Vol. 274: 269–303, 2004 | MARINE ECOLOGY PROGRESS SERIES
Mar Ecol Prog Ser | Published June 24

THEME SECTION

Perspectives on ecosystem-based approaches to the management of marine resources

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Introduction

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The urgent need to reduce the intense pressure and destructive power that modern fishing practices apply to the world's fisheries, and the oceans that support them, is now widely recognized (e.g. FAO 2002a, Hilborn et al. 2003). However, there is far less agreement over the exact levels to which fishing mortality must be reduced and over how to reduce the indirect effects of fishing (e.g. bycatch, destruction of the seafloor), in order to ensure sustainability of catches and the health of marine ecosystems. And this is to say nothing of disagreements over how these goals might be achieved. It has proven all too easy for various factions—including some fishery scientists—to blame our having arrived at the current crossroads on the ineffectiveness of existing management practices, and on the scientific advice that underlies it. Driven by these forces, and in recognition of the significant direct and collateral impacts that fishing imposes on marine ecosystems, an Ecosystem Approach to Fisheries (EAF) is rapidly being adopted by institutions charged with stewardship of the marine environment (e.g. NOAA 1999, Brodziak & Link 2002, FAO 2003, Garcia et al. 2003, Sinclair & Valdimarsson 2003). In conjunction with this EAF is the implementation of Marine Protected Areas (MPAs), including marine reserves. Both EAF and MPAs implicitly recognize that the value (to humanity) of the whole ecosystem is much greater than the sum of its parts—a commendable step forward in-and-of itself. However, there is some disagreement over whether the EAF, and MPAs, truly represent alternatives that will be any more effective in assisting us with sustainable management of marine resources than historical practices. Regardless of the approach that is taken to decide upon catch limits, or on the location, size and number of MPAs, there will always be the complicated (and socio-economically-politically charged) question of how these policies should be implemented and enforced; that is, governance (see, for example, Mace 2001, Sissenwine & Mace 2003, Caddy 2004, Cochrane 2004, Stefansson 2004). To address these issues, we solicited essay-style contributions from several of the marine and fishery scientists who are at the forefront of the ongoing debate. Those essays are presented here.

We will not use space summarizing the content of this Theme Section (TS)—we encourage you to read through it. Rather, we take this opportunity to highlight some of the most important conclusions that issue from the essays when they are taken as a whole and to add some commentary of our own. The acronyms used in this TS are listed in Table 1.

In the critical recommendation of such fishery management tools as limits on maximum fishing mortality, minimum spawning stock biomass, or total allowable catch levels, fishery scientists often disagree about seemingly subtle (to the layman) aspects of data analysis and interpretation. Although debates such as these are at the core of the scientific process, the fact that fishery scientists themselves do not always agree has been the focus of socio-political criticism, and is surely one of the reasons that advice on catch quotas is not often strictly heeded. In the case of the contributions to this TS, written by proponents sitting on both sides of the fence, there is a convincing consensus on most of the key issues. While there is disagreement over just

*Contributions are presented in alphabetical order (by first author)

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how severely depleted some fish stocks are, and on whether and how quickly they will recover, all agree that many stocks are overexploited. While there is some disagreement over just how much fishing must be reduced, all agree that current levels of overcapacity in the world's fishing fleets are not sustainable. While there is disagreement over equating MPAs and EAF, all agree that MPAs will complement other management tools, within an EAF or not. Thus, for each and every major issue, while there might be disagreement on the details, there is unanimity over the pressing need for action to protect marine ecosystems. And *that* must be made the focus of public attention.

Iles (1980) refers to '…a 'Bio-Energetic Multi-Species Ecosystem Dynamics (BEMUSED)… ' basis for setting catch quotas. This illustrates how the idea of taking an EAF is really nothing new, and it highlights that, unless we are truly more clever (and richer with data) than we were almost 25 yr ago, following EAF could leave us just as bemused, and/or muddled (see Hedgpeth 1977). Iles (1980) also stated that '…social, political, and economic factors are at least as important in fisheries management as the scientific knowledge of the resource.' This conclusion, arrived at 24 yr ago, is reiterated by several contributors to this TS—governance, and not science, remains the weakest link in the management chain (also see Hutchings et al. 1997, Harris 1998, Policansky 1998, FAO 2003, Cochrane 2004). Thus, even if we were able to provide managers with perfect scientific prediction, that alone will not help. Following from all of this, if there is any hope of succeeding with an EAF, or any real chance of controlling fishing, the organizations and institutions involved in the governance of marine resources will have to be totally revamped. The new structure will have to include stakeholders, social and political scientists, economists, lawyers, political lobbyists, educators, journalists, civil engineers, ecologists, fishery scientists and oceanographers, all operating in a conciliatory and integrative environment.

We hope that the following analogy will illustrate that it is untenable to ignore the counsel of fishery scientists, even when they disagree and/or provide advice that is based upon highly uncertain assessments (also see Stefansson 2004). If meteorologists say that a major storm is coming, people are relocated to safer places, and houses and buildings are boarded up. Even if the predictions about when and where the storm will hit—provided by extensive networks of expensive ground-based monitoring devices and weather satellites—are not very accurate (because the storm's behaviour is unpredictable), precautions are still taken, often over a very wide geographic area… *just in case*. This illustrates that society does not expect meteorologists to predict the weather with any degree of accuracy, yet we have somehow all learned to live with that, and take appropriate precautions nonetheless. In the face of this analogy, we must ask: why does society have higher expectations of fishery scientists with respect to their ability to accurately predict the numbers of fish that will be in the sea several years into the future? Further, why is it so difficult for fishery scientists to convince society, authorities, and stakeholders to take a precautionary approach towards the management and conservation of fish stocks (or whole ecosystems) (see Lotze's contribution to this TS)? Finally, if people are routinely relocated to a safe place when a potentially destructive storm is coming, why is it so difficult to recognize the inherent rights that marine fauna have to a safe haven (in the form, for example, of MPAs)? The international treaty represented by the Montreal Protocol on Substances that Deplete the Ozone Layer is another example of how society can respond when the stakes are high and the need is urgent: society *can* adopt and implement precautionary approaches to the management of the world's resources, even when there are complex mixtures of stake holders. Hopefully, we will be able to achieve the same for the world's marine ecosystems.

Table 1. Acronyms and their full forms used in the TS

Abbreviation/ acronym	Full name
BEMUSED	Bio-Energetic Multi Species Ecosystem Dynamics
CML	Census of Marine Life
EAF	Ecosystem Approach to Fisheries
EEZ	Exclusive Economic Zones
FAO	Food and Agriculture Organization
GIS	Geographic Information System
GLOBEC	Global Ocean Ecosystem Dynamic Programs
GOOS	Global Ocean Observing System
ICES	International Council for the Exploration of the Sea
ICNAF	International Convention for the Northwest Atlantic Fisheries
ITQ	Individual Transferable Quotas
IUCN	International Union for the Conservation of Nature
LME	Large Marine Ecosystem
MPA	Marine Protected Areas
MSY	Maximum Sustainable Yield
MVH	Member-Vagrant Hypothesis
NOAA	National Oceanic and Atmospheric Administration
OECD	Organisation for Economic Co-operation and Development
PISCO	Partnership for Interdisciplinary Studies of Coastal Oceans
UNDP	United Nations Development Plan
UNEP	United Nations Environmental Programme
TAC	Total Allowable Catch