Ecosystem based management (ebm) approaches

Marine environments are complex adaptive systems adjoined across multiple scales by ocean currents and species movements (Ruckelshaus et al, 2008). These ecosystems worldwide are in serious decline, primarily as a result of broadening anthropogenic pressures that exploit marine resources such as shipping, energy exploration, fisheries and tourism (MA, 2005; Curtin et al, 2010), which can alter natural ocean systems through habitat fragmentation, pollution, eutrophication, and biodiversity loss, as well as changing species composition by direct and indirect disturbance (Halpern, 2005). Seeing that no area on earth is unaffected by human pressures, these activities differ in their intensity of impact on the ecological health of biological communities at different spatial and temporal scales (Halpern, 2005). Up until now, traditional focus on single-species management has created organisational structures with pigeonholed decision-making processes, leading to restricted policy instruments that create policies that undermine sustainability (Crowder et al, 2008). Observable, deterioration of species, habitats and ecosystem services (ES) has provoked a growing consensus to develop a more holistic approach towards ecosystem based management (EBM) (USCOP, 2004). In this vein, this review will attempt to summarise some of the difficulties and challenges in the implementation of EBM with case studies.

In a broad sense, EBM is an integrated approach involving the wide-scale management of ecosystems as a whole, where all drivers and constituent impacts on ecosystem functioning is considered (Murawaski 2007). As such, these processes also incorporate stakeholder involvement, the integrated assessment of multiple “ drivers” or “ pressures” across marine environments (Curtin et al, 2010), an evaluation of taxonomic groups across biological hierarchies (Arkema et al, 2006), ocean-use sectors, scientific disciplines, and governance entities (Link 2014), plus a consideration of tradeoffs between multiple management objectives and the cumulative effects on ecosystem services (ES) resulting from management actions (Halpern 2008). A study by Pitcher (2009) attempted to evaluate the performance of 33 countries for the EBM of fisheries, which represents 90% of the worlds catch. To a worrying extent, no countries were rated as good, only four countries were `adequate', while 16/33 countries received fail grades (Pitcher, 2009). This study illustrates that only a few developed countries such as Australia, US, Canada, UK and Norway are clearly moving towards EBM, yet the few examples worldwide are small-scale fisheries or in their initial phases of development, thus EBM proponents are currently based in theory rather than tangible proof (Tallis, 2010).

The Millennium Ecosystem Assessment highlights the importance of incorporating ES into both governance and EBM dynamics (Olsson et al, 2008; MA, 2005; Young et al, 2007; Moreno et al, 2014). As such, ES provide key opportunities for industry and recreation, and have substantial cultural value (Leslie and McLeod, 2007). For instance, the tsunami in the Indian Ocean illustrates the function of wetlands in protecting human infrastructures from storm damage (Danielson et al, 2005). However, the severity and scale of human impacts reduces the capacity of marine ecosystems to provide ES to growing human populations, and the total loss of ES from 1997-2011 ranged between $4. 3 to 20. 2 trillion/year due to human-induced impacts (Costanza et al, 2014). Additionally, many ES are largely undervalued or are greatly over-valued by markets; nevertheless, they significantly contribute to human health (Harrison et al, 2014). In this context, it is critically important to understand the benefits of marine ecosystems in both ecological and economic terms (Leslie and McLeod, 2007; Borger et al, 2014).

EBM is foremost a policy objective involving various marine orientated organisations such as NOAA, UNEP, FAO, PICES and ICES (Link et al, 2014). However, one of the major problems is the paucity of common vision for the classification of units that management and planning are embarked on (Sloscombe, 1993), in conjunction with a lack of shared goals and objectives and a diversity of conceptual perspectives (Link et al, 2014), across resources, activities and sectors (McLeod and Leslie, 2009). For example, Baker et al (2014) suggests that characterising spatial and temporal boundaries may have a useful application to inform management in the Bering Sea for the integration of physical and community composition aspects. These types of spatial models use biogeographically defined units that incorporate physical structure, species distributions, habitat structure, and drivers that unite biological responses and species interactions, in order to organise marine ecosystems into multiple scales (Baker et al, 2014). These models are inherently a great concept since they may detect threshold shits in community structures, distributions of functional groups in individual species, shifts in multi-species groupings, as well as key identification of regions that have distinct biological features and regional boundaries (Baker et al, 2014). Additionally, enhanced management units should also incorporate ecosystem adaptability to build from existing units, and that the leading challenge is the creation of effective units for managers to make comparisons against (Sloscombe 1993). However, spatial modelling techniques do have a downside, since the indirect effects of biophysical changes in marine systems or considerations of climate change are not incorporated, inferring scientific uncertainty associated with these types of models, and inaccurate forward predictions.

A study by Corrie et al (2012) highlighted that tool-use such as spatial modelling to endorse EBM principles is recurrently causing frustrations from practitioners in relation to the complexity of use. Through interviews, this study revealed that EBM tool developers lacked sufficient funding to develop high quality tools, and there were reasons for these funding shortfalls. These types of software are designed by academics rather than software professionals, therefore tools are either procured at no cost or managers cannot afford licences or lack time to use low quality unmaintained products (Corrie et al, 2012). This study illustrates that without a fundamental shift in the development of tool making funding, the quantity of high quality EBM tools will reduce, and governmental mandates to implement EBM will continue to be unfulfilled (Corrie et al, 2012).

However, to effectively implement EBM mandates, managers need access to baseline environmental data that range across suitable temporal and spatial scales and that are directly related policy objectives (Sergeant et al, 2012). However, in many geographical regions, there remains a lack of credible historical and baseline data, and a lack of data sharing between sectors, which frequently results in meagre decision-making processes and environmental policy (Yaffee, 1997). This highlights that despite the acknowledgment of long-term data sets many fundamental data gaps still remain (Sergeant et al, 2012).

EBM requires collaboration across political boundaries, jurisdictions, and between disciplines and professions (Harrison et al, 2014). However, the construction of a collaborative network between multi-sectors to achieve common goals is thwarted with difficulty (16). For instance, Wondolleck and Yaffee (2005) highlight that the role of individuals at the level of organisation is a vital step for the facilitation of collaborative EBM developments, documenting that distrust, group attitudes, and conflicting organisational culture can hamper such processes, instead of creating coherence of policy between sectors (Leslie and Rosenberg, 2005). For instance, a case study for ground fisheries in Maine by Brewster (2011) showed a mismatch of conflicting mandates between catch shares (individual quota system) and EBM. Catch shares diverted attention from EBM such as migratory patterns and trophic relationships to single species management; yet in 2010, the Obama Administration endorsed a mandate for EBM. Likewise 87 to 90 % of fishermen were against catch shares, creating policy conflicts at local levels (Brewster, 2011). Therefore, an alliance of fisheries, marine scientists and non-governmental organisations drafted a proposal to implement EBM for the area of Maine. However, New England’s Council rejected the notion based on a lack of scientific data. This study highlights that conflict between collaborative entities and insufficient data quality is one of the major challenges for the implementation of EBM.

It is clear that piecemeal management approaches have not worked, as evidenced by the collapse of fisheries in current times (Arkema 2006), and that EBM is the optimal way to manage marine ecosystems. A good example is the successful transition of the Great Barrier Reef towards EBM due to the collaborative efforts of multiple sectors. Additionally, the usage of spatial and temporal modelling is an advantageous tool to nest economic and socio-ecological issues into a large area management. However, human conflict obstructs and delays the implementation of EBM

References:

(Arkema. K., 2006)

(Brewster. J. F., 2011)

(Borger. T., 2014)

(Corrie. C., 2012)

(Constanza. R., 1998)

(Costanza. R., 2014)

(Danielson. F, 2005)

(Danter. J., 2000)

(Guerry A., 2005)

(Halpern B., 2008)

(Harrison. P. A., 2014)

(Leslie. M., 2007)

(Link. J. S., 2014)

(McLeod. K., 2009)

(Murawski. S., 2007)

(O'Leary. R., 2006)

(Olsson. P., 2008)

(Commission, 2003)

(Assessment), 2005)

(Rosenberg. A., 2005)

(Ruckelshaus. M., 2008)

(Sergeant. J., 2012)

(Szaro. R., 1998)

(D, 1993)

(Tallis. H., 2010)

(Policy), 2004)

(Wondolleck. J., 2000)

(Worm. B., 2006)

(Young. R., 2007)