Ecosystem Based Management

Introduction

Until recently, the great majority of coral reef management projects have focused on immediate local threats and not on upland or watershed activities, or other non-point sources of impact. Many projects focus on small areas of a large ecosystem and fail to take ecological and social linkages into consideration. The management of the surrounding areas is often the major driver of changes within the managed area. Efforts to achieve holistic management must consider not only the fish and the coral reef resources but also the ecological, social, economic, and political aspects that involve all stakeholders. A key component of such a strategy would be promotion of healthy coral reef ecosystems by ensuring that economic development is managed in ways that maintain biodiversity and long-term productivity for sustained use of these systems (Crosby et al. 2002).

The primary goals of ecosystem-based management are to:

1. Integrate wise land use and watershed management practices with coral reef management under integrated coastal management umbrella.
2. Apply a holistic, ecosystem-based approach to all human use and impacts relevant to coral reef management.

Threats or barriers to successful ecosystem management include:

- Lack of participation between terrestrial and marine management agencies and industry.
- Lack of awareness of terrestrial or airborne impacts on the marine and coastal environment.
- The complexity of holistic management plans.
- There is a large number of different stakeholder and user groups to involve.

Key Lessons Learned and Recommendations

Integrated Coastal and Watershed Management

- EBM approach is necessary for projects covering large areas or small components of larger ecosystems.
- Management of coral reefs should be addressed through integrated and holistic management of related ecosystems and land uses.
- EBM/ICOM should be informed by science but care must be taken in translation between th advocacy vs. objective technical advisory role of science.

- Management regimes that are designed to meet community goals can achieve greater compliance and subsequent conservation success than regimes designed primarily for biodiversity conservation.
- Local action plans should be based on locally perceived threats/issues and sound data on local resource status.
- Iconic species and charismatic habitats can be useful for marketing an EBM approach.
- Tactical guidance which includes managing coastal systems at watershed scales, emphasizing monitoring, using area-based management and incorporating the recognition of uncertainties into decision making; is crucial to inform the transition of a fundamental shift in the management of activities to an ecosystem management for the oceans.
- Coastal marine system researches highlight the importance to recognize the connections, to expect surprises and to take precautions. It is important to maintain the full range of components and processes within systems in order to maintain the full range of ecological interactions, and to aim for resilience rather than for desired end-points.
- Tactically, management should occur at ecologically relevant scales such as watersheds, monitoring the status and trends of systems over long time periods and incorporating marine protected areas and marine reserves into management frameworks.
- Uncertainties must be incorporated into decision making, using insurance policies and enhancing our understanding of marine systems in order to better understand the effects of human actions.

Marine Protected Areas (MPAs)

- Coral-reef conservation based on large MPAs with weak enforcement may be ill-suited to the social, economic, and cultural context of many communities within the center of coral diversity, and insistence on these conservation methods may lead to polarization between national-government regulators and local communities.
- MPAs are often “sold” to fishing communities on the basis that increased catches due to spillover and enhanced recruitment from spawning in the MPA will more than make up for lost fishing grounds, increased effort and higher costs of fishers displaced from the MPA. To date, this assumption has never been proven. Spillover is generally measured as movement of biomass out of an MPA, with no concomitant measurement of biomass moving into the MPA. The net difference is the true measurement of spillover and has only ever been demonstrated for one species in one location.
- Given the complex nature of coral reef ecosystems, comprehensive biological and biophysical datasets are key to designing MPA networks. Before planning national or regional MPA networks, research is needed to determine critical spawning and nursery habitats, connectivity pathways (through tagging or physical oceanographic studies), and resilience of habitats, ecosystems, and livelihoods.

- The socioeconomic conditions and needs of communities must be a core focus if MPA management objectives are to be achieved. Formal workshops, participatory training exercises and identifying opportunities for community development built trust and achieved stewardship of the MPA planning process among communities.

Fisheries

- There has been a tendency to abandon contemporary Western approaches to fisheries management (e.g. quotas, bag limits, size limits, gear restrictions, market or export restrictions, etc.) in favor of MPAs. In many cases, however, these approaches may be of value in place of (or in addition to) MPAs. When planning reef fisheries management, realize that MPAs are only one tool from a wide array available to managers. Other methods of restricting catch and/or effort are valuable, do not displace fishers, and may cause fewer conflicts between fishers and other reef resource users.
- Replenishment closures can be very effective but it is important to assess inter-annual recruitment variability that results in increased fish stocks regionally and can overshadow any effect of closure.
- Not all fish species will respond in a similar fashion, thus the design of the closure should be particular to accommodate the target species to be replenished.
- Annual underwater monitoring of fish stocks is very necessary to detect inter-annual change in fish stocks. The information on fishing activity and community perceptions following the reopening of a temporary closure of a coral reef (for fish stock replenishment) is important for changes in resource allocation.

Pollution and Sedimentation

- Accumulated sediment is a lethal legacy for coastal coral reefs undergoing phase shifts due to nutrient input and the overfishing of grazing herbivorous species.
- Sediments are often resuspended by waves, preventing larval recruitment and thus the recovery of affected populations. Sediments also serve as a repository of pollutants associated with anoxic bottom sediments.
- Management must integrate issues of sedimentation and sediment re-suspension must into efforts at coastal reef protection, or further declines in resources will continue to occur.

Habitat Restoration

- While coral reef restoration activities are conceptually attractive, proactive and protective measures are essential, given the magnitude of coral reef damage, the complexity of coral reef ecological structure and function, and the fact that a 300-year-old coral can be killed in hours to weeks, but cannot be replaced for centuries.
- Monitoring of restoration projects is essential if we are to learn from past mistakes and past good-practice. Without it, you can evaluate neither the success

nor cost effectiveness of restoration, nor carry out adaptive management if needed constraints.

- Consider restoration not as a one-off event but as ongoing process over a time-scale of years which is likely to need adaptive management constraints.
- Setting up and monitoring of a few comparable “control” areas where no active restoration has been attempted is recommended. These provide a clear baseline against which you can evaluate the cost-effectiveness of your restoration interventions constraints.
- Consider how much monitoring can be feasibly undertaken (both detail and frequency) but be realistic. Better a little carefully and regularly collected data than a lot of poorly and irregularly collected data constraints.
- Routine maintenance visits to the restoration site are recommended. They are likely to be very cost-effective given the expense of active restoration and could prevent wholesale loss of transplants to predators.