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FRAMEWORKS FOR MANAGING MARINE RESOURCES IN AUSTRALIA THROUGH ECOSYSTEM APPROACHES: DO THEY FIT TOGETHER AND ARE THEY USEFUL?

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ABSTRACT

Many ecosystem-based terms have been generated to promote more holistic approaches to the management of natural resources. Within Australia, despite the progress made toward applying these concepts to fisheries management, the multitude of terms has often caused stakeholder confusion. A national workshop concluded that ecologically sustainable development (ESD; known elsewhere as sustainable development) should be the overall goal for government and that the other terms discussed (ecosystem-based management, ecosystem-based fisheries management, etc.) described strategies that should be used by various agencies and industry sectors to work toward this goal. All ecosystem-based approaches can cover the direct and indirect environmental impacts, social and economic outcomes, and governance systems associated with an activity. The main difference among them is the scope of the regions and activities covered and therefore the breadth of issues to be managed. A hierarchy of ESD-related frameworks and tools, designed to operate at a number of levels (the individual fisher, local and multiregional management agencies), is described, and the elements needed for their implementation (correct scope, transparency, inclusiveness, measurable objectives) are discussed. These results from Australia should be directly relevant to the implementation of ecosystem-based approaches in other locations.

Over the past decade an increasing number of terms and concepts (along with their acronyms) have been proposed for the holistic management of aquatic natural resources. These include marine ecosystem management (Larkin, 1996), ecosystem-based management (EBM; e.g., Ward et al., 2002), ecosystem-based fishery management (EBFM; e.g., Brodziak and Link, 2002), ecosystem approaches to fisheries (EAF; e.g., Garcia and Cochrane, 2005), integrated oceans management (IOM; National Oceans Office, 2004), environmental management systems (EMS; e.g., Seafood Services Australia, 2005), sustainable development (SD; WCED, 1987), and ecologically sustainable development (ESD; Commonwealth of Australia, 1992). They all include a recognition that management must deal with the full set of ecological consequences of an activity and, to a greater or lesser extent, an understanding of the social and economic implications of the activity for society.

In Australia, all three levels of government (local, state, and federal) have agreed to implement ESD for all activities under their jurisdiction. ESD was 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" (Commonwealth of Australia, 1992). For fisheries management, which is administered at either the state or the federal level, the implementation of ESD has progressed substantially over the past 5 yrs, mainly because of the requirement for all export-based fisheries to submit applications under the Australian (federal) government's guidelines for sustainable fisheries (Commonwealth of Australia, 2001; which has ESD as an underlying principle) or risk being unable to continue exporting their catch.

To assist with this implementation of ESD, the National ESD Reference Group (NESDRG) developed a framework for the reporting and assessment of wild capture fisheries. This framework outlined a four-step, risk-based process to help generate reports on all relevant ESD issues for a fishery; including impacts on target species and the broader ecosystem, along with the social and economic outcomes from the fishing activities and the current governance systems (Fletcher et al., 2005). Subsequently, all major fisheries in Australia have generated reports to meet the federal government's requirements. During this process difficulties sometimes arose from confusion concerning the relationship of the term ESD with terms describing other ecosystem-based approaches. Stakeholders were often unsure whether these were merely different names for ESD, whether they covered different issues, and especially whether any was "superior" to ESD.

Concurrent with the development and use of ESD frameworks for individual fisheries, other government-led initiatives were being developed that covered related issues such as integrated fisheries management in Western Australia (Department of Fisheries, 2000, 2002), regional marine planning in South Australia (Government of South Australia, 2004), and IOM at the national level (Commonwealth of Australia, 1998). The relationships of these various initiatives with ESD, and with each other, were also unclear and fueled debates among agencies about which concept and framework should be used and where responsibility for their development should reside.

Such discussions take considerable time and distract attention from progress toward development of more effective marine-resource management systems. Because of the urgent need to ensure that all these initiatives were being advanced in a complementary fashion (Table 1), the Natural Resources Management Standing Committee, which includes the heads of all the key state and federal agencies responsible for marine-resource management in Australia, began a process to unravel the complexity. Here, I outline the results of this process and describe how the various concepts can fit together effectively. Because similar debates are occurring elsewhere, the lessons we have already learned in Australia in attempting to implement them will be outlined.

Methods

The task of completing the analysis of "ecosystem-related" terms was assigned by the standing committee to the NESDRG, which includes representatives of most major government and nongovernment stakeholder groups and covers both the fishing and general environmental sectors. This reference group had been operating since 2000 and was instrumental in the successful development of the first ESD framework for individual wild capture fisheries (Fletcher et al., 2005). Furthermore, it was already acting as the steering committee for a number of related initiatives and was therefore in a unique position to compare the various systems.

The NESDRG held a workshop in April 2004 where the differences in the scope and concepts associated with each of the commonly used terms, along with the general problem of dealing with different terminology among groups and countries, were discussed. To minimize confusion, the most common terminology already being used in Australia to describe a type of assessment was generally retained rather than replaced with any newly adopted alternative. The final results were accepted by the standing committee at their July 2004 meeting. These outcomes and other relevant information on current progress toward ESD within Australia are presented below.

Results

The NESDRG determined that, within Australia, ESD should be seen as the overall goal for government and that the other terms (e.g., EBFM) described strategies that should be used by various sectors and agencies to work toward the overall goal of ESD. The group also agreed that, in any assessment using any ESD-related framework, all relevant environmental impacts, social and economic outcomes, and governance systems should be assessed but that the scope of the activities (and therefore the issues) addressed by the various frameworks might have to differ.

The primary factor affecting the choice of an appropriate scope for any management system is that any sector (be it an individual, industry, agency, or even government) faces issues that it can manage directly, issues that it can influence, and the surrounding environment, which it can neither control nor directly influence. Consequently, the main difference in implementation between these systems was judged to be the scope of issues that could be managed by the sector involved. The various management systems therefore form a hierarchy within an overall ESD context, wherein each level can provide the building blocks for the next (see Fig. 1).

Each of the terms and concepts considered here will be outlined in brief, with reference to more comprehensive descriptions and examples where completed assessments are available (Table 1). The descriptions will also outline the key differences between the levels and, importantly, how they can fit together.

(1) *An industry-level EMS* can be used to describe how an individual company, or a corporate group within a fishery or fishing area, is attempting to meet the ESD principles relevant to its activities. The company or group can describe how it will meet some, or all, of the management requirements dictated either directly by relevant regulations or indirectly as a response to community expectations. Such systems can be as informal as a set of codes of practice, or they can be highly refined and include third party auditing (see Fig. 2).

An increasing number of EMS are being developed by fishing-industry groups within Australia. This trend is due mainly to industry's recognizing that some form of environmental accreditation may help maintain its longer-term access, particularly in areas where competition for access to resources is high. For example, the EMS for the Gulf of Carpentaria Commercial Fishermen Association includes a commitment "to improve the relationship between fishermen in the area with other users of fisheries resources" (Ward, 2003). The association's code of conduct describes how it will reduce its by-catch and minimize its impacts on general water quality. The entire fishing industry now has help in formulating such systems from a comprehensive set of EMS tools developed for the purpose (Seafood Services Australia, 2005), which are based on the wild capture ESD framework.

An industry-level EMS will, however, generally not be able to deal directly with all elements required for the management of a fishery. Industries do not administer the development of relevant legislation and regulations and generally do not monitor the performance of the affected target stocks. These responsibilities are usually undertaken by the relevant fisheries-management agency on behalf of the community.

(2) *A fishery ESD report* deals with all the aspects of an individual fishery and describes how the relevant fisheries agency (in conjunction with industry and other stakeholders) is contributing, through its current management arrangements to ESD objectives. The national ESD framework (Fletcher et al., 2002; see Figure 3 for sum-

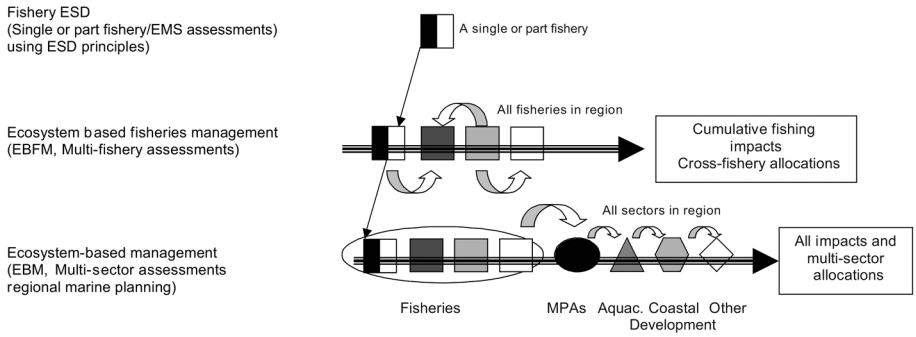

Figure 1. A diagrammatic representation of the relationships between three levels of the ecologically sustainable development (ESD)-related frameworks. The split box in the first and lower levels represents an EMS covering some elements of the fishery. The encircling of all the fisheries boxes within the ecosystem-based-management (EBM) level indicates that they represent only one sector at this level. The curved arrows indicate that allocation interactions are likely, not the direction of any impact. MPAs signifies marine protected areas; Aquac. signifies aquaculture.

mary) describes how to generate a report for an individual wild capture fishery and includes a number of tools that help with identifying all the relevant issues across the eight main components of ESD; completing risk assessments that help determine the appropriate level of response for each issue; and, where necessary, articulating a detailed plan of management that specifies operational objectives and the arrangements needed to achieve them, along with appropriate monitoring of performance. This system can, where relevant, directly incorporate any arrangements covered within a related industry-based EMS, making them complimentary processes (Fig. 2).

The national ESD framework, or at least some of its components, has assisted in the generation of many applications by fisheries to meet the Australian government's export requirements (see http://www.deh.gov.au). One of its most valuable components has been the adoption of structured stakeholder workshops that identify issues and complete the qualitative ecological risk assessments. These cover the risk generated by the fishery to target species, by-catch species, directly affected habitats, and the ecosystem in general. The inclusive nature of the process and the need to document outcomes fully has increased both the transparency and the discipline of management decision-making, but also the level of acceptance by the various stakeholder groups (Fletcher, 2005).

Using the ESD framework has generated comprehensive assessments of the impacts, both positive and negative, that directly link the performance of the fishery to the objectives and arrangements within its management plan (e.g., Kangas et al., 2005). Additional tools designed to assist with the assessment of social and economic outcomes have now also been detailed (Hundloe, 2002; Schirmer and Casey, 2005), enabling individual fisheries undergoing changes to their management to assess any potential socioeconomic impacts.

Although this process is comprehensive at an individual-fishery level and is generally seen as being successful, it does not assess the combined effects of different fisheries within the same area. Some environmental groups have therefore stated that the fishery-level ESD reports are still insufficient to meet their desire for fisheries to be managed according to the concept of "ecosystem-based management" (e.g., Dunlop, 2003). These concerns were related to issues like having defined allocations

Table 1. Summary of the relationships among ecosystem-related management approaches. Note that impacts may include both positive and negative effects and cover environmental, social, and economic issues. Environmental management systems (EMS); ecologically sustainable development (ESD).

Category of assessment	Scope	Seeks to manage	Key groups involved	Current Australian examples
Industry-sector EMS	Part of a single fishery Single region Single resource (aquatic)	Some or all impacts of an individual or group	Individuals, companies, industry associations	A list of current EMS reports and projects within Australia is available at: http://www.seafoodservices.com.au
Fishery ESD	Single fishery Single region Single resource (aquatic)	All impacts related to an individual fishery	Fisheries agencies (plus the above)	An extensive list of ESD-based reports for most Australian fisheries is available at: http://www.deh.gov.au
Ecosystem-based fishery management (EBFM)	Several fisheries Single region Single resource (aquatic)	All fishing-related impacts within a region	Fisheries agencies (plus multiple industry associations and stakeholder groups)	None yet, but processes to determine sector allocations have begun in some jurisdictions (http://www.fish.wa.gov.au/sec/man/ifm/index.php?0601)
Ecosystem-based management (EBM)	Several sectors Single region Single resource (aquatic)	All impacts occurring within a marine bioregion	Fisheries, environment, transport, aquaculture, tourism agencies (plus multiple stakeholders)	None yet, but a marine planning process is underway for the Spencer Gulf region of South Australia (http://www.environment.sa.gov.au)
Integrated oceans management (IOM)	Several sectors Several regions Single resource (aquatic)	As above for a series of marine bioregions	As above for a series of jurisdictions	Southeast Regional Marine Plan in Australia (no operational objectives/performance measures; see http://www.oceans.gov.au)
National ESD	Several sectors Several regions Several resources	All terrestrial, aquatic, and atmospheric impacts in a region or country	All government agencies, industry groups, and community	Various "state of the environment" reports (but these usually contain only indicators; i.e., operational objectives or measures to gauge performance are lacking; e.g., http://www.deh.gov.au)
International ESD	All sectors, regions, resources	As above for the world	As above for the world	UN protocols (e.g., Kyoto)

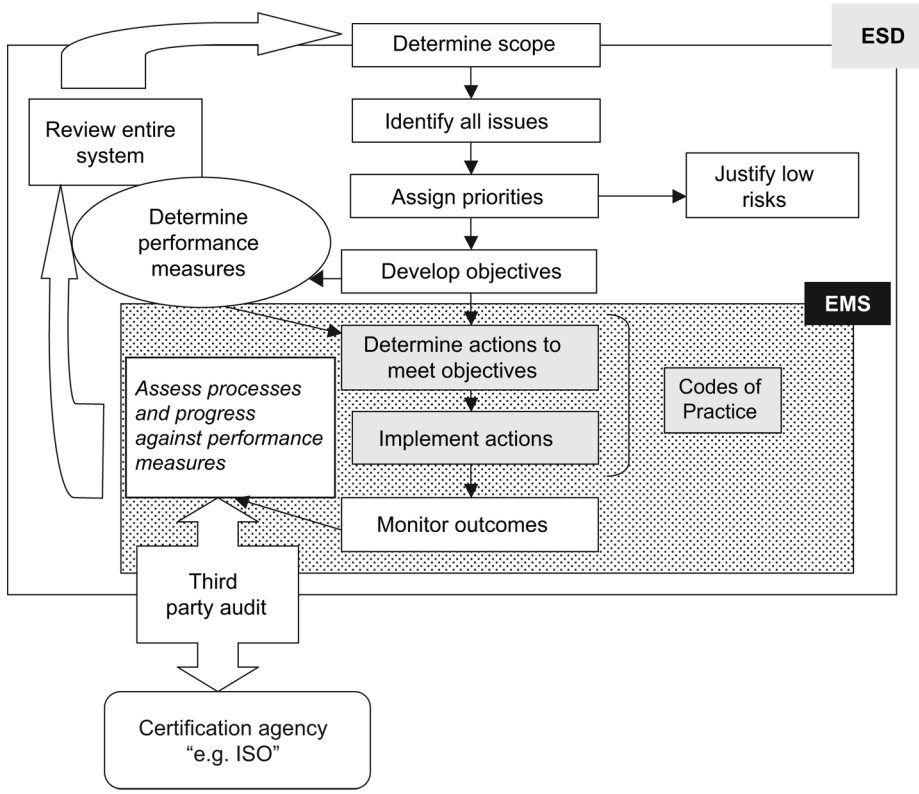

Figure 2. Diagram depicting how environmental management systems, codes of practice, and accreditation fit within the ESD Framework. The ESD elements outside the shaded area require input from the relevant management authorities and other stakeholders. The elements within the shaded area could be completed by industry as part of an environmental management system. The elements outside the box are those could be undertaken by third parties, such as auditors certified by the International Organization for Standardization (ISO).

among all sectors and an understanding of all human-caused changes within a region. Such issues cannot be addressed at the individual-fishery level.

(3) *EBFM* was defined as the assessment and management of all impacts and outcomes related to any commercial, recreational, charter, indigenous, or "no-take" sector operating within an ecosystem or bioregion. EBFM assessments should, therefore, cover the cumulative impacts on the environment that arise from the current suite of fisheries-related activities (Fig. 1). They should also document the overall social and economic outcomes that are generated by these activities given the current allocation of access within the region.

To undertake EBFM effectively requires integrating the impacts of the management arrangements of all individual fishing activities within a region to ensure that they are collectively achieving the whole of region objectives. These regional objectives and performance measures could, for example, include the total acceptable harvest levels for each of the key target species and the total area of habitat subject to trawling or significant disturbance. Finally, they could document any decisions on explicit allocations of access to resources among the competing fisheries sectors (commercial, recreational, etc.), possibly including the total area of "no-take" zones.

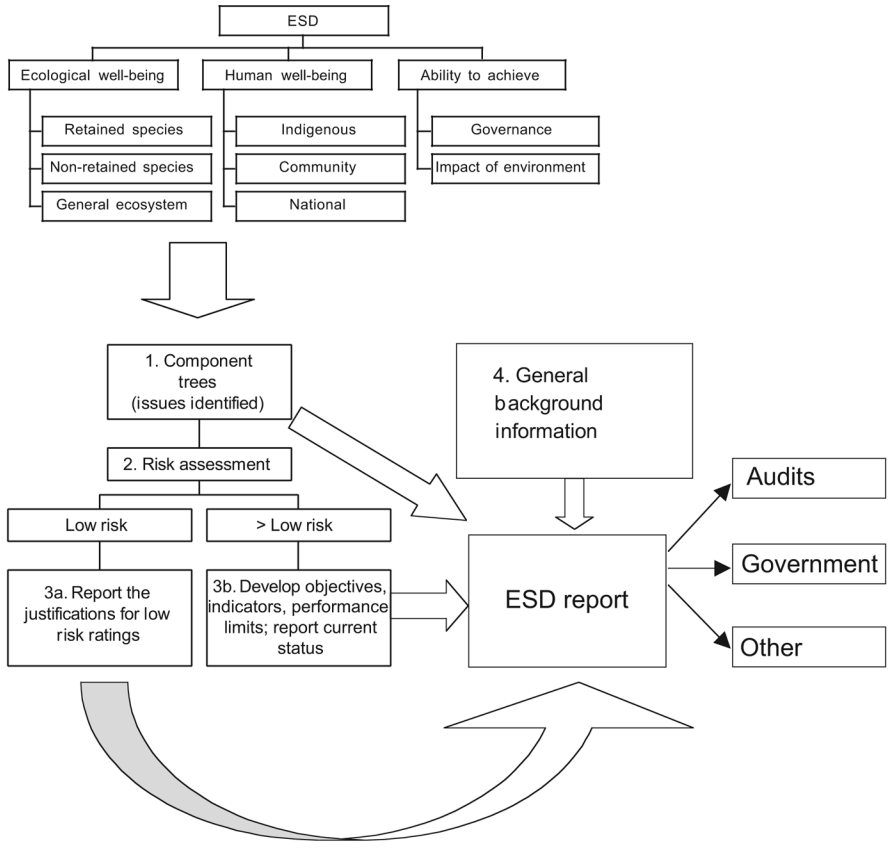

Figure 3. A summary of the processes involved in completing the Australian ESD reporting framework. The eight main elements of ESD are represented in the upper section. Each of these has a comprehensive generic component tree that is used to assist issue identification (Fletcher et al., 2002, 2005).

The completion of such assessments could reveal that, although individually each fishery is achieving its objectives, collectively the individual arrangements are not meeting the region's needs. This type of analysis has already been suggested for assessment of the impacts on threatened species in areas where each of several fisheries affects only minimal numbers but the combined impact may still be too high for recovery of the stock. In such cases, one or more of these fisheries may need to modify their management arrangements to permit achievement of the regional goals.

The EBFM framework also recognizes that single issues may require multiple and possibly competing objectives. For species that are the target of commercial, recreational, charter, and indigenous fishers and are also of interest to "no-take" groups, supplemental management objectives may be necessary in addition to the basic maintenance of an appropriate spawning-stock size. These supplementary objectives could address the need for areas with higher local abundances for viewing by divers or larger fish for trophy fishing, which would require different management arrangements in different areas.

This framework could also be used as the basis for assessing impacts on the ecological, social, and economic outcomes arising from any proposed changes in resource allocation among the various sectors. It should, therefore, be of value for the integrated fisheries management initiative that has begun in Western Australia, which seeks to allocate appropriate and explicit shares of the total harvest to the commercial, recreational, and indigenous sectors for each fishery resource with a high level of overlapping use (Department of Fisheries, 2000, 2002). An initial framework (based on the ESD system) for assisting with the allocation process has been developed (Department of Fisheries, 2002; Fletcher and Curnow, 2002), and the first sets of deliberations are underway (Department of Fisheries, 2005).

In conclusion, EBFM reports must demonstrate how the individual management plans and arrangements for each of the various commercial, recreational, and indigenous fisheries (including any relevant industry-level EMSs) combine to achieve regional fishery objectives (Table 1). Although the processes have begun, no EBFM-level reports have been completed that specify measurable objectives and their associated performance levels at the regional level and also outline the explicit allocations of access among all sectors.

Although it is broader than a single fishery, the defining element of EBFM (and the reason for the "F") is that it is restricted to activities that fisheries agencies can directly manage (i.e., that are covered by their act/legislation). Therefore, fisheries agencies (and their associated industries and stakeholders) cannot complete EBM, or regional marine planning, without the cooperation and involvement of other agencies and sectors.

(4) *Ecosystem-based management (EBM)* was defined as dealing with the aggregate management of all sectors (fishing, shipping, tourism, mining, etc.) operating within or affecting a single region to achieve ESD outcomes. Therefore, within the EBM framework, all fisheries collectively form only one of the many sectors involved; other industries (e.g., tourism, shipping) and stakeholders, along with the relevant government agencies, must be included in this process (Table 1). The frequent "competition" among these sectors/agencies for allocation of access to, and/or use of, the region's resources must also be recognized (Fig. 1). For example, the establishment of a marine reserve can shift the allocation of access from the fishing sector to various "nonfisheries" users (e.g., tourism, research); similarly granting aquaculture leases can reduce access to or amenity value for many other previous or potential users of an area.

Most allocations of access among sectors have previously occurred implicitly through independent decision-making processes often covered under different legislative instruments. Without a clear assessment of whether the current allocations are the optimum outcome for society, these decisions could have unnecessarily adverse effects on one or more sectors. To be effective, therefore, EBM requires a process whereby "whole of government" objectives and performance measures for the region can be generated. Implementing EBM also implies that regional marine plans should be developed that outline the management for all sectors to achieve agreed-upon regional outcomes, including explicit determination of the optimal allocation of access among the various sectors and uses.

Although no examples are currently available in which this process has been completed, a proposal, intended to assist this process, has been made that each sector (e.g., fishing, mining, transport, tourism, etc.) use the ESD framework and tools to pro-

vide its view of a region for both the ecological issues and socioeconomic outcomes. This would generate a consistent set of information, couched in similar terminology, which would facilitate the process of producing an integrated view by revealing overlaps or gaps in key issues and their objectives. Where competing objectives were identified, they could be reconciled through "whole of government" decisions.

Once regional objectives were developed, an integrated risk assessment could determine whether the current combination of management arrangements by all the agencies involved were appropriate. For example, this would be an unbiased way of determining the need for, or extent of, marine protected areas within a region, which are often seen as being obligatory for implementing EBM (e.g., by Ward et al., 2002).

(5) *Integrated oceans management (IOM)* is currently being implemented by the National Oceans Office (Commonwealth of Australia, 1998). It is intended not only to deal with all sectors in a region, but to cover a series of adjacent marine bioregions that form large marine ecosystems. An example of the scope of such a process is provided in the "plan" developed for the southeast region of Australia (National Oceans Office, 2004).

As with the implementation of EBM, unless these plans include clear and measurable whole-of-government objectives and agreed-upon performance targets (which in this case would need to include local, state, and federal levels of government), they risk merely reporting current activities along with a set of unmeasurable aspirations. If such plans existed, the operational management objectives of each of the affected sectors (i.e., at the Fishery ESD, EBFM, EBM levels) within this large marine ecosystem should be consistent with achieving these overall objectives. The approach outlined above for collating information for EBM should also be suitable at this higher level. In fact, as the number of sectors involved increases, so does the need for a consistent approach.

(6) *Full ESD* would require a completed IOM strategy that is linked to, or integrated with, a similarly comprehensive strategy for all adjacent terrestrial regions. These could be further expanded from regional- to national- and international-scale ESD assessments (Table 1). Taken to the logical (but totally unrealistic) end point, an ESD assessment could cover the entire planet.

Discussion

The frameworks and processes outlined above are beginning to turn what have generally been philosophical concepts into practical outcomes, albeit with differing levels of achievement (see Table 1 for summary). In particular, they have already been successful in facilitating the generation of assessments and management plans for individual fisheries that cover the full range of ecological issues associated with each of the various ecosystem-related strategies.

We have demonstrated that the range of ecosystem approaches being implemented in Australia, along with the other terms presented in the introduction, are just variations on a theme. None is "right" or "wrong." The term ecosystem approach to fisheries (EAF), as developed by FAO (FAO, 2003), has been adopted in many places (e.g., South Africa, Cochrane et al., 2004; U.S., Sissenwine and Murawski, 2004). Its scope and systems are fully consistent with the EMS, Fishery ESD, or EBFM levels outlined above, depending on whether a part of a fishery, a single fishery, or a collection of fisheries is being examined. Comparisons with other related concepts reveal similar

overlaps. The one clear difference is whether the approach just deals with the full set of ecological consequences resulting from an activity (e.g., Beamish and Mahnken, 1999; Link, 2002) or whether it explicitly acknowledges the requirement to consider the social and economic outcomes from these activities (e.g., Lane and Stephenson, 1995; Larkin, 1996; Chesson et al., 1999; Ward et al., 2002; Fletcher et al., 2005).

Using more general terms such as EAF or "ecosystem approach" may be (sensu Larkin, 1996) a useful "shorthand for more holistic approaches to resource management." The potential hazard associated with using any of these terms is that stakeholders often equate "ecosystem" with only the ecological aspects, a view that may or may not be appropriate. Whatever term is chosen it must, prior to implementation, have a clear definition, agreed to by all stakeholders, of which elements it includes.

Implementing any of these ecosystem approaches in a practical manner has previously proven difficult (e.g., Staples, 1997), as is reflected in the large number of reporting and management systems that have been proposed to assist the process (see reviews by Garcia and Staples, 2000; Charles, 2001). The experiences in Australia, where the ESD framework has been applied to varying degrees across different levels of activities, have revealed four key elements that appear necessary for the successful implementation of any ecosystem approach.

(1) Determining the scope of the assessment. This process includes developing a clear description of what is to be managed, determining whether it can be managed by the agencies and stakeholders involved, and ensuring that all relevant agencies and stakeholders are committed to the process. If any of these conditions are not met, either progress will be minimal or the outputs will probably not be useful. The recognition by the fisheries agencies in Australia that they alone could not achieve EBM has been a highly valuable outcome. It has provided significant motivation to generate a more whole-of-government approach to marine planning, especially where the establishment of marine protected areas is involved.

(2) An inclusive process for identifying all the issues that must be assessed across all areas of ESD (i.e., ecological, social, economic, governance). Most successful applications of this approach have directly involved stakeholders in the process of effectively breaking down the broad themes covered by ESD into more manageable-sized units relevant to the scope and circumstances of the sector or region being examined.

(3) Application of risk-assessment methods for the determination of which identified issues require direct management. This important process has significantly improved acceptance of the ESD framework both by managers, who were concerned that their workload would increase unnecessarily, and by the main stakeholder groups, who have been actively involved in all steps (Fletcher, 2005). Without the inclusion of the risk-assessment component, implementation of ESD across Australian fisheries would probably have been slowed substantially.

(4) For those issues requiring direct management, the clear establishment and documentation of the acceptable levels of performance, who is responsible for the management arrangements that will achieve these levels, and what review processes are needed to assess performance.

Most individual fisheries in Australia only successfully generated each of these components as part of the process of completing their ESD reports and applications (Table 1). These documents incorporate what is becoming an expanding body of indicators and reference points for target species (e.g., Gabriel and Mace, 1999) and

broader ecosystems issues (e.g., Garcia, 2000; Murawski, 2000; Sainsbury and Sumaila, 2002).

Despite this progress, few examples exist of "whole of government" objectives that can operate at a regional or larger scale. The different political cycles affecting the state and federal governments and the overlapping legislation and authority administered by several agencies even within one jurisdiction can make obtaining agreements at these levels slow and difficult. Many of those involved are only starting to recognize that marine planning is not synonymous with establishing marine protected areas but requires a dedicated and comprehensive process such as is generally used on land.

Even where each of the key elements outlined above has been put in place, the process has often not been simple. In general, the greater the scope of the analysis (i.e., the higher the level in the hierarchy), the more overlapping jurisdictions, agencies, and stakeholders become involved and the smaller the chance that the current governance arrangements (especially interagency and intergovernment processes) will allow development of an effective plan.

Appropriate governance arrangements are now recognized as a key element for all successful natural-resource management (e.g., Sissenwine and Mace, 2003). Because many regions of the world have jurisdictional arrangements for fisheries that are more complicated than those in Australia, the difficulties in achieving quick outcomes by applying the frameworks may be multiplied. Such problems do not mean that the frameworks "don't work." The various components and tools of the framework are effective in identifying discrepancies between the scope of issues covered and the governance arrangements in place, including whether the agencies and groups involved are capable of addressing these impediments. Clearly, different strategies will be needed for those fisheries or systems that involve multiple countries and agencies. These are largely policy and political issues, not science-based problems.

Finally, without assessments at the lower (i.e., individual-fishery) level, analyses and planning at either the multifishery or multisectoral level will be difficult. So far, attempts to use a top-down approach have rapidly encountered difficulties because of the lack of structured information available, as is apparent from the clear decline in the rate of progress at the higher categories of assessment (Table 1). The building-block approach (see Figure 1), whereby assessments completed at one level become inputs to the next, will take longer to get started but will probably be the most efficient method for completing assessments and planning at the regional and national levels.

In conclusion, the suite of definitions outlined above, along with the general ESD approach, has now been accepted by all relevant government agencies within Australia. We hope that these agreements will increase the efficiency of expanding the implementation of assessments to levels beyond the individual fishery by reducing the time previously spent discussing what should be assessed. The analysis of ecosystem-related concepts has already helped identify which agencies should be working collaboratively to ensure the efficient exchange of information among levels. Nonetheless, given the complexity of negotiations among sectors and agencies (including the frequent high turnover of staff), and despite the considerable progress already made at lower levels, the process will probably take a further 10 yrs to be fully implemented across all levels, sectors, and regions.

These frameworks and tools we have developed should have direct relevance for the implementation of ecosystem approaches elsewhere. Although our experiences have shown that obtaining agreement on the scope and having appropriate governance arrangements can be problematic, the best way forward is to start the process, whatever it is called. A vast amount of work is already being done around the world on by-catch, habitat impacts, community structure, and other ecosystem-related issues (e.g., Jennings and Kaiser, 1998; Hall, 1999). The use of these frameworks gives such programs "a home" and helps to determine the circumstances under which these issues must be addressed and at what level and scope.

Acknowledgments

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Literature Cited

Beamish, R. J. and C. Mahnken. 1999. Taking the next step in fisheries management. Pages 1–21 *in* Ecosystem approaches for fisheries management. AK-SG-99-01. Univ. Alaska, Fairbanks.

Brodziak, J. and J. Link. 2002. Ecosystem-based fishery management: what is it and how can we do it? Bull. Mar. Sci. 70: 589–611.

Charles, A. T. 2001. Sustainable fishery systems. Fish and aquatic resources Series 5. Blackwell Science, Malden. 370 p.

Chesson, J., H. Clayton, and B. Whitworth. 1999. Evaluation of fisheries-management systems with respect to sustainable development. ICES J. Mar. Sci. 56: 980–984.

Cochrane, K. L., C. J. Augustyn, A. C. Cockcroft, J. H. M. David, M. H. Griffiths, J. C. Groeneveld, M. R. Lipinski, M. J. Smales, C. D. Smith, and R. J. Q. Tarr. 2004. An ecosystem approach to fisheries in the southern Benguela context. Afr. J. Mar. Sci. 26: 9–35.

Commonwealth of Australia. 1992. The national strategy for ecologically sustainable development. Australian Government Publication Service, Canberra. 148 p.

_____. 1998. Australia's oceans policy, volume 1. Department of the Environment, Canberra. 52 p.

_____. 2001. Guidelines for the ecologically sustainable management of fisheries. Department of Environment and Heritage, Canberra. 16 p.

Dunlop, J. N. 2003. A conservation sector perspective on ESD assessment in Western Australian fisheries. Pages 43–45 *in* S. J. Newman, D. J. Gaughan, G. Jackson, M. C. Mackie, B. Molony, J. St John, P. Kailola, eds. Towards sustainability of data-limited multi-sector fisheries. Australian Society for Fish Biology Workshop Proceedings, September 2001. Fisheries Occasional Publication No. 5, Department of Fisheries, Perth.

Department of Fisheries. 2000. Protecting and sharing Western Australia's coastal fish resources: the path to integrated management. Fisheries Management Paper No. 135. Fisheries Western Australia, Perth. 90 p.

_____. 2002. Report to Minister for Agriculture, Forestry and Fisheries by the Integrated Fisheries Management Review Committee. Fisheries Management Paper No. 165. Department of Fisheries, Perth. 111 p.

_____. 2005. Allocation of the western rock lobster resource between user groups. Fisheries Occasional Paper No. 21. Department of Fisheries, Perth. 19 p.

FAO (Food and Agriculture Organization of the United Nations). 2003. Fisheries management 2. The ecosystem approach to fisheries. FAO Tech. Guide. Responsible Fisheries 4 (Supp. 2). 112 p.

Fletcher, W. J. 2005. Application of qualitative risk assessment methodology to prioritise issues for fisheries management. ICES J. Mar. Sci. 62: 1576–1587

_____ and I. Curnow. 2002. Processes for the allocation, reallocation and governance of resource access in connection with a framework for the future management of fisheries within Western Australia: a scoping paper developed for consideration and use by the Integrated Fisheries Management Review Committee. Fisheries Management Report No. 7. Department of Fisheries, Perth. 63 p.

_____, J. Chesson, M. Fisher, K. J. Sainsbury, T. Hundloe, A. D. M. Smith, and B. Whitworth. 2002. National ESD reporting framework for Australian fisheries: the "how to" guide for wild capture fisheries. FRDC Project 2000/145. Fisheries Research and Development Corporation, Canberra. 120 p.

_____, _____, K. J. Sainsbury, M. Fisher, and T. Hundloe. 2005. A flexible and practical framework for reporting on ecologically sustainable development for wild capture fisheries. Fish. Res. (Amst.) 71: 175–183.

Gabriel, W. L. and P. M. Mace. 1999. A review of biological reference points in the context of the precautionary approach. Pages 34–45 *in* V. R. Restrepo, ed. Proc. 5th National NMFS Stock Assessment Workshop: providing scientific advice to implement the precautionary approach under the Magnuson-Stevens fishery conservation and management act. NOAA Tech Memo. NMFS-F/SPO-40. U.S. Department of Commerce, Washington, D.C.

Garcia, S. M. 2000. The FAO definition of sustainable development and the code of conduct for responsible fisheries: an analysis of the related principles, criteria and indicators. Mar. Freshw. Res. 51: 535–540.

_____ and K. Cochrane. 2005. Ecosystem approach to fisheries: a review of implementation guidelines. ICES J. Mar. Sci. 62: 311–319.

_____ and D. J. Staples. 2000. Sustainability reference systems and indicators for responsible marine capture fisheries: a review of concepts and elements for a set of guidelines. Mar. Freshw. Res. 51: 385–426.

Government of South Australia, 2004. Living coast strategy for South Australia. Department for Environment and Heritage, Adelaide. 80 p.

Hall, S. J. 1999. The effects of fishing on marine ecosystems and communities. Blackwell Science, Oxford. 274 p.

Hundloe, T. J. 2002. Valuing fisheries. An economic framework. Univ. Queensland Press, St. Lucia. 257 p.

Jennings, S. and M. J. Kaiser. 1998. The effects of fishing on marine ecosystems. Adv. Mar. Biol. 34: 201–352.

Kangas, M., E. Sporer, J. McCrea, W. Fletcher, and V. Slowik. 2005. The Exmouth Gulf prawn fishery. ESD Report Series 1. Department of Fisheries, Perth. 132 p.

Lane, D. E. and R. L. Stephenson. 1995. Fisheries management science: the framework to link biological, economic, and social objectives in fisheries management. Aquat. Living Resour. 8: 215–221.

Larkin, P. A. 1996. Concepts and issues in marine ecosystem management. Rev. Fish Biol. Fish. 6: 139–164.

Link, J. S. 2002. What does ecosystem-based fisheries management mean? Fisheries (Bethesda) 27: 18–21.

Murawski, S. A. 2000. Definitions of overfishing from an ecosystem perspective. ICES J. Mar. Sci. 57: 649–658.

National Oceans Office. 2004. South-east regional marine plan, implementing Australia's oceans policy in the south-east marine region. National Oceans Office, Hobart. 108 p.

Sainsbury, K. J. and U. R. Sumaila. 2002. Incorporating ecosystem objectives into management of sustainable marine fisheries, including "best practice" reference point and use of marine protected areas. Pages 343–361 *in* M. Sinclair and G. Valdimarsson, eds. Responsible fisheries in the marine ecosystem. CAB International, New York.

Schirmer, J. and A. M. Casey. 2005. Social assessment handbook: a guide to methods and approaches for assessing the social sustainability of fisheries in Australia. Bureau of Rural Sciences, Canberra. 50 p.

Seafood Services Australia. 2005. Take your pick—the seafood EMS chooser, 2nd ed. Seafood Services Australia, Queensland. Available from: http://www.seafoodservices.com.au.

Sissenwine, M. P. and P. M. Mace. 2003. Governance for responsible fisheries: an ecosystem approach. Pages 363–390 *in* M. Sinclair and G. Valdimarsson, eds. Responsible fisheries in the marine ecosystem. CAB International, New York.

_____ and S. Murawski. 2004. Moving beyond "intelligent tinkering": advancing an ecosystem approach to fisheries. Mar. Ecol. Prog. Ser. 274: 291–295.

Staples, D. 1997. Indicators of sustainable development. Pages 719–725 *in* D. A. Hancock, ed. Developing and sustaining world fisheries resources: the state of the art and management: 2nd World Fisheries Congress. CSIRO Australia, Collingwood.

Ward, C. (compiler). 2003. Environmental management plan for Gulf of Carpentaria Commercial Fishermen Association Inc. 28 p. Available from: http://www.seafoodservices.com.au/files/goc_emp.pdf.

Ward, T., D. Tarte, E. Hegerl, and K. Short. 2002. Ecosystem-based management of marine capture fisheries. World Wide Fund for Nature Australia, Sydney. 80 p.

WCED (World Commission on Environment and Development). 1987. Our common future. Oxford Univ. Press, Oxford. 400 p.

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