MATCHING THEORY AND PRACTICE:

AN EXAMINATION OF PRACTITIONERS' DESCRIPTIONS OF ECOSYSTEM-BASED MANAGEMENT IN CENTRAL CALIFORNIA

By

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THESIS

Submitted in partial fulfillment of the requirements for the degree of Master of Arts in the Program in Environmental Studies at Brown University

Providence, Rhode Island

MAY 2010

This thesis by Tara Nicole Gancos is accepted in its present form
by the Program in Environmental Studies
as satisfying the thesis requirements for the degree of Master of Arts.

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VITA

I was born in Walnut Creek, California in March of 1984. Soon after, my parents moved to Georgia where I spent the next twenty years. I attended the University of Georgia (UGA) in Athens where I graduated *cum laude* in 2006 with a Bachelor of Science degree in Ecology. During my time at UGA, I conducted a senior thesis project under the supervision of Dr. Mark A. Bradford that resulted in a co-authored paper entitled *Slow-cycle effects of foliar herbivory alter the nitrogen acquisition and population size of Collembola*, which was published in the journal *Soil Biology and Biochemistry* in 2008. I also contributed to several other student research projects that studied small mammal populations at the Horseshoe Bend Ecological Experimental Research Site in Athens, GA under the guidance of Dr. Gary W. Barrett.

After college, I joined the Peace Corps and served as the Programs Coordinator for a parish-based environmental NGO in St. Thomas, Jamaica. It was during this time that I began to recognize the importance of integrating social, economic, and institutional perspectives with ecological considerations in the context of natural resource management and conservation efforts.

This revelation led me to Brown University where I began studying holistic management approaches, particularly ecosystem-based management (EBM), with my mentor Dr. Heather M. Leslie. Since starting the Environmental Studies Master's program at Brown, I took the lead role on a paper that compares and contrasts three EBM initiatives in the northeastern United States: the Massachusetts Ocean Management Plan, Rhode Island Special Area Management Plan, and Taunton Bay Project in Maine. This paper was co-authored with Dr. Leslie and individuals from each of these sites. It is being submitted for publication in the journal *Ocean and Coastal Management*. I was also a Research Assistant for Dr. Leslie in the summer of 2009. As an RA, I conducted case studies of two local-scale EBM efforts on the central California coast, which will be published online along with others from around the world produced by students at the University of Michigan and Duke University. My Master's thesis built upon these case studies.

I was awarded a Teaching Assistantship my first year at Brown, which enabled me to experience the joys and challenges of teaching. In total, I have now had the amazing opportunity to TA three classes – Environmental Studies, Environmental Science, and Marine Conservation Science and Policy – each of which has challenged me in different ways, expanded my understanding of environmental issues, and allowed me to further develop my communication and mentoring skills.

My time at Brown has been wonderful, fulfilling and enriching, and it has prepared me well for my next adventure, a doctoral program in Environmental Life Sciences, which I begin this fall (2010) at Arizona State University in Tempe, Arizona.

PREFACE

This thesis is submitted in partial fulfillment of the requirements for the degree of Master of Arts in the Program in Environmental Studies at Brown University. It is the product of work completed from 2008 – 2010.

After becoming interested in ecosystem-based management (EBM) per discussions with Dr. Heather M. Leslie, I accepted a Research Assistant position to develop case studies of two EBM demonstration sites funded by The David and Lucile Packard Foundation. I decided to focus on these sites as I investigated whether insufficient translation is responsible for discrepancies between the ideal EBM described by scholars in the published literature and experiences of sites practicing EBM 'in the water.'

In fall of 2009, I traveled to both sites with Dr. Leila Sievanen to conduct interviews. Upon returning, the interviews were transcribed and uploaded into NVIVO 8. I coded the transcripts and analyzed them during winter 2010, and the first draft of this thesis was prepared by late March.

Through this work I learned qualitative research methods, challenges and opportunities associated with interdisciplinarity and collaboration, and the history and politics of coastal and marine resource management.

ACKNOWLEDGEMENTS

First and foremost, I thank my advisor, Dr. Heather M. Leslie, for her consistently positive perspective, constructive guidance, and calm, encouraging demeanor. Her abundant support over the last two years has been invaluable to my success at Brown and my professional development. I greatly appreciate the opportunities she provided that enabled me to challenge myself and to grow as a scholar.

I also thank my readers, Dr. Leila Sievanen and Dr. Leah Vanwey, for their time and insightful comments. I appreciate the advice provided by Dr. Phil Brown and Dr. Timmons Roberts, and I am grateful for the support provided by Dr. Caroline Karp who comforted me during times of self-doubt. Additionally, I thank Patti Caton and Betsy Barlow for always being able to assist regardless of the issue.

Additionally, I thank The David and Lucile Packard Foundation for funding this project, and I greatly appreciate the individuals from the Elkhorn Slough Tidal Wetland Project and the San Luis Obispo Science and Ecosystem Alliance for their participation and willingness to share their work with us. Lastly, I appreciate all of the support provided by the faculty and staff in the Center for Environmental Studies and the Graduate School at Brown University.

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ABSTRACT

Ecosystem-based management (EBM) strives to address the inadequacies of traditional single-sector natural resource management approaches by targeting the full suite of ecosystem services being produced in a naturally delineated place, assessing cumulative impacts of different human activities, evaluating tradeoffs between objectives, and engaging stakeholders throughout the management process. Published articulations of EBM contain a variety of distinguishing characteristics, many of which have yet to be fully operationalized among pioneering EBM sites. Disparities between EBM theory and practice have been attributed by some to insufficient translation of EBM principles between scholars and practitioners. To determine the extent to which poor translation is inhibiting EBM implementation, I investigated two EBM demonstration sites on the central California coast, USA: the Elkhorn Slough Tidal Wetland Project (ESTWP) and the San Luis Obispo Science and Ecosystem Alliance (SLOSEA). Twenty-six semi-structured interviews were conducted with practitioners at these sites: ten from the ESTWP and sixteen from the SLOSEA. Distinguishing characteristics mentioned by practitioners in their descriptions of EBM were compared to published descriptions. The results indicate coherence between published articulations of EBM and practitioners' descriptions within and across sites. This led me to conclude insufficient translation of EBM concepts is not a problem at the ESTWP or SLOSEA. The interviews yielded indications of other EBM implementation challenges, which appear to be playing more significant roles in hindering progress of EBM at these sites.

1. INTRODUCTION

1.1. State of California's Coastal and Marine Resources

In recent decades, human use of California's coastal and marine ecosystems has intensified. No longer are these habitats solely targeted for traditional activities such as commercial and recreational fishing, tourism, shipping, and oil and gas extraction. They are now locations of emerging uses as well, including offshore aquaculture and renewable energy development. Coastal communities have grown in extent and density, and human activities have expanded into new sectors and spaces, amplifying overexploitation of biological resources, point and non-point source pollution, habitat destruction and degradation, and climate change (POC 2003, USCOP 2004, MA 2005). Acting in concert, these anthropogenic factors are impairing wildlife populations, altering food webs and ecosystem structure, degrading water quality, and compromising the well-being and sustainability of coastal communities. For example, many of California's fisheries have been serially depleted over the last thirty years (CDFG 2004), which has dramatically affected local economies. In addition, harmful algal blooms have increased in occurrence, causing more frequent area closures for oyster culture and greater incidences of disease and mortality among marine mammals (Sheehan and Tasto 2001). The deteriorating status of coastal and marine resources has been attributed to failures of traditional management approaches that focus on single sectors or activities to recognize connections between target and non-target resources and cumulative impacts of different human uses (POC 2003, USCOP 2004, Crowder et al. 2006).

To overcome the shortcomings of traditional natural resource management, holistic approaches based on systems theory and concepts such as coupled social-

ecological systems are being promoted for coastal and marine ecosystems (Crowder et al. 2006, McLeod and Leslie 2009a, Lester et al. 2010). Ecosystem-based management is such an approach that strives to maintain, and in some cases restore, ecosystem health and resilience through protection of ecosystem structure, function, and key processes, thus, ensuring sustained provision of ecosystem services (McLeod et al. 2005, COMPASS 2007).[1]

1.2. Ecosystem-Based Management

Ecosystem-based management (EBM) is a type of place-based management that strives to sustain a spectrum of ecosystem services and address desires for both use and protection in a particular ecosystem through management of a variety of human activities (McLeod and Leslie 2009a). There is no pre-determined spatial scale at which EBM should be implemented, but the system should be delineated by ecological rather than political boundaries that are understood to be porous because resources and people move across them (McLeod and Leslie 2009a). Component parts of the ecosystem as well as management problems are fundamentally interconnected in space and time (Yaffee 1999). EBM recognizes these interrelationships and considers social, economic, and institutional perspectives in conjunction with ecological concerns (McLeod and Leslie 2009a, Lester et al. 2010). In order to achieve multiple objectives, EBM recognizes cumulative impacts of different activities and evaluates tradeoffs between different values

[1] Ecosystem services are benefits humans derive from ecosystems, including "*provisional services* such as food, water, and fiber; *regulating services* that affect climate, disease, wastes and water quality; *cultural services* that provide recreational, aesthetic, and spiritual benefits; and *supporting services* such as soil formation, photosynthesis, and nutrient cycling" (MA 2005).

of associated human communities (McLeod and Leslie 2009a, Lester et al. 2010). In addition, ecosystem-based management seeks to enhance ecosystem resilience.[2]

In the published literature, EBM scholars have adopted best practices of other innovative management strategies and, as a result, advocate for diverse stakeholder engagement in planning and decision-making processes, interdisciplinary collaboration among stakeholders and agencies, and using local traditional knowledge and scientific data as the basis for decision-making. Furthermore, because systems are in a constant state of flux that cannot be fully predicted nor controlled, EBM addresses uncertainty by acknowledging knowledge gaps and taking an adaptive approach in which management actions are implemented as experiments and are adjusted as knowledge of the system, ecosystem conditions, technology and tools change (McLeod and Leslie 2009c, Lester et al. 2010).

1.3. Current State of Practice

The state of California has led the country in passing legislation encouraging holistic, ecosystem-based management approaches. Among the first pieces of such legislation was the 1998 Marine Life Management Act, which articulated the need to conserve marine ecosystems, sustain and restore fisheries, and ensure the long-term health of fishing communities (Sutton 2005). At the time, it embodied some of the most advanced fisheries management concepts in the country and demonstrated the shift in management foci from single species to ecosystems (CCMI 2008). In 1999, the Marine

[2] Resilience is the extent to which a system is able to maintain its structure, function, and identity in the face of disturbance.

Life Protection Act was passed, which entailed an unprecedented requirement to develop a statewide network of marine protected areas to preserve the richness and abundance of marine life as well as the complexity, organization, and integrity of marine ecosystems off the California coast (Sutton 2005; CCMI 2008). This was followed in 2004 by the California Ocean Protection Act, which requires the state to think about ecosystem-level dynamics when considering management decisions related to coastal and ocean resources (CCMI 2008).

At a local scale in California, EBM has been adopted as a means of conserving two of the only remaining wetland areas on the central California coast, outside of the San Francisco Bay: Elkhorn Slough and Morro Bay. Most watersheds in the region empty directly into the ocean, but in Elkhorn Slough and Morro Bay the watershed empties into a small embayment before draining into Monterey Bay and Estero Bay, respectively. These estuaries are rare and ecologically significant habitats that provide feeding grounds for migratory birds and nursery areas for offshore fisheries. They are also home to a disproportionate number of rare, threatened, and endangered species such as the southern sea otter (*Enhyra lutris nereis*), western snowy plover (*Charadrius alexandrines nivosus),* and steelhead trout (*Oncorhynchus mykiss*). In addition, estuaries are among the most threatened of all habitats in California (Sheehan and Tasto 2001).

The Elkhorn Slough Tidal Wetland Project in Elkhorn Slough and the San Luis Obispo Science and Ecosystem Alliance in Morro Bay received funding from The David and Lucile Packard Foundation to demonstrate ecosystem-based management in practice and, in doing so, elucidate the kinds of information about coastal and marine systems needed to implement EBM (Packard Foundation 2007). While the sites' proximity to one

another, analogous habitats, and similar spatial scales (2,690-acre slough and 30,290-acre watershed in Elkhorn Slough, and 2,300-acre estuary and 48,000-acre watershed in Morro Bay) make them comparable, they differ with respect to their local setting, ecosystem threats being addressed and management objectives, and the composition of agencies leading the effort (Table 1).

Each of the cases is described briefly below and their progress is compared to the ideal EBM portrayed among the peer-reviewed literature. Translation is presented as a possible explanation for discrepancies between EBM in theory and practice. Practitioners' descriptions of EBM from the ESTWP and SLOSEA are then investigated to determine whether EBM concepts found among published articulations are being effectively translated between scholars and practitioners at these sites, and whether translation is responsible for disparities between theoretical EBM and the state of practice of the ESTWP and SLOSEA.

1.3.1. The Elkhorn Slough Tidal Wetland Project (ESTWP)

Elkhorn Slough is a seasonal estuary that extends 7 miles inland from Monterey Bay in central California, approximately 100 miles south of San Francisco (Silberstein and Campbell 1989). The slough is among the largest expanses of tidal salt marsh habitat enduring in California today and it is recognized as a key conservation asset by local, state, and national entities. It was designated a National Oceanic and Atmospheric Administration (NOAA) National Estuarine Research Reserve (NERR) in 1979. The area is also home to a growing nature-based tourism industry, year-round crop production, and several world-class marine science research institutions, including the Monterey Bay

Aquarium Research Institute (MBARI), the Moss Landing Marine Laboratories (MLML), and the Hopkins Marine Lab of Stanford University.

Tidal erosion and subsequent drowning of salt marsh vegetation, inordinate nutrient inputs from upland agriculture, and limited solutions to these problems threaten the future of the slough, its rare marsh habitats, and the wildlife populations that depend upon them. Historical human alterations of hydrological dynamics at the mouth of the estuary and in the watershed have caused over 1,000 acres (approximately 50%) of the slough's salt marshes to disappear since 1870, and the conversion of the slough from salt marsh to mudflats is accelerating.

In 2005, recognizing the urgency of the erosion issue and the need to prioritize use of limited funding, the NERR, which is jointly operated by NOAA and the California Department of Fish and Game (DFG), initiated a two-year strategic planning process to develop restoration strategies with potential to reduce tidal scour and reverse the loss of important habitats in the slough (i.e., the management area). This planning process led to the Packard-funded Elkhorn Slough Tidal Wetland Project (ESTWP), an effort to conserve and restore estuarine habitats in Elkhorn Slough through an integrated approach supported by the local community and other stakeholders.

The interest in pursuing habitat restoration in Elkhorn Slough through ecosystem-based management emerged with the realization that tinkering with hydrological dynamics to curtail tidal erosion would impact water quality, wildlife populations, and other aspects of the ecosystem, including NERR neighbors and the local tourism industry. In addition, decisions regarding restoration and management activities in the slough

needed to be based on an informed understanding of the ecosystem and input from relevant stakeholders.

Prior to the Packard Foundation's funding of the ESTWP's EBM effort, resources were not available to engage a wide range of stakeholders, so management was done in a piecemeal fashion in areas of the ecosystem that fell under the purview of the NERR or the Elkhorn Slough Foundation (ESF), a local non-profit organization that owns and manages land around the slough for conservation purposes. Further, there was little coordination of research activities occurring in the area and minimal integration of research results produced by different institutions.

The ESTWP is managed by staff at the NERR in partnership with a Strategic Planning Team (SPT) and Science Panel (SP). The core EBM project team includes a handful of individuals from the NERR who oversee the ESTWP's administration and implementation, DFG, ESF, MBARI, and California State University Monterey Bay. The SPT is the primary decision-making body made up of representatives from the NERR, DFG, ESF, Monterey Bay National Marine Sanctuary, US Fish and Wildlife Service, US Army Corps of Engineers, Nature Conservancy, Ocean Conservancy, California Coastal Conservancy, University of San Francisco, Moss Landing Harbor District, and other federal, state, and local interests. The SP reviews scientific information and provides the SPT with guidance on technical matters and is comprised of a broad spectrum of more than eighty disciplinary and interdisciplinary experts who are responsible for studying the area and integrating their findings. In addition, there are nine working groups comprised of members of the SPT and SP that focus on specific areas of interest related to the project's objectives. Authority to make management decisions and implement restoration

projects is variable among ESTWP participants. A small number of ESTWP participants from the DFG and ESF have authority over NERR and ESF land, respectively. However, management decisions for land and resources outside of their purview cannot be made by the ESTWP.

To accomplish the ESTWP's overarching goal, ESTWP participants developed four potential alternative restoration projects. Over the past several years, the working groups have been investigating the slough's hydrology, nutrient and sediment dynamics, biological communities, economic values, and the political and financial feasibility of each alternative restoration project. The results of these studies were integrated to make predictions about future conditions of the slough under each alternative strategy.

In 2008, ESTWP team members decided to proceed with a pilot restoration project at the mouth of the Parsons Slough complex, a component of Elkhorn Slough. An adjustable sill (i.e., water control structure) will be constructed to reduce the tidal prism in Parsons Slough, and impacts on water quality, wildlife populations, and marsh habitats will be monitored over time to facilitate adaptive management of the structure and evaluate efficacy of this approach to inform decisions regarding a possible larger sill at the mouth of Elkhorn Slough in the future.

While these developments are promising, there are a few discrepancies between the ESTWP effort and EBM as it is described in the peer-reviewed literature. For example, published articulations of EBM emphasize multiple management objectives, including use and protection. However, the ESTWP is focused primarily on environmental protection, and while it is concerned with wider ecosystem impacts of management activities, at this point in time, the ESTWP is doing little to address threats

beyond the issue of erosion and subsequent habitat loss. Also, while an assessment of the economic and political feasibility of each restoration option was conducted, the ESTWP has done little to incorporate social and economic perspectives into planning and decision-making processes, which is another fundamental characteristic of EBM discussed among published descriptions of this approach. Furthermore, while a restoration option has been selected, it has not yet been implemented, which means desired ecosystem conditions have yet to be achieved.

1.3.2. The San Luis Obispo Science and Ecosystem Alliance (SLOSEA)

Morro Bay is located on the San Luis Obispo County coast, approximately 140 miles south of Elkhorn Slough. Like Elkhorn Slough, this estuary is a rare and important ecosystem in the region. In conjunction with its surrounding watershed, the area is home to over 250 species of wildlife, and in 1995 it was designated as a member of the US Environmental Protection Agency's (EPA) National Estuary Program. Morro Bay is the only all-weather port between Monterey and Santa Barbara, approximately 200 miles of coastline. It is a regional harbor facility that until thirty years ago was dominated by fishing industries, but tourism now leads the local economy. While Morro Bay is considered to be relatively healthy, pollution, invasive species, habitat degradation, climate change, and other environmental issues threaten the system's water quality, wildlife, and sustainability of the local economy.

Prior to 2006, scientific research, resource management, and stakeholder engagement in the Morro Bay area occurred among independently operating institutions with minimal coordination between them (SLOSE 2008). Fragmentation among groups

and agencies, and insufficient collaboration among them, made it difficult to obtain a comprehensive understanding of interactions between habitats, resources, and desired ecosystem services. It was unclear which ecosystem elements (e.g., species, nutrients, activities) were critical linking factors that impact other ecosystem components when manipulated. Also, understanding of connections between the social and ecological systems was deficient, and mechanisms for coupling local science with decision-making processes at relevant agencies were basically non-existent, which diminished opportunities for informed, coordinated decision-making and, hence, the likelihood of sustaining healthy, productive resources and habitats in the Morro Bay ecosystem (SLOSEA 2008).

Two local entities, the Morro Bay National Estuary Program (NEP) and the Marine Interests Groups of San Luis Obispo County (MIG), were well established in the area and were engaging stakeholders, monitoring resources, pursuing conservation efforts, and working towards sustainable use of Morro Bay's resources; however, there was negligible interaction between them and each focused on a different component of the system. The NEP is local non-profit organization funded primarily through grants from the EPA that focuses on integrated watershed management activities such as basic research, monitoring, restoration and protection of key species and habitats, outreach and education, and making connections among resource managers. The Marine Interests Group of San Luis Obispo County (MIG) was formed in 2003 as a multi-stakeholder consensus group supported by the World Wildlife Fund, assembled at the request of the county supervisors to discuss the possibility of expanding the Monterey Bay National Marine Sanctuary into coastal waters along San Luis Obispo County. The MIG is

comprised of fishermen, business people, the Chamber of Commerce, environmental groups, and others. It is primarily concerned with promoting an understanding of local offshore resources and the needs and interests of stakeholders who use and enjoy these resources as well as exploring means for enhancing these resources and their sustainable use (Wendt et al. 2009).

The need to integrate the activities, resources, and knowledge of these local groups with the scientific capacity of California Polytechnic State University in San Luis Obispo (Cal Poly) and government agencies with authority over the land and resources in the area was recognized by a scientist from Cal Poly. Along with the Director of the NEP and professional facilitator of the MIG, this scientist convened a variety of ecosystem actors and formed the San Luis Obispo Science and Ecosystem Alliance (SLOSEA) in 2006. Participants include representatives from the NEP, MIG, Cal Poly, DFG, California Coastal Commission, City of Morro May, NOAA Fisheries, Regional Water Quality Control Board, California Department of Parks and Recreation, US Fish and Wildlife Service, Los Osos Community Advisory Council, and other federal, state, and local interests.

SLOSEA's purpose is to improve environmental management of the area's resources by enhancing communication and collaboration among isolated institutions and coordinating their fragmented activities within the estuary, watershed, and coastal ocean (i.e., the Morro Bay ecosystem, the management area). At the time of SLOSEA's formation, The David and Lucile Packard Foundation awarded a planning grant to Cal Poly to support the development of a comprehensive EBM program proposal. The finished proposal was awarded funding from the Packard Foundation along with grants

from the Resources Legacy Fund Foundation and World Wildlife Fund, which were all supporting integrated, community-based resource management initiatives such as ecosystem-based management at the time.

Based on discussions between managers, scientists, and other SLOSEA project team members, several key areas of interest were identified and became the organization's primary initiative areas. The areas of interest include conservation of sensitive coastal habitats, preservation of native wildlife populations, management of coastal water quality, restoration of strongly supported fishing communities and enhancement of fishery resources, and re-establishment of a flourishing marine economy that provides diverse job opportunities and services to the local community. In an iterative process, managers and scientists aligned knowledge gaps and information needs with appropriate researchers and methodologies to generate data that is of use to local resource management agencies to facilitate informed management decisions. The boundaries of SLOSEA's activities vary based on the initiative.

SLOSEA is comprised of three primary groups: the Leadership Team, Advisory Committee, and Science Team. The SLOSEA Leadership Team includes the SLOSEA Program Director from Cal Poly, a SLOSEA Program Coordinator, the Director of the NEP, a Marine Policy and Communications Manager, and a Strategy and Fisheries Policy Advisor from the MIG. The role of the Leadership Team is to provide oversight and direction for the EBM effort and ensure strong, coherent connections are made between the scientific research being conducted and results produced and management decisions at relevant agencies. The Advisory Committee (AC) is SLOSEA's primary governing body. It is responsible for developing areas for scientific investigation, reviewing

research project objectives and methodologies and results, ensuring data products are linked with relevant resource management decision-making processes, and providing a environment in which participating agencies and stakeholders can share information relevant to the ecosystem, discuss challenges and opportunities, and form collaborative relationships. The Science Team (ST) is comprised of academic and agency scientists and associated research staff members (Wendt et al. 2009). This group's main responsibilities are to facilitate the development of appropriate research methodologies for chosen projects, review progress of ongoing research and activities in SLOSEA's initiative areas, and to assist with the integration of research results and management decisions. SLOSEA also engages partners who are members of the community that partake in SLOSEA discussions and activities and/or are hired as consultants for SLOSEA's initiatives (SLOSEA 2008).

Together, the Leadership Team, AC, and ST develop and execute SLOSEA's strategic plans, and working groups comprised of SLOSEA members collaborate to lead, organize, and implement activities in different initiative areas. While a few members of the AC possess the authority to make or directly influence management decisions at relevant government agencies, the leadership team lacks the power to make management and policy decisions. Leadership Team members serve more as administrators and facilitators of SLOSEA's activities with direct control only over SLOSEA's initiative areas.

Over the last several years, SLOSEA has made considerable progress in a several areas. Scientists affiliated with SLOSEA conducted field experiments to assess the impacts of human access to intertidal areas on sensitive wildlife and habitats, the results

of which were provided to the California Department of Parks and Recreation to help inform management decisions regarding public access to eighteen miles of newly acquired coastal property. Also, scientists affiliated with SLOSEA discovered a high incidence of nonylphenol, an industrial chemical, in the sediment and water in the bay, which has been linked to tumors in resident fish. Through partnerships forged by the AC, this discovery led to new agenda items at the Regional Water Quality Control Board regarding management of nonylphenol, and SLOSEA is pursuing nonylphenol regulatory changes at the state and federal level as well. In addition, SLOSEA has worked in collaboration with fishermen to develop a monitoring protocol for local nearshore fish stocks that integrates fishermen's thorough knowledge of the resource and fishing techniques with scientists' expertise in experimental design. This protocol is being used to evaluate effectiveness of recently established marine protected areas (MPAs), and SLOSEA and partners are also pursuing policy changes that would allow local data collected via this protocol to inform the setting of catch limits for regional fisheries.

SLOSEA's efforts have forged productive relationships among stakeholders and yielded insight into the functioning of the system; however, much of their work has yet to instigate management or policy changes. For example, more stringent regulation of nonylphenol is still being pursued as is the possibility for local data to be used in the setting of catch limits for regional fisheries. EBM is a form of management; therefore, management decisions must be made and actions taken before it is said to have occurred. In addition, while their data on human impacts on intertidal habitats has been used by the California Department of Parks and Recreation, these data have yet to be considered by the DFG who has authority over coastal land below mean high high tide and setting of

bag limits for invertebrates. Therefore, management changes have yet to be coordinated across agencies with different jurisdictions that jointly influence impacts on intertidal resources. Reducing institutional fragmentation and mitigating cumulative impacts of human activities are tenets of EBM that are recognized by SLOSEA, but have yet to be successful addressed.

Table 1: Similarities and differences of the Elkhorn Slough Tidal Wetland Project and the San Luis Obispo Science and Ecosystem Alliance.

SIMILARITIES	**ESTWP**	**SLOSEA**
Funding	The David and Lucile Packard Foundation to demonstrate ecosystem-based management	
Region	central California coast	
Habitats	estuary	
Scale	2,690 acre slough 30,290 area watershed	2,300 acre estuary 48,000 acre watershed
DIFFERENCES	**ESTWP**	**SLOSEA**
Local Setting	Rural	urban
Boundaries	Estuary	watershed, estuary, and nearshore ocean – varies by initiative
Objectives	Reduce erosion and restore salt marsh habitat	Improve water quality Promote sustainable fisheries Reduce invasive species Protect fragile habitats Prepare for climate change Enhance the marine economy Make links between science and management
Core Agencies	1. Elkhorn Slough National Estuarine Research Reserve (NOAA and DFG) 2. Elkhorn Slough Foundation	1. California Polytechnic State University – San Luis Obispo 2. Morro Bay National Estuary Program 3. Marine Interests Group of San Luis Obispo County

1.4. Disconnect between EBM in Theory and Practice

Both sites are engaged in on-going long-term processes and have made substantial progress towards operationalizing EBM and accomplishing their objectives. However, when one compares their approaches and current stage of implementation to the ideal portrayal of EBM found in the literature (Arkema et al. 2006, Leslie and McLeod 2007, McLeod and Leslie 2009a), there are reasons to conclude that full EBM implementation is hindered at these sites. As few examples of comprehensive EBM implementation and success currently exist, disconnects between EBM in theory and practice have been observed elsewhere (COMPASS 2007, Granek et al. 2009). Most EBM sites, like the ESTWP and SLOSEA, are implementing elements of this holistic, comprehensive approach (Arkema et al. 2006, Ruckelshaus et al. 2008, McLeod and Leslie 2009b).

These sites encompass rare, important estuary habitats that are hubs for human activity, which make them ideal places to investigate the efficacy of EBM. In addition, they are seemingly poised for success relative to local initiatives in other parts of the country and world. Both sites are supported by state-level legislation that promotes ecosystem-based management approaches, and there is considerable social interest in efforts to sustain coastal and marine resources, especially at these sites. Furthermore, the ESTWP and SLOSEA are situated in areas of rich scientific capacity and have histories of collaboration and stakeholder engagement. For these reasons, it is imperative that the ESTWP and SLOSEA are able to test whether it is possible to balance use and protection of coastal and marine resources and demonstrate the benefits promised by EBM scholars. If they are unable to demonstrate EBM in practice, the reasons must be elucidated.

Several factors may be responsible for discrepancies between EBM in theory and practice, including timing since these sites are in their first five years of planning and implementation, contextual factors, or insufficient translation of the concept. Arkema and colleagues (2006) investigated eighteen published definitions of ecosystem-based management and identified seventeen classifying criteria. They then investigated the degree to which these seventeen criteria were incorporated into forty-nine management plans for eight coastal and marine sites. They concluded interpretation of EBM was inconsistent between science and management because scientific principles embodied by published EBM definitions are not being incorporated into management objectives and interventions, which indicates insufficient translation of EBM concepts. Issues of translation have also been blamed for disparities between the reality of practice and ambitions articulated by related resource management frameworks such as integrated water resources management (IWRM) and integrated resources management (IRM), which both have bodies of literature that contain comprehensive sets of abstract, holistic principles similar to EBM (Bellamy et al. 1999, Medema et al. 2008).

Is insufficient translation of the concept of EBM responsible for discrepancies between EBM as it is articulated theoretically in the literature and EBM in practice at the ESTWP and SLOSEA? While Arkema et al.'s (2006) study investigated translation between the literature and management plans, to what extent has the concept been translated between the literature and practitioners? Have the characteristics described in published articulations of EBM been incorporated into the visions of practitioners at the ESTWP and SLOSEA? In other words, are practitioners at the ESTWP and SLOSEA aware of the characteristics that distinguish EBM in theory?

Understanding factors inhibiting sites' abilities to implement EBM is of the utmost importance. While poor translation does not necessarily mean management will be unsuccessful at achieving desired ecosystem conditions and provision of valued ecosystem services, it does mean EBM as a theory is not being fully tested, which impairs our ability to evaluate its effectiveness. Many factors, including history, culture, and institutional landscape, influence what EBM looks like 'in the water,' but barriers imposed by these factors may be more difficult to overcome than issues of translation. If translation is responsible for inhibiting progression of EBM, it may be possible to focus on enhanced communication and outreach efforts. If translation is not an issue, resources can be directed towards surmounting other implementation obstacles.

1.5. Research Questions and Predictions

To determine whether principles embodied by the concept of EBM are being effectively translated between the published literature and practitioners, I investigated two questions: 1. *How do practitioners from the Elkhorn Slough Tidal Wetland Project and the San Luis Obispo Science and Ecosystem Alliance describe ecosystem-based management?* 2. *Is there coherence between practitioners' descriptions of EBM and published articulations?*

Practitioners are considered to be anyone officially engaged in the EBM effort at each site. If the leadership at the site considers the individual to be a member of the leadership, advisory, or science groups, or to be a partner, sub-contractor, or informed member, they are considered to be a practitioner by the present study because they are involved in putting EBM into practice. However, not all practitioners may be considered

translators. Leaders at the sites who packaged their work as EBM to acquire funding are assumed to be the primary translators between the literature and others involved in these efforts (i.e., other practitioners). Although leaders at both sites expressed that they rarely use the phrase EBM anymore during their meetings, everyone engaged in these efforts is expected to be aware of EBM and its distinguishing characteristics because at some point during the course of their experience in the ESTWP or SLOSEA they were exposed to the concept and informed that they were funded by the Packard Foundation to demonstrate EBM.

Due to shared experiences and exposure to the concept, practitioners' descriptions of EBM were predicted to overlap within sites, although individual articulations were expected to be heterogeneous. Practitioners' descriptions were also predicted to coincide with their experience at their site, and because EBM plays out differently in different contexts due to sites' unique motivating factors, objectives, timeline, stakeholders, and resources (McLeod and Leslie 2009a), the same basic characteristics of EBM (i.e., multiple objectives for use and protection, addressing cumulative impacts and tradeoffs, engaging stakeholders, and adapting management) were expected to be mentioned across sites while the details of objectives and management activities, and emphasis on particular EBM principles, was expected to vary between the cases. Differences were also predicted among practitioners playing different roles in the EBM effort due to differential exposure to published articulations. Lastly, if translation is an issue, it was predicted that practitioners' descriptions of EBM would be incoherent with published articulations.

Coherence is being used as a metric for determining the degree to which EBM principles are being effectively translated between published articulations and

practitioners. If practitioners describe EBM using the same list of characteristics articulated among published definitions, these two sources of EBM descriptions are considered to be coherent; hence, translation is considered to be sufficient. EBM characteristics are those features that distinguish EBM in the publish literature (i.e. the features described in section 1.2 of this paper – e.g., place-based, addresses cumulative impacts, engages stakeholders).

2. RESEARCH DESIGN

This project was carried out under the auspices of a larger project funded by The David and Lucile Packard Foundation that is investigating how social, ecological, and institutional context influences the way EBM is playing out in practice at six of the Packard Foundation's Regional Initiatives/EBM demonstration sites in five countries (the United States, Mexico, Fiji, and Palau). The study sites for the present paper are two of those Regional Initiatives, and are the only US cases studied by the larger project.

2.1. Methods

Case studies were developed for each site based on primary and secondary literature and project documents, and semi-structured interviews were conducted with EBM practitioners. A case study approach was used to obtain an in-depth understanding of these sites and determine the influence of contextual factors on EBM implementation (Yin 2009). The document analysis provided a background on each site, including the ecological and socio-economic context, initiation process, goals and objectives, organizational structure, activities, and nature of stakeholder engagement, which

informed the case studies and enabled the project team to assess the current state of EBM at these sites – how each site is operationalizing the concept of EBM and the extent of their progress to date.

In September 2009, each site was visited for ten consecutive days, and semi-structured interviews were conducted by two members of the project team. We alternated in the role of lead interviewer. A semi-structured interview format was used to allow the interviewer to maintain discretion to pursue leads, yet provide a framework and focus for the interview that ensured important topics were covered (Bernard 2006). Such an approach enabled most efficient use of time given the limited period available to interact with practitioners at these sites. During the interviews, interviewees were asked a variety of questions related to their involvement at the site and the EBM effort, history of the EBM effort, facilitating factors and barriers to implementation, and outcomes of the effort so far (see Appendix A – Interview Guide and Questions). Specific to the interests of the present study, interviewees were asked, "What is your working definition of ecosystem-based management in this project?" The interviews were tape recorded to ensure accurate transcription.

Interviewees were selected with the help of the leadership at each site. Site leaders provided a list of practitioners indicating who might be willing to participate, their organizational affiliation, role in the project and level of involvement from intimately involved to people who are informed of the efforts' progress, but not actively engaged. Practitioners were broadly classified as representing different types of entities, including scientific, non-governmental, and government. Five individuals representing each of these types of entities were contacted to participate in the project. A total of 26

individuals were actually interviewed – 10 from the ESTWP and 16 from SLOSEA. The composition of the sample is not representative of the composition of practitioners involved at these sites. For example, more scientists were interviewed from SLOSEA than the ESTWP; however, there are actually more scientists involved in the effort at Elkhorn Slough.

Interviewees were classified by different attributes (i.e., descriptive qualities) to facilitate analysis (see Appendix B – Attribute Group Abundance by Site). The attributes used to classify interviewees included: age (young: <35, medium: 35-55, old: >55); gender (male, female); highest degree earned (unassigned, Doctorate, Masters, Bachelors, high school or lower); discipline of highest degree earned (unassigned, social, biological, physical, interdisciplinary); institutional setting (unassigned, not applicable, urban, rural, in-between); organization type (unassigned, not applicable, non-governmental, government, scientific); and project responsibility (science panel, advisory group, leadership, informed, partner). The project responsibility groups were based on project documents and are in line with site leaders' classification of practitioners. The unassigned value for several of the attributes was a default assignment given to interviewees that did not fit into any of the other defined values for the attribute and of which there were not enough interviewees with the same attribute value to create a new value class.

2.2. Analysis

To understand practitioners' descriptions of EBM, qualitative analysis of the transcribed interviews was conducted using QSR International's NVIVO 8 qualitative software tool. In NVIVO, interviewees' responses to the question, "What is your working

definition of EBM in this project?" were coded as "EBM definition." In addition, other sections of the interview where the interviewee explained the approach to EBM being taken at their site were coded as "EBM definition." This constituted the first layer of coding. From there, portions of the interviews coded for "EBM definition" were broken down into component characteristics and coded accordingly, forming a second layer of codes. A third layer of coding was done for a few of the characteristics to distinguish differences in the way interviewees described particular characteristics such as stakeholder engagement. The codes that were used emerged from the transcribed interviews. Therefore, while memos from published articulations of EBM enabled me to recognize distinguishing EBM characteristics, the codes were not pre-determined. They were created after reading through the transcriptions. Codes were not mutually exclusive, so some quotes were coded for multiple characteristics.

From here, queries were run in NVIVO to elucidate the characteristics mentioned most and least often by practitioners at each site and to see if different types of practitioners (i.e., practitioners with different attributes) mentioned certain characteristics more than others. Practitioners' descriptions were then compared across sites. To determine the degree of coherence between practitioners' descriptions of EBM and published articulations of this approach, characteristics mentioned by practitioners at each site were compared to the 17 criteria identified among published definitions by Arkema et al. (2006). In addition, because other published definitions of EBM have been articulated since 2006, practitioners' descriptions were compared to other published definitions and descriptions, in particular those found in McLeod and Leslie (2009).

3. RESULTS

In the following section, I describe the characteristics of EBM mentioned by practitioners at each site, beginning with those mentioned by the greatest number of interviewees. Representative quotes are provided to demonstrate how the characteristics were articulated. Some quotes contain multiple characteristics. Several of the codes/characteristics are similar; however, slight distinctions exist between them (e.g., holistic, interdisciplinary, integrates social and environmental objectives, considers the social context). I then compare results between the sites and among practitioners in different project responsibility groups. Lastly, characteristics of EBM mentioned by interviewees at the ESTWP and SLOSEA are compared to the seventeen criteria used by Arkema et al. (2006) and other published articulations of EBM.

3.1. ESTWP Practitioners' Descriptions of EBM

Multiple Objectives (90%)

While there was not full consensus on any particular characteristic of EBM among practitioners at the ESTWP, 9 out of 10 ESTWP interviewees recognized that EBM is a multi-objective approach:

> You're trying to look at everything instead of being species-specific or looking at just one habitat. (Resource Manager, ESTWP)

> EBM is the concept of expanding the view from single species to looking at them as a suite of species and how species' role in the ecosystem plays out across function. So it's thinking in the big picture and not managing for specifics. (Resource Manager, ESTWP)

> Not managing for fish. Not managing for just water quality. Not managing for boating, but taking everyone's needs together. (Scientist, ESTWP)

Engages Stakeholders (80%)

Stakeholder engagement was mentioned by 80% of ESTWP interviewees. Sixty percent specified engagement as involvement in planning and decision-making processes and 30% specified engagement as involvement in outreach and education.[3] The following quotes demonstrate how ESTWP interviewees described stakeholder engagement:

> Bringing lots of people to the table who had never been there before, engaging all these diverse stakeholders and talking about, "What do we want for the whole ecosystem?" (Scientist, ESTWP)

> The science, the policy makers, the funders […] all the people it takes to make change happen, getting them all together, organizing it, and pushing through to solve a problem. (Scientist, ESTWP)

> I think the most important elements were lots of diverse stakeholder involvement, so it isn't just one type of person or one organization that's doing it, but very diverse groups of people - decision makers and stakeholders - that was one of the important elements to us. (Scientist, ESTWP)

[3] Codes are not mutually exclusive; therefore, some interviewees described engagement as involvement in planning and decision-making as well as outreach and education.

> We need to get outreach and education to neighbors and interested parties so if there are issues that come up it's not about misunderstanding. (Scientist, ESTWP)

Science-Based (80%)

Eighty percent of interviewees from the ESTWP characterized EBM as an approach that relies heavily on natural scientific data to inform management decisions:

> Trying to get research to drive the decision-making or help the decision-making. (Resource Manager ESTWP)

> Having strong, sound, competent monitoring programs along with focused science is what it's about. (Resource Manager ESTWP)

> What we learned is that the science needs to be done before the policy and economics gets done. (Subcontractor, ESTWP)

Integrates Social and Environmental Objectives (70%)

Seventy percent of ESTWP interviewees specified that in EBM objectives include both social and environmental priorities, highlighted by three resource managers below:

> It also has to do with human use of the resources and trying to balance that with the way that you're managing the land. (Resource Manager, ESTWP)

> [EBM] considers the needs of all elements of the ecosystem, so plants and animals and people and economics and policy, hydrology, geology. Everything when you're making a decision. (Resource Manager, ESTWP)

> It certainly integrates the social, economic, and ecological objectives of a community trying to take care of itself. (Scientist, ESTWP)

> The collective approach to looking at Elkhorn Slough and its long-term health is ecosystem-based management. […] Identifying […] strategies for promoting the transmission of biological diversity forward in time, working with the economic development parts of the community, dealing with the political aspects of the community [...]. (Resource Manager, ESTWP)

Considers the Social Context (70%)

Integration of social and environmental objectives is facilitated by consideration of the social context in which the EBM effort is unfolding. Seventy percent of ESTWP interviewees expressed this sentiment:

> We also need information about the surrounding social kinds of things. (Resource Manager, ESTWP)

> Becoming more cognizant of how people are using resources within this larger ecosystem. (Resource Manager, ESTWP)

> I think it's looking at the whole picture […] [including] the social context. (Scientist, ESTWP)

Interdisciplinary (70%)

Seventy percent of interviewees at the ESTWP also described it as an approach that should be interdisciplinary as the following quotes indicate:

> EBM is supposed to be interdisciplinary […]. (Subcontractor, ESTWP)

> [EBM entails] integrating information from multiple disciplines. (Scientist, ESTWP)

Holistic (60%)

Sixty percent of ESTWP interviewees described EBM as a holistic approach to management of the area or a holistic means of solving a particular environmental problem:

> EBM is holistic management that considers the needs of all elements of the ecosystem – so plants and animals and people and economics and policy, hydrology, geology – everything when you're making a decision because that's what the ideal would be. (Resource Manager, ESTWP)

> Elkhorn Slough takes a full holistic approach. They are looking at the entire watershed, including land-based effects. (Resource Manager, ESTWP)

> For us, we're addressing specific problems and we're trying to do so in a way that maximizes the benefits for all aspects of the ecosystem, including humans, and minimizes the negative impacts. (Scientist, ESTWP)

> In a broad sense, it's a holistic approach to solving an environmental management question. (Scientist, ESTWP)

Long-Term Perspective (60%)

Managing the slough for the future was recognized by 60% of ESTWP interviewees as an overarching goal and primary vision of the EBM effort, as indicated by these representative quotes:

> What people here who care about this place want for the resource is EBM on the scale of lifetimes, you know, that's going to steward this place for five generations from now. (Scientist, ESTWP)

> We probably shouldn't call ours a project. It should be called a program because it will be a long time before there's an end. It's not just – do this one restoration fix and then you are done. […] It's going to need to be heavily managed for as far as history can see. (Resource Manager, ESTWP)

> We're trying to think more than ten years in advance – more like fifty to one-hundred years in advance. Things like sea level rise have forced us to think longer into the future. Ten years seems like a long time in terms of monitoring for specific species, but in trying to manage an ecosystem with bigger uncertainties, the time scale on which we think needs to be expanded. (Resource Manager, ESTWP)

> In our mind, we've done the spirit of EBM on some level [since before we called it EBM] […] and plan to for the next [several] decades. (Scientist, ESTWP)

> Be committed to working for decades to achieve that vision because it's not going to be instant. (Scientist, ESTWP)

Addresses Tradeoffs (60%)

Reducing the tidal prism to restore marsh habitat will affect water quality and wildlife populations. As a result, there is an obvious need to address tradeoffs in Elkhorn Slough, which was discussed by 60% of ESTWP interviewees:

> We're clearly weighing water quality, sharks, shorebirds, things that have nothing to do with the strict goal. What we are doing in practice […] is weighing these environmental tradeoffs and coming up with the solution that leads to the most sustainable, healthy system in the long run. (Scientist, ESTWP)

> The main issue here […] [is] how are you going to fix the erosion problem and slow that down, and how does that trade off with the water quality issues that may get worse if you stop […] or decrease the circulation. (Scientist, ESTWP)

Place-Based (30%)

The place-based nature of their approach was also recognized by 30% of ESTWP interviewees as they expressed the need for management objectives to be based on local conditions and objectives. This sentiment is highlighted by the next three quotes:

> [EBM is] place-based. (Scientist, ESTWP)

> It certainly integrates the […] objectives of a community trying to take care of itself. (Scientist, ESTWP)

> The collective approach to looking at Elkhorn Slough and its long-term health is ecosystem-based management. (Resource Manager, ESTWP)

Deals with Uncertainty (30%) and Adaptive Management (30%)

Thirty percent of ESTWP interviewees acknowledged the role of scientific uncertainty and the need to address it in order to make management decisions. Adaptive management was presented as a means of addressing this uncertainty by 30% of interviewees:

> We need to figure out how to address risks without a more certain outcome of the action, so I've been championing a large robust adaptive plan. In Elkhorn Slough, we're actually trying to address some of those uncertainties through applied studies – to test some of those uncertainties. (Resource Manager, ESTWP)

> Another outcome that's coming will be a monitoring plan or an adaptive management plan to manage the project, and having goals and red flags that tweak our management associated with that plan. (Scientist, ESTWP)

Precautionary Principle (10%)

Employing the precautionary principle was mentioned by 10% of ESTWP interviewees as a way of addressing uncertainty:

> The role of uncertainty and sort of precautionary principle aspect that goes into ecosystem-based management. I would say [that was among] our emphasis. (Scientist, ESTWP)

Focus on "Ecosystem Services" (20%)

While many practitioners described ecosystem benefits desired from Elkhorn Slough such as recreational opportunities, few interviewees used the phrase "ecosystem

services" when describing the ESTWP management foci. However, 20% of ESTWP interviewees used this terminology as demonstrated by the following quote:

> We are managing for ecosystem services. (Resource Manager, ESTWP)

Recognizes Interactions and Interconnections between Systems (20%)

Twenty percent of ESTWP interviewees acknowledged that different ecosystems interact and are interconnected:

> I think it's looking at the whole picture, not just one parameter or one concern, but looking at an entire ecosystem from the water quality to the biota, benthic, water column, uplands, the connection between watersheds to the sea, and everything in between, including the estuary. (Resource Manager, ESTWP)

> It's not just a marine and intertidal project […]. They are looking at land-sea connections [...]. A lot of the land-based things going on around the wetlands influence what is happening in the wetland, it's a priority for them. (Resource Manager, ESTWP)

Manages Human Impacts (10%)

Management of human impacts was mentioned by one ESTWP interviewee:

> Recognizing that the natural systems have limits and there are needs, and, when considering any kind of a restoration option or whatever we're considering, one has to look at the limitations and possibilities for the natural systems, and then, considering that humans are part of the system, how the human impact and the human context for all that plays into it […]. What the human impacts

were, what the impacts on humans would be, including the economy and the political system. (Subcontractor, ESTWP)

Coordinates Management Decisions across Jurisdictions (10%)

One ESTWP interviewee also expressed the need to coordinate management decisions across agencies as indicated here:

> Working at the federal, state, local level, having non-profits developing close partnerships with public agencies […]. Seems to me that that's what it is […]. The first challenge is trying to coordinate agencies that have sovereign authority over different pieces of the puzzle […], all these agencies that are built for the very specific purposes in mind. They don't necessarily communicate with one another very well […]. To me the biggest part of it is trying to coordinate the regulatory environment. (Resource Manager, ESTWP)

3.2. SLOSEA Practitioners' Descriptions of EBM

Science-based (100%)

All interviewees (16 of 16) from SLOSEA expressed that natural scientific research and data plays an important part in their management effort, as the following quotes indicate:

> I think that for ecosystem-based management to really work we're going to need to integrate the approach of the university that academic approach, the data-gathering approach, with the practicalities that I have to deal with as a policy maker. (Elected Official, SLOSEA)

> Think about the multiple things that are impacting this environment and bring that science to the management and regulatory arena. (Scientist, SLOSEA)

> "Using science to drive policy and decision-making by management and regulatory agencies […]. (Scientist, SLOSEA)

> [I] would love to see the [Land/Ocean Biogeochemical Observatory (LOBO) system] instrumentation continue long enough to actually show the effects of implementing the practices and that kind of thing […]. If those sensors could be maintained over a decade, for instance, you could really potentially start to see the changes that could come from […] some changes in management. (Scientist, SLOSEA)

Engages Stakeholders (94%)

Almost all SLOSEA interviewees recognized stakeholder engagement as a fundamental characteristic of the EBM effort. Sixty-nine percent of SLOSEA interviewees specified engagement as involvement in planning and decision-making processes, and 25% specified engagement as outreach and education. The following quotes demonstrate the various ways stakeholder engagement was described by SLOSEA interviewees:

> You can engage a broad range of stakeholders and get them interested and develop their knowledge and focus and get actions that make a difference in the ecosystem. (Community Group Representative, SLOSEA)

> We develop science that we might develop a management action from […], so there is an interaction between us [scientists and other stakeholders], but we're different elements of the whole management process. (Scientist, SLOSEA)

> [EBM] could be used to help the community fulfill that shared set of objectives that had arisen out of their own process of learning and developing their thinking about what was most desirable to do. So it's a matter of, "Ok, this is what the community and the various stakeholders want to accomplish" and "Oh, here is ecosystem-based management and a set of tools and interest and support to do it", and they, well, match. (Community Group Representative, SLOSEA)

> Bring the relevant agencies together […] around a table. (Resource Manager, SLOSEA)

> Engaging the community in the concept and in the local information being generated partly because some kinds of policy change will not happen unless there's broad support for them, and so engaging the public […] informing and engaging the public in the whole process and the concept and the results is an important objective as well. (Resource Manager, SLOSEA)

> If we don't sell it to the stakeholders as being a good idea in the long run [it won't work] […] and maybe that's where the educational part comes in. (Scientist, SLOSEA)

Multiple Objectives (88%)

The multi-objective nature of EBM was recognized by 88% of interviewees as highlighted in the three following quotes:

> So, the fisheries, the other flora and fauna, the water quality, and we are looking at that as how it affects both the human economic as well as the environmental values that we hold important here. (Elected Official, SLOSEA)

> It's looking at the complex of species rather than single species. It's looking at an array of actions. (Community Group Representative, SLOSEA)

> You're not just focused on clean water or just focused on endangered species. (Resource Manager, SLOSEA)

Integrates Social and Environmental Objectives (63%)

In addition, 63% of SLOSEA interviewees explained that the EBM effort integrates social and environmental objectives:

> If you're talking about managing the marine environment, it seems like we are trying to manage the marine environment to the benefit of a number of different constituents, if you will. The human constituents, the natural constituents, if we will, and the general health of all the natural systems that are at play there. (Elected Official, SLOSEA)

> Managing the resources by taking into account not only the ecosystem, what we normally consider the ecosystem in terms of biological resources, but also sort of a wider view of humans as part of the ecosystem and all the things that go along with that like economics and sociological components, so just taking a broader view of management of biological resources. (Scientist, SLOSEA)

Considers the Social Context (63%)

The importance of considering the social context of the EBM effort was also expressed by 63% of SLOSEA interviewees:

> All aspects of a community are taken into consideration in determining policy, management. (Participant, SLOSEA)

> [EBM considers], "What is the potential growth?" "What is the planned growth, potential realistic growth?"[…] At least what the plans are […] and then that's the human population side, and then there's the economy. If you're going to do an economically-based thing, then you have to know what industries are there, are potentially there. (Participant, SLOSEA)

> Well you need to know who's involved in all aspects of that ecosystem. Who are the decision-makers? And you need to know, obviously, the government, the regulations. (Ocean Advocate, SLOSEA)

> I think the jurisdictional interaction of jurisdictions is a very strong part of our definition of EBM. (Scientist, SLOSEA)

Place-Based (63%)

Sixty three percent of SLOSEA interviewees also recognized the focus on a particular place, its conditions and the desires of the associated community:

> You have to start by looking at where you're working and what your problems are. (Scientist, SLOSEA)

> It's a way to manage a geographic area using sound science just from that area and thinking about what actions do to the whole ecosystem instead of just to a small part of that ecosystem. (Ocean Advocate, SLOSEA)

> We have this broad idea that's looking at the entire ecosystem and bring in a lot of scientific information, community information, a very broad range of information to help guide the management of resources for that ecosystem. (Participant, SLOSEA)

Coordinates Management Decisions across Jurisdictions (50%)

The need to harmonize management decisions across agencies and jurisdictions was acknowledged by 50% of SLOSEA interviewees:

> To tackle some of the most pressing problems, like, let's say non-point source pollution, you're going to need the cooperation of a lot of overlapping regulatory agencies, a lot of overlapping social and economic interests, and until you can come up with a concept that's big enough for it to make sense – namely an ecosystem-scale concept of what's going on – I don't see that you have any chance of unraveling the overlap of state federal and local authorities […]. We all have to work together. (Elected Official, SLOSEA)

> I think one of the things we try to do is, which is an ecosystem-based tenet, if you will, is to break down these jurisdictional boundaries and get people working together across those jurisdictions. (Scientist, SLOSEA)

> I think that when we got started we wanted to integrate jurisdictions and increase communications among the managers in the ecosystem. I think we've done that. (Scientist, SLOSEA)

Recognizes Interactions and Interconnections between Systems (50%)

Fifty percent of SLOSEA interviewees discussed the importance of considering the interactions and connections between different ecosystems. Interactions and

connections between goal and objectives were mentioned by 38% of SLOSEA interviewees while interactions between agencies were recognized by 19% of SLOSEA interviewees. The following quotes highlight these sentiments:

> Land use […] that affects watershed integrity that affects marine habitat quality […]. (Elected Official, SLOSEA)

> And so one of the explicit things with SLOSEA that was part of the original proposal to Packard […] was trying to […] think about the bay not just as being influenced by the watershed, but the interaction with the ocean. Trying to understand that better and trying to address that. (Resource Manager, SLOSEA)

> SLOSEA, I would say, is trying to look at our area and the resources that we have on land and water and how they interact together. (Stakeholder, SLOSEA)

Recognizes Interactions and Interconnections between Goals and Objectives (38%)

> What are the key services that we're seeking to get or benefits or values that we're seeking from the environment? What are the threats and opportunities to that? How do those interact? (Community Group Representative, SLOSEA)

> People place a high value on coastal resources and protection of coastal resources, but they don't see the linkages between their on-going decisions, especially when it comes to land use […]. There's the landowner perspective and they are stakeholders and they have priorities and needs in terms of resource production, you know, cattle ranches, vineyards, whatever it is. They feel that that is a priority that benefits the greater community, so they see themselves as land stewards and

asking those people to shift their perspectives and start to think about coastal resources and the link between management of the land and the sea. (Stakeholder, SLOSEA)

Recognizes Interactions and Interconnections between Agencies (33%)

Paying attention to linkages and among different activities, different agencies and different habitats [...]. (Informed Participant, SLOSEA)

Interdisciplinary (44%)

Forty-four percent of SLOSEA interviewees described EBM as interdisciplinary:

[Someone] is looking at the science side, I'm looking at the organizational side, [someone else] has been long involved in restoration efforts in the community and the multi-state collaborative activities that he has focusing on the estuary, so we've been a good balance. (Participant, SLOSEA)

If we can sit together and one person focuses on one thing or one organization focuses on one aspect of what's going on, then everybody can kind of pick and choose what their strength is, and then if we can collaborate then we can make good decisions. (Resource Manager, SLOSEA)

Holistic (44%)

Forty-four percent of SLOSEA interviewees also described EBM as a holistic management approach that focuses on the system as a whole as demonstrated below:

> To me it means looking at the whole system and SLOSEA has even taken on not just the ocean systems, but land and water and their interrelated activities. So, it's more of a holistic approach. (Ocean Advocate, SLOSEA)

> You're trying to look at things holistically […] across jurisdictional lines, trying to look at natural boundaries […]. It's about trying to look at things at scientifically relevant scales and about really trying to engage stakeholders in a collaborative process so that you can make decisions on, you know, the right kind of information. […] Think about the bay not just as being influenced by the watershed, but the interaction with the ocean, trying to understand that better and trying to address that […]. It's an on-going sort of goal […] to do relevant […] scientific work that's really directly being steered and tied in with local resource managers […]. The concept is to manage the ecosystem and all its complexity. (Resource Manager, SLOSEA)

Manages Human Impacts (25%)

A quarter of SLOSEA interviewees expressed the need for management to address human impacts on the environment. For example:

> It links back to managing "human ecosystems" where ongoing and growing impacts are a given. (Stakeholder, SLOSEA)

> For me, […] when you think of ecosystem-based management, you're thinking of the natural systems that are in there and how they interact and what humans do to manipulate that natural system, and so, it's the human manipulation of those natural systems and making sure that that's coordinated so that you can manage the entire ecosystem. (Resource Manager, SLOSEA)

Long-Term Perspective (25%)

A quarter of SLOSEA interviewees also recognized the long-term perspective of the EBM effort. For instance:

> So, success in an ecosystem-based management program to me would be that you are ready to respond to these issues as they come up. […] I mean, there's no eventual goal that would say, "Ah, we're successful, now we can disband," in ecosystem-based management. It really is an on-going set of concerns, set of discussions. (Elected Official, SLOSEA)

> I think the main objectives of SLOSEA are to bring good scientific expertise to the question of, "What can we improve in Morro Bay and the adjacent coastal waters to have a long-term sustainable management plan that includes people – the economy, the fishermen?" (Scientist, SLOSEA)

> I think the whole idea of EBM in this case would be to keep an area viable, sustainable, viable for on into the future. (Participant, SLOSEA)

Adaptive Management (19%)

Adaptive management was discussed by 19% of SLOSEA interviewees, as indicated by the following quotes:

> There's been some evolution, as we've learned, and that's been intentional, you know, to have an adaptive management practice, if you will, for our own process. (Community Group Representative, SLOSEA)

> Picture this kind of adaptive management cycle of, you know, "We do science and we get information and influence management and we implement management and we keep doing science in sort of a cyclic [way]." You know, we've engaged people. We've collected a lot of scientific information. We've worked with the community. We're trying to influence management here. (Resource Manager, SLOSEA)

Addresses Tradeoffs (13%)

Thirteen percent of SLOSEA interviewees mentioned the need to evaluate tradeoffs between management objectives, as well as consider cumulative impacts of activities. The following quotes highlight these comments:

> So, it's that balance of how much activity is okay versus how much you have to restrict in order to preserve it for the future. (Resource Manager, SLOSEA)

Cumulative Impacts (13%)

> Ecosystem-based management [involves] explicitly examining tradeoffs and trying to look at things like cumulative impacts. (Scientist, SLOSEA)

> Implementing ecosystem-based management […] concerns long-term management of cumulative impacts. (Stakeholder SLOSEA)

Focus on "Ecosystem Services" (13%)

In addition, while most SLOSEA interviewees described various desired ecosystem benefits, only 13% used the concept of ecosystem services to describe the management foci:

> I look at ecosystem-based management as a way of identifying what are the key services that we're seeking to get or benefits or value that we're seeking from the environment? (Community Group Representative, SLOSEA)

> The whole oyster issues […] where you've got this oyster and this provisional service that's changing over time and why is that changing over time? Well, there's social reasons. There's ecological reason, multiple ecological reasons, so on and so forth. (Scientist, SLOSEA).

Manages for Resilience (6%)

One SLOSEA interviewee mentioned the need to consider resilience when implementing EBM. He stated:

> I look at ecosystem-based management as […] a systems view […] the interaction of the different components and then, how resilient are these systems to those threats or to changes? (Community Group Representative, SLOSEA)

Precautionary Principle (6%)

One SLOSEA interviewee mentioned being precautionary as a means of dealing with uncertainty. He said:

> What I've learned about the policy arena is that they're going to move forward no matter what the certainty is, so at least if we can bring solid science with its inherent limitations to the conversation, I think we're in a better position […]. I mean, why not be precautionary about it? (Scientist, SLOSEA)

3.3. Comparison of Descriptions Between Sites

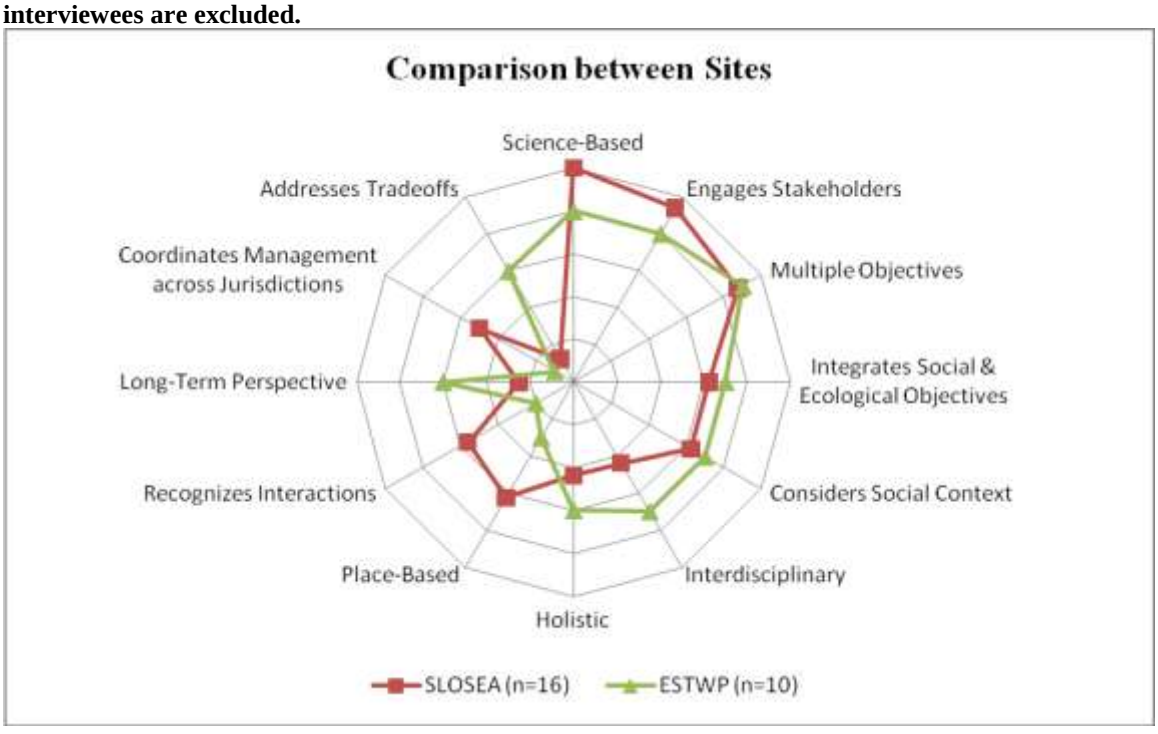
There were a number of similarities and differences between sites in terms of how practitioners described EBM (Table 2 and Figure 1). Several of the same characteristics were mentioned by 50% or more of interviewees from each site and, with few exceptions, the same characteristics were mentioned by practitioners at both sites. However, several distinctions exist.

First, some practitioners from the ESTWP described EBM as a holistic approach to solving an environmental problem, whereas this sentiment was not expressed by SLOSEA interviewees. Second, none of the ESTWP interviewees mentioned considering interactions and connections between goals and objectives or agencies; addressing cumulative impacts of human activities; or managing for resilience, whereas 38%, 33%, 13%, and 6% of SLOSEA interviewees acknowledged these characteristics, respectively. Third, EBM was described as an approach that focuses on long-term goals by 60% of interviewees from the ESTWP and only a quarter of interviewees from SLOSEA. Fourth, 50% of interviewees from SLOSEA described EBM as a type of management that recognizes interactions and interconnections between ecosystems compared to 20% of interviewees from the ESTWP. Fifth, coordination of management and policies across jurisdictions was mentioned by half of SLOSEA interviewees compared to only one person from the ESTWP. Lastly, evaluation of tradeoffs was mentioned 50% of ESTWP interviewees in contrast to 13% of SLOSEA interviewees.

Table 2: Comparison of descriptions provided by practitioners at the ESTWP and SLOSEA.

SIMILARITIES Characteristics mentioned by 50% or more of interviewees from both sites	DIFFERENCES
Multiple objectives	Some ESTWP interviewees describe EBM as holistic approach to specific problem
Integrates social and environmental objectives	No one from ESTWP mentioned interactions and connections between goals and objectives or between agencies; cumulative impacts; or resilience
Stakeholder engagement, primarily in planning and decision-making and, to a lesser degree, in outreach and education	Mention of long-term perspective
Science-based	Mention of interactions and connections between systems
Considers social context	Mention of coordination of management decisions across jurisdictions
	Mention of tradeoffs

Figure 1: Comparison of sites indicating the percentage of interviewees to mention each EBM characteristic. Axis lines are at intervals of 20%. Characteristics mentioned by less than 25% of total interviewees are excluded.



3.4. Comparison of Descriptions by Practitioners with Different Project Responsibilities

3.4.1. ESTWP

Practitioners playing different roles within the ESTWP described EBM similarly; however, leaders of the initiative articulated more comprehensive descriptions (Figure 2). In other words, relative to other project responsibility groups, a larger percentage of the leadership group articulated descriptions of EBM with more distinguishing characteristics. For example, a member of the science panel made the following comments when describing EBM:

> I don't really understand what it is. I mean I understand the acronym is ecosystem-based management and the words to me, is that you're trying to look at everything instead of being species-specific or looking at just one habitat, but since I've gotten from talking to people is it also has to do with human use of the resources and trying to balance that with the way that you're managing the land, and that's about all I know about it. (Resource Manager, ESTWP)

While members of the advisory group described it as:

> Using the regulatory, the scientific, social context approach to figure out how to improve ecosystems, maintain and improve them. […] It takes into account interagency collaboration, trying to get research to drive the decision-making or help the decision-making. (Scientist, ESTWP)

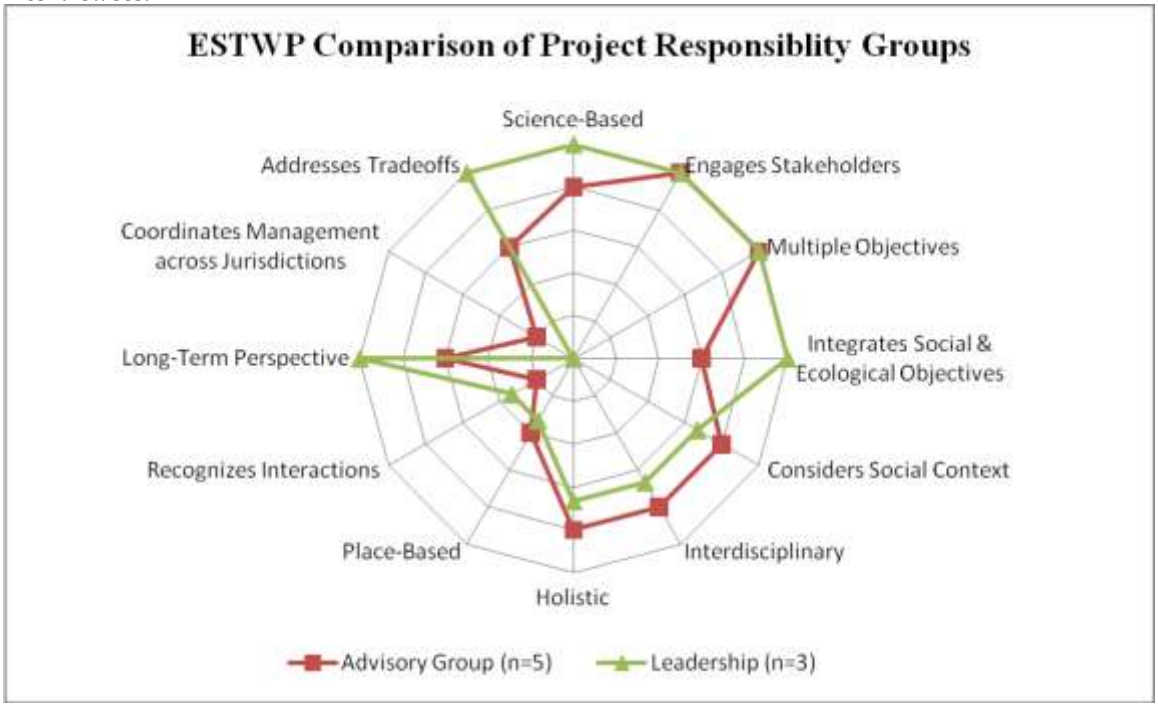
> EBM is the concept of expanding the view from single species to looking at them as a suite of species and how species' role in the ecosystem plays out across function. So, it's thinking in the

> big picture and not managing for specifics. Sometimes there are conflicts between species' needs, so it's a question of balancing specific resource management issues and overall goals of a management plan. It's all addressing scientific uncertainties to minimize risk. (Scientist, ESTWP)

In contrast to these descriptions, one of the site's leaders articulated the following definition, which indicates awareness of many EBM characteristics:

> Place-based. Um, integrating information from multiple disciplines, accommodating uncertainty, acknowledging and being transparent about the management of trade-offs, having some adaptive management process built into your program, and a few others. I can't remember them all […]. What we've been focused on is trying to solve a problem. And the TWP in itself is a narrow slice of EBM […] or it's an application of EBM. (Scientist, ESTWP)

Figure 2: Percentage of interviewees from different ESTWP project responsibility groups to mention each characteristic. Axis lines are at intervals of 20%. Characteristics mentioned by less than 25% of total interviewees are excluded. The science panel group is excluded because it has fewer than three interviewees.



3.4.2. SLOSEA

At SLOSEA, leaders also articulated more comprehensive descriptions of EBM – containing more characteristics than other interviewees' descriptions (Figure 3). For example, a member of the science panel group said the following when asked to define EBM:

> I mean it's almost like a social definition – like talk to all the people involved and bring some scientists on board that are willing to dig deeper and focus yet open enough to talk to the people around –the stakeholders that care […]. [EBM] is basically conservation biology with humans in mind. (Scientist, ESTWP)

While members of the advisory committee group discussed EBM in the following ways:

> My understanding is all aspects of a community are taken into consideration in determining policy, management […], so that would be the needs of the […] people to have clean water, to have access for recreation and beauty and just the beauty of a place, from the requirement to take into consideration the economic, the businesses that are, especially in an area like ours, that is tourist-based. That has to be taken into consideration to keep an area meeting all of the goals, and then from a marine standpoint, the fisheries. This is a fishing area, so you want to make sure the water is still supportive of what's been there. […] All of the aspects that we've come to revere and have precious to us continue to be so. (Participant, SLOSEA)

> This broad idea that's looking at the entire ecosystem and bring in […] a very broad range of information to help guide the management of resources for that ecosystem. So looking at not only the watershed or the bay or the nearshore area, but bringing all those in together. Using the scientific information from studies that we would do, […] the community-based information,

> which we've done studies on that also, but also the community links that the Bay Foundation and the NEP have developed – bringing that into it. Getting the managers of a lot of the government, federal, state, and local government agencies involved, and have those agencies and their resource needs direct what questions the scientists need to answer so that it can better help them to make better decisions on management of the resources. (Participant, SLOSEA)

> Trying to link as many of the components that affect the health of the ecosystem and bring as sound of science as we can to the decision-making process […], to translate stakeholder input and sound science to help make a substantive link between those two issues or components into decision-making. (Subcontractor, SLOSEA)

An informed member of the project team stated:

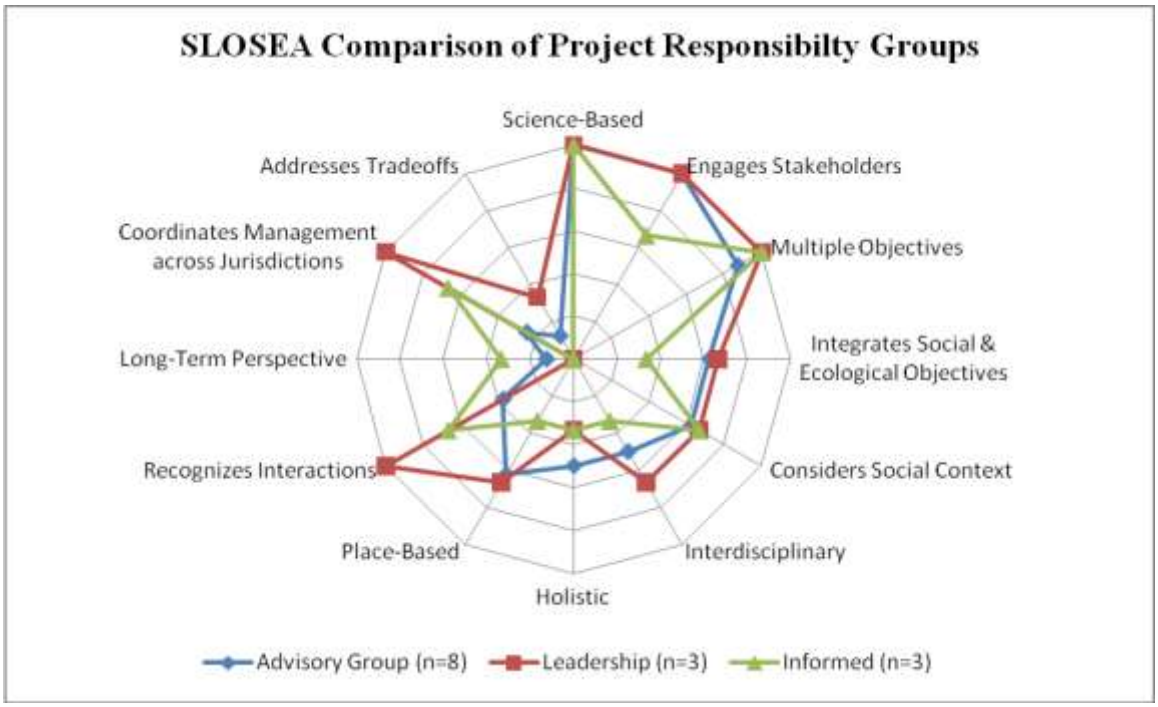
> It's a way to manage a geographic area using sound science just from that area and thinking about what actions do to the whole ecosystem instead of just to a small part of that ecosystem, and in order to do that it takes all people involved in the whole area to pull that off. (Ocean Advocate, SLOSEA)

Whereas, two of the site's leaders described EBM as follows:

> You're trying to look at things holistically across jurisdictions, so you're not just focused on clean water or just focused on endangered species. […] Trying to look at natural boundaries. […] It looks across different kinds of jurisdictional boundaries […]. Trying to look at things at scientifically relevant scales and about really trying to engage stakeholders in a collaborative process so that you can make decisions on, you know, the right kind of information. (Resource Manager, SLOSEA)

I look at ecosystem-based management as a way of identifying what are the key services that we're seeking to get or benefits or value that we're seeking from the environment? What are the threats and opportunities to that? How do those interact? What is, in essence, a systems view of that, the interaction of the different components, and then, how resilient are these systems to those threats or to changes? And then, where are the focal points for action? And how and what actions can be taken and what are the likely impacts of those actions to improve how that system functions? So, it's looking at the complex of species rather than single species. It's looking at an array of actions, and it's seeking to pull together both the natural environment or the non-human environment if you will, and also the human component of the environment. (Community Group Representative, SLOSEA)

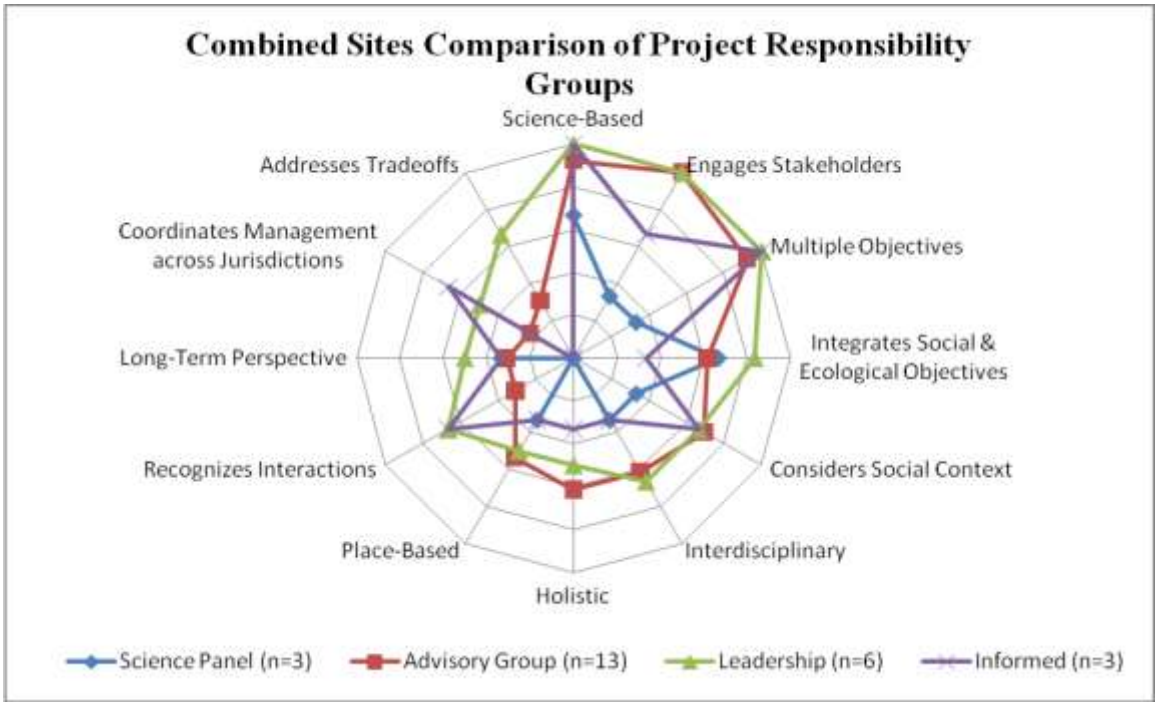
Figure 3: Percentage of interviewees from different SLOSEA project responsibility groups to mention each characteristic. Axis lines are at intervals of 20%. Characteristics mentioned by less than 25% of total interviewees are excluded. Groups with less than three members are excluded.



3.4.3. Sites Combined

With sites combined, at least half of the interviewees from the leadership group mentioned all the characteristics mentioned by other interviewees, with the exceptions of dealing with uncertainty and managing for resilience, which were mentioned by this group, but by less than 50% of the group's members (Figure 4).

Figure 4: Percentage of total interviewees from different project responsibility groups to mention each characteristic. Axis lines are at intervals of 20%. Characteristics mentioned by less than 25% of total interviewees are excluded. Groups with fewer than three members are excluded.



3.5. Other Differences Considered

No major differences were found among descriptions of EBM articulated by practitioners with different attributes (e.g., age, gender, institutional setting, organization type, or discipline) at either site.

3.6. Comparison of Practitioners' Descriptions to Published Articulations

3.6.1. ESTWP

Almost all of the characteristics mentioned by the ESTWP interviewees have analogous counterparts among Arkema et al.'s (2006) criteria (Table 3). All of Arkema et al.'s (2006) criteria were mentioned at least once among ESTWP interviewees; however, interviewees also mentioned characteristics not covered by Arkema et al.'s (2006) criteria, namely addressing tradeoffs and managing human impacts.

Table 3: Features of EBM mentioned by interviewees from ESTWP compared to the 17 criteria used to define EBM in the 18 published definitions considered in Arkema et al. 2006.

Characteristics mentioned by ESTWP interviewees	Analogous criteria from Arkema et al. 2006
Multiple objectives (n=9/10)	Sustainability, Ecosystem goods and services, Ecological health, Economic
Engages stakeholders (n=8/10)	Stakeholder, Inclusion of humans in ecosystem
Science-based (n=8/10)	Science-based, Technological, Monitoring
Integrates social and environmental objectives (n=7/10)	Inclusion of humans in ecosystem, Ecosystem goods and services, Ecological health
Considers the social context (n=7/10)	Inclusion of humans in ecosystem, Economic
Interdisciplinary (n=7/10)	Interdisciplinary
Holistic (n=6/10)	Sustainability, Complexity
Long-term perspective (n=6/10)	Sustainability
Addresses tradeoffs (n=6/10)	
Place-based (n=3/10)	Sustainability, Spatial, Boundaries
Adaptive management (n=3/10)	Adaptive
Recognizes interactions and interconnections (n=2/10)	Spatial, Temporal, Complexity
Focus on ecosystem services (n=2/10)	Ecosystem good and services
Seeks to coordinate management across jurisdictions (n=1/10)	Co-management
Precautionary principle (n=1/10)	Precautionary approach
Manages human impacts (n=1/10)	

3.6.2. SLOSEA

Like ESTWP, almost all characteristics mentioned by SLOSEA interviewees have analogous counterparts among Arkema et al.'s (2006) criteria (Table 4). All of Arkema et al.'s (2006) criteria were mentioned at least once by SLOSEA interviewees; however, SLOSEA interviewees also mentioned characteristics not covered by Arkema et al.'s (2006) analysis, including managing human impacts, addressing tradeoffs, addressing cumulative impacts and managing for resilience.

Table 4: Features of EBM mentioned by interviewees from SLOSEA compared to the 17 criteria used to define EBM in the 18 published definitions considered in Arkema et al. 2006.

Characteristics mentioned by SLOSEA interviewees	Analogous criteria from Arkema et al. 2006
Science-based (n=16//16)	Science-based, Technological, Monitoring
Engages stakeholders (n=15/16)	Stakeholder, Inclusion of humans in ecosystem
Multiple objectives (n=14/16)	Sustainability, Ecosystem goods and services, Ecological health, Economic
Place-based (n=10/16)	Sustainability, Spatial, Boundaries
Considers the social context (n=10/16)	Inclusion of humans in ecosystem, Economic
Integrates social and environmental objectives (n=10/16)	Inclusion of humans in ecosystem, Ecosystem goods and services, Ecological health
Recognizes interactions and connections (n=9/16)	Spatial, Temporal, Complexity
Seeks to coordinate management across jurisdictions (n=8/16)	Co-management
Holistic (n=7/16)	Sustainability, Complexity
Interdisciplinary (n=7/16)	Interdisciplinary
Manages human impacts (n=4/16)	
Long-term perspective (n=4/16)	Sustainability
Adaptive Management (n=3/16)	Adaptive
Focuses on ecosystem services (n=2/16)	Ecosystem goods and services
Addresses tradeoffs (n=2/16)	
Addresses cumulative impacts (n=2/16)	
Precautionary principle (n=1/16)	Precautionary approach
Manages human impacts (n=1/16)	

3.6.3. Sites Combined

The characteristics mentioned by interviewees at the ESTWP and SLOSEA, but not covered by Arkema et al.'s (2006) criteria are discussed among other EBM publications such as McLeod and Leslie's recently published book, *Ecosystem-Based Management for the Oceans* (2009). In their book, McLeod and Leslie (2009) explain that EBM aims to sustain multiple ecosystem benefits, some of which are linked; therefore, maximizing one may constrain another. As a result, EBM practitioners must explicitly recognize these connections and balance tradeoffs among objectives. McLeod and Leslie (2009) also state that EBM accounts for "cumulative impacts of multiple activities, both within and among sectors", and seeks to determine how these impacts influence the delivery of ecosystem services. In addition, McLeod and Leslie (2009) present resilience science as a foundational element of EBM because it acknowledges the intimate coupling of social and ecological systems and helps managers understand factors that influence how systems will respond to perturbations or management alternatives. Lastly, human impacts are responsible for degraded ecosystem conditions that have led to calls for improved management approaches such as EBM. Therefore, while Arkema and colleagues (2006) did not include management of human impacts among their criteria, natural resource management inherently targets human behavior and impacts (Groom et al. 2005).

4. DISCUSSION

Practitioners' descriptions of EBM consist of heterogeneous sets of characteristics with much overlap and consensus between individuals and sites. All of the characteristics

mentioned by interviewees at the ESTWP were mentioned by interviewees from SLOSEA; however, SLOSEA interviewees mentioned additional characteristics not articulated by ESTWP interviewees. Different EBM characteristics were mentioned by a larger proportion of interviewees at each site and leaders at both sites articulated more comprehensive descriptions of EBM that resemble published articulations more so than descriptions provided by practitioners with different project responsibilities. Overall, practitioners' descriptions of EBM appear to be coherent with published articulations.

4.1. Coherence Among Practitioners Within and Across Sites

While each interviewee articulated their description of EBM differently, within sites there was a lot of overlap among descriptions, particularly with regards to characteristics practitioners have observed and experienced during their participation in the EBM effort (e.g., stakeholder engagement, importance of science). It is likely their descriptions of EBM are similar due to shared experiences and exposure to the concept because practitioners have participated in many of the same meetings. This is in line with my predictions.

Agreement among practitioners' descriptions of EBM at a site may contribute to the initiative's success. Scholars have found that a common vision among inter-organizational collaborations contributes to achievement of desired outcomes. Shared visions serve as starting points for problem-solving efforts since they provide a guiding mission and foci for the group and encourage people to recognize that they are "in it together" (Wondollek and Yaffee 2000). In addition, clear aims have been found to

enable members to understand why the collaboration exists and why participating stakeholders are a part of it (Huxham and Vangen 1996).

The overlap among descriptions across sites may also be attributable to shared experiences and exposure to the phrase. As indicated earlier, these sites were both funded by the Packard Foundation to demonstrate EBM. Therefore, the leaders at both sites were exposed to the Packard Foundation's grantmaking strategy. This strategy articulated a description of EBM that emphasized collaboration and stakeholder engagement, a reliance on science, naturally delineated management boundaries, and adaptive management. Leaders from both site framed their effort to resemble this articulation, and they may have shared this framing of EBM with other practitioners, which possibly influenced how other practitioners described EBM although further research is needed to test this hypothesis. In addition, practitioners from Packard's six Regional Initiatives/EBM demonstration sites have convened to discuss EBM in practice. Mutual participation in these meetings may also have contributed to shared perceptions of EBM among ESTWP and SLOSEA practitioners.

4.2. Differences between Sites' Descriptions

The variable frequency of which some EBM characteristics were mentioned by interviewees from different sites as well as the mention of some characteristics by SLOSEA interviewees and not ESTWP interviewees appears to reflect each site's unique approach to EBM, which has been influenced by the local context and objectives. For example, some ESTWP interviewees described EBM as a holistic way to address a specific environmental threat. This is probably a consequence of the ESTWP's current

focus on addressing the issue of erosion and accelerating loss of salt marsh habitat in the slough. Also, ESTWP interviewees more often described EBM as a long-term process that will address other threats over time, which may similarly be attributable to the practitioners' experience at this site. In the last decade, emphasis was placed on reducing runoff from steep hillside farms surrounding the slough, and in the future the ESTWP participants hope to tackle water quality issues and other threats, once additional resources are available. ESTWP participants recognize the current emphasis on habitat restoration as the top priority at this point in time as the quotes provided in the results section demonstrate. The following quotes explain the perspective of ESTWP interviewees:

> What people here, who care about this place, want for the resource is EBM on the scale of lifetimes, you know, that's going to steward this place for five generations from now. […] This decade's challenge is the die-off of the salt marshes and the erosion of the deep muds with all the clams in it. Last decade's challenge was the strawberry farms. (Points to the hill.) This was all strawberry farms and now it's not, and ten years from now hopefully what we'll be doing is solving the nutrient load and pesticide load from Salinas River Valley that comes in here and affects the ecosystem substantially. (Scientist, ESTWP)

> We wrote a grant to start a big stakeholder, science-based project to come up with a coherent vision of what we want to manage the slough for. Originally, we'd hoped that that could cover all sorts of threats and solutions from pollution to invasive species to recreational uses to these hydrological alterations and somehow have […] teams tackling all of that at once so that we can do it because they inform each other and influence each

> other. But, we'd applied for […] over a million dollars and they gave us two or three hundred thousand, and so we scaled it back to dealing with what seemed like the most urgent and intractable threat, or the one that we most need different groups for, and really the most unmet need in the estuary, which is dealing with the hydrological alterations. (Scientist, ESTWP)

Sites also differed in regard to emphasis on coordination of management and policy decisions across agencies. Harmonizing management across jurisdictions is a top priority of SLOSEA since fragmented management and independent research activities served as part of the impetus for EBM in Morro Bay. The following proposal excerpt demonstrates this:

> Our program addresses a fundamental problem: Regional efforts to conduct science and manage the resources in the Morro Bay area are currently fragmented within narrowly defined elements of the ecosystem (e.g. land/estuary vs. coastal habitats, conservation vs. economic concerns) and driven by isolated institutions (e.g. local governments, State Parks, Coastal Commission, Fish and Game, Regional Water Quality Control Board) (Wendt 2006).

The effort in Elkhorn Slough requires little coordination across agencies since the current restoration option (i.e. the Parsons Slough sill) is being implemented on land owned and managed by participants of the ESTWP, specifically the DFG, which reduces the need for agency coordination at this time.

Similarly, most of SLOSEA's project documents and funding proposals for EBM activities explicitly state the importance of understanding linkages between the

watershed, estuary, and nearshore ocean. There is a lot of interest among SLOSEA participants to better understand how these ecosystems are linked through the movement of resources and how they reciprocally influence one another, which may explain why half of interviewees from SLOSEA described EBM as a type of management that recognizes interactions and interconnections between systems while only two interviewees from ESTWP mentioned this.

Also, in Elkhorn Slough, as participants of the ESTWP recently decided to move forward with a water control structure at the mouth of the Parsons Slough complex to reduce tidal erosion, discussions have taken place regarding tradeoffs between erosion control, water quality, and the status of various wildlife populations, as the following quote illustrates:

> This is an ecosystem and the webs are all connected, so if you look at it only from the perspective of geology and the physics of water circulation, you're going to miss a big part of the picture, so for the local group what EBM meant was considering 'how is this going to change the shorebird population, the otter population, the fish […], and fairly quickly that turns to the water quality impacts and people start looking in the watershed for sources of the nutrients. So that's where we got to EBM. (Scientist ESTWP)

This likely contributed to the more frequent mention of tradeoff evaluation among ESTWP interviewees.

As previously indicated, the concept of EBM plays out differently in different places due to cases' unique motivating factors, objectives, stakeholders, and local social, ecological, and institutional conditions (Granek et al. 2009, McLeod and Leslie 2009b),

and practitioners' experiences within their site appear to influence how they describe EBM. These dynamics appear to be responsible for the different descriptions of EBM articulated by practitioners at the two sites. Yaffee (1999) asserted that heterogeneity among conceptualizations and interpretations of EBM is not a hindrance, but is desirable as long as lessons can be learned from resulting experiences. Therefore, different applications of EBM and subsequent outcomes resulting from variable interpretations at the sites will yield insights into the feasibility of EBM and its possible achievements.

4.3. Differences between Project Responsibility Groups

The comprehensiveness of site leaders' descriptions was expected since these individuals are the primary translators at the sites and are responsible for framing their activities as EBM to acquire funding from the Packard Foundation. They may have been more exposed to the academic literature on the subject as well. Indicating the differential exposure of different project responsibility groups to the definition of EBM provided by the Packard Foundation, a member of the ESTWP Strategic Planning Team (i.e., advisory group) stated:

> That's about all I know about it. I'm not one of the Primary Investigators on the EBM grant, so I haven't been a part of those meetings. (Resource Manager, ESTWP)

In addition, two of SLOSEA's leaders contributed to several EBM publications and, therefore, are themselves responsible for some published articulations of EBM. This explains why their descriptions of EBM were more closely mirrored published definition. This also may have contributed to the more comprehensive set of characteristics

described by SLOSEA participants overall. While contextual factors may influence the characteristics that are emphasized and operationalized in each case, awareness of EBM's full scope, at least among leadership, suggests characteristics that are relevant to the objectives of the site will be applied when appropriate or circumstances permit.

4.4. Coherence between Literature and Practitioners

The overlap of EBM characteristics mentioned by practitioners and found among published articulations indicates coherence between these two sources, leading me to conclude translation is not an issue at these sites. This is important because EBM's characteristics must be translated between the literature and diverse practitioners for EBM to be fully operationalized and tested. Practitioners must understand what they are trying to accomplish and this understanding must be shared, which appears to be the case at both sites (Wondolleck and Yaffee 2000).

However, it is important to note that while practitioners at both sites recognized a range of characteristics associated with EBM, they are not, at this point in time, necessarily implementing all those elements. Practitioners from both sites have acknowledged this fact:

> I'm not saying we're hitting all those pieces – elements – equally, because we're not. […] The concept of "hey, we ought to be thinking of all these things" is smart. (Resource Manager, ESTWP)

> What we've been focused on is trying to solve a problem, and the TWP in itself is a narrow slice of EBM […] or it's an application of EBM. (Scientist, ESTWP)

> What I've seen happen here I think has been a piece of EBM. A piece where researchers engage local community and resource managers and focus work to help inform them and create ongoing relationships. (Resource Manager, SLOSEA)

In response to the question, "Do you think your project is doing EBM?" a scientist affiliated with SLOSEA replied, "We're certainly doing elements of it."

For example, several ESTWP interviewees acknowledged the role of social considerations in implementing EBM. However, due to their current emphasis on curtailing the erosion problem on NERR land, which has been set aside for environmental conservation purposes, the ESTWP has minimally considered social factors in their discussions and activities. As two scientists with the ESTWP explain:

> We don't have extractive industries that we're trying to balance the livelihood of local communities against some ecological preservation or biological preservation objective. (Scientist, ESTWP)

> If anything hasn't been successful, I would think that it would be how well we've brought in the economic and social side of things, but we're fortunate in that it's not that big of a player. (Scientist, ESTWP)

Relatedly, some ESTWP interviewees described EBM as interdisciplinary, but the mechanisms do not yet exist to fully integrate social and natural sciences. This was expressed in the following quote:

> One of the problems […] is that there has not been a way to integrate the multidisciplinary information […]. The other reports, the chemistry report, the biology report, the ecology reports, etcetera, really don't have a way of linking to the policy and economic forums in, I think, an optimal way. From the beginning there was never an information system […] to integrate the information. […] So, EBM is supposed to be interdisciplinary […]. It's not there yet. (Subcontractor, ESTWP)

At SLOSEA, a major emphasis has been placed on using science to inform and coordinate management decisions across agencies, but much of their research has yet to lead to management changes. One practitioner explains:

> You know you can provide information to decision-makers, but for one reason or another it's not used [...]. I think SLOSEA is still kind of learning this part of the process. Some of the early work they did having to do with coming up with guidelines for visitors and/or the opening of previously private intertidal areas to the public and developing guidelines, and I believe they took those guidelines to the Fish and Game Commission and they were very thoughtful about it, but then nothing happened. (Informed Member, SLOSEA)

Also at SLOSEA, practitioners recognized the need to evaluate tradeoffs, but in practice they have yet to do this. The following quote is indicative of this:

> One thing we're not evaluating in a strict sense is tradeoffs […]. Our evaluation of tradeoffs is more informal. If we take a restrictive role, people talk about it, so we're developing a management action memo. How strict do we want to be in this recommendation? Those tradeoffs

> are discussed, but they aren't formally assessed in the way they would ideally be assessed in EBM. (Scientist, SLOSEA)

4.5. Challenges to Comprehensive Implementation

As the above results indicate, translation of EBM characteristics between published definitions and practitioners is not a problem; however, there still exist disconnects between EBM in theory and EBM in practice at these sites. The interviews from this study shed light on some of the factors hindering sites' abilities to implement comprehensive EBM at this point in time. Resource limitations, the on-going and time-consuming nature of these processes and absence of well-developed tools are affecting progress at both sites. In addition, SLOSEA's progress is constrained by the existing, inefficient regulatory structure and scalar mismatches. These results and their implications will be discussed in greater detail in forthcoming papers, but are briefly talked about here.

First, an obvious constraint is funding. Limited resources inhibit sites' abilities to tackle the full array of issues plaguing their area and, therefore, from taking a fully ecosystem-based approach (COMPASS 2007). EBM is a resource-intensive process and, due to funding constraints, both sites have had to prioritize manageable issues that they possess the capacity to address given current resources. This is why the ESTWP is not currently pursuing the water quality concerns identified earlier. Funding constraints also inhibit sites' abilities to conduct research and maintain planning processes over periods of time needed to understand complex ecological dynamics and develop effective management strategies. These limitations were expressed by a number of interviewees:

> There's a great opportunity there, but we don't have the bandwidth to advance it even if it is a great idea that is a win-win for a bunch of people. Making it happen is physically impossible and so that's the greatest limitation I think – is having the bandwidth to take advantage of big opportunities. (Scientist, ESTWP)

> We'd applied for a […] grant for over a million dollars, and they gave us two or three hundred thousand, and so we scaled it back to dealing with what seemed like the most urgent and intractable threat, or the one that we most need different groups for, and really the most unmet need in the estuary, which is dealing with the hydrological alterations […]. Funding is the most major [challenge], I'd say, in that we could do a bunch of things tomorrow if we had a large staff with large budgets to do them. A lot of the big problems are well enough understood and have solutions that could be agreed upon by the stakeholders that could be implemented […]. If we had unlimited budgets we could solve a lot of the big problems. (Scientist, ESTWP)

> One [challenge] is securing sustainable funding to do the ongoing research. Because […] to understand these processes, there's such complexity to the processes that you can't just like do a snapshot and think you've got the whole picture and you can understand these dynamics […]. […] So, finding ways to get ongoing support to sustain [research], […] the need really to support sustained data collection on an ecosystem level to evaluate what's going on. So, that's one of the challenges, is funding to continue that research and those activities. (Community Representative, SLOSEA)

Second, the on-going, time-consuming nature of EBM processes limits the likelihood of achieving some ideal in a short period of time. Both sites are currently within the first five years of their EBM effort. These initiatives involve many

stakeholders who are operating on different schedules. As a result, knowledge accumulation, planning, decision-making, and implementation are sometimes out of sync and take time to progress. In addition, changes in social and ecological systems take years, decades, or even longer to come to fruition. Consequently, because these sites are still in the process of planning and beginning implementation of management measures, they have yet to achieve many measurable outcomes or engage in the full process of adaptive management (H. Leslie et al. unpublished data). The following quotes highlight this challenge:

> We haven't done the thing, some of the things we need to do to meet our goals. […] I mean we're in the process. We're well into it and I think we're on the right path. […] I think we've been very successful in getting to where we are right now, but we haven't actually changed the course of tidal scour. But we're about to try. (Resource Manager, ESTWP)

> It takes a long time to change government. (Stakeholder, SLOSEA)

Third, sufficient knowledge and well-developed tools that enable operationalization of certain facets of EBM have yet to be developed, and this impacts sites' abilities to engage in these ecosystem-based management activities (Arkema et al. 2006). For example, a mechanism for integrating multi-disciplinary information within the ESTWP is still lacking. This had made it difficult for the ESTWP to integrate natural and social science, although the importance of this integration is debatable among practitioners at this site. Also, uncertainty regarding management outcomes and the absence of decision-support tools hinders both sites' abilities to evaluate tradeoffs.

Fourth, fragmented authority over land and resources, and shortage of mechanisms or mandates for interagency coordination, have impeded SLOSEA's efforts to harmonize integration of research findings and management decisions across agencies (e.g., have the data from SLOSEA's human access initiative inform management changes at the DFG regarding catch limits for invertebrates, which would ensure decisions by the California Department of Parks and Recreation to limit public access to newly acquired coastal property would achieve their objective to protect sensitive intertidal resources). This challenge has been recognized among other cases as well (Crowder et al. 2006, COMPASS 2007). The limitations imposed by the existing regulatory structure are indicated in following quote:

> A place with less institutional fragmentation already may be more easily converted to this kind of EBM governance structure – this ideal EBM governance structure that will never happen here […]. That is an impediment to EBM […]. The system limits the amount of EBM. We talked about jurisdictional limitations and governance limitations and those sorts of things. So there are inherent limitations that don't allow you to approach some ideal. (Scientist, SLOSEA)

Fifth, mismatches between scales (i.e., spatial: the mismatch between the scale of ecosystem dynamics and governance, and temporal: between research findings and policy-making processes) have made it difficult for SLOSEA to use locally derived scientific data to inform needed management changes at state or federal levels (Crowder et al. 2006). The following quote demonstrates this:

> Well, I mean one challenge is about scale in that the SLOSEA program now sort of has expanded to include a pretty decent size of the coastline here, but the kinds of regulatory structures and management decisions that influence, that are relevant to a lot of these issues, are either at a state or federal scale […]. SLOSEA's gathering information about local fish populations and fisheries and the regulatory decisions are made at a state-wide scale […]. Even at the state-wide scale we're just a tiny dot on a map, and so there's a context and a scale problem in trying to influence policy from such a small piece of the, from the policy makers point of view, we're a very small dot on the map. I think that's one challenge that we have here is just one of being at a small scale relative to the policy decisions that are made. (Resource Manager, SLOSEA)

The five challenges described above seem to be inhibiting comprehensive implementation of EBM more so than insufficient translation. Efforts will need to be made at a site level to obtain additional, sustainable funding, which can enable sites to pursue additional threats and current activities more thoroughly. The EBM community, more broadly, should continue engaging in research and other efforts focused on restructuring governance systems and generating the knowledge and tools needed to integrate multi-disciplinary knowledge, systematically address tradeoffs, manage for resilience, and implement those other characteristics that have yet to be operationalized at these sites. Overcoming these obstacles will enable fuller implementation of this approach and, thus, evaluation of its effectiveness at restoring, maintaining, and enhancing desired ecosystem conditions.

4.6. Data Limitations and Future Research

This study was intended to investigate translation of ecosystem-based management principles between published definitions and practitioners at the ESTWP and SLOSEA, and to determine the degree to which translation is responsible for discrepancies between EBM as it is ideally described by the literature and the current state of progress at these sites. There are a number of ways in which the present study's data are limited. First, the sample size at both sites was small relative to the number of individuals involved in these efforts. We interviewed 10 people from the ESTWP and 16 people from SLOSEA, but there are over 100 people engaged in the ESTWP and more than 40 people participating in SLOSEA. A larger sample size and one that is more representative of the composition of practitioners at these sites would have enabled more robust conclusions. In addition, a larger and/or more representative sample may have illuminated greater distinctions between descriptions provided by different kinds of practitioners. Second, the selection of two local-scale cases located in the same region may have contributed to the similarities between practitioners' descriptions across sites. The results of this study may not be representative of practitioners' visions of EBM elsewhere, which means the results may not be generalizable. Third, having the leaders at each site suggest the sample may have biased the results in that the sample may not have been representative of everyone involved at these cases. Fourth, because this project was funded by the same institution funding these sites (i.e., The David and Lucile Packard Foundation) might have influenced the way people expressed themselves during the interviews. Some interviewees were under the impression we are allied with the funding agency, which we are not. Therefore, they sometimes appeared to be trying to justify

their work as if we were evaluating them. Fifth, investigation of the research questions was limited by the project being conducted within the context of a larger project that has different, although related, objectives. Had the interviews been focused only on the issue of translation, more freedom would have existed to probe these issues and ask additional questions related this topic, which would have produced a more comprehensive understanding of practitioners' conceptualizations of EBM. For instance, asking the question, "What is your working definition of EBM within the context of this project?" elicited a spontaneous, unstructured definition of ecosystem-based management. As a result, the absence of characteristics from practitioners' descriptions could not be attributed to their ignorance of those characteristics. It may instead indicate that those characteristics are not a priority to the practitioner, but making this conclusion would be an interpretive leap. Finally, because interviews were conducted by different members of the project team there exists the possibility for interviewer bias, which may have affected the data collected.

Future research should further investigate these questions among a larger and more representative set of individuals from each site and it is important to broaden the sample among individuals representing different types of entities and people whose behavior needs to change, in particular. In addition, interviewees should be provided a list of possible characteristics of EBM and allowed to choose those they believe are applicable. This would allow more comprehensive answers that reflect interviewees' full conceptualization of this approach instead of merely soliciting spontaneous articulations. Probing to find out what practitioners mean when they use terms and phrases such as holistic and adaptive management would also yield insights into how practitioners

perceive management principles and whether differences exist in the way they are being conceptualized. It would enhance understanding of how practitioners' visions compare to reality by explicitly asking interviewees if they think they are doing the characteristics mentioned, and why or why not. Asking where interviewees first heard of EBM and finding out the source(s) of their definitions would yield insights into why they are envisioning this type of management as they are. Having the same source would help explain the results. Furthermore, it would be important to ask how EBM differs from other management approaches practitioners have been engaged in as this would help determine how innovative and different EBM is from other approaches. It is also of interest for future research to compare site documents to published articulations of EBM using the methods described in Arkema et al. (2006) to determine whether the results of the present study persist or instead reflect Arkema et al.'s (2006) findings, thus, indicating the influence of the methods on conclusions related to the issue of translation. Exploring these issues among the larger EBM community by asking these questions in the context of sites in different regions, operating at different scales, focusing on different objectives, and engaging different stakeholders will also enhance the conclusions drawn from this study and help determine how representative ESTWP and SLOSEA are of other EBM initiatives. Lastly, these sites should be tracked over time to find out if interviewees' views of EBM change as the efforts progress.

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Appendix A - Interview Guide and Questions

Background on interviewee's connection to ocean and ecosystem-based management
Prompt: Tell me something about your work in (XYZ- area) and your role in (XYZ-project).

1. How long have you lived/worked in (Place XYZ)? What brought you here?
2. How did you get involved with (organization you are working with)?
3. what is your role in (organization you are working with)? Has your role in the region (place XYZ) changed over time?
4. On a map, where are your activities concentrated ?

How did Ecosystem-Based Management emerge at the site?
Introduce: We have a mandate to figure out how context affects ecosystem-based management.

1. Why/How did (your organization) begin working on (issues XYZ) in the (Place XYZ)?
2. What are the biggest threats that your project is trying to address?
3. *There are lots of definitions of EBM. What is your working definition of EBM in this project?* Is this a shared definition in the region? (If no: How is your definition different from the others?)
4. What was the motivation for implementing EBM in this region?
5. After the proposal was written, which groups have had the most influence in determining how the project is implemented? (List 3, if appropriate.)

Opportunities and barriers to implementation (i.e., How does Ecosystem-Based Management interact with histories, cultures, management institutions already in place?)
Prompt: We are really interested in how ecosystem theory translates into practice.

6. What are the challenges to implementing EBM here?
7. What are the opportunities/possibilities for implementing EBM here
8. What kind of information is needed to support EBM? Is that information being collected?

Outcomes
9. We've talked about all of these challenges, but overall has your EBM project been successful? Why/Why not?
10. Have there been any expected outcomes of EBM so far? Have there been any unexpected outcomes?
11. Do you think marine management will be substantially different 10 years into the future than it was 10 years ago? Why?

Appendix B – Attribute Group Abundance by Site

Distribution of interviewees by attribute and site. Number indicates how many interviewees in each group.			
Site	**ESTWP**	**SLOSEA**	**TOTAL**
SLOSEA	0	16	16
ESTWP	10	0	10
Organization Type			
Unassigned	0	1	1
Not Applicable	0	1	1
NGO	3	5	8
Government	6	5	11
Scientific	1	4	5
Discipline			
Unassigned	1	5	6
Social	0	4	4
Biological	4	6	10
Physical	2	0	2
Interdisciplinary	3	1	4
Project Responsibility			
Science Panel	2	1	3
Advisory Group	5	8	13
Leadership	3	3	6
Informed	0	3	3
Partner	0	1	1