Aloha ʻĀina

Bringing together innovative ideas and relevant literature to develop a collective approach for sustainably managing natural resources in Hawai'i.

Capstone Final Report
16 June 2012

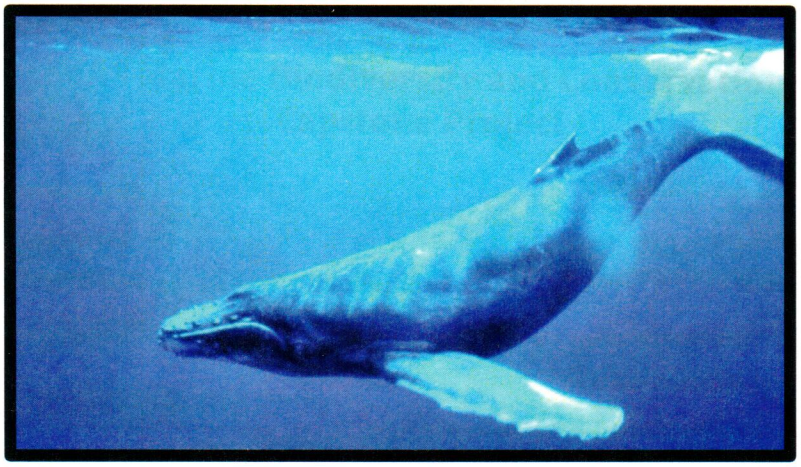

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*photo from www.wikipedia.com

Capstone Advisory Committee Final Capstone Project Signature Form

Aloha ʻĀina

Bringing together innovative ideas and relevant literature to develop a collective approach for sustainably managing natural resources in Hawaiʻi.

Tamara Mayer

Spring 2012
MAS Marine Biodiversity and Conservation
Capstone Project

Capstone Advisory Committee

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INTRODUCTION

NOAA's Hawaiian Islands Humpback Whale National Marine Sanctuary (HIHWNMS) is undergoing a management review process, as required by law every 5 years, to consider evolving from its current status as a sanctuary that manages a single species, the humpback whale (*Megaptera novaeangliae),* to a sanctuary that uses an ecosystem-based approach to manage all of the biocultural resources within its boundaries [1]. The revised plan will be built upon both Native Hawaiian and Western scientific principles. Other state and federal agencies in Hawai`i are also beginning to define and implement a similar approach to natural resource management [2,3]. Hawaiians have been successfully managing their natural resources for thousands of years, long before "western" contact [4, 5]. Established in 1992, the HIHWNMS has an opportunity to advance the assimilation of Native Hawaiian and Western scientific management approaches with the development of this revised management plan. Progress made toward creating and implementing a management plan that bridges the gap between Native Hawaiian and Western scientific groups by uniting the knowledge and culture of Native Hawaiians can also be used as a model for other Sanctuaries and marine protected areas around the world with local indigenous peoples.

My Capstone Project consists of (3) parts. First, a literature review examining Ecosystem-Based, Customary and Collective management approaches in the Pacific, and the compilation of an annotated bibliography, table of key terms and case studies from the literature. Second, based on this background reading and my work experiences in Fiji and Hawai`i, I developed (3) brief case studies that serve as examples of different management systems that share a common goal of utilizing customary knowledge to sustainably manage natural resource use. Lastly, I developed an analysis of the core concepts I consider fundamental to successfully uniting Ecosystem-Based and Customary practices into a Collective management approach. This includes ideas for a Hawai`i specific Collective approach, Aloha `Āina, and discussion of current and future products of this Capstone Project.

ANNOTATED BIBLIOGRAPHY

Investigating Ecosystem-Based Management, Customary Management, and Collective Management in the Pacific

**Literature organized by topic and date*

ECOSYSTEM-BASED MANAGEMENT

Sievanen, L., Campbell, L.M., and Leslie, H.M. (2012). Challenges to Interdisciplinary Research in Ecosystem-Based Management. *Conservation Biology*. DOI: 10.1111/j.1523-1739.2011.01808.x

ABSTRACT: Despite its necessity, integration of natural and social sciences to inform conservation efforts has been difficult. We examined the views of 63 scientists and practitioners involved in marine management in Mexico's Gulf of California, the central California coast, and the western Pacific on the challenges associated with integrating social science into research efforts that support ecosystem-based management (EBM) in marine systems. We used a semi structured interview format. Questions focused on how EBM was developed for these sites and how contextual factors affected its development and outcomes. Many of the traditional challenges linked with interdisciplinary research were present in the EBM projects we studied. However, a number of contextual elements affected how mandates to include social science were interpreted and implemented as well as how easily challenges could be addressed. For example, a common challenge is that conservation organizations are often dominated by natural scientists, but for some projects it was easier to address this imbalance than for others. We also found that the management and institutional histories that came before EBM in specific cases were important features of local context. Because challenges differed among cases, we believe resolving challenges to interdisciplinary research should be context specific.

ANNOTATION: Sievanen et al. explore the meaning of ecosystem-based management, specifying the ecosystem, including humans, be part of the management process and that interaction of multiple knowledge bases are necessary to advise management decisions governing human interactions with nonhuman components of the system. The authors examined six ecosystem-based management projects in four different geographic areas (Fiji, Palau, Mexico and California) where they investigated what "including humans" means in terms of management. All six project were inspired by undesirable environmental changes and all six projects expressed the need for both conservation and human well-being objectives. The authors comment that ecosystem-based management is supposed to be interdisciplinary in nature; however, all of the projects examined were criticized for not adequately incorporating social science. Furthermore, all projects

investigated portray the implementation of ecosystem-based management differently, likely because of geographic factors.

Implementation of ecosystem-based management in this particular Fiji example meant priority was given to applying important ecological criteria followed by the integration of socioeconomic information and traditional knowledge. The project in Fiji was more focused on the ecological aspects of concern, the personnel was ecologically oriented, and more money was spent on the ecology of the region than on socioeconomic aspects. This concept is new for many communities in Fiji as this country is recognized worldwide for its successful implementation of community-based management where the "roles of science and society are based on participatory theories and methods, whereas ecosystem-based management can encompass a variety of science-society interactions". Overall, the authors note that challenges faced in the regions attempting to implement ecosystem-based management differed on the basis of how it was interpreted by project employees and how the concept of ecosystem-based management was formed by "specific social, political and institutional contexts at the location and how context defined the kinds of social science involved". Regardless of region, the authors encourage ecosystem-based management efforts to incorporate more social scientists. This paper revealed that the ecosystem-based management field is currently dominated by natural scientists. Social scientists and natural scientists think about management questions differently, thus collaboration between the two groups could prove to be beneficial if approached correctly. This would ensure the needs of multiple sectors would be met in managing resources by an ecosystem-based management approach.

Authors included a few key questions that could be included in planning discussions:

- How can one understand (not just change) the human behavior of interest?
- Which disciplines within the social sciences can best contribute to this understanding?
- How might research be structured if different knowledge bases-TEK, social science, and natural science-support different understandings of the coupled natural and human systems or possible policy or management alternatives?
- What theoretical or analytical frameworks can be used to bring different data sets together?

Decision Guide: Selecting Decision Support Tools for Marine Spatial Planning PacMARA and Center for Ocean Solutions. (2011).

NO ABSTRACT AVAILABLE

ANNOTATION: This document defines and discusses marine spatial planning (MSP) as well as several of the tools that can be employed to implement MSP. Other terms used interchangeably with MSP include maritime spatial planning, integrated ocean management and systematic conservation. This guide defines MSP as "**decision-**

making approaches that use scientific and geospatial information to address conflicts and organize human activities in the ocean, while maintaining ecosystem health, function and services".

The guide outlines eight MSP tools. I discuss 3 of the 8 tools below, those widely used in the literature or that I thought were most user-friendly:

- *Atlantis*: intended for long-term decision-making; allows users to test management policies and assessment methods against representations of complex ecosystems
    - primarily used in fishery applications
    - allows users to identify trade-offs between and among species, gear types, management goals, and the direct and indirect effects of different management policies
    - tackles issues related to marine habitat, nutrients, and biodiversity
- *Invest*: identifies where ecosystem services are provided and used, and relates resource management decisions to the economy, human well-being, and the environment
    - shows where trade-offs and synergies may occur between and among different ecosystem services and biodiversity
- *MarineMap*: developed to encourage stakeholders to get involved by providing access to large amounts of authoritative geospatial information so they may suggest marine protected area boundaries that meet both their needs and requirements of the law

The decision guide also lists a website that outlines and links the public to an ecosystem-based management tool database: http://ebmtoolsdatabase.org/. These tools can be utilized to help develop a site-specific ecosystem-based management strategy. The tools offer a wide range of services including ones designed to involve stakeholders, investigate ecosystem services, habitat, topography/bathymetry, economic valuation, climate, etc. I describe a few user-friendly tools below:

- *AmericaSpeaks 21st Century Town Meeting/Brainstory Anywhere*: stakeholder involvement and engagement in management process
- *CLAM*: allows stakeholders to assess the social, economic and environmental trade-offs associated with development, remediation and use options for coastal lakes and estuaries
- *ConnIe*: connectivity in marine ecosystems
- *CommunityViz*: help people visualize, analyze and communicate about important land-use decision
- *Costing Nature*: analyzes ecosystem services provided by natural environments, identifying beneficiaries of these services and assessing impacts of human interventions

Examples of Ecosystem-Based Management in National Marine Sanctuaries: Moving from Theory to Practice. (2010). Marine Sanctuaries Conservation Series ONMS-10-02. NOAA.

NO ABSTRACT AVAILABLE

ANNOTATION: This paper was developed by a group of graduate students that investigated the role of the Office of National Marine Sanctuaries in developing and implementing ecosystem-based management within the Sanctuary sites during a semester seminar course. A series of case studies was produced that examine co-management strategies, stakeholder engagement, ecosystem-based management in policy language, marine zoning and emerging tools for ecosystem-based management implementation.

The section of this document that was of particular interest was the section discussing case studies that look at tools the Sanctuaries are actively using for ecosystem-based management implementation. This includes the *Papahanumokuakea Marine National Monument* and *Channel Islands National Marine Sanctuary.* The authors note that tools support successful implementation of EBM by "allowing for inclusion of numerous stakeholders, addressing multiple uses, and providing guidance on how to protect habitat and biodiversity while minimizing conflict". The Monument is utilizing an approach that combines stakeholder involvement with use of a spatial conservation-planning tool to implement EBM. Specifically, critical ecosystem benefits and cumulative impacts are identified and prioritized, and resource vulnerabilities defined, by involving and engaging many stakeholder groups. These priorities and vulnerabilities are incorporated into a site-based algorithm for marine spatial planning by overlaying the vulnerabilities with the threats. This approach was deemed to be useful because it informs the managers about what resources are most valued by stakeholders as well as which resources are most threatened. This data could be incorporated into maps using GIS for ecosystem-based management analysis and decision-making by agencies.

The *Channel Islands National Marine Sanctuary* utilized a Cumulative Impacts Tool (CIT), an "ecosystem-specific multi-scale spatial model" to determine site-specific ecosystem vulnerability and prioritize mitigation actions. Specifically, this tool "incorporates spatial information on marine habitats and the intensity of stressors associate with human activities and calculates the impact of those stressors on marine ecosystems based on the unique vulnerability of each ecosystem to each stressor".

Foley, M.M., Halpern, B.S., Micheli, F., Armsby, M.H., Caldwell, M.R., Crain, C.M., Prahler, E., Rohr, N., Sivas, D., Beck, M.W., Carr, M.H., Crowder, L.B., Duffy, J.E., Hacker, S.D., McLeod, K.L., Palumbi, S.R., Peterson, C.H., Regan, H.M., Ruckelshaus, M.H., Sandifer, P.A., and Steneck, R.S. (2010). Guiding Ecological Principles for Marine Spatial Planning. *Marine Policy*, 34, 955-966.

ABSTRACT: The declining health of marine ecosystems around the world is evidence that current piecemeal governance is inadequate to successfully support healthy coastal and ocean ecosystems and sustain human uses of the ocean. One proposed solution to this problem is ecosystem-based marine spatial planning (MSP), which is a process that informs the spatial distribution of activities in the ocean so that

existing and emerging uses can be maintained, use conflicts reduced, and ecosystem health and services protected and sustained for future generations. Because a key goal of ecosystem-based MSP is to maintain the delivery of ecosystem services that humans want and need, it must be based on ecological principles that articulate the scientifically recognized attributes of healthy, functioning ecosystems.
These principles should be incorporated into a decision-making framework with clearly defined targets for these ecological attributes. This paper identifies ecological principles for MSP based on a synthesis of previously suggested and/or operationalized principles, along with recommendations generated by a group of twenty ecologists and marine scientists with diverse backgrounds and perspectives on MSP. The proposed four main ecological principles to guide MSP—maintaining or restoring: native species diversity, habitat diversity and heterogeneity, key species, and connectivity—and two additional guidelines, the need to account for context and uncertainty, must be explicitly taken into account in the planning process. When applied in concert with social, economic, and governance principles, these ecological principles can inform the designation and siting of ocean uses and the management of activities in the ocean to maintain or restore healthy ecosystems, allow delivery of marine ecosystem services, and ensure sustainable economic and social benefits.

ANNOTATION: Foley et al. define *marine spatial planning* (MSP) as an "integrated planning framework that informs the spatial distribution of activities in the ocean so that existing and emerging uses can be maintained, use conflicts reduced, and ecosystem health and services protected and sustained for future generations". Furthermore, MSP is a process oceans depend on because it is a management framework that "balances the increasing number, diversity, and intensity of human activities with the ocean's ability to provide ecosystem services, incorporates appropriate ecological, economic, social and cultural perspectives, and supports management that is coordinated at the scale of ecosystems as well as political jurisdictions". This process designates authority, incorporates stakeholder participation, analyzes current and future ocean uses, and emphasizes enforcement, monitoring and adaptive management. Canada's Eastern Scotian Shelf Integrated Management project (ESSIM) appropriately utilizes stakeholder engagement to assess human uses and ecosystem features, and evaluates the interactions between these components to develop management objectives that encourage ecological well-being and sustainable human use of resources. The ESSIM project is a great example of utilizing the appropriate tools and planning process to achieve to goals of ecosystem-based MSP.

This paper discusses marine protected areas (MPA) designation and MSP, differentiating between the two by their goals (conservation v sustainable delivery of ecosystem services) but also noting that their goals are partly related and therefore there is value in looking at both MPAs and MSP for ecosystem-based principles, goals and lesson learned when developing management strategies.

The authors stress that ecological principles can be employed in an ecosystem-based management framework by guiding goals and objectives of the process.

Additionally, ecological principles can be utilized to make initial important spatial demarcations by using population data for the specific region, habitat diversity and heterogeneity information, and spatial arrangement data ensuring connectivity. All of these areas would be compared with socioeconomic goals to help determine which areas also provide ecosystem services.

Finally, the authors recommend that ecosystem-based MSP also satisfy several other objectives in order to be successful and effective. Stakeholders must be involved and participate throughout the process. The framework must display a thorough understanding and appreciation of the existing ocean policy, governance and management structure. Finally, MSP must be implemented within a framework that "ensures real public accountability, independent decision making, adaptive management, dependable funding, meaningful public and stakeholder participation, and public transparency".

Hoel, A.H. (ed.) (2009). Best Practices in Ecosystem-based Oceans Management in the Arctic. The Norwegian Polar Institute.

NO ABSTRACT AVAILABLE

ANNOTATION: This document discusses the status of ecosystem-based management in the Arctic from the perspective of countries that are currently managing ocean resources in the region. I discuss two sections: Ecosystem-based management in the United States and Ecosystem-based management in the Canadian Arctic.

Ecosystem-based management in the United States
The National Oceanic and Atmospheric Administration (NOAA) is the federal leader in defining and implementing this management strategy for protection and conservation of marine resources. The US defines ecosystem-based management as an "**an approach that requires that development activities be coordinated in a way that minimizes their impact on the environment and integrates thinking across environmental, socio-economic, political and sectoral realms**". The status of implementation in Arctic waters is "in progress".

A few key elements of ecosystem-based management in the US:

- emphasizes the protection of ecosystem structure, functioning, and key processes
- place-based
- explicitly accounts for the interconnectedness within systems, recognizing the importance of interactions between many target species or key services and other non-target species
- acknowledges interconnectedness among systems, such as between air, land and sea
- integrates ecological, social, economic, and institutional perspectives, recognizing their strong interdependences (based on information from Scientific Consensus Statement on Marine EBM, 2005)

NOAA took the lead on developing an ecosystem-based management strategy for successful management of ocean resources in response to the 2004 US Ocean Action Plan. This strategy was created with two goals in mind, ensure the protection of healthy and productive marine ecosystems that provide beneficial services to society and ensure the public is well informed about the strategy so they may act on behalf of coastal and marine ecosystems. Currently, NOAA has declared 8 ecosystems (regional) that also serve as the units of analysis for Integrated Ecosystem Assessments (IEAs). These are NOAAs primary means of implementing the ecosystem approach and are spatially based, scalable assessments that have 3 components:

- Monitoring
- Analysis of status and trends in space and time
- Integration and forecasting

NOAA is focusing current ecosystem-based management efforts in **Large Marine Ecosystems (LME)** or "regions of ocean space of about 200,000 km^2 or greater that encompass coastal areas from river basins and estuaries out seaward to the break or slope of the continental shelf, or out to the seaward extent of a well-defined principal current". The boundaries of these LMEs are defined by ecological criteria (i.e. bathymetry, hydrography, marine productivity and trophically linked populations). Management of the LMEs is centered around using a 5 component approach to ecosystem-based management that includes: **productivity, fish and fisheries, pollution and ecosystem health, socioeconomics, and governance.** NOAA is working with a suite of government and NGO partners to promote the use of LMEs for sustainable management of coastal and marine resources worldwide. A global network of LMEs would also link healthy, biodiversity-rich ecosystems with poverty alleviation and sustainable coastal and marine resource development. Currently, 110 countries, a network of 2500 scientists, marine specialist and resource managers are participating in 16 international LME projects. A plan is being developed for the Arctic.

Example: North Pacific Fisheries Management Council (NPFMC) has adopted an EBM approach for management of the EBS LME groundfish fishery through a 1.4-2.0 million metric ton Optimum Yield approach since 1982 that has maintained the health of the fisheries resources and stabilized the fisheries catch. Implemented a large-scale closure of marine areas along the Aleutians to protect cold coral and essential fish habitats.

Ecosystem-based management in the Canadian Arctic:
Canada is actively implementing ecosystem-based management strategies in the Arctic. Canada's definition of ecosystem-based management "**involves managing human activities in such a way that marine ecosystems health is not significantly impacted**". Key factors that help define how Canada intends to implement this strategy include: involving multiple disciplines, basing management on the best available knowledge, incorporating the precautionary principle and adaptive management principles, place-based, developing a strategy on a national

basis and implement it regionally, implement the strategy in phases and apply principles within the more expansive context of integrated management.

Canada is currently implementing an ecosystem-based management integrated ocean management approach in the Beaufort Sea. This region is co-managed by the Inuvialuit and Government of Canada as outlined by the Inuvialuit Land Claim Agreement for the Settlement Region (signed in 1984) and both the Inuvialuit and Government of Canada share resource management responsibilities in the land claim area. As part of this management strategy, the first Oceans Act marine protected area was created in Canadian Arctic water and the Inuvialuit Fisheries/Government of Canada Joint Committee was created for the co-management of "several fish and marine mammal stocks and collection of ecological knowledge through partnerships for scientific research and monitoring". Challenges that surround implementation of this strategy in the Arctic include lack of knowledge of the ecosystem area throughout winter and uncertainty about ecosystem stressors including climate change, disease and contaminants. Overall, this holistic, collaborative ecosystem-based management approach has been well-received and supported in the region.

The **Canada-Greenland and Beluga-Narwhal Management** scenario is an example of a region that needs an ecosystem-based management approach implemented but the implementation process remains to be a challenge because of disagreements that exist between scientists and hunters over beluga and narwhal abundance. Canada moved to protect the narwhal over wintering grounds in 2006 by limiting fishing gear, but this region is also an important halibut fishing ground and fishers have favored protecting their short-term target species capital over ensuring the long-term sustainability of the ecosystem.

Levin P.S., Fogarty, M.J., Murawski, S.A., and Fluharty, D. (2009). Integrated Ecosystem Assessments: Developing the Scientific Basis for Ecosystem-Based Management of the Ocean. PLoS Biol 7(1): e1000014. doi:10.1371/journal.pbio.1000014

NO ABSTRACT AVAILABLE

ANNOTATION: This is a **THEORETICAL PAPER** that defines ecosystem-based management and outlines "integrated ecosystem assessments" as a five-step process for organizing science and supporting societal interests in order to inform decisions in marine ecosystem-based management.

Ecosystem-based management is defined as a strategy for managing whole systems that includes humans as an integral component of the ecosystem. Humans are considered integral components because of the services humans derive from the ocean that directly impact the health of ecosystems. Ecosystem-based management strategies consider these ecosystem services, their impacts, and interactions between ecosystem components and management sectors. Levin et al. stress the

importance of understanding the whole system in order to successfully preserve and protect marine ecosystems and the services they provide to humans and the environment.

This paper also explicitly discusses "***integrated ecosystem assessments***" and I have outlined the 5-step process, presented in the paper, with important points.

1. Scoping
    a. Identify ecosystem objectives/threats
    b. Identify critical management drivers:
        i. pressures get stakeholders involved because interests and issues cross ecological, social, and political boundaries
        ii. resources are subject to multiple users/uses
    c. Identify appropriate governance structure
2. Indicator development
    a. Serve as proxies for ecosystem attributes of interest (resistance to change, resilience to perturbation, or maintenance of critical service functions)
    b. Indicators should be directly observable, understood by general public, cost-effective
3. Risk analysis: Identify risk posed by humans and natural processes
4. Management strategy evaluation
5. Ecosystem assessment

Levin, S.A., and Lubchenco, J. (2008). Resilience, Robustness, and Marine Ecosystem-based Management. *BioScience*, 58(1), 27-32.
http://www.bioone.org/doi/full/10.1641/B580107

ABSTRACT: Marine ecosystems provide essential services to humans, yet these services have been diminished, and their future sustainability endangered, by human patterns of exploitation that threaten system robustness and resilience. Marine ecosystems are complex adaptive systems composed of individual agents that interact with one another to produce collective effects, integrating scales from individual behaviors to the dynamics of whole systems. In such systems, small changes can be magnified through nonlinear interactions, facilitating regime shifts and collapses. Protection of the services these ecosystems provide must therefore maintain the adaptive capacities of these systems by preserving a balance among heterogeneity, modularity, and redundancy, tightening feedback loops to provide incentives for sound stewardship. The challenge for management is to increase incentives to individuals, and tighten reward loops, in ways that will strengthen the robustness and resilience of these systems and preserve their ability to provide ecosystem services for generations to come.

ANOTATION: This is a **THEORETICAL PAPER** that defines and discusses the concept of ecosystem-based management for the oceans. Ecosystem-based management is defined as the "application of ecological principles to achieve management of key activities affecting the marine environment". The ultimate goal is to attain sustainable marine ecosystems for future generations and this is

achieved by developing ecosystem-based management strategies that are defined on an ecological basis and that consider the interactions between human and non-human species and their habitats. The authors stress the importance of thinking about management from the perspective of whole systems (i.e. ecosystems) because a healthy, biodiversity-rich marine ecosystem is more resilient and more likely to provide sustainable ecosystem services. There are a suite of services that marine ecosystems provide including provisioning services (food and habitat), regulating services (regulation of coastal erosion, climate and disease outbreaks), supporting services (primary production, sequestration of pollutants, nutrient cycling), and cultural services (spiritual, religious, recreational and aesthetic). The hardest part of ecosystem-based management is finding effective ways to implement this concept so future generations can benefit from healthy, robust ecosystems and the services they provide. Specifically, Levin and Lubchenco stress the biggest "**challenge for management is to increase incentives to individuals, and tighten reward loops, in ways that will strengthen the robustness and resilience of these systems and preserve their ability to provide ecosystem services for generations to come**".

Ruckelshaus, M., Klinger, T., Knowlton, N., and DeMaster, D.P. (2008). Marine Ecosystem-based Management in Practice: Scientific and Governance Challenges. *BioScience*, 58(1), 53-63.
http://www.bioone.org/doi/full/10.1641/B580110

ABSTRACT: Ecosystem-based management (EBM) in the ocean is a relatively new approach, and existing applications are evolving from more traditional management of portions of ecosystems. Because comprehensive examples of EBM in the marine environment do not yet exist, we first summarize EBM principles that emerge from the fisheries and marine social and ecological literature. We then apply those principles to four cases in which large parts of marine ecosystems are being managed, and ask how including additional components of an EBM approach might improve the prospects for those ecosystems. The case studies provide examples of how additional elements of EBM approaches, if applied, could improve ecosystem function. In particular, two promising next steps for applying EBM are to identify management objectives for the ecosystem, including natural and human goals, and to ensure that the governance structure matches with the scale over which ecosystem elements are measured and managed.

ANNOTATION: This is a **THEORETICAL PAPER** that discusses the concept of ecosystem-based management and outlines factors that must be achieved for successful implementation.

Ruckelshaus et al. stress the importance of considering factors that drive human use of ecosystem services and assess the subsequent impacts on the health of the ecosystem when formulating an ecosystem-based management approach. Ecosystems are intimate systems that are "linked across multiple scales by flow of water and species movement" and humans play an influential role in this system.

Marine ecosystems are extremely susceptible to changes in biodiversity and function and human behavior influences this susceptibility. A goal of ecosystem-based management is to strengthen and protect ecosystem structure and health because a healthy, biodiversity-rich ecosystem is more likely to be resilient to environmental change and be able to maintain redundancies. This will allow ecosystems to better provide sustainable ecosystem services for future generations.

The authors recommend specific factors that must be adhered to in order to successfully implement an ecosystem-based management approach: "**balance the interests of diverse stakeholder groups, consider the status of both target and non-target species, incorporate networks of MPAs to protect habitats and their associated biota, and adapt an overarching system of ocean zoning to coordinate regulations of human activities in particular areas at particular times**". Suggestions for incorporating marine protected area (MPA) usage as a tool to implement ecosystem-based management include finding areas where habitats that serve the needs of many species throughout multiple life stages exist. MPAs should not be employed in regions where managers are protecting and conserving highly migratory species or in regions facing significant threats like climate change or disease.

Arkema, K.K., Abramson, S.C., and Dewsbury, B.M. (2006). Marine ecosystem-based management: from characterization to implementation. *Frontiers in Ecology and the Environment,* (4), 525–532. http://dx.doi.org/10.1890/1540-9295(2006)4[525:MEMFCT]2.0.CO;2

ABSTRACT: Over the past decade, policy makers, management agencies, and academic scientists have shown increasing interest in ecosystem-based management (EBM). Yet, the extent that EBM principles, deemed important by scientists, are adopted by managers is still uncertain. Here, we review scientific definitions of EBM and management plans for eight marine and coastal ecosystems to determine if management agencies and academics are approaching EBM in a similar manner. Although the scientific literature outlines specific ecological and social principles of EBM, we find that these details are only loosely incorporated into management plans and actions. Our results indicate that some principles of EBM are being put into practice, but the gap between the scientific literature and management plans suggests that these concepts need to be more effectively translated. Our results also reveal a need for operational tools to make scientific principles easier to put into practice, to further the implementation of EBM.

ANNOTATION: Arkema et al. discuss the concept of ecosystem-based management in this paper and focus on the implementation success of key ecosystem-based management principles in 8 management plans. The authors also point out reasons for unsuccessful implementation of principles scientists deemed important but not adopted by mangers.

First, there are numerous theoretical descriptions of ecosystem-based management

that exist in the literature. It is important to identify one commonly accepted definition that is simple yet descriptive and in easy-to-understand language so that resource managers can effectively communicate and implement ecosystem-based management principles. The definition from this paper that best fits this description is, "integrated management of human activities based on knowledge of ecosystem dynamics to achieve sustainable use of ecosystem goods and services, and maintenance of ecosystem integrity".

Second, the authors point out the disconnect that exists between scientists that determine which principles of ecosystem-based management are important and the resource managers that actually adopt and incorporate the principles into management plans. This may be the result of hard-to-understand language, too many definitions without any description for how to implement the concept or even a lack of communication for which principles are important and necessary to implement for successful management by ecosystems.

A few tools the Communication Partnership for Science and the Sea (COMPASS) support using to implement ecosystem-based management include "ecosystem level planning, cross-jurisdictional management goals, zoning, habitat restoration, co-management, adaptive management, and long-term monitoring".

Authors reviewed eight management plans in this paper to determine if ecosystem-based management principles are being approached and used in a similar manner. Authors broke 18 definitions of EBM down into 17 criteria that scientists use to define EBM and evaluated the management plans for examples of these 17 criteria

- *General criteria*: sustainability, ecological health, inclusion of humans into the ecosystem
- *Specific ecological criteria*: complexity, temporal, spatial
- *Specific human dimension criteria*: ecosystem goods/services, economic, stakeholder
- *Specific management criteria*: science-based, boundaries, technological, adaptive, co-management, precautionary, monitoring, interdisciplinary

Authors determined some principles were implemented, but a gap remains between the literature and implementation.

*Management plans evaluated in this paper include:

- Albemarle-Pamlico Sound
- Great Barrier Reef Marine Park
- San Francisco Bay Delta
- Channel Islands National Marine Sanctuary
- Florida Everglades (restoration plan-more specific)
- Willapa Bay
- Delaware Inland Bays

McLeod, K.L., Lubchenco, J., Palumbi, S.R., and Rosenberg, A.A. (2005). Scientific Consensus Statement on Marine Ecosystem-Based

Management. Signed by 217 academic scientists and policy experts with relevant expertise and published by the Communication Partnership for Science and the Sea at http://compassonline.org/?q=EBM

ABSTRACT: The current state of the oceans requires immediate action and attention. Solutions based on an integrated ecosystem approach hold the greatest promise for delivering desired results. From a scientific perspective, we now know enough to improve dramatically the conservation and management of marine systems through the implementation of ecosystem-based approaches.

ANNOTATION: This paper effectively defines and discusses ecosystem-based management and clearly outlines steps that must be followed to successfully implement this management approach. This paper aims to provide a consensus statement on marine ecosystem-based management from the scientific community that can be easily understood and interpreted by resource managers and other interested parties. This is one of the most useful papers on the subject.

The authors define ecosystem-based management as "**an integrated approach to management that considers the entire ecosystem, including humans**".

The goal of ecosystem-based management is to "maintain an ecosystem in a healthy, productive and resilient condition so that it can provide the services humans want and need for future generations".

Unique elements that describe the ecosystem-based management approach include:

- **protection** of biodiversity, ecosystem structure, and key processes
- **place-based**
- **interconnectedness within and among systems**, recognizing the importance of interactions
- **merges ecological, social, economic, and institutional perspectives**, recognizing their strong interdependencies

The most useful section of the paper is where authors explicitly outline factors that must be adhered to in order to successfully implement ecosystem-based management. This process as described in the paper is outlined below and involves many steps and the use of diverse tools :

- initiate **ecosystem-level planning**
  - consider impacts of multiple human activities on ecosystems
  - involve stakeholders
  - consider impacts of long-term environmental changes
- **cross-jurisdictional management goals**
  - formal agreements across local, state, federal and tribal authorities
- initiate **zoning** of regions of the ocean
  - reduces conflict among users of different services
  - coordinates multiple uses within the larger land- or seascape context
  - networks of marine reserves to protect biodiversity and habitats

        - use in conjunction with other types of MPAs
    - expand and improve coordination of **habitat restoration**
    - adapt **co-management** strategies
        - governments (federal, state, local, and tribal) and diverse stakeholders (local resource users, academic and research scientists, conservation interests, community members with TEK) *SHARE the responsibility for management and stewardship*
    - incorporate **adaptive management** to allow for readjustments when new information becomes available
    - establish long-term ocean and coastal observing, **monitoring** and research programs

Rosenberg, A. A., & McLeod, K. L. (2005). Implementing ecosystem-based approaches to management for the conservation of ecosystem services. *Marine Ecology Progress Series*, (300), 270-274. Retrieved from http://www.int-res.com/abstracts/meps/v434/p291-301/

ABSTRACT: The ability to manage complex systems effectively must stem from simplifications of ecological knowledge. We present a technique called the 'Ecosystem Principles Approach' (EPA) as a progressive way of incorporating ecology into goods and services assessments. The EPA moves away from the complexity of ecosystem functions and focuses on general ecological principles. These principles more explicitly define key elements of system functioning, are not spatially or temporally confined, and can be utilised in assessment and decision-making processes. When applied to a coastal system in New Zealand, the EPA highlighted that services were primarily dependent on connectivity and that the maintenance of healthy intertidal areas was highly important for system functioning. The approach also demonstrated a separation between locations where ecosystem functions were generated and where services were valued. A high level of multi-functionality and connectivity between goods and services in marine coastal systems suggests services should be managed collectively rather than individually. The strength of the EPA is that it aligns to the principles of 'Ecosystem-Based Management'. This approach demonstrates how ecological information can be simplified into a format that can advise policy and better integrate with management. It highlights the need for greater trans-disciplinary integration of ecology and social science to better understand how human interactions result in critical community shifts and loss of resilience.

ANNOTATION: This paper defines ecosystem-based management using the consensus statement definition from McLeod et al. (2005), "an integrated approach to management that considers the entire ecosystem, including humans". Authors focus the discussion of ecosystem-based management around ecosystem services and protecting the integrity of the environment for the future. Specifically, the goal of ecosystem-based management is to ensure the long-term sustainability of ecosystem services by preserving the health, productivity and resiliency of the ecosystem. Emphasis is placed on moving away from managing individual sectors,

activities or services because this will only lead to achieving short-term goals of maximizing catch, improving business opportunity or increasing economic development. Authors stress that the long-term sustainability of human uses will only be attained if there is a shift towards managing entire systems. Human and non-human species are intimately linked and their interactions must be considered when developing management plans. Human behavior undoubtedly drives human use patterns of resources and affects the long-term stability of ecosystem services. Thus, management goals must be framed with respect to the conservation of ecosystem services (i.e. ensuring that marine ecosystems can fully function in order to sustain the delivery of a wide range of services) including:

- Provisioning (food and fresh water)
- Regulating (climate and flood regulation)
- Cultural (spiritual, aesthetic)
- Supporting (nutrient cycling, primary production)

Management plans must also cross multiple sectors and be easily interpreted by all resources users to ensure effective protection of ecosystem health and conservation of services the ecosystem provides.

Pikitch, E.K., Santora, C., Babcock, E.A., Bakun, A., Bonfil, R., Conover, D.O., Dayton, P., Doukakis, P., Fluharty, D., Heneman, B., Houde, E.D., Link, J., Livingston, P.A., Mangel, M., McAllister, M.K., Pope, J., and Sainsbury, K.J. (2004). Ecosystem-Based Fishery Management. *Science*, (305).

ABSTRACT NOT AVAILABLE

ANNOTATION: This paper discusses applying ecosystem-based management principles towards managing fisheries. This approach is unique because it "essentially reverses the order of management priorities". The focus of fisheries management has previously been maximizing short-term goals like capitalizing on a single target species, a method that has proven to be ineffective in ensuring the sustainability of fisheries for future generations. This new approach encourages managers to concentrate efforts around the management of ecosystems rather than on the target species as this will help ensure the long-term sustainability and health of marine ecosystems and the fisheries they support. Ecosystem-based fisheries management is theoretically more effective than single-species management because it takes into account other ecosystem components, like habitat, predators and prey of target species, as well as their interactions. The objective of this approach is to sustain healthy marine ecosystems and the fisheries they support for the future. An additional benefit is the long-term socioeconomic benefits that will be acquired without compromising the integrity of the ecosystem.

The authors recognize that the effort required to move from management of a single, target species towards ecosystem-based fisheries management is great and will require cooperation of fishers and other stakeholders in order to be successfully implemented as a long-term management strategy. It is suggested that an incentive

program be developed to compensate fishers during the transition period to ensure cooperation as the new approach is established. Fishers will likely face hardship during this period and will be required to abide by fresh management regulation. Interestingly, with the move towards ecosystem-based fisheries management, management action would now be assessed at both the individual and ecosystem level. This means "**it is possible for a fishery to be considered overfished within the ecosystem plan when it is not overfished in a single-species context** (i.e. food web shift)". Authors denote ocean zoning will be an important component of the management strategy, helping to organize human use of the resources on a spatial and temporal scale. Zoning will also reduce bycatch, protecting multiple life stages of fish species by prohibiting certain gear type and use in critical areas. Adaptive management and employing the precautionary principle are also components of this ecosystem-based fisheries management concept. This approach is completely new and requires change, but the current management approach is failing and the future of the world's fisheries depend on finding a new, innovative way of thinking about fisheries management that can be effectively implemented and adhered to.

CUSTOMARY MANAGEMENT

Jokiel, P., Rodgers, K., Walsh, W., Polhemus, D., and Wilhelm, T. (2011). Marine Resource Management in the Hawaiian Archipelago: The Traditional Hawaiian System in Relation to the Western Approach. *The Journal of Marine Biology*. doi:10.1155/2011/151682

ABSTRACT: Over a period of many centuries the Polynesians who inhabited Hawai'i developed a carefully regulated and sustainable "ahupua'a" management system that integrated watershed, freshwater and nearshore marine resources based on the fundamental linkages between all ecosystems from the mountain tops to the sea. This traditional scheme employed adaptive management practices keyed to subtle changes in natural resources. Sophisticated social controls on resource utilization were an important component of the system. Over the past two centuries a "Western system" gradually replaced much of the traditional Hawaiian system. There are major differences between the two systems in the areas of management practices, management focus, knowledge base, dissemination of information, resource monitoring, legal authority, access rights, stewardship and enforcement. However, there is a recent shift toward incorporating elements of the traditional scheme using methods and terminology acceptable and appropriate to present day realities. This trend is exemplified by the management plan for the newly formed Papah¯anaumoku¯akea Marine National Monument in the Northwestern Hawaiian Islands. This is one of the largest protected areas in the world and is being managed with a focus on Native Hawaiian cultural values in relation to conservation, ecological, historical, scientific, and educational resource protection.

ANNOTATION: Jokiel et al. discuss traditional and contemporary marine resource management in Hawai`i, discussing the relevant history of the systems, management tools utilized, similarities and differences between the systems and specific aspects of the Papah¯anaumoku¯akea Marine National Monument management system in the Northwestern Hawaiian Islands.

Native Hawaiians historically managed their resources using a traditional watershed-based management system called ahupua`a, essentially an integrated coastal management system for the resources found from the mountaintop to the edge of the reef. The ali`i (chief) held all the natural resources in trust and the konohiki (expert resource manager for each area) managed the harvest rights of all extractive natural resources. The kupuna (elders trusted for their knowledge and wisdom) and the po`o lawai`a (master fishermen) made recommendations to the konohiki for management of the ocean resources.

Native Hawaiians managed their resources until 1898 when the Hawaiian Kingdom was overthrown and Hawaii was annexed to the United States. At this time, the government took over management of fisheries and with technological advancements beginning around the same time, there was a shift from fishing for subsistence to commercially fishing for profit. By 1986, there had already been an 80% reduction in coastal fish catch in Hawaii due to the commercialization of fisheries.

Contemporary management of coastal natural resources in Hawai`i is currently shared by the Hawai`i State Department of Land and Natural Resources (marine resources within 3 miles of land), Division of Aquatic Resources (living marine resources throughout the archipelago and within 3 miles of land) and the Office of Conservation and Coastal Lands (2 million acres of private and public submerged lands). The federal government oversees management activities outside of state boundaries to 200 miles from land, the US Economic Exclusive Zone.

There has been interest in incorporating Native Hawaiian management methods into contemporary management of natural resources in Hawai`i over the last decade, bringing back the ahupua'a system of integrated coastal management. In fact, the Papah¯anaumoku¯akea Marine National Monument management system was developed with traditional values in mind. The traditional basis for the management system exists, but it is still lacking some of the "cultural and spiritual dimensions of the traditional approach". Other management tools incorporated include use of marine protected areas, rotational and seasonal closures, fishing gear restrictions, size and bag limits and prevention of the take of certain species. The management process also encourages stakeholder involvement. Specific measures taken by the Monument to unite Native Hawaiians and Western scientists include the development of a cultural working group, sponsorship of interdisciplinary research projects that unite knowledge and data from different knowledge systems as it pertains to the management of the Monument's natural environment, and the

creation of a partnership between the Monument and the University of Hawai`i at Hilo that trains students to design projects that require research of both Native Hawaiian and marine science materials.

Overall, the traditional and contemporary management systems in Hawai`i were developed with similar goals of conserving and protecting the sustainability of natural resources for future generations. The biggest difference between the two systems is who is developing management methods and regulating use: the government in Western systems and the ruling ali`i in traditional systems.

Fagetele Bay National Marine Sanctuary: Draft Management Plan. (2011).

NO ABSTRACT AVAILABLE

ANNOTATION: The United States government is responsible for the management of the Fagatele Bay National Marine Sanctuary (FBNMS) and NOAA is the federal agency responsible for developing and implementing management plans for this region. Although government driven, the Sanctuary strives to utilize both traditional and contemporary tools for the management of marine resources within its boundaries. A draft management plan was released in 2011 and includes an action plan devoted to getting Sanctuary communities engaged while incorporating Samoan culture and protecting cultural heritage and maritime heritage resources. The government retains authority over the management of the Sanctuary, but seeks to best preserve and protect the ecosystem by involving the community in Sanctuary management and operations. **The key to maintaining health coastal and marine ecosystems in Samoa is to understanding the larger cultural heritage and connections between people and the marine environment**.

American Samoa culture has developed over the last 3000 years and communities are intimately linked to the ocean as is reflected in their customs and traditions, also referred to as *fa'a*-Samoa. This is the "Samoan Way" and has kept "Samoans strongly nationalistic and cautious about changes that might threaten the traditional way of life". The *fa'a*-Samoa concept of tapu has been used to conserve resources by restricting resources use in stressed areas. Tapu was incorporated into the draft management plan as a way to connect the Sanctuary and its communities with an increased understanding of resource protection. The Sanctuary hopes the incorporation of *fa'a*-Samoa will have important cultural and environmental significance.

Ideas for incorporating it into management of the Sanctuary include creating a volunteer program to increase local pride in the Sanctuary by involving community members in education and outreach, research and monitoring and enforcement. Local volunteers will be able to help build well-informed communities that care about their impacts on the resources and the Sanctuary. Additionally, Sanctuary staff plans to include traditional dances and customs into Sanctuary events that will help establish respectful relationships between NOAA, the community and the

Sanctuary. There will be opportunities to promote traditional artisanal crafts and skills in the Sanctuary and a Cultural Exchange Program will be established to promote cross-cultural relationships related to marine resource and cultural protection by giving Sanctuary volunteers an opportunity to experience a different indigenous culture inherent in other Sanctuaries while providing a chance to share a common interest in management of resources for future generations.

Veitayaki, J. (2011). Fisheries resource-use culture in Fiji and its implications. Culture and sustainable development in the Pacific. pp. 116-130.

NO ABSTRACT AVAILABLE

ANNOTATION: This book chapter focuses on fisheries management strategies in Fiji, discussing both traditional and collaborative methods currently employed. Coastal communities rely heavily on marine resources for their cultural significance as well as for protein and income. Historically, traditional management methods based on local knowledge of natural and cultural systems were utilized to manage resources for future generations. Recent technological advancements and socioeconomic modernization have contributed to increased pressures on marine resources by local communities, subsequently leading to rapid overexploitation. Veitayaki includes, "with the economic demands to which the people are subjected and their increased capacity and productivity levels, the sustainable use of marine resources has become a major issue". Recently, management approaches have shifted towards a traditional-contemporary system that considers the recent changes in local communities, providing knowledge that can be strategically exercised to enhance the sustainable consumption of resources. This can be troublesome to employ sometimes because traditional communities often do not fully understand the contemporary environmental issues or scientific explanations of ecosystem interrelationships. However, this collaborative approach can be useful too because it incorporates people into the ecosystem as well as features of their culture and tradition.

The most common traditional practice still utilized in Fiji is the customary ownership of rights to fishing grounds that extend from shore to the outer reef slope, rights defined and owned by social units called *vanua*. Permission must be granted to outsiders wishing to fish the grounds and the *vanua* may place bans on certain fishing methods or gear to conserve resources.

Fishing grounds are sacred in Fiji and often portions are closed to preserve the resources for cultural events like births, weddings or funerals. *Taboos* are a part of Fijian culture and these often guide fishing practices. For example, fishermen of Qoma associate sea turtles with the supernatural, ceasing fishing activity when a sea turtle swims through their net because that signifies they caught enough for that particular fishing venture. Furthermore, all Fijians have a fish *totem*, and the taboos associated with their totem help with conservation efforts because their totem

cannot be caught or consumed. Fijian communities are frequently pressured by social obligations to community work, even if detrimental to their job as a fisher, limiting fishing activity and helping preserve resources. The majority of traditional management takes place inshore, while the Fiji Fisheries Division (government) manage the recently developed offshore commercial fisheries industry.

The Fiji Fisheries Division manages the recreational and commercial fishing activity that takes place offshore. Offshore activity has been beneficial because of the monetary benefit generated from exports as well as relieving some of the stress on the overexploited inshore resources. Additionally, **the government has allowed communities to continue to manage inshore waters through customary rights**. The Fiji Fisheries Division requires all commercial fishers to have a license that may be renewed annually and that is nontransferable. They have given local communities licenses to sell to commercial fishers wishing to fish their inshore regions, but this is subject to approval by the community. Theoretically, this method limits the number of resource users in customary or inshore areas while also removing open access conditions. However, this system is also subject to abuse, as local communities may choose to accept money instead of preserving their fishing grounds. The government encourages commercial activities to take place offshore by utilizing Fish Aggregation Devices (FADs) and half-cabin FAO-designed fishing boats, hoping that these incentives will take some of the pressures off inshore regions and leaving those regions for traditional uses.

A number of communities in Fiji have noticed changes in their resources and sought help from researchers at local universities to help assess their resource use issues and develop management methods that utilize both traditional and contemporary tools. Community members in Kaba Point reached out to researchers and government officials to scientifically access a fisheries management plan they created. The assessment indicated that fishery resources were intensively over used and the chief of Kaba subsequently banned the use of gillnets for 6-months and refused to renew the 17 commercial fishing licenses given out the year before to help protect their inshore fishing region. This particular community has turned to aquaculture and deep-sea fishing as ways to alleviate the pressure of the resources close to home. Some communities are also participating in marine education programs put on by the government and NGOs to educate their community members about the importance of conserving resources so future generations can benefit from the same resources. Overall, Fiji is utilizing a collaborative co-management approach to effectively manage their marine resources as ecological and socioeconomic aspects of their region change.

Grayson, J. et al. (2010). Options for Managing the Sustainable Use of Green Turtles: Perceptions of Hammond Islanders in Torres Strait. *Conservation and Society*, 8(1), 73-83.

ABSTRACT: One of the largest populations of green turtles (*Chelonia mydas*) in the world spends at least part of its life cycle in the remote Torres Strait between

Australia and Papua New Guinea. This population is subjected to traditional harvests from geographically dispersed communities including along the northern and eastern coasts of Australia, Indonesia and south-western Pacific nations. In Torres Strait, green turtle hunting is classed as a traditional fishery and is guaranteed by Australian legislation (Native Title Act 1993) and the Torres Strait Treaty between Australia and Papua New Guinea that aims to protect the traditional lifestyle of the region's indigenous peoples. To investigate the Islanders' thoughts and aspirations regarding marine turtle management, we interviewed hunters and Islander Elders from the Hammond Island community in the Kaurareg nation of Kaiwalagal. Although not the Traditional Owners of the Kaiwalagal sea country in which they live and hunt, Hammond Islanders wish to be involved in the management of resources on which they depend, including marine turtles. They considered community-based processes to be important, especially the application of (1) cultural norms to the development of tools to achieve compliance and enforcement within the community, and (2) consensus-based decision-making amongst hunters and elders within the community, with regard to the use of more formal rules. However, the need for co-operation with other communities and stakeholders across scales was also recognised, particularly with regard to enforcement. Our results suggest that co-management is likely to be a more appropriate approach for managing green turtles in Torres Strait than either community-based management or government-driven management.

ANNOTATION: Grayson discusses the unique management scenario of one of the world's largest Green sea turtle populations, located in the Great Barrier Reef/Torres Strait region. This population is both protected by the National Environmental and Protection Biodiversity Conservation Act of 1999 and Queensland's Nature Conservancy Act of 1992, but is also subjected to legal traditional harvests by indigenous Torres Strait Islanders and Aboriginal people as part of their traditional way of life. The legal take of sea turtles in this region is allowed under the Native Title Act of 1993 and Torres Strait Treaty of 1985, both pieces of Australian government legislation. It is well recognized that effective management of sea turtles in this region will reflect coordination with the local communities, as they do continue to harvest Green sea turtles legally for cultural and consumptive uses.

In 2008, the Australian Government funded 8 communities in the region to draft their own management plans for Green sea turtles and dugongs. Some consider this approach effective because by including the communities and giving them responsibility, both island customs and the sea turtle populations will remain intact for future generations. In this particular case, **co-management** between the government and the local community was an appropriate approach because the people have legal rights to use the resource (sea turtle in this case), the local community requires access to the resource for cultural survival and livelihood and management of this resource must occur in order to preserve the resource for the future. This specific co-management scheme is unique because the traditional community and the Australian government share management responsibilities, but

the government has given the community the majority of power in making management decisions. This approach may be successful in this case because of the remote location of the community and the interest the community has in conserving the resource because they fear a future without turtles as part of their culture. Furthermore, this community believes that fewer government mandated management strategies will be imposed on them if they are able to effectively manage their own resource use.

In managing sea turtles in the Torres Strait region, community members support incorporation of spatial management and quotas, but do not support use of seasonal closures or sex/size-based limits. It appears that co-management of sea turtles in Torres Strait is traditionally managed, but some contemporary tools are utilized as well.

Grayson makes a memorable point when she distinguishes between Western and Traditional management agendas noting that "the deeper agenda for most conservationists is to make nature... meaningful to rural communities... and local communities are concerned with... regaining control over natural resources and improving their well-being". The differences in management objectives may ultimately drive the differences in methods employed.

Cinner, J. (2005). Socioeconomic factors influencing customary marine tenure in the Indo Pacific. *Ecology and Society*, 10(1), 36. [online] URL: http://www.ecologyandsociety.org/vol10/iss1/art36/

ABSTRACT: For generations communities in the Western Pacific have employed a range of resource management techniques (including periodic reef closures, gear restrictions, entry limitations, and the protection of spawning aggregations) to limit marine resource use. Localized control over marine resources, commonly known as customary marine tenure (CMT), is the legal and cultural foundation for many of these practices. Because of their perceived potential to meet both conservation and community goals, these traditional resource management techniques are being revitalized by communities, governments, and NGOs as an integral part of national and regional marine conservation plans in the Pacific. However, the viability of conservation strategies built on a foundation of marine tenure may be in question, as it remains unclear whether marine tenure systems will be able to withstand the profound social and economic changes sweeping the Pacific region. Numerous studies have suggested that changes in marine tenure are attributed to social and economic factors, however, specific relationships between socioeconomic conditions and marine tenure are still not well understood. This paper examines the social and economic characteristics of 21 coastal communities in Papua New Guinea and Indonesia, and explores the characteristics of the communities that employ exclusive marine tenure to answer the following questions: Which socioeconomic factors are related to the presence of CMT regimes? How might socioeconomic factors influence the ability of communities to employ or maintain CMT regimes? Distance to market, immigration, dependence on fishing, and conflicts were found to

be related to the presence of highly exclusive marine tenure systems. Exploring these relationships will help conservation practitioners better understand how future social changes may influence the foundation of conservation and development projects.

ANNOTATION: Cinner discusses and defines customary marine tenure (CMT) in this paper and investigates which socioeconomic factors are linked to the presence of CMT in traditional management regimes.

CMT delineates access to inshore marine resources and traditional social units manage access to these resources. Management ranges from setting gear restrictions, employing marine protected areas, employing seasonal closures and controlling species fished.

CMT is a community-based approach to management that is typically used to govern the commons of regions that have **low immigrant populations, are a greater distance to the market to sell goods, have higher dependence on fishing for their livelihood and often are engaged in conflict over marine resources**. Cinner established this socioeconomic factor-CMT relationship by conducting 954 surveys in traditional communities in the Western-Pacific region.

Cinner stresses that CMT empowers the community to self-regulate activities that affect the sustainability of resources, which subsequently alleviates the financial strain of finding ways for the government to enforce regulation.

Drew, J. (2005). Use of Traditional Ecological Knowledge in Marine Conservation. *Conservation Biology*, 19(4), 1286-1293.

ABSTRACT: Traditional ecological knowledge (TEK) represents multiple bodies of knowledge accumulated through many generations of close interactions between people and the natural world. TEK and its application via customary ecological management plans can be useful in modern conservation programs. I disaggregate the term TEK into its constituent parts and show several ways in which TEK can strengthen research designs by increasing locality-specific knowledge, including environmental linkages occurring in those localities. Examples of the uses of TEK in conservation include folk taxonomy in systematics in Micronesia, species knowledge for conservation in Kiribati, and fishers' knowledge of ecological interactions for reserve design in Belize. When conservationists recognize the utility of TEK, they can engage in an equitable exchange of knowledge and foster shared responsibility with indigenous people. These types of exchanges can also provide an opportunity for indigenous people to develop a scientific infrastructure.

ANNOTATION: Drew discusses and defines traditional ecological knowledge (TEK) in this paper. Berkes (2000) definition of TEK, "**a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings**

(including humans) with one another and with their environment" is proposed as the universal term to describe this knowledge base. Drew adds that TEK is site-specific, accumulated through trial and error over many years and is necessary for cultural survival.

Drew suggests a few useful points when seeking to extract TEK for collaboration into management plans. TEK dissemination requires trust and is not a one-time extraction process. Specifically, one "must develop mutually respectful relationships with indigenous peoples and enter into a dialogue on terms set by the holders of TEK". Once a relationship has been established there will be an opportunity for long-term collaboration with TEK holders.

3 major advantages of integrating components of TEK into management plans as described:

1. Location-specific knowledge (i.e. juvenile habitats, spawning aggregations)
2. Increased knowledge of environmental linkages (i.e. long-term association benefit)
3. Local capacity building and power sharing

TEK falls into 3 main categories that pertain to ecological research:

1. Folk taxonomy and systematics
    a. Looks at the way other cultures organize their world
    b. Investigating whether fauna is organized by morphology or function may help conservationist figure out which species are targeted economically/ecologically
2. Population-level knowledge
3. Ecological relationships

One last interesting point Drew makes touches on the objectives of management in Traditional versus Western communities. Drew asks if indigenous peoples are conservationists and argues that some see traditional management actions like "resource rotation, food taboos and self-imposed harvest limits as results of optimal harvesting", not conservation.

Thomas, F. (2003). 'Taming the Lagoon': Aquaculture Development and the Future of Customary Marine Tenure in Kiribato, Central Pacific. Geografiska Annaler. Series B, *Human Geography*, 85(4), Special Issue: Nature-Society Interactions on Islands, 243-252.

ABSTRACT: The atolls and low-lying limestone islands of Kiribati (Micronesia) illustrate the challenges of economic development based on natural resources exploitation. For that reason, the widely scattered island nation has relied heavily on foreign aid and remittances sent by merchant seamen. However, it is becoming apparent that excessive reliance on external support can no longer be considered secure in the medium to longer term, notably with cutbacks in aid assistance and advances in marine technology. In attempts at achieving 'self-reliance', successive governments have always perceived marine resources development, particularly

living resources, as a means of attaining greater economic independence. Recently, efforts have been underway to promote inshore and aquaculture development by smallholders. Seaweed farming, and especially black pearl production, are new commercial ventures. Giant clam mariculture remains an option. While it is too early to measure the success of some of these projects, their establishment may have important implications for reviving marine tenure by encouraging smallholders to reassert their traditional rights to inshore resources. Customary marine tenure (CMT) has declined significantly as a result of colonial intrusion. Today, the impact of population growth, urbanization, more efficient extractive technologies and expanding market opportunities calls for more effective village-based control of threatened resources. Close monitoring of aquaculture projects will be required to minimize potential conflicts over traditional marine ownership.

ANNOTATION: Kiribati is an independent nation that relied on foreign aid in the past, but with decreasing aid and improvements in technology, has become a nation that relies on marine resources for their livelihood. Kiribati has the worlds second largest EEZ totaling more than 3.5 million square kilometers, but resources within the EEZ is also heavily affected by serious weather conditions. Kiribati has moved its focus towards developing inshore artisanal fisheries including promoting aquaculture like seaweed farming, pearl farming, production of giant clams and raising aquarium fish for export. Thomas includes "aquaculture can assist in ensuring food security, replenish or enhance natural stocks of economically important resources, such as giant clams, provide employment for potentially lucrative export markets, and alleviate poverty by supplying low-cost fish for rural and urban consumers".

Kiribati is a Pacific Island nation that traditionally managed their land and marine resources before Western contact and up until the 1940s using customary marine tenure. *Kainga*, the main social group comprised of members of extended family, owned and managed marine areas in narrow strips extending from shore to the reef utilizing the area for economic production and social exchanges. After 1940 the British stepped in and slowly moved away from the customary marine tenure system, revoking rights of local communities. Rights to resources in Kiribati became open access, leading to exploitation and unsustainable harvest practices.

Kiribati is currently moving back towards the concept of customary marine tenure as the inshore and aquaculture ventures develop. It is believed that resources will be quickly exploited if the system does not move away from open access rights because the population is growing, urbanization is taking place, more efficient extractive technologies exist and export demands are increasing with the development of the new marine industries. All of these factors will provide increased stress on the resources. Utilizing the *customary marine tenure system will keep communities accountable* because people are likely to conform to rules imposed by their traditional social organization. Customary marine tenure could prove to be a successful management approach in Kiribati if fishers *pursue profitable activities that will also ensure the long-term stability of resources* (sustainable

aquaculture activities), *cooperative ventures are strengthened*, and *traditional ecological knowledge is effectively employed in the management of resources.* This system will keep local communities accountable for their actions that will help conserve marine resources for future generations.

Berkes, F., Colding, J, and Folke, C. (2000). Rediscovery of Traditional Ecological Knowledge as Adaptive Management. *Ecological Applications.* 10(5), 1251-1262.

ABSTRACT: Indigenous groups offer alternative knowledge and perspectives based on their own locally developed practices of resource use. We surveyed the international literature to focus on the role of Traditional Ecological Knowledge in monitoring, responding to, and managing ecosystem processes and functions, with special attention to ecological resilience. Case studies revealed that there exists a diversity of local or traditional practices for ecosystem management. These include multiple species management, resource rotation, succession management, landscape patchiness management, and other ways of responding to and managing pulses and ecological surprises. Social mechanisms behind these traditional practices include a number of adaptations for the generation, accumulation, and transmission of knowledge; the use of local institutions to provide leaders/stewards and rules for social regulation; mechanisms for cultural internalization of traditional practices; and the development of appropriate world views and cultural values. Some traditional knowledge and management systems were characterized by the use of local ecological knowledge to interpret and respond to feedbacks from the environment to guide the direction of resource management. These traditional systems had certain similarities to adaptive management with its emphasis on feedback learning, and its treatment of uncertainty and unpredictability intrinsic to all ecosystems.

ANNOTATION: Berkes et al. define traditional ecological knowledge (TEK) and discuss its application in traditional adaptive management of natural resources. TEK is defined as a "**cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment".** This knowledge base is accumulated over time, tested by trial and error, by people that depend on the use of this knowledge for survival. **This system is dependent on local social mechanisms** for intergenerational transmission of knowledge and building resilience in ecosystems. TEK is place-based and used as an adaptive management tool to ensure ecological resiliency of natural resources for future generations. Berkes et al. describes its use as an adaptive management tool best when describing TEK as a "library of information on how to cope with dynamic change in complex systems".

Berkes et al. discuss traditional watershed-based management systems in the Pacific. These systems focus on management of complex systems that include land

and ocean resources, and the people that use these ecosystem services. All contents of the ecosystem are intimately connected. Areas are defined by biogeographic boundaries and are managed by specific groups of people. A few of these systems are discussed below:

- ancient Hawaiian *ahupua'a*
  - "the ecosystem unit extends from upland forests protected by taboo, downstream to the coral reef and lagoon"
- Soloman Islands *puava*
  - "all the resources and land in a watershed, from the top of a mountain to the open sea outside the barrier reef"
- Fijian *vanua*
  - Mountain to edge of the reef

Berkes et al. include a few key points about TEK and its application in adaptive management that are useful (direct from the source, Berkes et al., 2000):

- Management may be carried out using rules that are locally crafted and socially enforced by the users themselves
- Resource use tends to be flexible, using area rotations, species switching, and other practices
- The users have accumulated an ecological knowledge base that helps respond to environmental feedbacks, such as changes in the catch per unit of effort that help monitor the status of the response
- A diversity of resources are used for livelihood security, keeping options open and minimizing risk

Poepoe, K., Bartram, P., and Friedlander, A. The Use of Traditional Hawaiian Knowledge in the Contemporary Management of Marine Resources. Putting Fishers' Knowledge to Work: Conference Proceedings, pp. 328-339.

NO ABSTRACT AVAILABLE

ANNOTATION: Poepoe et al. define traditional knowledge as "cultural protocol" and discuss its application in contemporary management of natural resources in Hawai`i, specifically in managing important food fish species in Mo`omoni Bay on the island of Moloka`i. Cultural protocol "combines knowledge, practice, and belief, fundamental characteristics that evolve over time within a specific cultural and ecological context of most traditional systems" and it "guides traditional practices of Native Hawaiians" that affect natural resource use.

The authors outline a few of the most important practices:

1. Conserving resources for future generations
2. Self-restraint: People are respected for taking only what they need for immediate use
3. Respect for ancestors: They provided "knowledge for survival"
4. Lokahi ("harmony"): Fishing establishes an intimate relationship of respect and harmony with the ocean

5. Malama ("take care of living things"): nurture and respect the ocean and its living resources
6. Laulima ("many hands"): sharing and cooperation maintains family unity and community interdependence and this ultimately reduces the intensity of subsistence fishing activities
7. Ha`ahu`a ("humility"): Realization that humans are part of the living world and not superior beings
8. `Imi `Ike ("to seek knowledge"): young fishers must train with a community fishing expert to attain title of "expert" and this requires the fisher be knowledgeable of life cycles, diet, feeding habits, preferred habitats, and growing conditions for many species

The ancient traditional Hawaiian management system involved managing resources from the mountains to the ocean by enforcement of kapu (strict rules). Konohiki enforced the kapu on behalf of the ali`i. The authors stress that there is a need to find ways of communicating details about the Hawaiian system so it may be more effectively incorporated into contemporary management systems. A contemporary version of the ancient kapu system is currently being used in Mo`omoni Bay on Moloka`i Island where education, social pressures and family encouraging behavior that will lead to sustainable use of natural resources. The Ho`olehua community depends on subsistence farming and fishing for survival. In fact, their "cultural survival is entwined with resource conservation". One ways the community continues to transfer knowledge, cultural values and social identity to future generations is through the repetition of subsistence fishing activities. This community has the basic elements of a fishery management system in place that includes: a conservation ethic, community support, management knowledge and a system of monitoring.

The authors description of Hawaiian management knowledge is memorable and described as "a form of adaptive management... that takes a dynamic view of ecosystems, emphasizes processes that are part of resource renewal, acknowledges uncertainty and unpredictability, and stresses the importance of ecosystem resilience. The system continues to evolve through oral transmission, imitation, and demonstration".

A unique aspect of their resource monitoring program was establishment of a fish spawning moon calendar. Moon calendars are used as a "predictive tool based on awareness of natural cycles and their relationship to fishing and farming success". Community monitors created a calendar identifying the spawning periods of important food fish species by observing spawning behavior and sampling fish gonads. This will help guide where and when fishers can harvest and provides valuable information to help community monitors determine when to implement traditional closures or kapu so the natural rhythms of the species are not disturbed.

Krech, S. (1994). Ideas: From the National Humanities Center. *Ecology and the American Indian.*

NO ABSTRACT AVAILABLE

ANNOTATION: Krech discusses the different perspectives of what caused the near-extinction of the buffalo, presenting a cynical opinion that maybe not all American Indians were environmentalists as many claim them to be.

The image of the "Crying Indian became iconic" and asserted the American Indian as a non-polluting conservationist that was intimately linked with nature. Many regarded the American Indian as one that harbored the "secret of how to live in harmony with Mother Earth, to use what she offers without hurting her". The American Indian relied on buffalo for food, trade and as part of their culture, sustainably harvesting buffalo for survival. However, with the railroad expansion across the western US, the hunt for buffalo moved away from subsistence harvesting to a commercial hunt. The Whitemen, sportsmen and entrepreneurs, greedily hunted buffalo, however, the American Indian began communal hunting to compete with the Whitemen and their unsustainable hunting practices. It is still unclear whether it was the greedy Whitemen or wasteful American Indians that are responsible for the near-extinction of the buffalo. The American Indians hunted buffalo until the end, running herds over embankments and killing far more than any community could ever use, believing that God or Nature would provide an endless supply of buffalo regardless of harvesting practices. Krech uses this article as an opportunity to incite ideas about the source of waste in modern communal hunting practices (i.e. fishing) pointing out that historical accounts of traditional harvesting practices never fail to mention the ritual or sacrality associated with the hunt, but always fail to mention the waste generated from the practice. It is possible modern day wasteful practices had their roots in ancient traditional practices. Krech also urges the reader not to think about the American Indian as a conservationist, but instead, to respect their harvesting practices because it was a valuable component of their culture and spiritual ritual.

COLLECTIVE MANAGEMENT

Aswani, S. (2011). Socioecological Approaches for Combining Ecosystem-based and Customary Management in Oceania. *Journal of Marine Biology.*

ABSTRACT: This paper summarizes various integrated methodological approaches for studying Customary Management for the purpose of designing hybrid CM-Ecosystem-Based Management (EBM) systems in Oceania. Using marine conservation in the Western Solomon Islands as an example, the paper illustrates various interdisciplinary human ecological methods that can assist in designing hybrid conservation programs. The study of human-environmental interactions from a socio-ecological perspective allows us to discern people's understanding of their immediate environment, differential forms of local resource governance and

use (e.g., sea tenure and foraging strategies), and existing conflicts between various stakeholders, among other social and ecological factors. More generally, the paper shows how coupled studies of natural and social processes can foster management regimes that are more adaptive and effective and that move toward holistic, ecosystem-based marine conservation in the Pacific Island region.

ANNOTATION: Aswani discusses customary governance and management systems (CM) in the Pacific and communicates the importance of coupling this approach and Ecosystem-Based Management (EBM) in order to attain sustainable management of natural resources. Even though CM has its roots in socioecological and historical practices and EBM in scientific principles, their objectives intersect in numerous ways which create opportunities for uniting the two approaches for maximum management success.

Important definitions:

- CM is "**cultural and historical practices designed to regulate the use of, access to, and transfer of resources locally, and they are informed by indigenous ecological knowledge and embedded in customary land- and sea-tenure institutions".**
- EBM is the "**management of a particular ecosystem's structure, function, and processes to sustain and foster ecosystem services for human society, and, therefore, it focuses on the interconnectedness of ecological, social, and economic parameters for developing place-based management plans of an ecosystem**".

Aswani discusses his work in the New Georgia Group in the Western Solomon Islands to demonstrate use of real-world "interdisciplinary human ecological" models for blending CM and EBM systems. One of the most useful models joins indigenous ecological knowledge and marine science research data with GIS to map habitats, fish species and abundance, and fishing hot spots. In this particular case, 10 local men and women were selected because of their fishing expertise and knowledge of the marine environment, and each participant contributed local knowledge of their inshore habitats. This same information was explored through marine science research, where local field assistants conducted an underwater census examining and documenting the inshore habitat features. Both the local knowledge and marine science research data were mapped and compared for accuracy using GIS. Community fishers were interviewed about location of living marine resources, sites of major biological events like spawning, and location of fishing grounds. Data was collected on the same topics through marine science research, and both data sets were mapped using GIS. Comparisons between the indigenous ecological knowledge and marine science research yielded between 75-85% equivalence. The analysis of the data sets was utilized to implement a network of marine protected areas (MPAs) that would be valued and respected by the local community, and maximize protection important biological processes contributing to more resources for future generations to use.

Aswani points to many ways indigenous people in the Pacific Islands are managing their resources using an ecosystem-based approach by employing customary management practices. Although the wording and origin of many of the principles in CM and EBM are different, the overall objectives of the two management systems share many similarities. CM is currently being utilized in many nations and effort should be placed on coupling CM and EBM practices to achieve the best management system possible so future generations may continue to use resources sustainably. A few of the similarities are outlined below:

- CM principle that "sea space and land space exist continuously" correlates with the EBM core principle of **connectivity** between terrestrial and marine ecosystems
    - In the Solomon Islands, *pepeso* is used as an "inclusive property domain that is divided into 4 main zones: mainland, lagoon, outer barrier islands and their adjacent sea-facing habitats, and the open ocean"
    - Similar examples include the Hawaiian *ahupua'a*, the Fijian *vanua* and the Marovo *puava*
    - Origin of principle is different, but both offer a holistic view of the environment
- CM gives Pacific Islander nations exclusive rights to resources which enables communities to implement EBM tools like MPAs or taboo sites and/or establish spatial, temporal, gear, effort, species and catch limitations to sustainably manage their resources by (direct from Aswani 2011):
    - Protecting vulnerable species and habitats (i.e. biodiversity and ecosystem structure and function)
    - Protecting susceptible life history stages (i.e. spawning and nursery grounds)
- CM is inherently **interdisciplinary**, and shaped by **adaptive management** (i.e. management decisions influenced as people learn about uncertainties); both are also objectives of EBM
- CM is place-based; management using EBM should also be site-specific

Bohensky, E. L., and Y. Maru. (2011). Indigenous knowledge, science, and resilience: what have we learned from a decade of international literature on "integration"? *Ecology and Society*, 16(4). http://dx.doi.org/10.5751/ES-04342-160406

ABSTRACT: Despite the increasing trend worldwide of integrating indigenous and scientific knowledge in natural resource management, there has been little stock-taking of literature on lessons learned from bringing indigenous knowledge and science together and the implications for maintaining and building social-ecological system resilience. In this paper we investigate: (1) themes, questions, or problems encountered for integration of indigenous knowledge and science; (2) the relationship between knowledge integration and social-ecological system resilience; and (3) critical features of knowledge integration practice needed to foster productive and mutually beneficial relationships between indigenous knowledge and science. We examine these questions through content analyses of three special journal issues and an edited book published in the past decade on indigenous, local,

and traditional knowledge and its interface with science. We identified broad themes in the literature related to: (1) similarities and differences between knowledge systems; (2) methods and processes of integration; (3) social contexts of integration; and (4) evaluation of knowledge. A minority of papers discuss a relationship between knowledge integration and social-ecological system resilience, but there remains a lack of clarity and empirical evidence for such a relationship that can help distinguish how indigenous knowledge and knowledge integration contribute most to resilience. Four critical features of knowledge integration are likely to enable a more productive and mutually beneficial relationship between indigenous and scientific knowledge: new frames for integration, greater cognizance of the social contexts of integration, expanded modes of knowledge evaluation, and involvement of inter-cultural "knowledge bridgers."

ANNOTATION: Bohensky and Maru discuss the similarities and differences between traditional and contemporary science knowledge systems and the possibility of developing a collaborative approach from different knowledge systems for the management of resources.

The authors reviewed a number of articles and presented different perspectives on integrating traditional knowledge and scientific knowledge, ultimately presenting the knowledge systems as separate entities that are enriched through interaction with one another. Bohensky and Maru stress the importance of avoiding usage of the word "integration" and instead encourage use of a collaborative approach that avoids placing labels on the process. The word "integration" remains problematic when trying to bring different people and ideas together because it often invokes feelings of past power imbalances, one must decide which knowledge system is "new" and which is "existing", and the distinct identities of each knowledge system are lost when one system is integrated into the other system.
Instead, the focus should be on developing a collective approach that allows the *originality* and *core identity* of each individual knowledge base to *remain valuable in itself* and is *not diluted* through combination with other types of knowledge. A memorable example is Australia's "Caring for Country" to nurture and maintain ecosystems.

Furthermore, the authors make a few suggestions for making this collective approach successful. First, the collective approach must bring benefits to both the local communities and scientists and both groups must share an interest in management issues if it is to be valued, respected and protected. Start local with ideas and work towards global ideas. Stress the importance of preserving resources for *future generations*. Bohensky and Maru also point out that traditional knowledge is inherently interdisciplinary and therefore local communities must be engaged about social, political and ecological knowledge. Too often the focus is on ecological knowledge, but there is much to be learned from all facets of the traditional knowledge system. Finally, traditional knowledge holders should be encouraged to get involved in the science process because dual knowledge holders can play a vital role as "bridgers" in knowledge collaboration.

Gratani, M., J. R. A. Butler, F. Royee, P. Valentine, D. Burrows, W. I. Canendo, and A. S. Anderson. (2011). Is validation of indigenous ecological knowledge a disrespectful process? A case study of traditional fishing poisons and invasive fish management from the Wet Tropics, Australia. ***Ecology and Society*****, 16(3).** http://dx.doi.org/10.5751/ES-04249-160325

ABSTRACT: Despite the growing recognition of the contribution that indigenous ecological knowledge (IEK) can make to contemporary 'western' science-based natural resource management (NRM), integration of the two knowledge systems has not reached its full potential in Australia. One explanation is that there is an implicit requirement for IEK to be validated by western scientific knowledge (SK), which has stalled its application and perpetuated the primacy of SK over IEK. Consequently, there is little experience of IEK validation, indigenous peoples' perspectives of the process, and no formal frameworks to achieve mutual and equitable validation of both IEK and SK. In this paper we assess the opportunities and limitations of validation processes using a case study of traditional fishing poisons for invasive fish management in the Wet Tropics World Heritage Area of Australia. The study was conducted within a co-research approach between the Aboriginal holders of the IEK, who are among the paper's authors, and science-based biologists. We jointly carried out scientific laboratory trials that demonstrated that fishing poisons are effective at immobilizing invasive tilapia. Retrospective interviews with indigenous co-researchers showed that they did not find the experience of validation disrespectful, but instead empowering and necessary for their IEK to be understood and appreciated by scientists and included in NRM. Based on our experiences and knowledge of socialization theory we present a framework for the potential future design of collaborative validation processes to facilitate the integration of IEK into mainstream NRM, and the acceptance of SK within indigenous communities in Australia.

ANNOTATION: Gratani et al. explore the process of integrating indigenous ecological knowledge into scientific knowledge for management of resources in Australia. Specifically, the authors examine whether traditional knowledge should be validated to facilitate its integration into contemporary management plans, whether validation by science is a disrespectful process and if local communities accept scientific knowledge. This is accomplished through a review of literature and a case study in Australia.

The authors acknowledge that the two knowledge systems are unique as knowledge is produced on opposite sides of the cultural divide often leading to different social values that may be stored in different forms (i.e. scientific publications in western societies and a story or dance in traditional societies), but they also suggest integrating these different knowledge systems is necessary to protect and conserve the planet's environmental and cultural resources for the future. Two extreme perspectives are presented regarding the validation process. The first states indigenous knowledge must first be validated against science to be valued and

adopted, but this raises issues over equity and may lead to local communities feeling disempowered and disrespected. The opposite view suggests indigenous knowledge systems do not need to be validated by science because they have proved their validity by successfully supporting local communities for thousands of years.

The authors determined this validation process against science was not disrespectful in the case study examining traditional fishing poisons and invasive fish management in the wet tropics, but also point out that this view may be exclusive to this particular case. Elders of an indigenous community approached scientists about validating their traditional knowledge of fish poisons because they hoped it would raise awareness of traditional knowledge among the nonindigenous community and government agencies, and potentially contribute to contemporary Natural Resource Management. In fact, the results empowered the local community in negotiations with the government about their involvement in the co-management of their traditional estates.

Nursey-Bray, M. (2011). Social Contexts and Customary Fisheries: Marine Protected Areas and Indigenous Use, Australia. *Environmental Management*, 47, 671-683.

ABSTRACT: Worldwide, the implementation of marine protected areas (MPAs) offers opportunities for delivering fisheries and biodiversity management objectives. In Australia however, the primary function of an MPA is that of biodiversity conservation. Nonetheless, the management of Indigenous customary fisheries is one area where fisheries and biodiversity issues converge. This article examines the relationship between biodiversity and customary fisheries in an MPA context by investigation of the role and importance of Indigenous social contexts. Using case study examples from Australia, I explore the role of Indigenous social contexts in two dimensions: (i) management of traditional fisheries and (ii) Indigenous contribution to fisheries within an MPA. Findings demonstrate two narratives concerning social contexts, one of recognition and the other concerning Indigenous involvement in management. I conclude with a survey of Indigenous management initiatives within MPAs. The article ends with a discussion of the utility of understanding social contexts in any marine management endeavour, specifically other social contexts within an MPA.

ANNOTATION: Nursey-Bray examines the relationship between customary fisheries and Western scientific conservation efforts in Australia. Emphasis is placed on the role of marine protected areas in Australia because of their importance in uniting Indigenous fishing interests and marine biodiversity and conservation objectives, but also because they generate tension between the two groups. Marine protected areas were created to "protect Australia's biological diversity at all levels", however; it has been difficult for Western conservationists to learn how to engage with the Indigenous peoples that live within and rely on the harvesting of resources for their

livelihoods within marine protected area boundaries. Indigenous peoples of Australia feel they are owners of the resources, and feel their rights to natural resources for cultural and subsistence should be recognized by the federal government. Furthermore, they feel they should play a role in decision-making as it pertains to management of natural resources they utilize. The legal rights of Indigenous peoples in Australia have been increasing over the past fifteen years and their role in natural resource management in Australia has been concomitantly growing.

Nursey-Bray discusses the establishment of regionally-based Aboriginal fisheries advisory committees, development of documents like the Draft Western Australia Indigenous Fishing Strategy to record how Indigenous peoples of Australia define and view their rights to natural resource harvesting for traditional purposes, and discuss the increased involvement of the Indigenous peoples of Australia with the Great Barrier Reef Marine Park Authority. Furthermore, traditional use marine resource agreements (TUMRA), a legal tool to outline joint agreements for place-specific management of natural resources in Australia, are currently being employed to manage hunting activities, describe Indigenous roles in monitoring and compliance, and educate the public about the traditional uses of managed areas. Lastly, Nursey-Bray discusses Indigenous Protected Areas, which are marine protected areas developed on Indigenous-owned land that are fused into the national system of Australian marine protected areas. These areas are managed by the Indigenous peoples of Australia, allow sustainable harvest of resources for traditional use and protect cultural biodiversity, are funded by the federal government and aim to protect resources for the long-term so future generations will continue to reap benefits. IPAs are working in Australia because these marine protected areas have incorporated "social justice components" ensuring that power is shared between the Indigenous peoples of Australia and the federal government, ecological sustainability is attained and economic livelihoods protected.

Prober, S. M., M. H. O'Connor, and F. J. Walsh. (2011). Australian Aboriginal peoples' seasonal knowledge: a potential basis for shared understanding in environmental management. *Ecology and Society*, 16(2). [online] http://www.ecologyandsociety.org/vol16/iss2/art12/

ABSTRACT: Natural resource scientists and managers increasingly recognize traditional ecological knowledge (TEK) for its potential contribution to contemporary natural resource management (NRM) and, through this, to more resilient social-ecological systems. In practice, however, inadequate cross-cultural means to organize and communicate TEK can limit its effective inclusion in management decisions. Indigenous seasonal knowledge involving temporal knowledge of biota, landscapes, weather, seasonal cycles, and their links with culture and land uses is one type of TEK relevant to this issue. We reviewed the literature on Australian Aboriginal seasonal knowledge to characterize contemporary and potential applications to NRM. This knowledge was often documented through cross-cultural collaboration in the form of ecological

calendars. Our analysis revealed a variety of basic and applied environmental information in Aboriginal seasonal descriptions and calendars that can contribute directly to NRM. Documented applications have been limited to date, but include fire management, inclusion as general material in NRM
plans, and interpretative information about environments. Emerging applications include water management and climate change monitoring. Importantly, seasonal knowledge can also contribute indirectly to NRM outcomes by providing an organizing framework for the recovery, retention, and cross- cultural communication of TEK and linking to its broader cultural and cosmological contexts. We conclude that by facilitating the combination of experiential with experimental knowledge and fostering complementarity of different knowledge systems, Aboriginal seasonal knowledge can increasingly contribute to more resilient social-ecological outcomes in NRM. Nevertheless, the seasonal framework should augment, rather than override, other approaches to cross-cultural NRM such as those with spatial and/or social-ecological emphasis.

ANNOTATION: Prober et al. suggest combining contemporary and traditional knowledge systems will effectively lead to more resilient social-ecological systems; however, it is often a challenge to find ways of organizing and communicating traditional ecological knowledge because it is rarely in written form and the complete knowledge system is rarely held by a single person. This article explores using traditional seasonal knowledge in the form of ecological calendars as a means of effectively presenting traditional ecological knowledge in a form that can be used to help manage resources in a contemporary system. Traditional management evolved over thousands of years and was developed within a cosmological context, so traditional management regimes are often based on cyclical processes that are embedded strongly in place and the ecology of that place. Seasonal knowledge involves temporal knowledge of biota, landscapes, weather, seasonal cycles, and their links with culture and land uses. Specific uses of seasonal knowledge in contemporary management in Australia include fishers' use of the Coast tea-tree to mark the entry of snapper into Port Philip Bay in Victoria and in 2004 to help design fish spawning closures in Cape York. In Hawaii, ecological moon calendars have been used to predict spawning times for several fish species as well as in fish pond management and there is room to expand its use to connect traditional and contemporary knowledge systems for future management of natural resources in Hawaii.

Cinner, J., and Aswani, S. (2007). Integrating customary management into marine conservation. *Biological Conservation*, 140, 201-216.

ABSTRACT: In many parts of the world, there is increasing interest among scientists, managers, and communities in merging long-enduring customary practices such as taboos that limit resource use with contemporary resource management initiatives. Here, we synthesize the literature on the customary management of coral reefs emerging from diverse disciplines including anthropology, common property economics, and ecology. First, we review various customary management strategies

and draw parallels with Western fisheries management. Secondly, we examine customary resource management and conservation. We argue that, while resource conservation often appears to be an unintended by-product of other social processes, customary management can, in fact, conserve marine resources. In the third section, we examine the resilience of customary management institutions to socioeconomic transformations. We suggest that in conditions of high population and commercialization of marine resources, property rights may become strengthened but arrangements that rely on self-restraint become weakened. Finally, we examine the commensurability of customary management and conservation. We emphasize that practical and conceptual differences exist between customary management and contemporary conservation which have often led to failed attempts to hybridize these systems. However, when these differences are understood and acknowledged there exists a potential to develop adaptive management systems that are: (1) highly flexible; (2) able to conserve resources, and; (3) able to meet community goals. In each section, we provide research priorities. We conclude by developing six key features of successful hybrid management systems.

ANNOTATION: Cinner and Aswani define and discuss the objectives of customary management, as well as socioeconomic factors that affect the success of this management approach. The authors also outline customary management strategies commonly employed and relate these strategies to Western management strategies. Finally, the authors present 6 ideas for a hybrid management strategy that would be adaptive, embrace traditional ecological knowledge and scientific knowledge and be respected by communities.

Suggestions of strategies to employ to attain sustainable management of resources using a hybrid management approach (direct from Cinner and Aswani 2007):

- Allocate catch quotas in individually transferable quota (ITQ) systems
- Use traditional ecological knowledge to locate and temporarily restrict fishing in spawning aggregation sites of commercially valuable species
- Map vulnerable benthic habitats for integration into conservation plans
- Adaptively experiment with gear restrictions
- Implement temporary closures to manage stocks
- Establish community owned and managed MPAs

A few Pacific Islander nations including Palau, the Cook Islands, the Solomon Islands, Fiji, Samoa, and Vanuatu have designed and implemented hybrid management approaches that include gear restrictions and MPAs. Shankar Aswani worked with local communities in the Western Solomon Islands to develop and implement a hybrid marine management program. The program began in 1999 by bringing together indigenous ecological knowledge and Western management tools like marine protected areas (MPAs), growing to a system of 23 no-take marine reserves in 2006. This program was created through a stakeholder participatory process that effectively combined indigenous ecological knowledge and marine science research data, utilizing tools like GIS to map this information and finally,

using these maps to formulate boundaries for community-based MPAs that continue to bring benefits to both the people and the environment.

A few additional points from the paper:

- Hybrid management can provide a cost-effective solution to managing natural resources in regions lacking sufficient biological and socioeconomic data and where government regulation is weak
- Socioeconomic conditions favoring self-restraint in customary management regimes include low population, greater distance to markets and economic equality
- Compliance with customary management systems can be often attributed to relationships with community members, spiritual and religious beliefs
- Repercussions of violating customary management regulations involve, payment of cash or livestock, violence, gossiping and other forms of social pressure
- "Paleontological evidence of species extinctions following the arrival of humans on Pacific Islands has been used to argue that a conservation ethic did not exist among pre-colonial Pacific Islanders" (206)
- Communities may not have developed a conservation ethic if they never exceeded sustainable harvesting limits of its natural resources

Customary management is defined as "**local practices that are designed to regulate the use, access, and transfer of resources... [and] are informed by indigenous ecological knowledge and are culturally embedded in customary land and sea tenure institutions... [evolving] through adaptive processes**" (202).

Gibson, B., and Puniwai, N. (2006). Developing an Archetype for Integrating Native Hawaiian Traditional Knowledge with Earth System Science Education. *Journal of Geoscience Education*, 54(3), 287-294.

ABSTRACT: There is a recognized need by educators to increase interest in the sciences among underrepresented minority groups, and thus increase the number of minorities (including indigenous peoples) going into geoscience-related professions. For example, populations on Pacific islands are one of the most vulnerable to climate change; yet they often lack the "in-house" scientific expertise to monitor their local environments. We believe that the weaving of Western science ideals with traditional knowledge through a culturally appropriate curriculum can be a highly effective way to convey Earth system science topics to indigenous peoples, such as Native Hawaiians. We developed a curriculum which emphasized the integration of traditional knowledge, geospatial technologies, and Earth system science. The resulting summer institute course, *Kaha Ki`i `Aina*, was ranked highly by the Native Hawaiian students. Further integration of traditional knowledge with Western science in the curriculum should create a pathway to attract more indigenous peoples, like the Native Hawaiians, into the geosciences.

ANNOTATION: This paper discusses traditional ecological knowledge (TEK), the need to entice more Native Hawaiians into the geosciences, and outlines a

curriculum that was designed to engage Native Hawaiians about TEK and Western science as it relates to sustainably managing resources in the face of climate change.

Definitions of TEK:

- "a cumulative knowledge and beliefs, handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment. Further, TEK is an attribute of societies with historical continuity in resource use practices; by and large, these are non-industrial or less technologically advanced societies, many of them indigenous or tribal" (Berkes 1993)
- "...a body of knowledge built up by a group of people through generations of living in close contact with nature" (Johnson 1992)

Pacific Islander communities are heavily influenced by natural and anthropogenic factors that are contributing to the depletion of natural resources. In Hawaii, there are many communities that are interested in finding ways to sustainably manage their environment. Many of these communities are equipped with Native Hawaiian knowledge, but lack an understanding of the science processes occurring in their local environment. The authors emphasize the importance of using education as a tool to merge the two knowledge systems, encourage Native Hawaiian engagement in science and ultimately help to sustainably manage resources in Hawaii. Interestingly, the authors suggest that Native Hawaiians are "less inclined to pursue a... career path unless they see themselves represented in the community in that manner" and many Native Hawaiians fail to see the connection between Native Hawaiian knowledge and Western science, contributing to little engagement of Native Hawaiian communities in the science and social science disciplines.

The authors designed a 2-week summer course entitled *"Kaha Ki'I 'Aina"* that aimed to blend Native Hawaiian traditional knowledge and Earth system science. Twelve Native Hawaiian students enrolled in the course, all ages 13-15. The course was designed to expose students to the inshore marine environment and terrestrial environment, showcasing the connectedness between systems. The 2-week course was engaging, consisting of field trips and activities, where students learned about the science and Native Hawaiian culture surrounding each area of the *ahupua'a* as well as the links between the systems. Students learned basic computer and presentation skills, and how to use a global positioning system (GPS) and create maps using geographic information system (GIS) software.

A specific example from the course involved a field trip to the Hakalau Forest National Wildlife Refuge. Students learned an *'oli komo* (chant) before entering the forest, enabling them to reach out to their Native Hawaiian ancestors for blessings, knowledge and good judgement. Next, the students learned about how their ancestors used the resources in the forest, including how birdcatchers would use the sap from the Breadfruit tree to catch i*'iwi* and *'apapane* to get brightly colored feathers used to make cloaks for the *ali'i*. Students also learned that the same birds are now endangered or threatened due to habitat destruction and disease. The

ahupua'a system was employed to help show students the linkages between the biological knowledge and their cultural knowledge. Students also used their GPS skills to mark location specifics about birds and their habitats and this data was ultimately incorporated into figures for management plans for the National Wildlife Refuge. Overall this course proved effective by equipping Native Hawaiian youths with new technical skills and knowledge that they can bring back to their communities.

Veitayaki, J. (1998). Traditional and community-based marine resources management system in Fiji: An evolving integrated process. *Coastal Management*, 26(1), 47-60.

ABSTRACT: The traditional and community-based marine resources management system in Fiji is evolving to meet the challenges of contemporary societies. The traditional system of resource management addresses some of the common issues relating to resource management at the community level. Coastal communities are well placed to play a leading role in the proper use of their marine resources. This case study illustrates how the contemporary management arrangements in places like Fiji are a combination of traditional and contemporary practices which address issues and concerns relating to effective marine resources management.

ANNOTATION: Veitayaki discusses Fiji's movement towards an integrated approach for management of natural resources. It is necessary to integrate traditional and community-based management methods into contemporary management regimes in order to respond to changing ecological and socioeconomic conditions in Fiji. Some regions in Fiji recognize resources are rapidly depleting and see value In reaching out to scientists in order to develop site-specific collaborative management plans to conserve resources for future generations; however, most traditional communities do not fully understand the contemporary environmental issues or scientific explanations of ecosystem interrelationships and remain skeptical of the integration process. Fiji is a country comprised mostly of traditional communities so traditional and community-based approaches are most effective and appropriate because it directly involves the people, their culture and tradition. Traditional communities have rights to inshore fishing grounds, and local communities are beginning to see their inshore fisheries disappear. Many of these communities have reached out to collaborate with scientists from the University of the South Pacific, NGOs or other institutions with hopes of integrating their traditional management methods with scientific or contemporary methods to conserve and protect their local resources for the future. Veitayaki notes that the greatest successes thus far in developing an integrated management regime have been in fisheries management in traditional communities. The people are seen as integral components of the ecology of the inshore coastal zone and are reaping benefits (i.e. more fish, bigger fish, greater diversity of species) from an integrated management approach that incorporates traditional knowledge like seasonal knowledge and contemporary methods like Marine Protected Areas.

KEY TERMS

Ecosystem-Based Management (EBM)

Source	Definition
Sievanen et al. 2011	Acknowledges the central role of humans in ecosystems.
Aswani 2011	The management of a particular ecosystem's structure, function, and processes to sustain and foster ecosystem services for human society, and, therefore, it focuses on the interconnectedness of ecological, social, and economic parameters for developing place-based management plans of an ecosystem.
Lindholm and Pavia 2010	-Christensen et al. (1996) defined ecosystem management as "management driven by explicit goals, executed by policies, protocols, and practices, and made adaptable by monitoring and research based on our best understanding of the ecological interactions and processes necessary to sustain ecosystem composition, structure, and function." -Ecosystem-based management integrates many sectors and stakeholders, considers cumulative impacts, explicitly includes humans as integral to the system, and preserves important services for humans as goals for management.
Hoel 2009 (USA)	An approach that requires that development activities be coordinated in a way that minimizes their impact on the environment and integrates thinking across environmental, socioeconomic, political and sectoral realms.
Hoel 2009 (Canada)	-Involves managing human activities in such a way that marine ecosystems health is not significantly impacted. -Holistic and cross-disciplinary, based on best available knowledge, a phase implementation process, nationally developed and regionally implemented, area-based, objective based, applied within the broader context of integrated management, incorporates the precautionary approach and adaptive management principles.
Levin et al. 2009	Defines management strategies for entire systems, not simply individual components of the ecosystem; takes into account interactions among ecosystem components and management sectors, as well as cumulative impacts of a wide spectrum of ocean-use systems; considers humans an integral part of the ecosystem, since humans derive a portfolio of services from the ecosystem and also act as a driver influencing ecosystem processes.
Levin and Lubchenco 2008	*EBM* for the oceans is the application of ecological principles to achieve integrated management of key activities affecting the marine environment. -Explicitly considers the interdependence of all ecosystem components, including species both human and nonhuman and their environments -Defines boundaries for management on basis of ecological rather than political criteria.
Ruckelshaus et al. 2008	*EBM* strategy should balance the interests of diverse

	stakeholder groups, consider the status of both target and non-target species, incorporate networks of MPAs to protect habitats and their associated biota, and adapt an overarching system of ocean zoning to coordinate regulations of human activities in particular areas at particular times.
Murawski 2007	Implies a management scheme primarily designed to address overall ecosystem considerations.
Arkema et al. 2006	*Integrated management of human activities based on knowledge of ecosystem dynamics to achieve sustainable use of ecosystem goods and services, and maintenance of ecosystem integrity. - A broad, holistic approach, involving the management of species, other natural commodities, and humans as components of the larger ecosystem -The comprehensive integrated management of human activities based on the best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of marine ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity
McLeod et al. 2005 -Also in Hoel 2009, Sievanen et al. 2011, Rosenberg and McLeod 2005	***An integrated approach to management that considers the entire ecosystem, including humans.**
Wikipedia *sources: Christensen et al. 1996, McLeod et al. 2005	An environmental management approach that recognizes the full array of interactions within an ecosystem, including humans, rather than considering single issues, species, or ecosystem services in isolation.

Ecosystem Approaches to Management (EAM)

Source	Definition
Murawski 2007	-Extending existing management foci (e.g. fisheries) to include additional considerations consistent with ecosystem management characteristics. - Provides a comprehensive framework for marine and coastal resource decision making. In contrast to individual species or single issue management, *EAM* considers a wider range of relevant ecological, environmental, and human factors bearing on societal choices regarding resource use (from NOAA).

Ecosystem-Based Fisheries Management (EBFM)

Source	Definition
Pikitch et al. 2004	Reverses the order of management priorities to start with the ecosystem rather than the target species.

Ecosystem Approaches to Fisheries (EAF)

Source	Definition
Murawski 2007	Strives to balance diverse societal objectives, by taking into account the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries (from FAO).

Marine Spatial Planning (MSP)

Source	Definition
Foley et al. 2010	-An integrated planning framework that informs the spatial distribution of activities in the ocean so that existing and emerging uses can be maintained, use conflicts reduced, and ecosystem health and services protected and sustained for future generations. -Ecosystem-based *MSP* is an integrated planning framework that informs the spatial distribution of activities in and on the ocean in order to support current and future uses of ocean ecosystems and maintain the delivery of valuable ecosystem services for future generations in a way that meets ecological, economic, and social objectives. - Emerged as a framework for implementing an ecosystem-based, coordinated governance structure in the world's oceans.
Center for Ocean Solutions, Decision Guide: Selecting Decision Support Tools for Marine Spatial Planning 2011	*MSP*, maritime spatial planning, integrated ocean management, and systematic conservation and marine use planning all denote similar decision making approaches that use scientific and geospatial information to address conflicts and organize human activities in the ocean, while maintaining ecosystem health, function and services.
Wikipedia	-A tool that brings together multiple users of the ocean – including energy, industry, government, conservation and recreation – to make informed and coordinated decisions about how to use marine resources sustainably. MSP uses maps to create a more comprehensive picture of a marine area – identifying where and how an ocean area is being used and what natural resources and habitat exist. -The United Kingdom's Department of Environment, Food and Rural Affairs define MSP as a "strategic, forward-looking planning for regulating, managing and protecting the marine environment, including through allocation of space, that addresses the multiple, cumulative, and potentially conflicting uses of the sea".

Large Marine Ecosystems (LME)

Source	Definition
Hoel 2009	Regions of ocean space of about 200,000 km2 or greater that encompass coastal areas from river basins and estuaries out seaward to the break or slope of the continental shelf, or out to the seaward extent of a well-defined principal current

Connectivity

Source	Definition
Foley et al. 2010	Can occur through the movement of individuals (larvae or adults), nutrients, or materials (e.g., nutrient and detritus) across permeable habitat boundaries; *connectivity* among habitats and populations in marine ecosystems is critical for population and species persistence.

Traditional Ecological Knowledge

Source	Definition
Gibson and Puniwai 2006	Berkes (2003) defined TEK as "a cumulative knowledge and beliefs, handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment. Further, TEK is an attribute of societies with historical continuity in resource use practices; by and large, these are non-industrial or less technologically advanced societies, many of them indigenous or tribal". -Johnson (1992) defined TEK as "...a body of knowledge built up by a group of people through generations of living in close contact with nature".
Drew 2005	Complex and represents the accumulated knowledge about species, their environments and their interactions accrued and passed down over multiple generations -Site-specific, represents the information necessary for cultural survival, accumulated through trial-and-error over many years -It is not disseminated quickly and requires trust
Berkes 2000 -Also in (Drew 2005), (Gratani et al. 2011)	***A cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment.** -An attribute of societies with historical continuity in resource use practice -May be holistic in outlook and adaptive by nature, gathered over generations by observers whose lives depended on this information and its use -It often accumulates incrementally, tested by trial-and-error and transmitted to future generations orally or

	by shared practical experiences
Wikipedia *source: Berkes 2000	A cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission. [It concerns] the relationship of living beings (including human) with one another and with their environment.

Customary Marine Tenure

Source	Definition
Cinner 2005	Legal and cultural foundation for localized control over marine resources -Access to inshore marine resources is generally controlled by social units including individuals, families, clans or other kinship-based institutions and villages -These marine tenure institutions can range from relatively simple communally-owned marine areas from which outsiders are excluded to the complex and overlapping system of individual and family rights to space, species, gear and even specific techniques of using gear

Customary Management

Source	Definition
Aswani 2011	Cultural and historical practices designed to regulate the use of, access to, and transfer of resources locally, and they are informed by indigenous ecological knowledge and embedded in customary land- and sea-tenure institutions.
Cinner and Aswani 2007	-Local practices that are designed to regulate the use, access, and transfer of resources... [and] are informed by indigenous ecological knowledge and are culturally embedded in customary land and sea tenure institutions... [evolving] through adaptive processes. -Typically dynamic and adaptively evolving to reflect changes in social, political, economic, and cultural conditions.

Collective Management

Source	Definition
Mayer 2012 *portions of definition from Hoel 2009, Arkema et al. 2006 and McLeod et al. 2005	A collective approach to managing the ecosystem, built upon customary and western scientific knowledge systems, that assimilates thinking across *environmental, socioeconomic, geographic* and *political realms* in order to attain sustainable use of ecosystem goods and services and preserve ecosystem integrity for *future generations.*

CASE STUDIES IN THE CAPSTONE LITERATURE

SOURCE	LOCATION	PLAYERS	SYSTEM	RIGHTS	LEGISLATION	ISSUES
Nursey-Bray (2011)	Australia	Indigenous peoples of Australia, Federal Government of Australia	Co-management	Yes, Legal	The Mabo Decision 1992, Native Title Act 1993, Native Title Amendment Act 1998, Env. Protection and Biodiversity Conservation Act 1999, Blue Mud Bay Decision 2008	Maintain the biodiversity of the Australian marine environment, enable indigenous peoples of Australia's access and use rights to customary fisheries
Grayson (2010)	Torres Strait / Australia	Torres Strait Islanders, Federal Government of Australia	Co-management	Yes, Legal	Torres Strait Treaty 1985, Native Title Act 1993	Management of one the world's largest Green sea turtle population and dugongs
Olympic Coast National Marine Sanctuary Management Plan (2012)	Olympic Coast National Marine Sanctuary / Washington State	Olympic Coast Tribes, Washington State, NOAA	Co-management	Yes, Legal treaty-protected	United States v. Washington 1974, Treaty of Olympic 1855, Treaty of Neah Bay 1855	Management and protection of treaty resources, ensure resilience of resources, promote the continuing health of the Olympic Coast ecosystem
Aswani (2011)	New Georgia Group in the Solomon Islands	Indigenous peoples of the New Georgia group in the Solomon Islands, Shankar Aswani	Community-driven	Yes, Customary Marine Tenure	n/a	Manage the sustainable use of resources (utilizing hybrid management system)
Johannes (1998)	Vanuatu	Indigenous peoples of Vanuatu (27 villages), Fisheries Department	Community-driven	Yes, Customary Marine Tenure	n/a	Sustainable management of the customary trochus fishery
Poepoe et al.	Mo'omoni Bay on the island of Moloka'i/Hawaii	Native Hawaiians in the Ho'olehua Hawaiian Homestead	Community-driven	Yes	Hawaiian Homes Commission Act 1921	Manage subsistence fishing activities at a level that maintains sustainable use and allows for important reproductive events to occur, maintaining the stock for future generations
Veitayaki (2011)	Fiji	Indigenous peoples of Fiji, Fiji Fisheries Department	Community-driven	Yes, Customary Marine Tenure	n/a	Restore depleted fisheries, sustainable manage access to and use of inshore resources
Jokiel et al. (2011)	Hawaii	Native Hawaiians, State of Hawaii, NOAA	Government-driven	Limited	n/a	Support and enhance conservation of the natural, cultural and historic resources within the Papahanaumokuakea Marine National Monument
Fagatele Bay National Marine Sanctuary Draft Management Plan (2011)	Fagatele Bay National Marine Sanctuary / America Samoa	Indigenous peoples of American Samoa, NOAA	Government-driven	Limited	n/a	"Promote stewardship through active engagement of sanctuary communities while incorporating Samoan culture and protecting cultural heritage and maritime heritage resources."

SOURCE	METHOD FOR ENGAGING LOCAL KNOWLEDGE OR UNITING KNOWLEDGE SYSTEMS	
	METHOD	DESCRIPTION
Nursey-Bray (2011)	Traditional Use Marine Resource Agreements (TUMRA)	A legal tool to outline joint agreements for place-specific management of natural resources in Australia; currently being employed to manage hunting activities, describe Indigenous roles in monitoring and compliance, and educate the public about the traditional uses of managed areas within Great Barrier Reef boundaries (partnership between GBRMPA, EPA and Indigenous peoples of Australia)
	Indigenous Protected Areas (IPAs)	Indigenous-owned land managed for "cultural biodiversity and conservation permitting customary sustainable resource use and sharing of benefit"; federal gov't provides monetary funds; managed under IUCN criteria
	Development of "Networks" i.e. Northern Australia Land and Sea Management Alliance (NAILSMA)	Network of Indigenous peoples of Australia that acts as a collective voice to "support practical Indigenous land and sea management...across the whole of the North"
	Development of "Indigenous-Driven Management Enterprises Within MPAs " i.e. Wuthathi Land and Sea Management Framework: Integrating Culture and Conservation	Enabled the Wuthathi community to assert their rights to access, control and manage their land and seas; effective management = ensuring economic and community development are as important as environmental sustainability
Grayson (2010)	Community Management Plans	The federal government of Australia funded 8 communities to draft their own place-specific management plans for the Green sea turtle and dugong giving the community the majority of responsibility in ensuring the sustainable use of these resources; appropriate approach because of remote location of the islands and the communities reliance on resources for subsistence and livelihood; communities support use of spatial planning and quotas but do not support size/sex limits or seasonal closures
Prober et al. (2011)	Ecological Calendars	A means of effectively presenting traditional ecological knowledge in a form that can be used to help manage resources in a contemporary system. Traditional management evolved over thousands of years and was developed within a cosmological context, so traditional management regimes are often based on cyclical processes that are embedded strongly in place and the ecology of that place. Seasonal knowledge involves temporal knowledge of biota, landscapes, weather, seasonal cycles, and their links with culture and land uses. Specific uses of seasonal knowledge in contemporary management in Australia include fishers' use of the Coast tea-tree to mark the entry of snapper into Port Philip Bay in Victoria and in 2004 to help design fish spawning closures in Cape York.
Olympic Coast National Marine Sanctuary Management Plan (2012)	Creation of the Intergovernmental Policy Council (IPC)	Composed of NOAA, State of Washington, Quinault Indian Nation and the Hoh, Makah and Quileute Tribes. The IPC serves as a forum to exchange knowledge, set priorities and develop management recommendations for the Olympic Coast
	Development of Action Plans	Designed to encourage collaborative research and monitoring that will inform and enhance ecosystem-based management efforts in the sanctuary. All action plans outline links to goals, specific strategies for achieving goals and activities for how to accomplish strategy, and key partners (stakeholder involvement). They also include both customary knowledge and scientific terminology/data.
Aswani (2011)	Interdisciplinary Human Ecological Models	10 men and women were selected for their fishing expertise and knowledge of the local marine environment, each contributing local knowledge about habitats, fish species and abundance, and fishing hot spots. Scientific data was collected on these same topics in the community's inshore region. Local knowledge and scientific data were mapped and the analysis of the data sets was utilized to implement a network of marine protected areas (MPAs) that would be valued and respected by the local community, and maximize protection important biological processes contributing to more resources for future generations to use.
Johannes (1998)	Government-assisted Management	Fisheries biologist Moses Amos announced over the radio that the federal government would provide trochus management advice to communities that requested it. Amos conducted trochus surveys on community fishing grounds and provided basic information on trochus life history, reasons for encouraging size limitations and closed seasons (i.e. reproduction), temporal trends in populations and information about local near-shore currents. Information between resource owners, fishers and Amos were

		shared informally around the kava bowl. Final management decisions were left to the community because each needed to balance their local socioeconomic concerns with biological information provided by Amos.
Poepoe et al.	Fish Spawning Moon Calendar	Moon calendars are used as a "predictive tool based on awareness of natural cycles and their relationship to fishing and farming success". Community monitors created a calendar identifying the spawning periods of important food fish species by observing spawning behavior and sampling fish gonads. This helps guide where and when fishers can harvest and provides valuable information to help community monitors determine when to implement traditional closures or kapu so the natural rhythms of the species are not disturbed.
	Community conservation ethic based on customary Hawaiian caretaker (*konohiki*) practices	The community has no formal fisheries management plan, rather they follow an informal code of conduct that encourages responsible fishing practices. Community support, customary knowledge of management and a monitoring program are the key elements of this code of conduct. This particular community relies on fishing for subsistence and therefore relies on one another for their livelihood. The Hui Malama o Mo'omomi, or customary marine resource conservation system, was revived in 1993 by appealing to Hawaiian cultural beliefs, values and conservation ethics. This system encouraged responsible fishing by holding individuals accountable, drawing on family and social pressures and training youths in the community to be "good marine citizens".
Veitayaki (2011)	Government-assisted Management	The Fiji Fisheries Department allocated rights to manage access to and use of inshore resources to local Fijian communities including the right to sell commercial fishing licenses to outsiders wishing to fish inshore customary fishing grounds. The Fiji Fisheries Department has focused their efforts on managing the commercial fishing industry in the offshore waters of Fiji. This arrangement has allowed Fijian communities to manage resources using customary methods, but also turn to NGOs and academia for assistance in designing collective management systems that are built on a foundation of both customary and scientific principles. Marine protected areas and gear restrictions are often employed in these systems.
Jokiel et al. (2011)	Cultural Working Group	Opportunity to engage Native Hawaiians in the management process of this no-take marine protected area. The group is composed of Native Hawaiian practitioners, scholars, teachers, kupuna, fishermen and community members.
	Monument sponsored interdisciplinary research projects	Provides an opportunity to for scientists, cultural practitioners and fishermen to work together and unite their knowledge and data as it pertains to sustainably managing the Monument's natural environment.
	Partnership with the University of Hawaii at Hilo	The Monument is training students to design research projects that require the study of both Native Hawaiian and marine science materials.
	Incorporating Native Hawaiian language i.e. Papahanaumokuakea	Incorporating Native Hawaiian language into management systems that have customary spiritual and cultural meanings aid the Monument in its intent to manage the area using traditional values. Furthermore, Native Hawaiians may be better able to connect with the Monument's management system if it is built on a foundation of values that are respected.
Fagatele Bay National Marine Sanctuary Draft Management Plan (2011)	Incorporate *fa'a-Samoa*	"The Samoan Way"; keeps Samoans "strongly nationalistic and cautious about changes that might threaten the traditional way of life"; connects Samoans to the sanctuary; develop education and outreach programs and materials for the sanctuary that features fa'a Samoa and includes Samoan stories, films, dances and customs
	Community Volunteer Program	Getting communities involved in education and outreach, research and monitoring, and interpretive enforcement for the sanctuary will help establish a local pride within the sanctuary, and allow community members to enhance and share their knowledge. Volunteers help bridge the communication gap between the sanctuary and communities, building a better-informed community and more effective sanctuary.
	Sanctuary Cultural Exchange Program	Incentive program for community volunteers that enables individuals to travel to other sanctuaries, engage with other indigenous cultures, share their own culture and unite with others that share the same conservation ethic.

CAPSTONE LITERATURE REFERENCES (by topic & date)

ECOSYSTEM BASED MANAGEMENT

Sievanen, L., Campbell, L.M., and Leslie, H.M. (2012). Challenges to Interdisciplinary Research in Ecosystem-Based Management. *Conservation Biology*. DOI: 10.1111/j.1523-1739.2011.01808.x

Decision Guide: Selecting Decision Support Tools for Marine Spatial Planning PacMARA and Center for Ocean Solutions. 2011.

Examples of Ecosystem-Based Management in National Marine Sanctuaries: Moving from Theory to Practice. (2010). Marine Sanctuaries Conservation Series ONMS-10-02. NOAA.

Foley, M.M., Halpern, B.S., Micheli, F., Armsby, M.H., Caldwell, M.R., Crain, C.M., Prahler, E., Rohr, N., Sivas, D., Beck, M.W., Carr, M.H., Crowder, L.B., Duffy, J.E., Hacker, S.D., McLeod, K.L., Palumbi, S.R., Peterson, C.H., Regan, H.M., Ruckelshaus, M.H., Sandifer, P.A., and Steneck, R.S. (2010). Guiding Ecological Principles for Marine Spatial Planning. *Marine Policy*, 34, 955-966.

Hoel, A.H. (ed.) (2009). Best Practices in Ecosystem-based Oceans Management in the Arctic. The Norwegian Polar Institute.

Levin P.S., Fogarty, M.J., Murawski, S.A., and Fluharty, D. (2009). Integrated Ecosystem Assessments: Developing the Scientific Basis for Ecosystem-Based Management of the Ocean. PLoS Biol 7(1): e1000014. doi:10.1371/journal.pbio.1000014

Levin, S.A., and Lubchenco, J. (2008). Resilience, Robustness, and Marine Ecosystem-based Management. *BioScience*. 58(1), 27-32. http://www.bioone.org/doi/full/10.1641/B580107

Ruckelshaus, M., Klinger, T., Knowlton, N., and DeMaster, D.P. (2008). Marine Ecosystem-based Management in Practice: Scientific and Governance Challenges. *BioScience*, 58(1), 53-63. http://www.bioone.org/doi/full/10.1641/B580110

Arkema, K.K., Abramson, S.C., and Dewsbury, B.M. (2006). Marine ecosystem-based management: from characterization to implementation. *Frontiers in Ecology and the Environment*, 4, 525–532. http://dx.doi.org/10.1890/1540-9295(2006)4[525:MEMFCT]2.0.CO;2

McLeod, K.L., Lubchenco, J., Palumbi, S.R., and Rosenberg, A.A. (2005). Scientific Consensus Statement on Marine Ecosystem-Based Management. Signed by 217 academic scientists and policy experts with relevant expertise and published by the Communication Partnership for Science and the Sea at http://compassonline.org/?q=EBM

Rosenberg, A. A., & McLeod, K. L. (2005). Implementing ecosystem-based approaches to management for the conservation of ecosystem services. *Marine Ecology Progress Series*, (300), 270-274. Retrieved from http://www.int-res.com/abstracts/meps/v434/p291-301/

Pikitch, E.K., Santora, C., Babcock, E.A., Bakun, A., Bonfil, R., Conover, D.O., Dayton, P., Doukakis, P., Fluharty, D., Heneman, B., Houde, E.D., Link, J., Livingston, P.A., Mangel, M., McAllister, M.K., Pope, J., and Sainsbury, K.J. (2004). Ecosystem-Based Fishery Management. *Science*, (305).

CUSTOMARY MANAGEMENT

Jokiel, P., Rodgers, K., Walsh, W., Polhemus, D., and Wilhelm, T. (2011). Marine Resource Management in the Hawaiian Archipelago: The Traditional Hawaiian System in Relation to the Western Approach. *The Journal of Marine Biology*. doi:10.1155/2011/151682

Fagetele Bay National Marine Sanctuary: Draft Management Plan. (2011).

Veitayaki, J. (2011). Fisheries resource-use culture in Fiji and its implications. Culture and sustainable development in the Pacific. pp. 116-130.

Grayson, J. et al. (2010). Options for Managing the Sustainable Use of Green Turtles: Perceptions of Hammond Islanders in Torres Strait. *Conservation and Society*, 8(1), 73-83.

Cinner, J. (2005). Socioeconomic factors influencing customary marine tenure in the Indo Pacific. *Ecology and Society*, 10(1), 36. [online] URL: http://www.ecologyandsociety.org/vol10/iss1/art36/

Drew, J. (2005). Use of Traditional Ecological Knowledge in Marine

Conservation. *Conservation Biology*. Volume 19, No. 4, pp 1286-1293.

Thomas, F. (2003). 'Taming the Lagoon': Aquaculture Development and the Future of Customary Marine Tenure in Kiribati, Central Pacific. Geografiska Annaler. Series B, *Human Geography*, Vol. 85, No. 4, Special Issue: Nature-Society Interactions on Islands, pp. 243-252.

Berkes, F., Colding, J, and Folke, C. (2000). Rediscovery of Traditional Ecological Knowledge as Adaptive Management. *Ecological Applications,* (10)5, 1251-1262.

Poepoe, K., Bartram, P., and Friedlander, A. The Use of Traditional Hawaiian Knowledge in the Contemporary Management of Marine Resources. Putting Fishers' Knowledge to Work: Conference Proceedings, pp. 328-339.

Krech, S. (1994). Ideas: From the National Humanities Center. *Ecology and the American Indian.*

COLLECTIVE MANAGEMENT

Aswani, S. (2011). Socioecological Approaches for Combining Ecosystem-based and Customary Management in Oceania. *Journal of Marine Biology.*

Bohensky, E. L., and Y. Maru. (2011). Indigenous knowledge, science, and resilience: what have we learned from a decade of international literature on "integration"? *Ecology and Society*, 16(4). http://dx.doi.org/10.5751/ES-04342-160406

Gratani, M., J. R. A. Butler, F. Royee, P. Valentine, D. Burrows, W. I. Canendo, and A. S. Anderson. (2011). Is validation of indigenous ecological knowledge a disrespectful process? A case study of traditional fishing poisons and invasive fish management from the Wet Tropics, Australia. *Ecology and Society*, 16(3). http://dx.doi.org/10.5751/ES-04249-160325

Nursey-Bray, M. (2011). Social Contexts and Customary Fisheries: Marine Protected Areas and Indigenous Use, Australia. *Environmental Management*, 47, 671-683.

Prober, S. M., M. H. O'Connor, and F. J. Walsh. (2011). Australian Aboriginal peoples' seasonal knowledge: a potential basis for shared understanding

in environmental management. *Ecology and Society*, 16(2). [online] http://www.ecologyandsociety.org/vol16/iss2/art12/

Cinner, J., and Aswani, S. (2007). Integrating customary management into marine conservation. *Biological Conservation*, 140, 201-216.

Gibson, B., and Puniwai, N. (2006). Developing an Archetype for Integrating Native Hawaiian Traditional Knowledge with Earth System Science Education. *Journal of Geoscience Education*, 54(3), 287-294.

Veitayaki, J. (1998). Traditional and community-based marine resources management system in Fiji: An evolving integrated process. *Coastal Management*, 26(1), 47-60.

ADDITIONAL CASE STUDIES: Based on Personal Work Experiences and Analysis of Relevant Management Plans

I present these brief case studies to illustrate (3) examples of DIFFERENT management systems (community-driven, co-management and government-driven) that all SHARE the common goal of utilizing customary knowledge to sustainably manage natural resource use. Each case study has different key players that must set management priorities, choose appropriate place-based management tools and ensure monitoring and compliance with the management regime. I emphasize that the biggest different between the systems is the interaction of (2) factors, community rights to resources and government jurisdiction over the management process.

	FIJI	OCNMS	HIHWNMS
	Common Goal: Utilize customary knowledge to sustainably manage natural resource use.		
KEY PLAYERS	Yaro, Ligau, Daku Villages, NGOs & University of the South Pacific	Olympic Coast Tribes, Washington State & NOAA: Intergovernmental Policy Council	State of Hawai`i & NOAA
COMMUNITY RIGHTS	Customary Marine Tenure	Treaty-Protected Rights	Limited
GOVERNMENT JURISDICTION	Limited Inshore	Co-management: Olympic Coast Tribes, Washington State and NOAA	Co-management: State of Hawai`i and NOAA*
MANAGEMENT SYSTEM	Community-Driven	Co-management	Government-Driven

FIJI – Kia Island
OCNMS – Olympic Coast National Marine Sanctuary
HIHWNMS – Hawaiian Islands Humpback Whale National Marine Sanctuary

The first case study, Fiji, is based on personal work experience on Kia Island. Kia Island is a small island in far north Fiji that is comprised of three traditional villages that all rely on fishing the world's third largest barrier reef, the Great Sea Reef, for subsistence and their cultural and economic livelihood. The inshore fishing grounds and reef are traditionally managed by the villages on the island, or customary marine tenure. Each of the villages has a chief that oversees all fishing

activities, and often receives orders from the provincial chief on the mainland that must be adhered to as well. The resources are managed for sustainable use, utilizing customary knowledge to guide many of their management approaches. I observed the use of gear restrictions (i.e. no nets or use of SCUBA), species restrictions (i.e. the endangered humphead wrasse) and seasonal closures (i.e. beche-de-mer). However, it was also apparent that restrictions were not adhered to if a fishers economic livelihood was at stake or there was an upcoming important cultural event (i.e. wedding, provincial chief request for fish). The World Wildlife Fund helped the community set-up its first marine protected area in 2005, a region that is still monitored by the island. This is a region that is often targeted by mainland poachers during the night, and if caught by the island monitors, often results in violence. I observed a poaching event that sent 2 full boatloads of Kia Island fishers to the site, where 2 fishers were struck with rocks and batteries and had to be taken to the mainland hospital, and fishers were jailed after confronting each other on the mainland the next day. The chief of Yaro Village invited a UK-based NGO to start-up a joint marine conservation program on the island after community members started noticing a decline in resource availability, even after the establishment of the marine protected area. I lived as a local on the island as a marine conservation intern as part of this joint program, where I lived in Yaro Village, conducted daily fisher surveys (i.e. learning species caught, how many, how often, economical value/unit, gear used), immersed myself in the island culture, helped design and implement a marine conservation program at the island primary school, and established relationships. The intention of this joint program is to establish a collective approach to sustainably managing the Great Sea Reef resources so future generations of Kia Islands can continue to rely on these same resources for subsistence, and their cultural and economic livelihood.

The second case study, the Olympic Coast National Marine Sanctuary (OCNMS), is based on my analysis of sanctuary's most recent (2012) management plan. This particular region is inhabited by the Hoh, Makah and Quileute Native American Tribes. These tribes all rely on resources within OCNMS boundaries for subsistence, and their cultural and economic livelihood, and their rights to these resources are treaty-protected. This allows the Olympic Coast Tribes to be equal players in the development and implementation of management approaches for the region. The sanctuary was tasked with designing a management plan for the Olympic Coast region that would ensure management and protection of treaty resources, resilience of the resources for future generations and maintenance of the health of the ecosystem. The Intergovernmental Policy Council (IPC), comprised of the Olympic Coast Tribes, Washington State and NOAA, was created in 2008 to serve as a place where knowledge could be shared, management priorities set (that consider the environmental, socioeconomic and political realms of the region), and a management framework developed. As part of this framework, the IPC developed 4 Action Plans that were designed to encourage collaborative research and monitoring. Each Action Plan utilizes both customary and scientific knowledge / tools, and outlines links to framework goals, specific strategies for achieving these goals, actions for how to accomplish the strategies and includes key partners

(stakeholders). The Action Plans cover everything from habitat mapping and classification to physical and chemical oceanography to communities and ecosystems. The intention of these Action Plans is to utilize the information collected to adaptively manage the sanctuary so the resources are successfully managed for use now and in the future. Resources will likely be better managed if all stakeholders share responsibility in managing the resources and are part of the process from the beginning, as is the case here. This management plan was only released in 2012, so time will tell if this collective approach yields positive results for the resources, the Olympic Coast Tribes, Washington State and NOAA.

The third case study, the Hawaiian Islands Humpback Whale National Marine Sanctuary (HIHWNMS), is based on a brief work experience with the sanctuary as part of my Master's Capstone Project. The sanctuary is currently undergoing a management review process to develop a management plan for the sanctuary that will be built upon Native Hawaiian and Western Scientific knowledge systems. Currently, the sanctuary is co-managed by the State of Hawai`i and NOAA and Native Hawaiian involvement in the sanctuary's management process in informal and on a volunteer basis. Tools like the Ecological Moon Calendar are currently being used to bring Native Hawaiian and Western Scientific knowledge together in a form that can be used by the sanctuary to help manage resource use for future generations. The Aha Moku Bill of Hawai`i is expected to pass this July (2012), formally recognizing the role of the Native Hawaiian Aha Moku System in managing natural resources and establishing a Native Hawaiian Aha Moku advisory committee within the Department of Natural Resources for the State of Hawai`i [7]. The Aha Moku System is the customary Native Hawaiian management system built upon the concept of *`ahupua`a* , handed down through the generations orally, and is a system that has been successfully employed to sustainably manage resources for the past ten centuries in Hawai`i [8]. I speculate that if this bill passes, Native Hawaiians may acquire formal legal rights to resources and may become the third equal player in the co-management of resources within the HIHWNMS boundaries (currently only the State of Hawai`i and NOAA). There could be changes ahead for management systems in Hawai`i.

MY THOUGHTS ON COLLECTIVE MANAGEMENT

The content of this section was developed based on analysis of background reading conducted for the Annotated Bibliography and my own personal work experiences in Fiji and Hawai`i, and is the opinion of Tamara Mayer.

What is Collective Management?

Collective Management is built upon Customary and Western scientific knowledge systems and is an approach to managing the ecosystem that assimilates thinking across *environmental, socioeconomic, geographic* and *political realms* in order to attain sustainable use of ecosystem goods and services and preserve ecosystem integrity for *future generations.*

-Mayer 2012*

*portions of definition from Hoel 2009, Arkema et al. 2006 and McLeod et al. 2005

Why does Collective Management have the potential to be more successful in managing resources than Customary or Ecosystem-Based Management?

Customary Management and Ecosystem-Based Management have roots in different knowledge systems (i.e. Customary in socioecological and historical practices, EBM in scientific principles), but their objective, achieving sustainable use of resources, intersects in numerous ways which creates opportunities for uniting the two knowledge systems into a Collective Management approach for maximum management success (Aswani 2011). Customary and Ecosystem-Based Management are BETTER TOGETHER!

My Guiding Principles of Collective Management

Based on analysis of my readings and case studies, I believe there are four guiding principles of Collective Management that should be adhered to for maximum management success, including:

1. **Stakeholder involvement**
2. **Setting clear management priorities to quantify progress**
    a. Utilizing appropriate place-based management tools
        i. Customary (i.e. seasonal closures)
        ii. Ecosystem-Based (i.e. marine protected areas, GIS)
3. **Monitoring and assessment**
4. **Enforcement and Vigilance**

Factors Influencing Implementation of My Guiding Principles of Collective Management

It is my understanding that implementation of these Collective Management guiding principles will vary by region based on the interaction of two factors:

1. **Community rights to resources**
    a. *Customary marine tenure* (Social units have the right to manage inshore activities and inshore use of resources)
    b. *Treaty-protected* or *legal rights*
    c. *Limited* or *informal rights*
2. **Government jurisdiction** (i.e. Does the government have formal authority to manage resources?)
    a. *Community-driven management* (Limited government authority)
    b. *Co-management* (often shared responsibility between government and community, but not always)
    c. *Government-driven management* (Informal community engagement)

TABLE 1.
The combination of these two factors influence the relationship between stakeholders and likely the outcome of resource management.

Community Rights	Government Jurisdiction	Outcome
Customary marine tenure	Limited	Community-driven system
Treaty-protected or legal	Formal authority	Co-management system
Limited or informal	Formal authority	Government-driven system

Communities that have recognized rights to resources are more likely to feel empowered, engage and contribute knowledge and ideas for sustainably managing resources for use, respect the management tools employed and enforce the rules. Recognized rights may be informal (customary marine tenure) or formal (treaty-protected or legal rights). In both cases, communities are major stakeholders in the management system and they have the authority to set priorities and make decisions. Recognized rights also protect subsistence and cultural uses of resources, and economic livelihoods.

Customary marine tenure is often employed in regions where the government has limited jurisdiction over the management process. This may be because of geographical limitations (i.e. not feasible for government to have a presence if nation is made up of hundreds of islands), cost of employing a government-driven system or the importance of subsistence, cultural and economic activities in the region. These community-driven management systems are generally effective because the community has a vested interest in sustaining use of resources for future generations. Furthermore, respect for the social units that manage resources keep communities abiding by the rules. Failure of community-driven management systems often occur in communities where there is not a strong social bond within the community, and where community members are lured by economic incentive to exploit resources [9,10].

Treaty-protected or legal community rights to resources are often utilized in regions where the government has formal jurisdiction over the management process. This

often results in a co-management system, where communities share the responsibility of managing resources but also enjoy the freedom to utilize resources legally for subsistence and cultural uses, and to ensure their economic livelihood [9, 10].

In cases where communities have limited or informal rights, the government usually has formal jurisdiction over the management process. The government may recognize community rights to resources, but their rights are not formally protected in government-driven systems. Communities often are less inspired to participate in such management systems because they distrust the government and fear their ability to utilize resources for subsistence and cultural uses, and to sustain their economic livelihood, could change at any moment in time. Furthermore, communities are often hesitant to engage about their traditional ecological knowledge, fearing misuse of their place-based knowledge of resources. Governments that want to include communities in the management process, informally, often spend lots of time building trust and forming meaningful relationships [9, 10].

Aloha ʻĀina

An innovative and uniquely Hawaiian approach to managing natural resources in Hawaiʻi. This approach can be described as "Collective Management" because it blends knowledge and tools from Native Hawaiian and Western scientific systems while also allowing the *core identity* of each system to remain intact.

The Hawaiian Islands Humpback Whale National Marine Sanctuary, Southwest Fisheries Science Center and Scripps Institution of Oceanography formed a collaborative planning partnership in January 2012 to brainstorm ideas for a Hawaiʻi-specific collective management approach that would be built on a foundation of Native Hawaiian culture and principles, and Western science. Aloha ʻĀina was the product of this committee's first brainstorming meeting. Based on analysis of Bohensky and Maru's paper entitled: "Indigenous knowledge, science, and resilience: what have we learned from a decade of international literature on "integration"? (2011), I suggested developing a name for this Hawaiʻi-specific collective approach that would avoid placing labels on the process of uniting two difference knowledge systems and that would be a concept that ALL Hawaiians could identify with and respect. The Hawaiian Islands Humpback Whale National Marine Sanctuary suggested the ancient Hawaiian concept, Aloha ʻĀina, deep love of the land and sea. Aloha ʻĀina was coined as the sanctuary's collective management approach. Furthermore, the collaborative partnership is planning a workshop for July 5-6, 2012, to discuss implementation of Aloha ʻĀina in the sanctuary, and was appropriately named, Aloha ʻĀina.

Ideas for Engaging with Native Hawaiians

**guidelines and first principles are a modification of activities presented in:*

Hawai'i Conservation Alliance (2012). Hawaiian Culture and Conservation in Hawai'i. Hawai'i Conservation Alliance. HCA Position Paper, Honolulu. [online] http://hawaiiconservation.org/resources/publications/position_papers

- Meaningfully engage with Native Hawaiian communities about place-based social, political and ecological knowledge;

- Encourage Native Hawaiian knowledge holders to *get involved* in science processes because these dual knowledge holders can play a vital role as "bridgers" in knowledge collaboration

- Increase efforts to recruit, train, and hire Native Hawaiians into organizations at all levels;

- Include stakeholder Native Hawaiian communities in development and implementation of resource management plans as appropriate; convene Native Hawaiian advisory bodies for planning and management consultation and advice;

- Collective approach must bring *benefits* to all resources users, and both Native Hawaiian communities and Western scientists must *share an interest in management issues* if it is to be valued, respected and protected;

- Respectfully, seek out and ask permission to incorporate Native Hawaiian place-based knowledge as a foundation for site-specific management;

- Work with and support Native Hawaiian practitioners on resource access and management issues;

- Actively explore and utilize Native Hawaiian resource management knowledge and systems for their modern relevance in finding approaches to sustainably manage resources for future generations;

- Reinforce Native Hawaiian values that build appreciation and responsibility for natural resources;

- Learn the history of Native Hawaiian relationships with the land and work to rebuild and maintain the relationships tying Native Hawaiians to any given site;

- Increase the use of Native Hawaiian language, values and concepts in policy making and practice (e.g., in traditional place names, naming of new species, the creation of job titles and programs); and

- Encourage other agencies and landowners that work to sustainably manage

Hawaiian ecosystems to unite Native Hawaiian and western science knowledge, values and approaches for more effective management of resources.

Ideas for Implementing Future Aloha ʻĀina Projects

- Use **Ecological Moon Calendars** as a tool to unite specific Native Hawaiian seasonal knowledge and Western scientific research data about the resource.
  -incorporate moon phases specific to region, art and maps

- Incorporate Native Hawaiian and Western scientific knowledge about coastal species, location and type of habitats, and fishing hot spots into **GIS to develop maps** that will be useful in designing **MPAs** that will be valuable, protected and respected by resource users
  -protect the valuable place-based knowledge of Native Hawaiians by not making the information public; utilize it only in the planning process

- Develop a **Cultural Exchange Program** for Native Hawaiian volunteers as an incentive for helping design, implement and/or enforce Aloha ʻĀina in their community; offers an opportunity to travel, learn, engage and share their culture with other communities in Hawaiʻi or the Pacific region that are implementing similar natural resource management programs (ideal for regions not employing co-management systems)
  -modeled after American Samoa's Cultural Exchange Program

- Design short, intensive **Collective Knowledge Educational Programs** that target Hawaiʻi's youth, Native Hawaiian communities and tourists, and offers each of these audiences an opportunity to learn about and gain an appreciation for Hawaiʻi's natural environment from the perspective of both Native Hawaiian culture and Western scientific research.
  -modeled after Barbara Gibson and Noelani Puniwai's Kaha Kiʻi ʻAina ("To paint a picture of the Earth"), a 2-week intensive summer course that offered middle school students an opportunity to learn about the Earth System Science through Native Hawaiian Traditional Knowledge and Western scientific research (i.e. learning to use GPS and GIS)

- Establish **Native Hawaiian Protected Areas** to protect the subsistence and cultural uses of resources, and the economic livelihood of Native Hawaiians. These areas would be designated by Native Hawaiians, and formally recognized by the federal and state governments (ideal for regions not employing co-management systems).
  -idea stemmed from Melissa Nursey-Bray's discussion of Indigenous Protected Areas in her paper entitled: "Social Contexts and Customary Fisheries: Marine Protected Areas and Indigenous Use, Australia" (2011)

- **Aloha ʻĀina Blog: Bringing together innovative ideas and relevant**

literature to develop a collective approach for sustainably managing natural resources in Hawaii. My intention is that this blog will serve as a platform to connect people and their ideas for Aloha ʻĀina. Check it out: www.aloha-aina.com

REFERENCES

[1] Hawaiian Islands Humpback Whale National Marine Sanctuary: Management Plan Review. Spring 2011.

[2] Report of the Native Hawaiian Working Group for the Sanctuary Advisory Council. 2011. Management Recommendations for the Hawaiian Islands Humpback Whale National Marine Sanctuary. http://hawaiihumpbackwhale.noaa.gov/management/pdfs/nativehawaiian_wg_report.pdf

[3] Report of the Ecosystem Protections Working Group for the Sanctuary Advisory Council. 2011. http://hawaiihumpbackwhale.noaa.gov/management/pdfs/ecosystemprotections_wg_report.pdf

[4] Jokiel, P., Rodgers, K., Walsh, W., Polhemus, D., and Wilhelm, T. 2011. *Marine Resource Management in the Hawaiian Archipelago: The Traditional Hawaiian System in Relation to the Western Approach.* The Journal of Marine Biology. doi:10.1155/2011/151682

[5] Poepoe, K., Bartram, P., and Friedlander, A. *The Use of Traditional Hawaiian Knowledge in the Contemporary Management of Marine Resources.* Putting Fishers' Knowledge to Work: Conference Proceedings, pp. 328-339.

[6] Natural Area Reserves System 2011. 'Āhihi-Kīna'u Natural Area Reserve Draft Management Plan. Prepared for Department of Land and Natural Resources, Honolulu, Hawai'i.http://hawaii.gov/dlnr/dofaw/nars/narsc/narsc-meeting-3.5.11-3.7.11/A-K%20Draft%20feb%2025.pdf

[7] S.B. NO. 3053. A Bill for an Act: Relating to Native Hawaiians. The Senate, Twenty-sixth legislature, 2012. State of Hawaii.

[8] Aha Moku. http://www.ahamoku.org/.

[9] Aswani, S. (2011). Socioecological Approaches for Combining Ecosystem-based and Customary Management in Oceania. *Journal of Marine Biology.*

[10] Cinner, J. (2005). Socioeconomic factors influencing customary marine tenure in the Indo Pacific. *Ecology and Society*, 10(1), 36. [online] URL: http://www.ecologyandsociety.org/vol10/iss1/art36/.