From the above discussion it is clear that policy makers have largely driven the move towards EBFM. This policy-driven approach is entirely appropriate for community owned resources, but the scientific community is struggling to reach consensus on what is required for EBFM (Brownman and Stergiou 2004). The major challenge for science is to translate broad policy statements about preservation of ecosystems into practical ways of setting and measuring progress towards ecosystem-level goals and specifying ecosystem-level indicators and trigger points for performance monitoring.

Particular challenges for science stem from the vagueness of the terminology used in policy and legislation. For example, the term “ecosystem” is not precisely defined, let alone concepts such as the “natural structure and function of ecosystems” which are to be preserved. There is also a very poor

understanding of the large scale dynamics of food webs and other ecological patterns and processes that occur at the scale on which fisheries operate.

Extension of single species management approaches to non-target species (e.g. bycatch species and other predator species), with targets and performance monitoring, may represent the first stage in moving towards EBFM (Hall and Mainprize 2004). It has been argued that effective management to prevent overexploitation of target species, bycatch and other vulnerable species is all that is required for EBFM, because if single species are protected, then there would be minimal disruption at community and ecosystem levels (reviewed by Hall and Mainprize 2004). If this argument is accepted, then EBFM would simply require application of current methods to more species.

From the principles of EBFM given by Ward et al. (2002) and the FAO (2003a), it is argued that targets for single species would need to be set with regard for the need to preserve the “natural structure and function of ecosystems”. This is generally not the case, because targets are usually based on single species population models that do not consider the species’ role in the larger system (Link 2002a). It has been shown, for example, that if each species in a multi-species fishery were harvested at an “optimal” level as determined by single species models, primary production would be insufficient to support the fishery (May et al. 1979). To get around this, biomass trade-offs among species must occur (Link 2002b), requiring cross-fishery management of multiple stocks. Furthermore, some authors have argued that because EBFM has specific ecosystem level goals, these should be specifically addressed by management (Sainsbury and Sumaila 2003).

Several recent international fisheries conferences have focused on the challenges of EBFM, and there are numerous examples of how science may meet the challenges (e.g. Brodziak and Link 2002; Link et al. 2002; Latour et al. 2003). These examples have all been for ‘data-rich’ (and ‘science-rich’) fisheries. In ‘data deficient’ systems such as the small scale fisheries in NSW, the main challenge for the development of environmental assessments has been the lack of knowledge and data about target fish species and aspects of the ecosystem in which they live including non-target species, habitats and ecological processes. This challenge will be mirrored in the implementation of EBFM. A lack of knowledge and data gaps will result in uncertainty about what to measure to monitor performance and detect changes (both positive and negative) in an ecosystem as a result of management actions.

It would be easy to assume that additional investment in ecological science may resolve this lack of knowledge and data about the ecosystems in which fisheries are embedded. There are, however, some important methodological constraints that need to be recognised. These are discussed below.

5.2 Scientific methods for EBFM

Although it is recognised that experimentation provides the most robust method to infer cause and effect in ecological systems (Underwood 1990) and that adaptive or experimental management policies provide a powerful strategy to better understand how natural systems respond to management

(Hilborn and Walters 1992; McAllister and Peterman 1992), there are important constraints with these approaches that must be recognised. At the scale of fishery systems, it is difficult to replicate, randomise and control treatments. The experimental units simply don’t exist, the costs of such work are too high, or the imposition of such policies is extremely unpopular and politically untenable. These difficulties have been evident for relatively simple single species management issues, but are also apparent for more complex ecosystem type issues (Walters 1997). In Australia, there are examples of successes of such approaches but they have been difficult and expensive to undertake (Sainsbury 1988; Sainsbury et al. 1997; Punt et al. 2001).

An alternative research method to investigate aquatic ecosystems is the application of ecotrophic models. Models such as Ecopath (Christensen and Pauly 1992) and Ecosim (Walters et al. 1997; Christensen and Walters 2004) have been important heuristic tools for scientists working on fishery systems. The range of application of these models has been remarkable (Christensen and Walters 2004) and many fisheries management agencies, including the NSW Department of Primary Industries, are investing in such approaches. Within Australia, alternative trophodynamics modelling frameworks are being developed (Fulton et al. 2003; Fulton and Smith 2004). The resources required to develop such models are not insignificant and the models have an impressive appetite for data. Calibration of the dynamic model Ecosim is best undertaken using a time-series of estimated biomasses of at least some of the functional groups within the model. Such time-series are not usually available for the smaller scale, less valuable fisheries that we have in coastal Australia. It is too early to fully understand the long-term impact of these models upon aquatic resource management in Australia.

During the preparation of the environmental assessments described earlier, Australian researchers were motivated to develop a series of approaches that could be applied to understand the risks associated with fisheries. There was neither the time nor the resources to apply traditional scientific methods such as experimentation or quantitative models, so a series of qualitative risk assessment methods were developed. Qualitative risk assessment is used to identify and prioritise issues that put components of the ecosystem in danger of becoming unsustainable (Stobutzki et al. 2001; Fletcher et al. 2002; Ward et al. 2002). The main feature these assessments have in common is that they divide the ecosystem into its component parts, such as habitats, various ecological processes, non-target species, bait etc. This ensures all aspects of the ecosystem that could potentially be impacted by the operation of a fishery, either directly or indirectly, are considered.

The NSW Department of Primary Industries in its recent environmental impact statements of commercial fisheries has taken a slightly different approach in identifying issues. Like Fletcher (2002), the NSW scheme divides the ecosystem into its component parts but the issues are identified based on the outcomes of the qualitative risk assessment on each of these components. Specific issues are clearly identified that contribute to a component of the ecosystem being at higher risk of becoming unsustainable. The qualitative risk assessment methodology is an important outcome for EBFM and

identifies the components of the ecosystem at higher levels of risk and the need for an appropriate managerial response to address these issues.

Environmental assessment of fisheries in Australia has thus stimulated the development of some innovative methods to better understand the ecological impacts of fisheries. Results of such analyses are tightly bound to the managerial responses that are codified in updated management strategies or plans. Implementation of these plans is the next major challenge for all Australian fisheries.

6 Discussion

6.1 The context of EBFM

The elements, principles and actions associated with EBFM have been derived from existing international conventions and agreements and, in particular, the FAO Code of Conduct for Responsible Fisheries. Australia, like many countries, has well developed policies and laws that capture and operationalise these international instruments across all environmental issues (not just fisheries). The primary mechanism used within Australia (and particularly NSW) that literally forced additional deliberation of ecological issues in fisheries is environmental impact assessment. Alignment of the outcomes from these environmental assessment processes with the FAO Technical Paper on the Ecosystem Approach to Fisheries is not perfect and nor would we expect it to be. Some international authors, such as Jennings (2004) have already noted that environmental impact assessment is one possible strategy for applying EBFM.

The question remains however: Have we actually been undertaking EBFM in Australia and NSW? During the assessment processes it became apparent that there are huge deficiencies in our understanding of aquatic ecosystems and the impact of fisheries upon them. If you simply assumed that “you cannot manage what you do not understand”, then claims for the implementation of EBFM would be treated with some scepticism. EBFM and ESD are, however, complex multi-faceted concepts that cannot be interpreted with such simple causality. The following sections elaborate on this issue.

6.2 “Ecosystems” are not simply scientific constructs

Whether ecological scientists like it or not, the terms “ecology”, “ecologist”, “ecological” and “ecosystem” now have a much broader range of application than as defined by science (see, for example Preston 1995; Zeide 2001). These definitions become even more diffuse once the role of humans is included. Gilpin (1996) included definitions for ecobalance, ecodevelopment, ecofeminism, ecofundamentalism, eco-labelling, ecogism, ecopolitics, ecosphere, ecotax and ecotourism. Western societies now have an association with the prefix “eco” (from oikos, Greek for “house” (Anon. 1987)) that has a life beyond a relatively narrow scientific definition of “ecosystem”. When the phrase “ecosystem” is used, we would be naive to think that the context would not be broadened in an attempt to capture

the broad range of ideologies likely to be present in contemporary fisheries management. Ecological science will have an important role to play in EBFM, but the discipline is unlikely to set the agenda. Rather, ecological scientists must offer expertise and a “reality-check” on what could be understood as well as attempt to communicate any constraints and trade-offs that should be acknowledged in decision-making (Lackey 1998b).

6.3 Costs and benefits of science

Adaptive management and experimental management have been identified as the most effective strategies for improving our understanding of natural systems (Hilborn and Walters 1992; McAllister and Peterman 1992). Rather than re-iterate and re-recommend the adoption of these policies, we will make some simple remarks about why integration of such approaches has been so difficult. As discussed above, application of scientifically-based methods to improve our understanding in large-scale natural systems is difficult and expensive. Long-term programs require the commitment of staff and research agencies, and have substantial logistical costs. Outcomes are usually more equivocal than expected because of large variances of observations. In aquatic systems of extremely high economic value or national significance, such as the Great Barrier Reef or Antarctic waters, the Commonwealth of Australia allocates the necessary resources to undertake these substantial research and monitoring programmes.

Such resources are not, however, available for all aquatic systems in Australia. Smaller fisheries tend not to attract the sizeable resources required for large ecological research programs. There is an economic argument associated with this issue that is important to appreciate, and was stated clearly in the IGAE “... measures adopted [to manage environmental issues] should be cost-effective and not be disproportionate to the significance of the environmental problems being addressed”. This policy is closely associated with the notion of “polluter pays” (Agenda 21 Principle 16) or the internalization of environmental costs. In NSW this is formally codified in s 6(2)(d) of the *Protection of the Environment Administration Act 1991*.

If the sustainability principle of “internalizing environmental costs” is translated into a policy of cost-recovery, then the resources for research and monitoring would be sourced from industry. Taking such a decision in smaller fisheries would cause significant and, perhaps, unacceptable social impact on fishers. Alternatively, given that the pressures for EBFM could be traced back to the “public interest”, it could be argued that these resources should be obtained from other sources of government revenue. Unfortunately the demand for publicly funded services is substantial. Funding of expensive ecological research for the implementation of EBFM will need to compete with other demands upon the public purse such as health and education. Such portfolio allocation decisions must remain political in nature. There will always be pressure to reduce the costs of research and management in small scale fisheries; it is likely that, in such systems, there will be a greater reliance upon fisheries-dependent data and the need to develop co-operative partnerships with industry (Parma et al. 2001; Orensanz et al. 2005).

6.4 Be wary of complex management systems

Even if additional resources for more sophisticated ecological science are available, there is no guarantee that such knowledge can be successfully integrated into a management system. Jennings (2004) recently pointed out that the science involved in EBFM is likely to be far more complex than that used for single-species fisheries management. There will now be a mix of scientific disciplines, methods and results. Given the acknowledged difficulties that fisheries managers have had using the relatively simple results from single species stock assessment (Walters and Maguire 1996) it would be optimistic to think that the additional scientific input from ecological science would be smoothly integrated into decision-making. Development of “ecosystem-based” indicators and performance measures would clearly be a first step in this process (Hall and Mainprize 2004) but it may be overly ambitious to think that the rich complexities of marine ecosystems (which are a crucial part of human values associated with them) can be quantified to the satisfaction of all stakeholders. Furthermore, large uncertainties associated with such indicators may limit the ability of managers or policy makers to make changes that have large socio-economic impacts (real or perceived).

A significant concern about EBFM is the potential for it to become unworkably complex. Cochrane (1999) and Healey (1998) have both pointed out that complex systems of natural resource management have significant drawbacks. Such systems are difficult to develop and maintain and as information, ideas and policies become more complex, fundamental limitations of decision-makers to comprehend and act upon information become apparent (Hammond et al. 1983). It would be nonsense to assume that the best way to improve a troubled simple management system is to replace it with a highly complex one. Complex management systems will also be expensive to develop and maintain, and the resources used will have associated opportunity costs.

6.5 Balancing ecological, economic and social factors in decision-making

Conflicts within natural resource management are, at their core, consequences of differing value systems held by members of our society (Preston 1995; Harding 1998). As values change, so do demands upon the public authorities charged with managing these resources. Human value systems do not change uniformly, nor in a pluralistic society could we expect them to. As these changes occur, public pressure will develop and be applied through a variety of institutional channels (as we have seen in the examples from Australia). Natural resource agencies respond to these pressures by making changes to management systems that will suit some stakeholders but not others. If issues of substantial income-loss arise they are usually resolved by compensation of affected parties. We must recognise that such decisions are inherently political; and in a modern democracy we would want them to remain that way. The best “checks and balances” of executive power in such situations are workable administrative and environmental laws to ensure that such decisions are accountable.

People are sometimes somewhat naive in their appreciation of the value-based nature of environmental issues and sustainability arguments. Researchers in environmental economics have identified a range of models of sustainability from “strong” to “weak” which reflect the degree to which natural capital can be replaced with man-made capital (George 1999). Economic and social goals can change rapidly and somewhat unpredictably, as illustrated in the rapid rise and influence of green politics in the last 40 years.

6.6 Ecosystems and EBFM

We have argued that the development of EBFM is so closely integrated with ESD, that appropriate policy and legal instruments are already in place in Australia. The major consequence of these instruments (and this did not happen overnight) was the environmental assessment of fisheries and the development or refinement of many fisheries management strategies. Implementation of these strategies will be more difficult than writing them, and significant constraints will be subsequently identified. Studies into aquatic ecosystems are not likely to be a priority for the limited research resources available to support the management of smaller fisheries. Our understanding of many aquatic ecosystems is likely to remain poor, but the nomenclature of EBFM can still be justified once you accept the richer dimensions associated with the idea.

Lackey (1998b), in a highly recommended paper (also see Lackey 1998a; Lackey 2001), noted (at p. 24) that “Ecosystem management is place-based and the boundaries of the place of concern must be clearly and formally defined”. It is likely that some of the positive reception to “eco...” is closely associated with people’s sense of place or home. This has long been recognised in Australian Indigenous societies and is a powerful motivating factor in community-based groups who usually have a thorough knowledge of local circumstances. Perhaps the greatest challenge for EBFM is not the ecological science, but the re-orientation of established structures of governance to better suit the place-based nature of the ecological, economic and social mosaics that constitute contemporary fisheries.

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