The Humboldt Bay Ecosystem Program

Our vision is a vibrant, thriving, and resilient Humboldt Bay Ecosystem that supports the well-being of our human and natural communities.

Final Report
January 2007 through December 2008

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Executive Summary

The Humboldt Bay Ecosystem contains globally significant old growth temperate forests, rare wildlife species, unique Native American cultures, sparse population, small communities, and a history of fishing and forestry industries. Maintaining ecological integrity and promoting human well-being is challenging but the rewards are exceptional. In this unusual time when state and national policy demands for multidisciplinary science are ahead of what the scientific community can directly provide, an ecosystem approach is a practical way to strengthen the link between science, management and societal values and provide this vital information to policy makers.

In the Humboldt Bay Ecosystem we were fortunate to receive funding from the Coastal Conservancy to implement ecosystem-based management (EBM), which is an inherently participatory process. The program is starting “small” by ecosystem standards but “large” compared to the norm of scientific and management studies. Our Advisory Team, 31 scientists and managers, prioritized issues, recommendations and policies from the Humboldt Bay Management Plan and the Humboldt Bay Watershed Salmon and Steelhead Conservation Plan, both completed in 2006. The Humboldt Bay Management Plan establishes clear management direction for the Humboldt Bay Harbor, Recreation, and Conservation District to actively focus on implementation of EBM. The Humboldt Bay Watershed Salmon and Steelhead Conservation Plan was adopted in its entirety by the California Department of Fish and Game Salmon Recovery Plan for the North Coast. Both plans were created from community input between 1999 and 2006. The issues in the plans are things the community cares about.

The significance of ecosystem-based management (EBM) as an organizing concept was recognized by the Humboldt Bay Harbor, Recreation and Conservation District in Conservation Element Planning Policy CAE-1 (page 200-201):

“The District has adopted ecosystem-based management (often EBM) as an intrinsic focus for managing Humboldt Bay. EBM is considered to a core tenet and overarching Plan element. EBM is a management philosophy that incorporates the following elements:

- Partnerships and citizen participation
- Science-based approach
- Long-term focus that incorporates adaptive management
- Comprehensive perspective”

From Humboldt Bay Management Plan

The Advisory Team used issues, policies and recommendations from the two plans to develop concept proposals with an ecosystem approach. The proposals address sediment dynamics, ecosystem indicators, cost/benefit analysis of impacts and tradeoffs of land use conversions, an organizational analysis for an “EBM entity” and development of an ecosystem conceptual model. The overarching conceptual model will unify our current understanding of how the Humboldt Bay Ecosystem works. The conceptual model will also include new information as it becomes available and will deliver this information in formats useful to everyone. For example, in EBM we might ask the question “What ecosystem indicators are necessary to evaluate the status of the ecosystem and what is the minimal set of indicators needed for effective management?”
The proposals cover the next 3 to 5 years. These projects will vastly increase our capacity to implement EBM, reduce management costs, and provide a venue to expand the role of science in ecosystem stewardship. The Humboldt Bay Ecosystem Program became a learning institution in our first year of work. We addressed many complex issues, recognized when we were stuck, and through our own leadership we were able to move forward. We are in a unique geographical position to collaborate with EBM projects in Oregon and California, providing an opportunity to address priority issues in the West Coast Governor’s Agreement, the California Ocean Protection Council Strategic Plan, the NOAA California Current Integrated Ecosystem Assessment, the COMPASS California Current Ecosystem-based management Program, and the Central and Northern California Ocean Observing Systems program. We are founding members and participants in the West Coast EBM Implementers Network. We met with private foundations in April 2008, submitted and received funding for a Humboldt Bay Ecosystem Program Strategic Planning Workshop in January 2009. We will concurrently develop and build our outreach and communication program and integrate with participants in other regional and West Coast-wide programs.

Our accomplishments since January 2007 include:
Formation of the Core and Advisory Teams
Development
  Vision and mission statements,
  Definition of EBM for our program
  Description of Humboldt Bay Ecosystem geospatial boundaries
  Establishment of several subcommittees
  Cultural Resources Inventory Workshop and Report
  Submission of proposal on watershed, bay and nearshore ocean sediment dynamics, transport, and effect on eelgrass distribution
  Founding members and participants in the West Coast Ecosystem-based Management Implementers Network
  Humboldt Bay and Eel River Estuary Intertidal and Subtidal Habitat Goals Report
  Proposal submitted and funded to host a Strategic Planning Workshop
  Participation in the Humboldt Bay Harbor, Recreation, and Conservation District Advisory Committee
Humboldt Bay Ecosystem Fact Sheet

Location: 275 miles north of San Francisco, California
140 miles south of Port Orford, Oregon
Watershed: 225 square miles
Sub-basins: Mad River and McDaniel’s Slough, Arcata Urban Creeks, Jacoby Creek, Freshwater Creek System, Eureka Urban Creeks, Elk River, Salmon Creek
Some of the most important, viable stocks of Coho salmon in watershed tributaries
Land Use:
- Timber production – 54%
- Open Space and parks – 14%
- Urban – 10%
- Agriculture – 9%
- Rural residence – 7%
- Other – 6%
Population:
- Arcata – 14,000
- Eureka – 30,000
- Small, rural communities – 33,000
  Fairhaven, Samoa, Manila, Bayside, Freshwater, Kneeland, Cutten, King Salmon, Field’s Landing, Table Bluff
Humboldt Bay: 25 square miles of surface area at high tide (San Francisco Bay is 63 times larger) and 8 square miles of surface area are low tide
Uses:
- Harbor – commercial shipping, tug and tow, research vessels, tall ships
- Cultural – Indian Island World Ceremony site restoration
- Recreation – fishing, kayaking, wind surfing, sailing, bird watching,
- Clamming, photography and others
- Mariculture – approximately 300 acres of shellfish operations
Resources:
- 4000 acres of eelgrass
- 900 acres of salt marsh, reduced from 10,000 acres 130 years ago
- 60% of Brandt geese in Pacific Flyway population use Humboldt Bay between December and April, peak spring population of 21,000
- >110 species of fish
- Second only to San Francisco Bay in numbers and diversity of migratory water-associated birds wintering in coastal segment of Pacific Flyway of California
- Threatened species include
  - Tidewater Goby
  - Coho Salmon
  - Coastal cutthroat trout
  - Northern Red-legged frog
  - Snowy Plover
Littoral Cell: Trinidad Head to Cape Mendocino
- 40 miles long
- Extreme wave climate
- Approximately 1 million cubic yards of sand removed annually from harbor entrance
Figure 1: Humboldt Bay and Watershed Location Map
Humboldt Bay Ecosystem Ecological Boundaries

The Humboldt Bay Ecosystem ecological boundary is assigned to primary, secondary and tertiary zones to reflect the concept that there are multiple levels of influence or engagement in different parts of the Humboldt Bay Ecosystem that affect ecosystem processes on different spatial and temporal scales. All zones include ecological, social, cultural, and economic processes involving the biological and physical components of the Humboldt Bay Ecosystem.

The primary zone includes Humboldt Bay waters inside the jetties, its historical tideland area and all current and historical tidally influenced areas. This area includes spatial scales in the ten’s of kilometers and is an area where management actions directly affect ecosystem processes. This zone extends to an elevation break of approximately 10 feet.

The secondary zone includes all of the primary zone, plus the Humboldt Bay Watershed, and the nearshore extending from Trinidad Head to False Cape and out to a maximum of approximately 30 fathoms (55 m). This includes the major urban centers, small communities and other watershed land uses. The maximum depth of this zone is intended to encompass the Eureka littoral cell and processes on the scale of hundred’s of kilometers (e.g., sediment transport), as well as coastal areas outside of Humboldt Bay that are affected by human activities within the Bay. This zone is an area where management actions that address ecosystem interactions between land and marine habitats affect ecosystem processes in the primary zone.

The tertiary zone of influence includes the watersheds of Trinidad, Little River, Mad River, Humboldt Bay, Eel River and Bear River, and the nearshore ocean from Trinidad Head to Cape Mendocino and offshore to encompass physical processes and human management activities that affect the primary zone. This tertiary zone encompasses processes on the scale of 10,000’s of kilometers where effects to the Humboldt Bay Ecosystem are less well understood. This zone includes the Eureka littoral cell, the dredge spoil site, some of the fishing grounds off our coast, and offshore areas that encompass oceanographic processes affecting the primary or secondary zones (e.g., transport of organisms).

On a larger scale, the Humboldt Bay Ecosystem is part of the California Current Large Marine Ecosystem and the Pacific Northwest ecosystem. Although linkages are even less well understood, we recognize this larger scale can influence the Humboldt Bay Ecosystem, but that direct management actions in this area are less likely to occur from our region.
Figure 2: Humboldt Bay Ecosystem Ecological Boundaries
Background

A group of resource managers and scientists created the Humboldt Bay Ecosystem Program (HBEIP) inspired by a unique combination of planning, community involvement, national, state and local policy. Locally, watershed and bay management plans were developed concurrently between 1999 and 2006. Because many people participated in both processes, a general awareness of the need to integrate issues common to both plans, as described in the Executive Summary, grew. At the national level, the U.S. Commission on Ocean Policy and the Pew Oceans Commission completed plans in 2003 and 2004. From our local perspective, a compelling concept in these plans was the recommendation for an ecosystem-based management (EBM) approach to coastal and ocean management. California responded definitively to the national ocean policy plans and passed the Ocean Protection Act in September 2004. Ecosystem based management is a priority of the Ocean Protection Council Strategic Plan. The West Coast Governor’s Agreement on Ocean Health, signed in September 2006, places EBM among its priorities and organizing concepts. All of these national, regional, and state plans support and encourage EBM. Our local socio-political context changed when the Humboldt Bay Harbor, Recreation and Conservation District embraced EBM and adopted it as their approach to policies in the Humboldt Bay Management Plan in 2006.

The Humboldt Bay Ecosystem Program began in November 2006 with funding from the State Coastal Conservancy. We adopted an ecosystem-based management (EBM) approach to identifying priority issues from the bay and watershed plans. The EBM approach enables us to build on hundreds of hours of community input, incorporates new knowledge, empowers us to act, and provides a unique opportunity to move forward and accomplish management and conservation objectives. We are aware of the need to think and manage differently and are committed to continue learning and sharing our experiences with others.

The goal of the Humboldt Bay Ecosystem Program (HBEIP) is to protect and improve the health and well-being of the community and natural resources, valued by all who live and visit the region. Like every community we have a suite of issues including timber harvest, water quality, sediment contamination, port development, harbor dredging, stormwater runoff, urbanization, and restoration of salmonids and wetland habitats. Making progress on these issues is impossible without addressing inherent conflicts in our community. Historically, our community has shown we can become strongly polarized over these issues. However, we recognize that addressing these issues individually is insufficient.

A local example of single species management is declining salmonids populations in the Humboldt Bay Ecosystem. In the current management scenario, the ecosystem is not able to sustain delivery of this economic, aesthetic, and spiritual resource. Healthy salmon populations depend on a healthy, productive ecosystem. An EBM approach to declining salmonid populations would include an integrated approach to management that considers the entire ecosystem, including humans. Currently fisheries management, endangered and threatened species recovery, coastal zone management, water quality management, and timber harvest are managed separately, though all these activities interact and have unknown cumulative impacts to salmon. The structure, function and processes of the ecosystem are lost in this fragmented
management scenario. There is no accounting for the interconnectedness throughout the ecosystem and no integration of ecological, social, economic, and institutional perspectives.

Our project is a community-based process addressing the Humboldt Bay Ecosystem. The advantage of our small scale is the ability to build institutional capacity, constituencies, and credibility as we grow. It is also the scale people are most closely linked to and reliant upon. In order to begin linking our project with a larger scale effort, we participated in the founding meeting of the West Coast EBM Implementers Network and the first annual meeting of the Network. In the absence of accepted methodology to implement EBM, we will work in collaboration with the other local projects to make the jump from a small, regional program to an operational, integrated California Current EBM effort more rapid. We will learn from each other as we create a culture of EBM. In the Humboldt Bay Ecosystem, we intend to establish a fully integrated program directed at multiple issues and goals within the large, complex, California Current System.

Ecosystem-based management (EBM) offers an opportunity to address ecosystem issues, use scientific advances, develop economic opportunities, and create policies to improve the effectiveness of community planning and natural resource management (Figure 3). We have a novel setting and suite of management, community, and government institutions with a desire to learn and adapt. EBM offers us an approach that incorporates the new knowledge and provides a way forward.

Figure 3. Interface Model Presented by S. Rumrill at Pacific Estuarine Research Society, 2007. (Used with permission, S. Rumrill pers. comm. March 2008).
Mission and Objectives

The mission of the Humboldt Bay Ecosystem (HBEP) Program is to increase our scientific understanding of the Humboldt Bay ecosystem and to create an integrated framework for resource management and collaboration that links the needs of people, habitats, and species to ensure a healthy future for Humboldt Bay’s natural and human communities.

The objectives of the Humboldt Bay Ecosystem Program are:

- Develop vision and mission statements
- Develop working definitions of:
  - Ecosystem-based management
  - Ecological boundaries
  - Ecosystem-based management project criteria
- Evaluate issues, policies, and recommendations identified in the Humboldt Bay Management Plan and Humboldt Bay Watershed Salmon and Steelhead Conservation Plan
- Identify priority ecosystem issues
- Evaluate local and regional capacity for an ecosystem database and/or entity to house Humboldt Bay Ecosystem information
- Develop two to seven proposals addressing priority ecosystem issues
- Participate in the Humboldt Bay Harbor, Recreation and Conservation District Advisory Committee
- Participate in the West Coast Ecosystem-based Management Implementers Network
- Expand stakeholder and public participation in HBEP
- Set the stage for future ecosystem-based management in the Humboldt Bay Ecosystem

Methods and Results

Formation of Core and Advisory Teams

January to May 2007

All participation in the Humboldt Bay Ecosystem Program (HBEP) is voluntary. A Core Team that serves as the project steering committee was formed in December 2006. Core Team members were solicited from several local workshops, from large email lists, and local committees. This was a public process. Presentations and announcements were made at meetings and workshops. Eight people serve on the Core Team. The first task of the Core Team was to form an Advisory Team (Member listed in Appendix A).

Advisory Team members were invited to participate in one year of meetings to launch the HBEP. Formation of the Advisory Team launched the Humboldt Ecosystem Program in June 2007. Criteria used to select Advisory Team members were:

- Expertise in watershed or bay resources from a scientific, management, or business perspective
- Currently working in the ecosystem or previous significant involvement
- Willingness to collaborate on multi-disciplinary projects
- Ability to commit to one year of participation that included one 3 hour meeting per month and approximately 2 hours per month of reading or other project activity

**June through August 2007**

The Advisory Team, which includes the Core Team, first met on June 12, 2007. There are 31 members. Before the first meeting, Advisory Team members were provided with several ecosystem-based management (EBM) papers to read in preparation for our first meeting (Appendix B). The Humboldt Bay Ecosystem-based management definition, ecological boundaries, and EBM proposal criteria were developed using concepts from these papers. At the first meeting, the Advisory Team developed ground rules and a consensus-based, decision-making process. We recognized the need and arranged for a local facilitator to lead our discussions on an as-needed basis.

The facilitator from Redwood Community Action Agency, worked with us and used expert facilitation methods to develop our working definitions, criteria, evaluation of recommendations and issues in the two local plans, and to reach consensus on our concept proposals. The bay and watershed plans provided the HBEP with over 200 community-based issues, policies, and recommendations. We assessed overlap, grouped, and prioritized major issues (Appendix C). Meeting notes posted on the program website (http://groups.ucanr.org/HumboldtBayEBM/) contain the details of these discussions. Six subcommittees formed to develop the major issues into proposals.

**September 2007 through June 2008**

Six subcommittees were formed in September and within two months identified priority concept topics. The first topics selected for proposal development are indicated with an asterisk*

- **Conceptual Model**
  - Interactive Humboldt Bay Ecosystem Model *
- **Biological Resources**
  - Develop a large-scale restoration project that includes intertidal and subtidal habitat. Design this project to be a “pilot” project for other restoration by measuring"
  - Identify a suite of biological metrics to measure management action or restoration action effective
  - Ecosystem Indicators*
  - Map and assess Bay habitats
  - Identify and quantify habitat goals and habitat functions for key species
  - Isotope study to determine carbon pathways
  - Framework for Invasive Species Management
- **Physical Processes and Water Quality**
  - Sediment Budget
  - Sediment Dynamics and Circulation*
  - Increased bay and watershed water quality and physical process monitoring
• Bathymetric and topographical mapping, especially of upper reaches of Bay
  • Cultural Socioeconomic
    o Develop model to show range of benefits and impacts flowing from current, existing land uses
    o Develop adaptation strategy for sea level rise
    o Develop matrix and process model to facilitate economic and non-market costs and benefits analysis for land use and management options*
    o Develop indicators for ecological indicators study
  • Implementation
    o Develop Memorandum of Mutual Understanding for short term EBM continuation*
    o Develop organizational design analysis to examine different types of structures for an “EBM entity” in the Humboldt Bay Ecosystem*
    o Expand the existing collaborative effort and implement EBM through creation of an integrated framework that links the needs of people, habitats and species in the Humboldt Bay Ecosystem*
  • Art and EBM
    o Develop Outreach Coordinator Position to integrate EBM activities into numerous local art activities and programs
      ▪ (This subcommittee has not prepared a proposal concept at this time.)

Approximately 6 to 12 Advisory Team members serve on one or two of these subcommittees. Because of the overlap, the Advisory Team decided three subcommittees, Biological Resources, Physical Processes, and Cultural Socioeconomic, would meet at the scheduled Advisory Team time. The other three subcommittees agreed to meet between Advisory Team meetings. Between September 2007 and June 2008, subcommittees held additional meetings. In September 2008, a Steering Committee was formed for the Strategic Planning Workshop scheduled for January 2008 (Figure 4).
Figure 4. Core Team, Advisory Team, Subcommittees, Public Participation, and the Strategic Planning Steering Committee meetings of the Humboldt Bay Ecosystem Program from June 2007 to November 2008. Public participation is shown for Advisory Team meetings only. This figure does not include the Core Team meetings from Jan to June 2007. It is important to note that Advisory Team members participated in subcommittee meetings. The total number of individuals who participated in the program at all meetings from June 2007 to November 2008 was 62. Of these, 29 are Advisory Team members and 33 are stakeholders.

Each subcommittee worked from the priority issue list developed by the Advisory Team in July and August (Appendix C). They selected one concept to develop first (see list above). The subcommittees worked to integrate these watershed and bay issues into a unified proposal with an ecosystem approach. Two meetings, Dec. 2007 and Jan. 2008 were devoted to facilitated discussion to accomplish this goal. The Advisory Team identified topics that could be addressed with local expertise and would build local capacity to address other ecosystem issues.

The Advisory Team reached a consensus decision on five proposal topics to pursue and develop by May 2008:

- Conceptual Model
- Ecosystem Indicators
- Sediment Circulation and Dynamics
- Socioeconomic Analysis and Model
- Implementation

These concepts respond to policies and recommendations in the Bay and Management Plan. Table 1 shows these relationships.
<table>
<thead>
<tr>
<th>Humboldt Bay Ecosystem Concept</th>
<th>Humboldt Bay Management Plan Policy</th>
<th>Humboldt Bay Watershed Salmon and Steelhead Plan Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conceptual Model</td>
<td>CAE-1: maintain Humboldt Bay Ecosystem, CEP-4: Maintain functional capacity of aquatic ecosystems, CPE-2: Increased use of District website for communication</td>
<td>Water Quality III. C. Cumulative Effects;</td>
</tr>
<tr>
<td>Ecosystem Indicators</td>
<td>HFA-7: Identify ecological factors affecting fish; CAE-1: base management decisions on maintaining Humboldt Bay Ecosystem; CAE-2: Maintain, restore and enhance aquatic ecosystem integrity, CAS-1: maintain biological diversity and important habitats; CAS-2: maintain conditions required for commercially important fish, invertebrates, plants; CEP-4: maintain functional capacity of aquatic ecosystems</td>
<td>All Estuary Habitat Structure A2, A6, A9, Riparian Habitat A1, B III Water Quality I A (all) sediment</td>
</tr>
<tr>
<td>Sediment Circulation and Dynamics</td>
<td>HWM-6: Identify sediment dynamics and develop sediment management; CAE-1: base management decisions on maintaining ecosystem, CAE-5: Work cooperatively to develop and implement water quality plan, CEP-5: Water quality protection is required</td>
<td>A III. Habitat Structure. Channel A1, A2, C5, C,- all on sediment; B III Water Quality A Pollution</td>
</tr>
<tr>
<td>Socioeconomic Analysis and Model</td>
<td>RA-2: Partnership with recreation providers; ROP 2: needs assessment and use preference data; CAE 4: work cooperatively to develop and implement a restoration plan</td>
<td>B III Water quality B- Socioeconomic impacts of watershed management</td>
</tr>
<tr>
<td>Implementation</td>
<td>RIO 1: Develop interpretive program, CPE-3: Establish Humboldt Bay Management Plan Advisory Committee</td>
<td>B III Water Quality G whole section: education and coordination</td>
</tr>
</tbody>
</table>
This was a turning point in the HBEP. We realized that we were a learning institution and a successful working group. We had created a space for conversations where everyone felt safe and wanted to have a say. We recognized when we were stuck and had the ability to address the challenge and move forward. We are on our way to increasing our understanding of how people interact with the ecosystems and improving communication about environmental and societal complexity. We are eager to engage additional collaborators and stakeholders as we proceed.

We had a unique opportunity in April 2008 to host representatives from three foundations, the David and Lucille Packard Foundation, the Resources Legacy Fund Foundation, and the Nature Conservancy for a two-day visit. The first day we held an Advisory Team meeting in the morning, gave an overview of HBEP and had a very exciting and lively discussion. An afternoon tour of wetland and dune restoration projects showed foundation representatives some of the existing activities and collaborations active around the Bay. A guided tour of Humboldt Bay on the R/V Coral Sea included the Advisory Team and many invited guests. There was also ample time for networking, individual and small group discussions. On day 2, the foundation representative attended the morning session of the Humboldt Bay Symposium, which included a session on EBM. In the afternoon we held a thorough de-briefing meeting that lead to the idea of a Strategic Planning Workshop for the Humboldt Bay Ecosystem Program.

At our HBEP Advisory Team meetings in May and July, we developed a Strategic Planning Workshop proposal that was funded by the David and Lucille Packard Foundation. Humboldt State University and California Sea Grant are also supporting the Strategic Planning Workshop. We are working with a consulting group, Foundations of Success (FOS). FOS is recognized for its work with businesses, conservation groups, and EBM programs in adaptive management and strategic planning. The purpose of the workshop is to increase public and stakeholder involvement in HBEP and to refine or revamp our concept proposals.

**Outreach**

Our outreach efforts included establishing a project website, presentations to local groups and at two international conferences. A total of 21 presentations were made to approximately 500 people between June 2007 and October 2008. Numerous monthly updates on the EBM program were made at North Coast Institute of Marine Science, the Humboldt Bay Shellfish Technical Advisory Committee, and at North Coast GIS Users Group meetings between September 2007 and April 2008.

Locally, we presented targeted outreach to the Pacific Coast Joint Venture, Humboldt County Supervisors, Central and Northern California Ocean Observing System (CENCOOS), and the North Coast GIS Users Group (NCUG), Humboldt County Farm Bureau, City of Trinidad, the California Ocean Protection Council, and the City of Eureka. Each group was contacted and arrangements made for a presentation on the HBEP as an item on their meeting agenda. HBEP information sheets were distributed at presentations (Appendix C). Discussions following the presentations resulted in substantive input, suggestions, and collaboration. For example, we are working with the NCUG and CENCOOS on data base development. Humboldt County Supervisors and the Farm Bureau strongly suggested including the agricultural community in our
program. The Pacific Coast Joint Venture wants to work with us to develop an outreach coordinator position.

Advisory Team meeting times and agendas were disseminated via email list serves, at local meetings, and on the HBEP website. Two local newspapers published articles and photos on the project, we were interviewed on local radio programs twice, and we were interviewed by local Channel 3 news in July. It is always difficult to directly relate outreach to participation, but during this period, eight people regularly attended monthly Advisory Team meetings and participated in our discussions and subcommittees. Humboldt State University Sociology graduate students began attending the Advisory Team, Biological Resources Subcommittee and Cultural Socioeconomic Subcommittee meetings in August. Two of these students are working with faculty to develop EBM masters theses. All students are serving on the EBM Strategic Planning Workshop Steering Committee.

We also gave invited presentations at two international conferences, Coastal Zone 2007 and the annual meeting of the American Fisheries Society, September 2007. These presentations gave the HBEP considerable visibility to many other EBM and related projects.

![Outreach Presentations](image)

Figure 5. Presentations given on the Humboldt Bay Ecosystem Program and the number of participants, Pacific Coast Joint Venture (PCJV), North Coast Users Group (NCUG), Central and Northern California Ocean Observing Systems (CENCOOS), Humboldt County Supervisors (Supervisors), Coastal Zone Conference, Humboldt County Farm Bureau, American Fisheries Society Conference (AFS), Ocean Protection Council (OPC), City of Trinidad, Fisheries Class at Humboldt State University (HSU), City of Eureka, North Coast Institute of Marine Science (NCIMS), Port Orford Ocean Resources Team, West Coast EBM Implementers Network.
Program Participation

Meeting length and participation:
- Core Team members met monthly for two hours from Jan. 2007 through November 2008. Six to 9 people attended each meeting.
- Advisory Team members participated in a monthly, three-hour meeting June 2007 through April 2008. Fourteen to 29 members attended each meeting.
- Subcommittees met for 2 to 4 hours monthly and involved 2 to 12 people.
- Public participation ranged from 2 to 10 per meeting.
- The Strategic Planning Steering Committee met three times with 10 to 14 participants per meeting.
- Public participation was a total of 33 people over all Advisory Team meetings

Overall the total number of Advisory Team hours contributed to the project, assuming a three-hour meeting length, was 1110 hours of participation and in-kind support (Table 2). This voluntary work was done by private scientists, agency managers, NGO representatives, stakeholders and the public. It represents an enormous contribution and investment of time and expertise by this group of people. HBEP is successful because of these substantive contributions of over 800 people-hours (Table 2).

Table 2: Attendance, meeting length, and hours of participation for the Humboldt Bay Ecosystem Program from January 2007 to November 2008.

<table>
<thead>
<tr>
<th>Group</th>
<th>Attendance (sum of number of people per all meetings)</th>
<th>Meeting length (hours)</th>
<th>Hours of participation</th>
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<tbody>
<tr>
<td>Core Team</td>
<td>146</td>
<td>2</td>
<td>292</td>
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<tr>
<td>Advisory Team</td>
<td>370</td>
<td>3</td>
<td>1110</td>
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<td>SUBCOMMITTES</td>
<td></td>
<td></td>
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<tr>
<td>Art and EBM</td>
<td>4</td>
<td>2</td>
<td>8</td>
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<tr>
<td>Conceptual Model</td>
<td>20</td>
<td>2</td>
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<td>Biological Resources</td>
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<td>Cultural Socioeconomic</td>
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<td>Implementation</td>
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<td>Physical processes and water quality</td>
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<td>Public Participation</td>
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<td>Strategic Planning Steering Committee</td>
<td>34</td>
<td>2</td>
<td>68</td>
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<tr>
<td>TOTAL</td>
<td>852</td>
<td>22</td>
<td>2,118</td>
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</table>
Proposal Concepts

Unified Proposal

Our proposal has strong community based roots and the participants are energized and ready to mobilize ecosystem-based management. Our roots are ourselves, our love of our community, our human networks, and knowledge of to the land, bay and ocean. We are a small community and still understand our cultural and economic connections to the land and natural resources. Two community-based plans developed between 1999 and 2006 form the foundation of our EBM program. Hundreds of people participated in workshops, meetings, writing, emails, phone conversations, and numerous other dialogues throughout the community, all of which is reflected in over 100 recommendations, policies and issues found in the Bay and watershed plans. These plans were developed from the bottom up and represent community values and issues that are important to people who live here.

Our vision of the future comes from the past year and a half of work completed by participants in the Humboldt Bay Ecosystem Program. We are increasing our capacity to synthesize and communicate scientific knowledge to managers, stakeholders and policy makers and to develop multidisciplinary teams and programs. The complexity of EBM demands knowledge and skills to adapt to changing conditions and to learn from our own experiences. The proposal concepts presented here reflect the knowledge and expertise of the Advisory Team and the collaborators who joined us during the first phase of the program. From our collective knowledge, we know there are hundreds of documents, videos, and artistic works that speak to us about a wide range of species, habitats, history, economic, social, and cultural issues, and other areas of interest.

Conceptual Model

Our first proposal aims to synthesize all, or most, of this information, into a conceptual model that describes our current understanding of how the Humboldt Bay Ecosystem works. We decided to use a Bayesian Belief Network (BBN) for our conceptual model as these networks can incorporate quantitative, anecdotal, historical, and other qualitative data (Charles River Analytics, Inc. 2004). This conceptual model of our understanding of Humboldt Bay will give our community a shared, adaptable knowledge base to meet a variety of needs including diagnosing underlying problems, isolating causes and effects, providing a shared common tool from which to develop alternatives, generating quantitative predictions of ecosystem response, a means to identify appropriate ecosystem indicators and potential thresholds, and a means to refine research, management, and restoration needs.

Sediment Dynamics and Circulation

Following our assessment of the issues identified in the bay and watershed plans, sediment source, distribution and transport emerged as a compelling issue with natural resource, human and ecosystem impacts. In the watershed, land use practices on large (timber harvest) and small scales (individual home) has the potential to generate sediment, which may cause problems for rural drinking supplies, flooding throughout the ecosystem, and generally reduced water quality. For organisms, such as salmonids, living in rivers and tributaries, sediment negatively impacts juvenile survival, foraging and growth. In the bay, watershed sediment has unknown impacts.
Real information about sediment within the bay and sources of oceanic sediment is very limited. For this reason, the second component of the Unified Proposal is to examine Sediment Dynamics and Circulation. This concept was submitted as a proposal to the Ocean Protection Council Strategic Initiative Program on March 14, 2008. Understanding sediment dynamics in the watershed, bay and nearshore ocean lays the foundation for understanding transport of pollutants, nutrients and organisms throughout the ecosystem. It also brought together a qualified team of local scientists and managers to conduct the project.

**Ecosystem Indicators**

Knowledge of sediment dynamics is connected to both ecological and human attributes in the Ecosystem Indicators concept. Indicators are a method to measure cause and affect mechanisms that can be incorporated into the BBN. The Biological Resources subcommittee studied a book, *Estuarine Indicators* by S. Bortone (2005), read over 20 papers from the scientific literature, and several West Coast indicators studies conducted by US EPA, NOAA Fisheries, and other agencies. We found there are many outstanding studies of indicators but only two that integrate indicators with an ecosystem approach (Niemi et al. 2004, Syndeman and Elliot 2008). We developed a concept proposal with 9 ecosystem indicators. The Biological Resources subcommittee met with the Cultural Socioeconomic subcommittee twice and expects to include land use and land cover change, coastal restoration, population and land use trends, or other socioeconomic indicators in the final proposal. Development of these indicators should be completed before publication of this report.

**Land Conversion Cost-Benefits Analysis**

The Cultural Socioeconomic concept proposal identifies a sub-model component of the Conceptual Model. This predictive model will assist managers, planners and economic development programs to analyze benefits, impacts and tradeoffs for land use conversions using an EBM approach. Indicators chosen for the model will be incorporated into the Ecosystem Indicators proposal. This proposal focused on the tradeoffs involved in restoration of low gradient lands, including agricultural pastures, that surround Humboldt Bay and the Eel River Estuary, to tidally influenced areas. While this is a controversial issue the need to address rising sea level, drainage issues, and providing habitat and migratory corridors is a critical ecosystem issue.

**EBM Governance**

Perhaps Ecosystem-based management should be called Ecosystem Governance since the changes it requires in goals and human behavior are profound. We can only make changes in our management structures if people accept and adopt the concepts into their values, policies, laws, and institutions. The Implementation proposal addresses the short term and the long term need to diffuse EBM into governance. In the next one to three years, a successful Humboldt Ecosystem Program may implement EBM by creating advisory committees, working groups, user organizations, non-governmental organizations, joint power authorities, commissions or other entities dedicated to incorporating EBM concepts into governance processes. In a longer time frame, as institutional capacity develops an “EBM entity” may be useful to house new scientific information, governing and management structures. This proposal analyzes various organizational structures and develops a core of well-informed and supportive stakeholders.
The Humboldt Bay Ecosystem Conceptual Model: Developing a conceptual model to support ecosystem-based management in Humboldt Bay

Conceptual models are descriptions of the general functional relationships among the essential components of an ecosystem. They provide a key link between early planning and later evaluation and implementation. The subcommittee felt a Conceptual Model for the Humboldt Bay Ecosystem would be an effective way to express a general understanding of more complex processes in our ecosystem in a flexible framework.

For example, physical oceanographers might use the Conceptual Model to help explain and predict Humboldt Bay channel form response to dredging. Ecologists might use the watershed/bay continuum as a scientific framework to describe ecosystem change in response to sea level rise. Biologists might analyze the trophic structure to understand carbon pathways. Engineers could use the model to examine forces and geometries to calculate changes in hydrology. Community and economic development practitioners could use this model to identify sustainable alternatives to traditional natural resource uses and opportunities for “jobs and the environment.”

Numerous synthesis reports note the utility of conceptual models to organize information and in many cases suggest that development of such models earlier rather than later can be valuable in identifying key uncertainties, dominant forcing mechanisms, setting priorities for research, and generating realistic expectations with respect to expected consequences of management actions. To support ongoing development and implementation of ecosystem-based management (EBM) for Humboldt Bay and its environs, we propose to develop a conceptual model that will describe links between the physical, chemical, biological, social and economic components of the Humboldt Bay Ecosystem (HBE) using a Bayesian Belief Network (BBN) to capture...
information on the expected response of ecosystem components to change in other components, in terms of both functional response and the uncertainty in our understanding of this functional response. BBN have been used in a broad range of fields, including economics, ecological risk assessment, power plant management, and others. The broad application of BBN stems from their ability to provide a flexible framework that (1) can synthesize information from various sources and of highly variable nature (e.g., rigorous local empirical measurements, model outputs, information synthesized from the literature, expert opinion) including the uncertainty associated with such information, (2) support exploration of alternative scenarios, efforts to identify potentially critical factors, and preliminary development of ecosystem indicators, (3) allow incremental or wholesale augmentation of the information contained within the modeling framework and thus evolution of the conceptual model as more is learned about the system, and (4) provide output (i.e., predictions of the modeled system’s state) in terms of likelihoods suitable for informing management decisions. BBN can be ‘crafted’ to synthesize information, but they can also be ‘fit’ to diverse sets of data (which is why they are a big part of artificial intelligence research). Reference URLs are listed below for more information.

To accomplish this work, we propose the following:

- Literature syntheses and meta-analyses of available data on linkages between components that span broad elements of the ecosystem, with a general focus on “bottom-up” relationships between mechanisms that affect habitat quality and thus affect species’ distributions or abundances. This effort will include work on physical forcing and physical processes that lead to habitat formation, work on the direct or indirect responses of biological components across a range of trophic levels and taxonomic groups to physical processes (i.e., mechanistic and correlative approaches to elucidating functional relationships), and take into account human activities and human-caused disturbance. Initially the Conceptual Model will be developed using current understanding of the structure and function of the ecosystem (SEE “HUMBOLDT BAY AND EEL RIVER ESTUARY INTERTIDAL AND SUBTIDAL HABITAT GOALS PROJECT” IN RELATED PROJECTS).

- Compilation of information resulting from preceding synthesis and analysis into a BBN-based conceptual model of the Humboldt Bay Ecosystem, designed in such a way to allow both examination of current conditions and uncertainties and projection of expected changes under varying management scenarios. For example, natural resource managers could examine a management action and ask, “What are the most important human and resource interactions and impacts?” Or, “How can I measure the social impacts of resource use?”

- Development of a web-based outreach interface through which the public can interact with the model to gain an understanding of how the ecosystem might respond to different societal decisions, and importantly, to educate the public on the state of our scientific understanding of the system and the importance of recognizing what uncertainties must be reduced through research in order to more effectively manage the HBE.

- Deliverable will include literature/parameter database and synthesis reports, documented BBN submodels, GIS based results where feasible, and an interactive website with a graphic conceptual model of the Humboldt Bay Ecosystem.
Humboldt Bay Ecosystem Database to Support the Conceptual Model

The topic of a Humboldt Bay Ecosystem database arose in many meetings, especially when we were discussing the Conceptual Model. Data and information are critical to support the science-based monitoring and adaptive management components of EBM. Our survey and communications were a modest effort to determine the need and utility of such a database.

A survey was developed in collaboration with the NOAA Coastal Services Center. The survey was delivered to all Advisory Team members (n=31) and GIS technicians in local governments and agencies (n=12). The survey is in Appendix D. There were 20 responses from the Advisory Team and 10 responses from the local GIS experts. We also communicated with Central and Northern California Ocean Observing Systems, Humboldt State University, the California Spatial Information Library and several EBM programs around the country to explore how similar databases were developed and delivered.

Survey Responses
There were 20 responses from the Advisory Team and 10 responses from the local GIS experts.

Several local efforts produced some aspect of an ecosystem database in the reporting period. The Resources Legacy Fund Foundation made a grant to Humboldt State to create a publicly accessible database of the best scientific information to support the design of Marine Protected Area on the North Coast of California. This project was completed and the bibliography is online http://www.humboldt.edu/~ncalmis/

Question 1. How useful would an EBM database be to you and your organization?

18 respondents thought the database was a good idea, they would be interested in using it when possible and would take steps to incorporate its use in new and current projects. One respondent would use it from time to time. Three responses said the EBM database would be a critical component of their operational efforts.

This result is not too surprising as one respondent commented “we’ve been working around various pieces of this for a long time and have developed some tools to help. With a slug of funding we could do the sort of big push necessary to consolidate everything into a single well-designed portal.”

The Humboldt Bay and Eel River Estuary Intertidal and Subtidal Habitat Goals Project developed a PDF library with over 700 documents on Humboldt Bay and over 100 on the Eel River Estuary. The DRAFT Project Report contains data summaries of many of these documents. This data could be used in the Humboldt Bay Ecosystem Conceptual Model.

The Humboldt Bay and Eel River Estuary Intertidal and Subtidal Habitat Goals Project also developed a Humboldt Bay Spatial Data Inventory that was shared widely and is available on the project website (http://groups.ucanr.org/HumboldtHabitatGoals/) and the EBM website (http://groups.ucanr.org/HumboldtBayEBM/)
The Humboldt Bay Harbor, Recreation and Conservation District and California Department of Fish and Game were funded by US EPA to develop a database and website of all monitoring projects in Humboldt Bay and Eel River Estuary. This website could be reviewed for data.

**Question 2. Which audience would benefit from or use this portal?**

- State Agencies – 20
- Floodplain Managers – 13
- State and local emergency managers – 10
- County planners – 16
- University and academic institutions – 20
- NGO’s – 20
- Coastal land trusts – 17
- Insurance industry – 3

It appears from these responses that a Humboldt Bay Ecosystem database would be widely used.

**Question 3. Prioritize your preferred type of data access. 1= most useful, 2= second most useful, etc.**

- Data set listing – 2.57 ± 1.6 (range 1 to 5)
- Web mapping atlas – 1.50 ± 0.65 (range 1 to 3)
- Data delivery services – 2.00 ± 1.11 (range 1 to 4)
- Computer modeling services – 3.53 ±1.19 (range 1 to 5)
- Performance management – 3.33 ± 1.18 (range 1 to 5)

A Humboldt Bay and Eel River Estuary Eco-Atlas was published near the time of this survey. The atlas is another product from the Harbor District and CDFG funded by US EPA. A CD with the atlas is available from Adam Wagschal, 707-443-0801, or adam@portofhumboldtbay.org.

Availability of the Ecoatlas probably influenced local responses to these questions. However the Ecoatlas is a very useful tool. Data delivery services such as data downloads and ARC server were the second most popular preferred data access method. However, one or more respondents selected each data access method, suggesting that a database needs to be well thought out and planned before it is developed. The set up or architecture of the database should allow all forms of data access if feasible.

**Question 4. What roles are important to you in a database or portal?**

Cataloging and mapping received 15 responses each and delivery received 12. It appears all these items are important to develop a database.
Question 5. What organization should be responsible for housing such a proposed portal/database?

Respondents often suggested more than one organization, but the answers included:
New entity – Humboldt Bay Institute – 10
Humboldt State University – 9
Sea Grant 7
Humboldt Bay Harbor District - 3
“Working group of agencies, academic…” – 2
Put it on another website like CENCOOS or CDFG – 2
California Dept of Fish and Game – 1

Many respondents commented that the database/portal required an entity be persistent, responsible and willing to maintain sufficient expertise to maintain, improve and support the database. Many commented that the database did not need to be local but that they would prefer it local anyway, if possible.

Question 6. What organization do you feel is best suited for the task?

Humboldt State University - 12
Sea Grant - 9
Humboldt Bay Harbor, Recreation and Conservation District - 6
New entity – Humboldt Bay Institute – 6
University of California - 3
Cal Fish and Game/Pacific States Marine Fisheries Commission – 3

Question 7. What data types would potentially be of greatest use to your organization?

Biological -17
Chemical – 14
Earth measurements/geomorphological – 17
Physical – 18
Social/human activity – 10

Again it appears a broad database with multiple types of data is most desirable. It should be noted the lower value of social/human activity data responses may reflect the overall low number of social scientists and economists in our area.

Question 8. Would your organization be interested in providing human, financial, or technical resources to support this project?

There were 15 positive responses and 3 negative responses. Several people did not complete this question.
Comments mostly stated that some amount of staff time could be allocated to support the database for specific tasks. Also comments stated it would be necessary to have a committee or advisory board to develop protocols, metadata requirements and to prioritize data. Overall there was general support for the database and willingness to contribute to it.

Question 9. We realize that a quality Information Technology staff is necessary to the success of this project. In addition, do you feel a coordinating body is necessary to provide oversight and guidance to manage the portal?

People must get tired near the end of a survey. There were less responses to #8 than #9. Responses were 14 yes and 1 no. In general, most survey participants are aware of the need to provide accurate and useable data.

When the Conceptual Model is developed and/or receives funding, the database will be at the core of the project and will require a multidisciplinary partnership. The database will be the supporting tool to the Conceptual Model with a comprehensive range of products, both technical, archival and conceptual. A prototype information system may need to be assembled and tested to demonstrate the viability of technical systems. In an emerging ecosystem-based management framework, there is a huge need for an integrated database to be used as a research and decision support tool.

We will also need to look diligently to find out who has what data and where. Do we want to host the data? Or just the metadata and catalog the different data types? CENCOOS is actively creating data inventories and we could serve as the Humboldt Bay Ecosystem database. It would be useful to keep in touch with CENCOOS, especially since Frank Shaughnessy, Humboldt State University Biology Professor, is currently the local coordinator.

Additional information on BBN:
From: Francis et al. 2007. Fisheries

Figure 7. Example of a graphic conceptual model from an ecosystem-based management program in Alaska. We would like to develop an interactive, graphic conceptual model in this format for the Humboldt Bay Ecosystem. It would be especially useful for public education and a valuable part of an interactive website.

Circulation and Sediment Dynamics

Introduction

The bathymetry of Humboldt Bay is described as a multi-basin, bar-built, coastal lagoon and is a consequence of natural forces, such as climate-driven river flow, sea level rise, tides and winds, and anthropogenic activities such as channel deepening, dredging, tidal marsh conversion, and vessel traffic and infrastructure.

Deepening of the natural channels for navigation, annual maintenance dredging in the Bar, Entrance, and Inner Federal Navigation Channels, and stabilization of the mouth of Humboldt Bay with jetties, maintains the hydraulic connectivity between the bay and the Pacific Ocean. These and other anthropogenic activities have changed the volume of flood and ebb-tidal shoals, modified the tidal prism, and modified the natural hydrodynamic processes of Humboldt Bay.

Sediment dynamics in the Humboldt Bay Ecosystem are linked to primary productivity and driven by land use and oceanic inputs, among other factors. Studies of Humboldt Bay and
similar estuaries support the need to manage sediment delivery to the bay. Resuspended sediments can increase the turbidity above natural levels and limit the productivity of subtidal estuarine habitat by reducing light penetration and, hence, the primary productivity essential to estuarine food webs.

Due to high sediment loads and concentrations Freshwater Creek, Jacoby Creek and Elk River watersheds, which are tributaries to Humboldt Bay, have been listed as sediment impaired under Section 303(d) of the Clean Water Act by the Regional Water Quality Control Board. Humboldt Bay is not currently listed for sediment or turbidity impairment, however it is listed for dioxin and PCB impairments.

Recent work has estimated that less than 6% of the sediment annually dredged from Humboldt Bay (approximately 1 million cubic yards) come from the surrounding watersheds. However, due to the location of tributary inputs into Humboldt Bay, the watershed sediment inputs could be having a disproportionate negative effect on bay primary productivity. A better understanding of circulation and sediment dynamics in Humboldt Bay would provide valuable information to manage for listed impairments along with other water quality constituents such as sediment bound nutrients, toxics, and coliform.

Specific Issues

To address circulation patterns and sediment dynamics in Humboldt Bay we have identified the following specific issues:

- What are the circulation and transport patterns in and around Humboldt Bay?
- What are the sediment inputs to Humboldt Bay and how do they get distributed, stored and/or removed?
- How does the suspended sediment load vary in space and time in Humboldt Bay and what are the implications for light limitation of primary productivity (e.g., eelgrass)?
- How do current and future management actions involving sediment removal or addition affect spatial and temporal circulation patterns and geomorphic change (erosion and deposition) in the bay?
- How have historic management actions affected circulation and transport patterns in and around Humboldt Bay?

Proposed Work Items

To address these issues we propose the following work items for Humboldt Bay and tributaries:

- Develop, calibrate and verify a circulation and sediment transport model(s)
- Application of model(s) to sediment related management decisions
- Develop a detailed long-term sediment budget
- Expand existing water quality and transport process sampling and monitoring
Development of a Circulation and Sediment Transport Modeling Tool Framework

We envision the development of a circulation and sediment transport-modeling framework that can address the complex issues related to hydrodynamics and sediment dynamics in and around Humboldt Bay. Likely collaborators include Humboldt State faculty and students from Oceanography and Engineering, local consultants, and agencies such as the US ACE. The proposed modeling framework is the first step in building capacity for future modeling and research needs in Humboldt Bay as other water quality related issues are identified. The following steps outline one potential framework:

1. Apply a suite of river, estuarine, and ocean-based circulation and transport models to the Humboldt Bay region. Specific recommendations to consider include:
   a. Environmental Fluid Dynamic Code, EFDC (distributed by the US EPA)
   b. WASP (distributed by the US EPA)
   c. M2D (part of SMS; sold by EMS-I; supported and used by US ACE)
   d. ADCIRC (part of SMS; sold by EMS-I; supported and used by US ACE)
   e. STWAVE/CGWAVE/WABED or other ocean wave model (part of SMS; sold by EMS-I; supported and used by US ACE)
   f. Sediment transport software (e.g., EFDC, SED2D, CMS-M2D)
   g. TRIM3D (USGS)
   h. ELCIRC (freeware; preliminary version developed by A. Baptista)

2. Determine model initial conditions:
   a. Initial bathymetry: requires combination of new accurate LIDAR, plus detailed bathymetry soundings (e.g., multibeam), and measurements of shallow water channels/small tributaries.
   b. Sediment composition (for potential resuspension/erosion)

3. Monitor forcing data for desired periods (e.g., “event” basis – 1 week – to seasonal, e.g. quarterly to annual):
   a. Wind velocities (hourly)
   b. Tidal height and current outside bay entrance (predictable)
   c. Wave conditions near the entrance (collaborate with NWS – predictions/South Spit buoy observations, Buoy 22 observations)
   d. Tributary flows
   e. Sediment inputs:
      i. From tributaries: suspended and bed load
      ii. From ocean - measured across Entrance: suspended and bed load/bed forms

4. Model validation data around bay
   a. Currents (water velocities and profiles)
   b. Suspended sediments (turbidity, SSC and SSL, size distributions)
   c. Geomorphic change (map net bed changes)
   d. Tidal stages within bay
   e. Spectral transmission profiles (PAR levels, Secchi disk observations)
Application of Modeling Framework to Management

The developed and calibrated model(s) could be used by a number of end users, such as managers, agencies, researchers, and the public to address a range of sediment related issues. Specific sediment related management issues include:

1. Short-term Issues: model scenario runs
   a. Implications of current dredging practices
   b. Implications of hardening projects (e.g., bank and shore armoring)
   c. Implications of additional port development (new docks, etc.)
   d. Implications of aquaculture expansion
   e. Implications for restoration projects

2. Long-term Issues: model scenario runs
   a. Implications of reduced sediment inputs from reductions in sediment loads from Humboldt Bay tributaries (TMDL applications)

3. Other model uses:
   a. Oil spill response,
   b. Modeling transport and distribution of other sediment bound or water quality constituents such as toxics, nutrients, and coliform.

Detailed Sediment Budget

We identified the need for a detailed sediment budget to identify long-term sediment inputs into Humboldt Bay. The sediment budget could identify temporal historic sediment delivery rates from the watershed, identify historic changes to bay (e.g. deposition rates over time), and current sources and distribution of sediment inputs to and dredged from the bay (e.g. tributary inputs versus ocean inputs). Proposed work items include:

1. In Humboldt Bay
   a. Sediment cores in North and South Bays (grain size, soil age)
   b. Resuspension rates and concentrations of mudflat sediments
   c. Investigate fine sediment/clay mineralogy of mudflats
   d. Suspended sediment concentrations in water column at different locations

2. Inputs from Ocean
   a. Measure temporal sand transport (bed load) in and out of entrance
   b. Measure suspended sediment concentration and loads in and out of entrance

3. Inputs from Watershed
   a. Measure suspended and bedload concentrations and load from major tributaries entering the bay
   b. Estimate or periodic measurements of sediment loads of minor tributaries
   c. Estimate or periodic measurements of urban sediment loads
Expand Existing Sampling and Monitoring Network

We identified the need to expand the existing water quality sampling and monitoring network in Humboldt Bay. Identified sampling and monitoring needs are outlined below.

1. Expand CICORE monitoring network in Humboldt Bay
2. Expand sampling and monitoring into tributary estuaries, such as Freshwater Slough
3. Install webcams to document and monitor sediment and turbidity circulation patterns in Humboldt Bay (e.g. on Samoa Bridge, Eureka WWTF)
4. Instigate community based monitoring, such as Secchi disk measurements

A final identified need is conduct a detailed water quality assessment of Humboldt Bay water and sediments (e.g. State of Humboldt Bay) to identify potential toxics, metals and other constituents of concern for future efforts.

Ecosystem Indicators

Statement of the Problem

Ecosystem indicators are one way to communicate information about the state of the ecosystem as well as the cultural, social and economic benefits derived from its resources. Ecosystem indicators are expected to function like economic indicators. For example, we commonly equate the jobless rate as an indicator of the economy as a whole. Ecosystem indicators can be used to describe information about the overall environment whether it is for management decisions or scientific analysis. An ecosystem indicator can be a clue to a larger scale trend or phenomenon that is not immediately obvious. For example the appearance of some plankton species in coastal waters signifies impending shellfish harvest closures. Ecosystem indicators are selected to assess the condition of the ecosystem and to detect environmental change related to human disturbance.

Ecosystem indicators are meaningful to natural resource management when they have a cause and effect argument. This means an ecological indicator must link an ecosystem attribute to change. By understanding cause and effect, we can establish and describe the interacting factors. This sets the stage for better stewardship and management. We propose to develop ecosystem indicators that will provide baseline information against which to measure effectiveness of future management actions. We intend the ecosystem indicators to connect watershed and bay science, policy, and management to larger scales in the nearshore and California Current System as we learn more.

Traditionally indicators have been designed to provide specific information on local conditions such as water clarity or habitat condition. For an ecosystem approach, we want to develop indicators that measure stress-response relationships for multiple stressors over various temporal and spatial scales. These indicators are essential to measure the condition of the ecosystem, to identify the stressors, to communicate this to the public, and to protect human health and the health of Humboldt Bay Ecosystem.
We considered several management questions from the Humboldt Bay Management Plan and the Humboldt Bay Salmon and Steelhead Conservation Plan to develop ecological indicators for the Humboldt Bay Ecosystem. The overarching questions are:

- What indicators are necessary to understand the status of ecosystem services
- What is the minimal set needed for effective management?

The management issues and questions were:

- How do we protect and enhance habitats while considering:
  - Sea level rise
  - Coho salmon
  - Non-indigenous species impacts
  - Pollutant inputs such as oil spills, storm water, sediment
- What are ecological indicators within shellfish culture areas and what are suitable indicators in similar habitat outside of shellfish culture areas?
- What are ecological indicators that will relate land-based runoff into creeks and the bay? What habitat change has occurred in estuarine restoration projects?
- What are the tradeoffs when considering a levee breach?
  - Biological
  - Physical changes to the channels
  - Agriculture land conversion
  - How well are local traditions and culture understood?
  - Loss of agriculture production
  - Gain of shore bird or other uses
  - Changes in human community use patterns

In general the ecosystem-based management literature recognizes the need for developing appropriate social and economic measures of ecosystem services that can be shown to result from ecosystem-based management approaches. Some foundational information needed to accomplish this includes indicators such as:

- Human use pattern data characterized using mapping and geospatial references
- Measurable changes in the ecosystem health linked to measurable changes in economic activity – the indicator of this factor has not been developed at this time.

Goals and Objectives

- Develop indicators, using published literature, that have a cause and effect argument
- Develop indicators that detect change in watershed, bay and oceanic influences
- Develop indicators with a broad scientific perspective that are SMART:
  - Specific
  - Measurable
  - Achievable
  - Relevant
  - Tractable
- Develop products for
  - Scientists: publications
  - Managers: analyzed and synthesized data
Everyone

- Interactive web-based products to test “what if” questions
- A Report Card System showing trends in the indicators

- Include a self-assessment process so that we can adapt indicators as needed to achieve our goals
- Disseminate results to public, policy, and scientific audiences through publications, presentations, website and other information exchanges.
- Scientists and managers as collaborators will become leaders and catalysts of institutional change
- Increase the level of involvement of socio-economic sectors into ecological monitoring
- Build bridges across institutions, natural and social sciences, science and management, to scale up from watershed/bay to nearshore and ocean

Methods and Approach

We propose a combination of indicators to clarify anthropogenic and natural stresses in the Humboldt Bay Ecosystem. Characterizing the effects of multiple stressors is challenging, as effects may be synergistic, additive, or antagonistic. We chose multiple taxa representing the structure of the biological community of Humboldt Bay as our indicators. Each indicator has its own relevant spatial and temporal scale that will improve our knowledge of the stress—response relationship. Effective management requires we know the relevant spatial and temporal scale(s) so that management actions can match the scale of the phenomena being measured.

The results of this study will be used to describe cause and affect mechanisms. Results and data will be integrated into the Conceptual Model to reassess management issues, identify new issues or areas to include in the program, and test ecological and social system interactions. Results from indicator monitoring and research will be analyzed using multi-factorial and multivariate statistical approaches. We intend to use a deliberate, structured process of adaptive management to evaluate the effectiveness of the indicators.

The indicators we propose are:

**Eelgrass connectivity and functional patch size:** Large eelgrass meadows, fringing beds, and various sizes of eelgrass patches abound in Humboldt Bay. From a management perspective, a common question is “At what size does a patch of eelgrass habitat become functional for bay fauna?” We decided to examine eelgrass patch size in relation to fish biodiversity and specifically in relation to two eelgrass dependent fish species, Tubesnouts and Bay Pipefish. When we know the size of functional eelgrass habitat for fish, managers will also have a tool to assess impacts to eelgrass from activities such as shoreline hardening, construction of docks, or to examine new shellfish culture methods.

**Eelgrass depth distribution:** Eelgrass distribution in Humboldt Bay is limited by light availability. Eelgrass is important to fisheries, sensitive to nutrients, an integrator of decreased light and increased sedimentation. There are established direct sampling protocols for eelgrass density and extent. The inter-annual variability of eelgrass distribution is a direct indicator of habitat loss or gain. This is necessary to establish baseline conditions, to monitor effectiveness of restoration programs, and to gauge changes in this valuable resource. Trends in this indicator are expected to reveal suspended sediment and turbidity values around the Bay.
Juvenile Coho salmon rearing habitat use: Survival and growth of juvenile Coho salmon integrate biophysical characteristics of freshwater, estuarine and ocean habitats. Several active qualitative studies have documented habitats utilized by juvenile Coho salmon. For an ecosystem indicator, we propose to tag juvenile Coho salmon to determine proportional population habitat use, duration of use and survival rates. This information will be used to target and evaluate the effectiveness of estuarine restoration projects, will allow resource managers to develop the concept of habitat types for salmon, and allow evaluation of overall ecosystem health. This indicators will have applications throughout Washington, Oregon, and California as juvenile salmon use these habitats for juvenile rearing in all systems studied so far.

English Sole: These fish species tend to be the repository contaminants from anthropogenic inputs. There is a need to establish the linkage between these stressors and impacts to the frequency of English Sole tumors and lesions. English Sole have an extensive literature on relationship of liver tumors and external lesions relative to benthic contaminants. The benthos is a highly variable environment and the sampling will need to capture the time and place(s) of interest. This is critical in establishing baseline condition for managers whose responsibility is to assess ecological condition and mitigate impacts caused by anthropogenic impacts.

Juvenile Dungeness crab abundance: Trends in annual abundance in Humboldt Bay can be collected concurrent with fish assemblage work. This is an experimental indicator that we think may convey information on the condition of the crab resource, may be useful in evaluating the success of estuarine restoration projects, and is delivered to Humboldt Bay via the circulation of the California Current system. Locally, several restoration projects have observed high juvenile Dungeness crab populations in recently restored estuarine areas. We have data on relative juvenile Dungeness crab from juvenile fish habitat utilization studies conducted since 2001 in Humboldt Bay. We propose using juvenile Dungeness crab abundance measured as the number per juvenile rockfish trap as the initial indicator.

Pacific oyster growth: This is another experimental indicator that will link ocean conditions to an important bay resource. Monitoring Pacific oyster growth on long line systems would be an easy measurement to take and may also prove useful to shellfish growers.

Sea bird colony success: Methods for long-term sampling and measuring environmental variables are established. The indicator is quantified sea bird nesting on offshore rocks, adult and juvenile survival. This indicator integrates oceanographic food supply with the reproductive success of sea birds and also is an indicator for ocean conditions and trophic level interactions. This study can integrate with similar studies in other parts of the California Current system.

Habitat loss, fragmentation, and degradation: This indicator will measure overall restoration initiatives (number of acres restored, preserved, enhanced), fish passage (miles opened, stream blockage removed) and habitat impaired (erosion, invasive species, conversion). These indicators will show the essential outcomes of management actions, will indicate if management is sustaining ecosystem processes, and will provide opportunities for comparison and provide information for strategic estuarine restoration.
Table 3. Proposed Humboldt Bay Ecosystem Indicators.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Stressor</th>
<th>Effect</th>
<th>Management issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional eelgrass habitat</td>
<td>Dredging, land use in watershed, shoreline armoring, fishing pressure</td>
<td>Abundance and distribution of fish species dependent on eelgrass and fish biodiversity</td>
<td>Need for quantified information on functional eelgrass habitat size and distribution required by endemic species</td>
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<tr>
<td>Eelgrass distribution</td>
<td>Land use, dredging, climate change, nitrogen</td>
<td>Change in proportion of population survival</td>
<td>Habitat, survival and recovery for endangered species, TMDL for sediment, effectiveness of restoration projects or technologies</td>
</tr>
<tr>
<td>Juvenile salmonid abundance and habitat use</td>
<td>Storm water runoff, land use, climate change effects on low gradient rearing systems, water removals in summer month</td>
<td>Change in proportion of population using streams, estuarine and bay habitats</td>
<td></td>
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<tr>
<td>English sole tumors and liver lesions</td>
<td>Legacy pollution in benthic habitats</td>
<td>External tumors and liver lesions</td>
<td>Benthic sediment contamination</td>
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<tr>
<td>Juvenile Dungeness crab abundance</td>
<td>Climate change, fishing pressure</td>
<td>Reduced abundance indicates ocean conditions, adult population and reproductive success</td>
<td>Forage species for many fish that use Humboldt Bay, source of recruits for commercial fishery</td>
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<tr>
<td>Oyster growth</td>
<td>Climate change, change in upwelling pattern and chlorophyll a</td>
<td>Reduced or enhanced oyster growth. Changes in oyster condition in Humboldt Bay</td>
<td>Will shellfish culture need to move up along the tidal gradient? What impact will increase seawater temperatures have on oyster growth and reproduction in Humboldt Bay?</td>
</tr>
<tr>
<td>Sea bird colony success</td>
<td>Climate change, changes in upwelling patterns, forage species availability</td>
<td>Change in trends of colony success, reproductive success, survival, relative abundance of sea birds</td>
<td>What happens in this key part of the California Current system between Trinidad Head and Cape Mendocino?</td>
</tr>
<tr>
<td>Habitat loss, fragmentation and degradation</td>
<td>Habitat conversion-</td>
<td>Abundance and distribution of tidewater gobies, extent per habitat over time, distribution per habitat type, inventory of human use, increase surface water run off, increased sediment input, reduced habitat connectivity, extent of wetlands</td>
<td>What are tradeoffs of land use conversions? What are opportunities for habitat connectivity across landscapes? Where are habitat bottlenecks?</td>
</tr>
<tr>
<td>Habitat fragmentation or change</td>
<td>Climate change – sea level rise</td>
<td>Over wintering shore bird population abundance, changes in vegetation</td>
<td>How can we develop an adaptation strategy to sea level rise?</td>
</tr>
</tbody>
</table>
Socioeconomic Analysis and Model

Proposal Overview: Ecosystem-based management seeks to promote healthy, productive and resilient natural and human communities will require the ability to integrate and reconcile the requirements of both the community and the ecosystem. Lack of integrated knowledge about socio-economic processes and their place in EBM makes it difficult for managers and decision makers to consider the full range of cultural and socioeconomic impacts when evaluating proposed projects, planning, and developing land-use or resource management policies.

The socioeconomic proposal would provide the Humboldt Bay Ecosystem Project with a matrix and process model to facilitate analysis of socioeconomic issues including benefits/costs, impacts and tradeoffs for agricultural and restoration land-use and management options focused (initially) on the Humboldt Bay tidelands and diked former tidelands (the Humboldt Bay Ecosystem primary ecological zone). The socioeconomic model would complement or be integrated into the conceptual model for key ecosystem and biophysical processes and may include indicators used in the Ecological Indicators Concept Proposal.

Uses: While many groups could make use of the matrix/model, the proposal would initially be geared for government agency decision makers.
Potential applications:
- Elucidating the relationship between economic/cultural values and land-use options
- A methodology for analyzing benefits/costs, impacts and tradeoffs associated with restoration projects around the bay
- Inform development or modification of programs (e.g. outreach, education), policies (e.g. land-use, resource management) and instruments (e.g. incentives) to support Humboldt Bay EBM.
Benefits:
- Information for decisions about allocation of public resources
- Informing public agencies developing land use and resource management policies

Partners & participants: Intended users of the decision tools, strategies and resources developed
- Land use and resource managers
- Local agencies
- Landowners
- EBM entity
- Resource users
- Community members
- Interested industry and non-profit entities

Activities and Outputs
- Outreach & inclusion of additional stakeholders into EBM Socioeconomic Team
- Identify, review & analyze potential socioeconomic implications of implementing EBM
- Identify and evaluate existing datasets for incorporation in a GIS based socioeconomic characterization (and/or EBM conceptual model)
- Define cultural and socioeconomic goals, objectives and indicators
- Develop resource use objectives that achieve socioeconomic goals and recognize ecosystem limits
- Evaluate socioeconomic implications of different EBM scenarios
- Develop and test a matrix-model for analyzing tradeoffs to assist decision makers and managers in evaluating when and where and how restoration of wetland and tidal functions to agricultural land should occur and the potential ecological and socioeconomic consequences. What alternate courses of action could improve human well-being while enhancing ecosystem function?
- Develop strategies and alternate economic activities for reducing the competition between economic development and the environment
- Develop policies and incentives to facilitate economic transitions to achieve EBM objectives
- Promote diversification & innovation in “ecosystem friendly” community & economic development

Short-term outcomes
- Resource & land use managers have capacity and resources to practice ecosystem-based management that maximizes socioeconomic, cultural & ecosystem values and beneficial uses
- Landowners and other community members have access to information and resources to analyze tradeoffs and to use “ecosystem friendly” practices in their economic, subsistence, recreational, and residential activities.
- Economic & Community development officials have the capacity and resources to promote economic development & community development that meets ecological, cultural and socioeconomic objectives.
Long-term outcomes

- Enhanced ecosystem functions, integrity and ecosystem services provision
- Improved creation and retention of ecosystem friendly jobs
- Enhanced economic vitality of communities
- Reduced rural poverty
- Reduced competition between economic development, community development and ecosystem integrity
- Equitable distribution of benefits & burdens (impacts)
- Enhanced cultural, community, household wellbeing and quality of life

Implementation of the Humboldt Bay Ecosystem-based Management Program

The goal of the HBEP is to further the implementation of ecosystem-based management in the Humboldt Bay ecosystem. Possible mechanisms to accomplish this goal include establishing a Humboldt Bay Institute, a Memorandum of Understanding between local organizations, a joint powers agreement, or a non-profit organization. This project would conduct an organizational analysis exploring possible features and recommend the optimal mechanism to pursue.

Opportunity addressed by project

The individuals and entities demonstrating their ongoing commitment to Ecosystem Based Management all believe this collaborative effort can take concrete steps towards our vision of a vibrant, thriving, and resilient Humboldt Bay ecosystem that supports the well-being of our human and natural communities. The Humboldt Bay Ecosystem Project is an example of a successful collaborative effort based on the commitment of time and resources from diverse parties that has resulted in shared understanding, trust and productive working relationships. There is an opportunity to harness the momentum generated by this project and to further leverage the resources and capacity to implement an ecosystem based management program in the Humboldt Bay area.

The Humboldt Bay Ecosystem Project (HBEP) has built on the work of the Humboldt Bay Watershed Advisory Committee and the Humboldt Bay Harbor, Recreation & Conservation District (Bay District) in an ongoing effort to implement EBM in the Humboldt Bay area. The HBEP Advisory Team has drafted proposals based on identified priorities in order to take the next steps towards implementing EBM, including this implementation project.

This proposal was submitted as a one-page concept to the North Coast Water Quality Control Board in September 2008 (Appendix F).

Project Purpose

The Humboldt Bay Ecosystem Program Implementation Proposal proposes to expand the existing collaborative effort to implement EBM and to create an integrated framework that provides a broad, adaptive and inclusive means for implementing ecosystem-based management (EBM). Development of the Framework for the HBEP will involve the ongoing collaboration of local agencies, resource managers and local constituencies to determine the goals, structure,
processes, and planning necessary to guide implementation of ecosystem-based management in the Humboldt Bay area.

Methods & Approach
Implementing EBM in the Humboldt Bay area requires ongoing integration of several distinct but interrelated elements including:

- Knowledge of our ecosystem and human communities
- Planning and collaboration
- Decision making structures
- Capacity, resources and commitment to support efforts

This EBM implementation project will build upon the successes of existing collaborative effort by maintaining the core team and advisory team structure. The core team will continue to hold the big picture and provide ongoing coordination. The advisory team and working groups will take on the specific tasks necessary to achieve the project objectives for implementing EBM.

Objectives

- Agency, private and community sector stakeholders are actively involved in assessment, goal setting, planning and project activities
- Adoption of goals that define desired environmental and socioeconomic outcomes, and set measurable objectives, targets and outcome indicators based on assessment of environmental, social & institutional issues & their implications.
- Development of community, agency and institutional capacity for EBM implementation
- Defined structure, process and action plan for EBM implementation
- Priority Humboldt Bay District Management Plan Policies implemented

Implementation Projects & Activities

- Design structure and process for outcome-based EBM
- Secure commitment & participation of resource & land management agencies
- Conduct outreach to secure commitment and involvement of diverse stakeholders
- Explore idea of creating a Humboldt Bay Institute
- Founding mechanisms: agreements, documentation of structure, membership
- Dispute resolution mechanisms to address competing and conflicting uses and needs
- Develop horizontal & vertical coordination mechanisms
- Develop and adopt goals that define desired outcomes, objectives, targets & indicators
- Provide support & assistance to Humboldt Bay District in implementing Humboldt Bay Management Plan
- Policy Analysis & Design
- Document current regulatory requirements for estuarine restoration projects
- Develop economic, legal, voluntary and regulatory instruments
- Harmonize existing laws, information, plans, policies, etc…
- Develop scenarios for alternative regulatory pathways
- Develop a “regulatory compliance roadmap” for projects
- Enhance community & agency capacity for implementation
- Secure agency, stakeholder and community commitment and long term funding
- Adopt, fund, and adaptively co-manage the Humboldt Bay Institute
Desired Outcomes of Project

*Short Term Outcomes:*
- Participants develop a shared understanding and agree on purpose, founding mechanisms and initial institutional arrangements & policy design.
- Priority Humboldt Bay Management Plan Policies are implemented
- A framework for implementation is developed for Humboldt Bay Ecosystem-Based Management.
- Stakeholders form a core of well-informed and committed resource managers, local agencies and constituencies that actively support the program.
- Opportunities for economic and community development are identified and developed to improve well-being for residents, the community and the coastal ecosystem.
- Enhanced agency and community capacity supports EBM locally.
- Humboldt Bay Institute is recognized as a “go to” place for implementing EBM.

*Medium Term Outcomes:*
- There is ongoing stakeholder collaboration in all stages of design and implementation.
- There is integration of top-down and bottom-up efforts; learning and adaptation occurs by adjusting targets, policies and institutional arrangements.
- There are changes in the behavior of institutions, groups, businesses, individuals, and investments.
- Community and agency capacity develops through collaboration, education and outreach.
- Mutual trust continues developing among resource managers, local agencies and constituencies, and there is increased capacity to resolve or manage natural resource conflicts.
- Transition to more sustainable economy is increasing innovation, economic diversification, and widely shared benefits.

*Long Term Outcomes:*
- The Humboldt Bay ecosystem’s natural and human communities are increasingly healthy, productive and resilient.
Related Projects

Historical and Cultural Resource Characterization 2008

This project was funded by the NOAA Coastal Services Center and was completed by Planwest Partners and the Center for Indian Community Development. The project completed a Historical and Cultural Resources Characterization and Human Dimensions Regional Roundtable for Humboldt Bay. The purpose was to gain a better understanding of the social, economic, and cultural factors that influence community support for coastal conservation. Information gained during the Human Dimensions Roundtable was integrated into the Characterization Report. The historical and cultural information are intended to assist in understanding historical activities and events and cultural resources that have influenced the present condition of Humboldt Bay and to assist agencies and decision makers when they evaluate projects and programs. The full report is available on the EB website at http://groups.ucanr.org/HumboldtBayEBM/Documents247/ or by contacting Susan Schlosser, 707-443-8369 or scschlosser@ucdavis.edu.

Humboldt Bay and Eel River Estuary Intertidal and Subtidal Habitat Goals Project Report

The Habitat Goals Draft Report presents the finding of the Humboldt Bay and Eel River Estuary Intertidal and Subtidal Habitat Goals Project Advisory Team. The project focused on intertidal and subtidal habitats, but there are many other areas in the ecosystem that are biologically important and which could benefit from effort to develop habitat goals. This project’s emphasis on intertidal and subtidal habitats does not mean these other areas are not in need of improvement and better protection.

The geographic scope of the Habitat Goals Project includes Humboldt Bay and waters to the head of the tide and the Eel River Estuary to Fernbridge. The project began in December 2007 with funding from the California Coastal Conservancy to the Eureka Sea Grant Office and will be completed in March 2009.

The Humboldt Bay and Eel River Estuary Intertidal and Subtidal Habitat Goals Project involved several steps and includes six primary objectives:

1. Complete digitized habitat mapping of the study area in collaboration with the NOAA Coastal Services Center
2. Develop a library of documents, reports, papers and maps with information on habitats in Humboldt Bay and the Eel River Estuary
3. Prepare a report describing the habitats
4. Complete a Conservation Action Plan (CAP) for the study area
5. Identify indicators that could be used for strategic monitoring of the study area
6. Prepare management and research recommendations

1.) Digitized aerial mapping was not possible during 2007 and 2008. Cloudy and foggy weather prevented deployment of the aircraft and no images were taken. We will continue our efforts to obtain this imagery in 2009, in collaboration with the NOAA Coastal Services Center. In
September 2008, we “discovered” a set of images taken by Dr. A. Roberts, Simon Frazer University, Vancouver, Canada, in collaboration with Dr. S. Steinberg, Humboldt State University, Arcata, California. These images were taken in 2005 at the high resolution (0.25 m) required by the Humboldt Bay and Eel River Estuary Intertidal and Subtidal Habitat Goals Project (hereafter Habitat Goals). These images will be ortho-rectified by Dr. Roberts and the NOAA Coastal Services Center will complete the habitat mapping.

If we are fortunate to obtain new images in 2009, we will be able to use the 2005 images in a change analysis. If no images are obtained in 2009, the 2005 images are a significant addition to a sparse set of maps available for Humboldt Bay and will be the first digitized image for the Eel River Estuary.

We will use the 2005 and/or 2009 maps to quantify and illustrate Habitat Goals. It has proven very difficult to quantify habitats from previous studies as no comprehensive map of Humboldt Bay has been completed since 2000. There are many problems and errors with older maps. There are no benthic habitat maps for the Eel River Estuary.

2.) Between January and October 2008, we compiled a digital library with over 700 entries for Humboldt Bay habitats and over 100 for Eel River Estuary habitats. We concurrently reviewed and synthesized this information into the Draft Humboldt Bay and Eel River Estuary Intertidal and Subtidal Habitat Goals Project Report. This will be an on-going project as we plan to add to the library as new materials become available. The library is available upon request and is in EndNote software.

3.) The report on Humboldt Bay and Eel River Estuary habitats will be completed when funding is reinstated.

4.) The Advisory Team for the Habitat Goals project met monthly between Dec. 2007 and May 2008, and twice a month between June 2007 and November 2008. Meetings were used primarily to complete the Conservation Action Planning Process. The Team has completed the following CAP steps:
   Identify Conservation Targets
   Develop Key Ecological Attributes and Indicators for the Attributes
   Identify stresses and sources of stress to the Key Ecological Attributes
   Rank the sources of stress

5.) Indicators with ranges for poor, fair, good and excellent will be developed from the CAP process results and information from the Habitat Goals Report.

6.) Management and research recommendations will be developed from the CAP ecological attributes and the ranked sources of stress. These recommendations will be included in the final Habitat Goals Report. The next logical steps following release of the final Report will be a combination of management, monitoring, and research. We hope the final Habitat Goals report will establish a reasonable, scientific basis for an ecosystem approach to natural resource management.
Plans for the Future

We have followed a logical and incremental approach, explored ecosystem-based management concepts, and developed working definitions and concept proposals. In the next year, we expect the Humboldt Bay Ecosystem Program to become more multi-faceted, include more participants, and implement some major efforts such as:

- Conduct the Strategic Planning Workshop in January 2009
- Develop the concept proposals in this report and submit them to various potential funders
- Integrate into local Humboldt Bay management
  - Participate in Humboldt Bay Harbor, Recreation and Conservation District Advisory Committee
- Integrate into local economic development community to strengthen our understanding of ecological and social system interactions and to educate ourselves about information and activities of these programs.
  - Humboldt County Prosperity Network
  - Humboldt County General Plan activities
  - Humboldt Area Foundation Programs
- Promote effective community involvement and education
  - Overlap membership with science/management team (Advisory Team)
  - Develop goals & targets that stakeholders care about
  - Develop review process for concept proposals by stakeholders
  - Build community support
  - Integrate EBM program into many local art programs
  - Promote participation by stakeholders and community and maintain momentum
- Integration in California Current Ecosystem-based Management Programs (CCEBM)
  - Develop method(s) to scale up to the CCEBM
  - Develop indicators that each of the six west coast EBM programs can use
  - Develop educational materials about indicators and model to make the CCEBM relevant to people
  - Attend meetings of larger scale EBM projects to get to know the participants:
    - California Current EBM Program – (COMPASS)
    - NOAA Integrated Ecosystem Assessment
    - Central and Northern Ocean Observing Systems (CENCOOS)
    - EBM workshops organized by the West Coast Governors Agreement process
    - EBM workshops organized by the Ocean Protection Council
- West Coast EBM Implementers Network
  - Develop and Fund Outreach Coordinator Position with the primary function to engage and maintain stakeholder relationships.
<table>
<thead>
<tr>
<th>NAME</th>
<th>ORGANIZATION</th>
<th>E-MAIL</th>
</tr>
</thead>
<tbody>
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Appendix B: EBM Bibliography and Literature Cited


Appendix C: Priority issues cross-linked with the Humboldt Bay Management Plan and the Humboldt Bay Watershed Salmon and Steelhead Conservation Plan
Humboldt Bay Ecosystem-Based Management Program
Issues/Needs/Gaps/Uncertainties

The Humboldt Bay Ecosystem Program Advisory Team identified priority issues in July 2007. These issues were cross-linked with Humboldt Bay Management Plan and Humboldt Bay Watershed Salmon and Steelhead Conservation Plan policies and recommendations. The issues that occurred in both plans and that have local capacity to conduct were our first cut of concepts to consider for development into ecosystem-based management projects.

Abbreviations used in the Tables are:

**Humboldt Bay Management Plan (HBMP) (H = harbor, C=conservation, R=recreation)**
- CAE – Maintaining and Enhancing Aquatic Ecosystems
- CAS-Aquatic Species Management
- CEP-Humboldt Bay Ecosystem Management Program Elements
- CPE-Public Involvement and Outreach
- HFA– Fishing and Aquaculture
- HWM- Waterway Maintenance
- HRS – Regulatory Streamlining
- HSM – Shoreline Management
- HTM – Toxic Material Management
- RA- Recreation Administration
- RFA- Recreational Facilities and Access Improvements
- RIO- Recreation Interpretation and Outreach
- ROP- Recreation Opportunity Planning
- RSA-Recreation Specific Activities

**Humboldt Bay Watershed Salmon and Steelhead Conservation Plan (HBWAC)**
- A. Habitat Structure
- B. Water quality
- C. Water quantity
- D. Cumulative watershed effects
- E. Salmonid population studies
- F. Coordinated monitoring
- G. Plan effectiveness and coordination

**Linking Land and Sea: A Northern California Coastal Conservation Needs Assessment (LLS)**
Nineteen recommendations numbered 1 – 19.
Table 1: The first is a list of the “issues” identified by the Advisory Team at our July 13 meeting. There are two columns, one is the issue and the second column indicates the Plan and recommendation or policy number that identifies this issue. If the issue is followed by a number (n=X), this issue was identified by more than one person.

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<th>Advisory Team Issue</th>
<th>Plan</th>
<th>Policy or Recommendation</th>
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<tr>
<td>Environmental predictability and climate change (n=2)</td>
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<tr>
<td>Regional sea level rise, infrastructure and property risks (n=2)</td>
<td>HBMP</td>
<td>HSM 3 &amp; 7</td>
</tr>
<tr>
<td></td>
<td>HBWAC</td>
<td>A II. 4</td>
</tr>
<tr>
<td>Need for a bay circulation model to understand transport processes – include salinity, temperature and sediment in relation to bay circulation (n=3)</td>
<td>HBMP</td>
<td>HWM-6</td>
</tr>
<tr>
<td></td>
<td>HBWAC</td>
<td>A.III.A.1&amp;9</td>
</tr>
<tr>
<td>Expand on bathymetry of bay and historical tidelands (n=2)</td>
<td></td>
<td>A.I.A.1 &amp; A.II.A.2</td>
</tr>
<tr>
<td>Water quality, pollution issues, hotspots in Bay and sediments – identify sources, pathways (n=4)</td>
<td>HBMP</td>
<td>HTM1</td>
</tr>
<tr>
<td></td>
<td>LLS</td>
<td>8</td>
</tr>
<tr>
<td>Water quality – temperature, salinity, sediment, nutrients, coliform, toxins, concentrations, driving force</td>
<td>HBMP</td>
<td>CEP 5</td>
</tr>
<tr>
<td></td>
<td>HBWAC</td>
<td>B.I.A.1, B.II.B, B.III.A</td>
</tr>
<tr>
<td>Air quality effects</td>
<td>CEP-13</td>
<td></td>
</tr>
<tr>
<td>Positive cumulative effects of wetland restoration,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Define desired outcome and future conditions of bay</td>
<td>All HBMP policies</td>
<td></td>
</tr>
<tr>
<td>Identify quantitative and qualitative habitat goals for the bay (big picture of habitat restoration goals), representative habitats for protection</td>
<td>HBMP</td>
<td>CAS 1</td>
</tr>
<tr>
<td></td>
<td>HBWAC</td>
<td>A.I.A.5</td>
</tr>
<tr>
<td></td>
<td>LLS</td>
<td>6,7</td>
</tr>
<tr>
<td>Develop conceptual model to visually show program intent (box model with arrows) and relationships</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storm water treatment at wastewater plants, data gap related to elements that aren’t treatable and flow through facilities into the bay and their adverse effects</td>
<td>HBMP</td>
<td>CEP 5</td>
</tr>
<tr>
<td>Wave/ocean energy generation and ocean aquaculture effects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assess restoration of tidelands; use information to establish cost effectiveness of projects</td>
<td>HBMP</td>
<td>CAE 4</td>
</tr>
<tr>
<td>Invasive species, pathway and the influence on native species</td>
<td>HBMP</td>
<td>CAS 4</td>
</tr>
<tr>
<td>Trophic level interactions</td>
<td>HBMP</td>
<td>CAE 3&amp;4,CAS 2&amp;3</td>
</tr>
<tr>
<td>Habitat function for key species</td>
<td>HBMP</td>
<td>CAE 2&amp;3</td>
</tr>
<tr>
<td></td>
<td>HBWAC</td>
<td>A.I.A.2</td>
</tr>
<tr>
<td>Ecological and environmental factors affecting fish populations</td>
<td>HBMP</td>
<td>HFA 7 &amp; 8</td>
</tr>
<tr>
<td></td>
<td>HBWAC</td>
<td>A. I,III,IV &amp; V, B., B. III,C</td>
</tr>
</tbody>
</table>
| Designation of critical habitat for tidewater goby | HBMP  
| Loss of timber and agriculture land to development with secondary results | HBMP  
| Better linkage, holistic management of watershed and tributary sediment entering Humboldt Bay, effects of watershed sediments on primary and secondary Bay production (n=2) | HBMP  
| Urban runoff, storm water pollution, ways to deal with it – Storm Water Coalition | HBMP  
| Humboldt County General Plan update and how land use/development will influence the bay and watershed (Tom Hoffweber, J. Miller) | HBMP  
| Economical and ecological justification for former tideland restoration to benefit fisheries, recreation and general health of the bay | HBMP  
| Definition of funding needs. | HBWAC  
| Coordination with ongoing parallel projects, long range planning efforts and future projects, funding directions and economic development | HBWAC  
| Ecological economics - flow of goods and services, implications of management decisions, not just monetary | HBWAC  
| Mapping of Advisory Team efforts to regulatory processes | HBMP  
| Restoring former tidelands - inventory and prioritize sites | HBMP  
| Identify generic restoration actions, identify regulatory jurisdictions on those actions, generic impact analysis, develop mitigations measures for actions – programmatic EIR for restoration process (n=2) | HBMP  
| Development incentives for ecosystem approach and good stewardship for private landowners | HBWAC  
| Encourage public participation to enforce desired actions and outcomes of program | HBMP  
| Loss of tidelands and tidal habitat along the edge of the bay due to development | HBMP  
| Address alternative energy projects – ocean energy | HBWAC  
| Need funding source to police improper use of wildlife areas (illegal camps, garbage) | HBWAC  
| Social and environmental justice issues around the bay | HBWAC |
EBM framework needs to be well articulated and understood by community [not just the community, but by politicos, decision-makers, funders, those with an interest in supporting implementation] | HBMP | CPE 3
---|---|---
Address regulatory conflicts and consistency, crossing jurisdictional boundaries, inconsistent land use policies | HBMP | HRS 1
Address regulatory policies that result in negative impacts to ecosystem, e.g. conversion of productive resource areas to development, Williamson Act

Effects of different recreation activities on the ecosystem | HBMP | ROP 2
Develop central database of all projects | HBMP | CPE 2
LLS | 12,15
Establish authority to recommend or make regulatory changes, proposal for reviewing regulatory overlap and jurisdictions and effects on the bay, regulations govern land use | HBMP | HRS 1
Need for EBM project outreach (S. Schlosser stated that two public meeting are in the proposal) | LLS | 13
Encourage stewardship by providing access to land around the bay; promote appreciation of outdoors; ease impact to sensitive areas by providing access to additional areas; new development should include component for recreational use | HBMP | RA 2, ROP 2 & 3, RFA 1, RIO 1 & 2
Coordinate efforts to involve all groups in relation to Humboldt Bay EBM; organization (not agency) to protect common interests/values of community | LLS | 12,15
Articulate discussions to interest public, motivate involvement - use of art as medium to communicate – different base to protect resource, youth oriented
Coordination of all entities involved – one-stop shopping to reach target audience regarding efforts and projects in Humboldt Bay EBM area
Outreach to land use regulators - cities, county planners, regarding effects of decisions on ecosystem
Ag Extension agents, NRCS, RCD to reach different audiences | LLS | 15
Forestry representative, wider representation
Promote kayak access – water trails | HBMP | RA 2, RSA 9
Invite speakers for specific topics – County representative to discuss General Plan overview; support for policies that protect and benefit Humboldt Bay | HBMP | CAS 4
Develop public transportation to alleviate fossil fuels | HBMP | CEP 13
Outreach to nurseries selling invasive plants
Table 2. Humboldt Bay Ecosystem Program Advisory Team issues lumped together by category.

<table>
<thead>
<tr>
<th>Category</th>
<th>Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Air Quality</strong></td>
<td>1. Air quality effects</td>
</tr>
<tr>
<td>Bay &amp; Nearshore Processes</td>
<td>1. Environmental predictability and climate change (n=2),</td>
</tr>
<tr>
<td></td>
<td>2. Regional sea level rise, infrastructure and property risks (n=2)</td>
</tr>
<tr>
<td></td>
<td>3. Need for a bay circulation model to understand transport processes – include salinity, temperature and sediment in relation to bay circulation (n=3)</td>
</tr>
<tr>
<td></td>
<td>4. Expand on bathymetry of bay and historical tidelands (n=2)</td>
</tr>
<tr>
<td><strong>Biological Resources</strong></td>
<td>1. Positive cumulative effects of wetland restoration,</td>
</tr>
<tr>
<td></td>
<td>2. Identify quantitative and qualitative habitat goals for the bay (big picture of habitat restoration goals), representative habitats for protection</td>
</tr>
<tr>
<td></td>
<td>3. Assess restoration of tidelands; use information to establish cost effectiveness of projects</td>
</tr>
<tr>
<td></td>
<td>4. Habitat function for key species</td>
</tr>
<tr>
<td></td>
<td>5. Ecological and environmental factors affecting fish populations</td>
</tr>
<tr>
<td></td>
<td>6. Designation of critical habitat for tidewater goby</td>
</tr>
<tr>
<td></td>
<td>7. Economical and ecological justification for former tideland restoration to benefit fisheries, recreation and general health of the bay</td>
</tr>
<tr>
<td></td>
<td>8. Restoring former tidelands - inventory and prioritize sites</td>
</tr>
<tr>
<td></td>
<td>9. Loss of tidelands and tidal habitat along the edge of the bay due to development</td>
</tr>
<tr>
<td></td>
<td>10. Better linkage, holistic management of watershed and tributary sediment entering Humboldt Bay, effects of watershed sediments on primary and secondary Bay production (n=2)</td>
</tr>
<tr>
<td></td>
<td>11. Invasive species, pathway and the influence on native species</td>
</tr>
<tr>
<td><strong>Conceptual Model</strong></td>
<td>1. Define desired outcome and future conditions of bay</td>
</tr>
<tr>
<td></td>
<td>2. Develop conceptual model to visually show program intent (box model with arrows) and relationships</td>
</tr>
<tr>
<td></td>
<td>3. Trophic level interactions</td>
</tr>
<tr>
<td></td>
<td>4. EBM framework needs to be well articulated and understood by community [not just the community, but by politicos, decision-makers, funders, those with an interest in supporting implementation]</td>
</tr>
<tr>
<td><strong>Governance</strong></td>
<td>1. Humboldt County General Plan update and how land use/development will influence the bay and watershed (Tom Hoffweber, J. Miller)</td>
</tr>
<tr>
<td></td>
<td>2. Identify generic restoration actions, identify regulatory jurisdictions on those actions, generic impact analysis, develop mitigations measures for actions – programmatic EIR for restoration process (n=2)</td>
</tr>
<tr>
<td></td>
<td>3. MLPA process in northern California</td>
</tr>
</tbody>
</table>
| Socioeconomics | 1. Loss of timber and agriculture land to development with secondary results  
2. Economical and ecological justification for former tideland restoration to benefit fisheries, recreation and general health of the bay  
3. Ecological economics - flow of goods and services, implications of management decisions, not just monetary  
4. Mapping of Advisory Team efforts to regulatory processes  
5. Definition of funding needs  
6. Encourage public participation to enforce desired actions and outcomes of program  
7. Need funding source to police improper use of wildlife areas (illegal camps, garbage)  
8. Social and environmental justice issues around the bay |
| --- | --- |
| Outreach | 1. Coordination with ongoing parallel projects, long range planning efforts and future projects, funding directions and economic development  
2. EBM framework needs to be well articulated and understood by community [not just the community, but by politicos, decision-makers, funders, those with an interest in supporting implementation]  
3. Encourage stewardship by providing access to land around the bay; promote appreciation of outdoors; ease impact to sensitive areas by providing access to additional areas; new development should include component for recreational use  
4. Coordinate efforts to involve all groups in relation to Humboldt Bay EBM; organization (not agency) to protect common interests/values of community  
5. Articulate discussions to interest public, motivate involvement - use of art as medium to communicate – different base to protect resource, youth oriented  
6. Outreach to land use regulators - cities, county planners, regarding effects of decisions on ecosystem  
7. Ag Extension agents, NRCS, RCD to reach different audiences  
8. Forestry representative, wider representation  
9. Outreach to nurseries selling invasive plants |
| Ocean Energy | 1. Wave/ocean energy generation and ocean aquaculture effects  
2. Address alternative energy projects – ocean energy |
| --- | --- |
| Land use and transportation planning | 4. Land use and transportation planning effects on the bay  
5. Development incentives for ecosystem approach and good stewardship for private landowners  
6. Address regulatory conflicts and consistency, crossing jurisdictional boundaries, inconsistent land use policies  
7. Address regulatory policies that result in negative impacts to ecosystem, ie conversion of productive resource areas to development, Williamson Act  
8. Establish authority to recommend or make regulatory changes, proposal for reviewing regulatory overlap and jurisdictions and effects on the bay, regulations govern land use |
| Development incentives for ecosystem and good stewardship | 1. Development incentives for ecosystem approach and good stewardship for private landowners  
2. Address regulatory conflicts and consistency, crossing jurisdictional boundaries, inconsistent land use policies  
3. Address regulatory policies that result in negative impacts to ecosystem, ie conversion of productive resource areas to development, Williamson Act  
4. Establish authority to recommend or make regulatory changes, proposal for reviewing regulatory overlap and jurisdictions and effects on the bay, regulations govern land use |
<p>| Environmental Justice | 7. Social and environmental justice issues around the bay |</p>
<table>
<thead>
<tr>
<th>Water Quality</th>
<th>9. Effects of different recreation activities on the ecosystem</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10. Promote kayak access – water trails</td>
</tr>
<tr>
<td>Water Quality</td>
<td>1. Water quality, pollution issues, hotspots in Bay and sediments – identify sources, pathways (n=4)</td>
</tr>
<tr>
<td></td>
<td>2. Water quality – temperature, salinity, sediment, nutrients, coliform, toxins, concentrations, driving force</td>
</tr>
<tr>
<td></td>
<td>3. Storm water treatment at wastewater plants, data gap related to elements that aren’t treatable and flow through facilities into the bay and their adverse effects</td>
</tr>
<tr>
<td></td>
<td>4. Urban runoff, storm water pollution, ways to deal with it – Storm Water Coalition</td>
</tr>
</tbody>
</table>
Appendix D: Humboldt Bay Ecosystem Program Outreach Flyers
Humboldt Bay Ecosystem Program
http://groups.ucanr.org/HumboldtBayEBM/

What: The Humboldt Bay Ecosystem Program is an innovative and exciting new program coordinated by the Eureka Sea Grant Office. The program is building an ecosystem-based management framework, preparing proposals on high priority ecosystem issues, and developing recommendations for establishment and maintenance of a Humboldt Bay Ecosystem database. Ecosystem-based management is a comprehensive process of integrated resource management that considers the entire ecosystem, including humans. It integrates the best available scientific, traditional and local knowledge, is geographically specific, defines management based on ecological boundaries, addresses complexities of natural processes and social systems, considers multiple simultaneous factors influencing management, and is collaborative, integrating social and environmental goals.

The purpose of this project is to develop practical implementation of an ecosystem approach. The program will identify issues using the Humboldt Bay Management Plan, the Humboldt Bay Watershed Salmon and Steelhead Conservation Plan, and Linking Land and Sea: A Conservation Needs Assessment as a foundation. These three plans involved stakeholders and the public in participatory processes resulting in policies, recommendations and issue identification.

Why: After decades of research, improved scientific understanding of ecosystems and increased public involvement in natural resource issues, ecosystem-based management offers a new paradigm for protecting and enhancing our natural resources. Citizens of the Humboldt Bay Ecosystem are experienced with interactive programs requiring stakeholder participation in decision-making. We have a definable ecosystem, a strong sense of place, and treasure our quality of life.

COUNTY: Recent completion of the Humboldt Bay Management Plan and a recently completed needs assessment “Linking Land and Sea” identify a collaborative ecosystem-based management program as the most likely approach to successfully address complex ecosystem issues.

STATE: In California there has been a leap in policy supporting ecosystem-based management through planning and support by the California Ocean Protection Council. Practical implementation of ecosystem-based management is among the Ocean Protection Council’s priorities.

FEDERAL: The Pew Ocean Commission and the US Commission on Ocean Policy recommended collaboration and an ecosystem approach to coastal and ocean issues. Agencies are evolving an ecosystem approach to science and management to meet public demands for improved management of coastal and ocean environments.

Action: The Advisory Team has 31 members and has developed an ecosystem-based management working definition, geospatial boundary, proposal criteria and format. Subcommittees are now working on proposals for biological resources, water quality and physical processes, cultural, social and economic issues, and implementation. The Technical Capacity Team will recommend how we can establish and maintain a Humboldt Bay Ecosystem database. Both teams will have the support of the Sea Grant staff and a Core Team. Documents, maps, document summaries, and invited experts that are requested will be provided for the Advisory and Technical Capacity Teams.

All meetings are public.
Humboldt Bay Ecosystem Program
Participatory Processes
The Humboldt Bay Ecosystem Program website: http://groups.ucanr.org/HumboldtBayEBM/

Meeting dates, meeting notes, related documents, and a public input survey are available on the website. You can also email comments to Debbie Marshall: dmmarshall@ucdavis.edu or to Susan Schlosser scschlosser@ucdavis.edu

The Humboldt Bay Ecosystem Program is coordinated by the Eureka Sea Grant Office. The program will build an ecosystem-based management framework, prepare two to six proposals on high priority issues, and develop recommendations for establishment and maintenance of a Humboldt Bay Ecosystem database.

The purpose of the Humboldt Bay Ecosystem Program is to implement recommendations from:
- The Humboldt Bay Watershed Salmon and Steelhead Conservation Plan
- The Humboldt Bay Management Plan
- Linking Land and Sea: A Coastal Needs Assessment

Each of these plans included community input that involved stakeholders and the public in numerous workshops, meetings, surveys, and interviews. The plans identify issues, recommendations, and policies. The Humboldt Bay Ecosystem Program Advisory Team consists of scientists and managers with a broad range of knowledge and skills. The Advisory Team will identify priority ecosystem issues and develop proposals for research, education, or outreach that inform or implement ecosystem-based management for the Humboldt Bay Ecosystem using these plans as a foundation.

Public participation is strongly encouraged. There are several ways the public can participate in the Humboldt Bay Ecosystem Program:
- Attend monthly Advisory Team meetings – Schedule, time and location are on the website.
  - Give comments verbally, in writing or via the web survey
  - Feedback from the Advisory Team will be given at meetings and/or the website.
- Submit comments, questions, or suggestions via the project website
  - Feedback from the Advisory Team will be given at meetings and/or the website.
- Attend public meetings in 2008
  - Update on project accomplishments including draft proposals
  - Provide and receive information for use by the Advisory Team
- Presentations to local groups
  - Contact Susan Schlosser if your group or organization would like a presentation on the Humboldt Bay Ecosystem Program.
- Join a subcommittee and collaborate on Humboldt Bay Ecosystem Program proposal(s)
- As invited expert speakers

Advisory Team meetings are open to the public and are held on the second Friday of each month. Meetings are held from 9 am to noon.
Appendix E: Database Survey
Humboldt Bay Ecosystem Program

Ecosystem database needs survey

1. How useful would an EBM database be to you and your organization?
   - I would rarely, if ever use this database.
   - I would use this database from time to time.
   - This database is a great idea and I would be interested in using it when possible.
   - My organization would take steps to incorporate its use in new and current projects.
   - The EBM database system would be a critical component of our operational efforts.

2. In your view, which of the following audiences may benefit from/use this portal?
   Select all that apply.
   - State agencies in deal with coastal issues (DNR, DEQ, F&W)
   - Floodplain managers
   - State and local emergency managers
   - County planners
   - University and academic institutions
   - NGOs (TNC, Ocean Conservancy, etc)
   - Coastal land trusts
   - Insurance industry

3. Please prioritize your preferred types of data access, 1 = most useful, 2 = second most useful, etc.
   - Data set listing (aggregation of)
   - Web mapping/atlas
   - Data delivery services (data download, Arc Server)
   - Computer modeling services
   - Performance management (dynamic graphs, charts and reports)

4. What roles are important to you in a database or portal?
   - Cataloging
   - Mapping
   - Delivery

5. What organization should be responsible for housing such a proposed portal/database?

6. What organization do you feel is best suited for the task?
7. What data types would potentially be of greatest use to your organization? (Select all that apply)

<p>| |</p>
<table>
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<tbody>
<tr>
<td>Biological</td>
</tr>
<tr>
<td>Chemical</td>
</tr>
<tr>
<td>Earth measurement/Geomorphological</td>
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<tr>
<td>Physical</td>
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<tr>
<td>Social/Human use activity</td>
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8. Would your organization be interested in providing human, financial, or technical resources to support this project?

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<tbody>
<tr>
<td>Yes</td>
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<tr>
<td>No</td>
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</tbody>
</table>

If yes, please describe and/or specify.

9. We realize that a quality Information Technology staff is necessary to the success of this project. In addition, do you feel a coordinating body is necessary to provide oversight and guidance to manage the portal?

<p>| |</p>
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<tbody>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
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</tbody>
</table>

If yes, please briefly describe.

Additional Comments:
North Coast RWQCB Supplemental Environmental Project (SEP) Proposal
October 27, 2008

1. Project Title: Humboldt Bay Institute

2. Proposing and administering organization:
   Susan Schlosser, Marine Advisor
   University of California Sea Grant Program
   2 Commercial St., Suite 4
   Eureka CA 95501
   scschlosser@ucdavis.edu (707) 443-8369

   Additional project contact
   Rebecca Price-Hall,
   2016 Golf Course Rd.
   Bayside CA 95524
   pricehall@humboldt1.com (707) 822-6540

3. Project Description: Humboldt Bay Area agencies and organizations concerned with water quality and quantity, the bay ecosystem, and community well-being have identified a need for integrating information about these issues and coordinating more effectively with each other. Creation of a Humboldt Bay Institute (HBI) would provide a vehicle for coordination, development, integration and dissemination of knowledge about water and the ecosystem in and around Humboldt Bay in an ecosystem-based management framework. For example, the institute could facilitate development and funding of a collaborative watershed and bay sediment dynamics study and a dioxin workshop. The HBI SEP’s intended benefits include improved coordination of water quality research, projects and monitoring, an integrated water quality and ecosystem knowledge base, increased local capacity and expertise to improve water quality, and ecosystem integrity, and enhanced beneficial water uses. The HBI could provide added value statewide by serving as a model for other communities seeking to improve their capacity to resolve water quality issues.

The HBI concept is being developed by the Humboldt Bay Ecosystem Program (HBEP) in support of HBEP’s mission to create an integrated framework that links the needs of people, habitats and species by increasing our scientific understanding of our ecosystem and by promoting community-wide collaboration in sound natural resource management. The HBEP advisory team of 31 scientists, tribal & community representatives, and resource managers will further specify HBI’s role and design in their upcoming strategic planning process. The Coastal Conservancy awarded funding of $75,000 to Susan Schlosser through December 2008 to develop the HBEP and its priority projects, of which HBI is one.

4. Project Cost: Susan Schlosser, director of the HBEP is requesting $90,000 for a third party Supplemental Environmental Project to fund creation and initial operation of a Humboldt Bay Institute. The SEP request includes funding for consultant fees, office expenses, part time staff, and grant administration. The David and Lucille Packard Foundation ($68,000) and California Sea Grant ($17,000) are funding HBEP’s Strategic Plan development.
Humboldt Bay Institute (HBI) Preliminary Budget & Schedule

<table>
<thead>
<tr>
<th>Item</th>
<th>Total cost</th>
<th>SEP Request</th>
<th>Match</th>
<th>Schedule</th>
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</thead>
<tbody>
<tr>
<td>1. HBEP Strategic Planning</td>
<td>85,000</td>
<td>0</td>
<td>85,000</td>
<td>Nov 2008-Mar 2009</td>
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<tr>
<td>2. Institute Design &amp; Formation</td>
<td>10,000</td>
<td>10,000</td>
<td></td>
<td>Feb - Jun 2009</td>
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<tr>
<td>3. HBI Office Expenses</td>
<td>10,200</td>
<td>10,200</td>
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<td>June 2009 - May 2011</td>
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<td>4. HBI 1/2 time coordinator</td>
<td>50,000</td>
<td>50,000</td>
<td></td>
<td>June 2009 - May 2011</td>
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<tr>
<td>5. SEP Grant Administration (UC)</td>
<td>19,800</td>
<td>19,800</td>
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<td>SEP Grant Period</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>$175,000</strong></td>
<td><strong>$90,000</strong></td>
<td><strong>$85,000</strong></td>
<td></td>
</tr>
</tbody>
</table>

5. Project Schedule (see Preliminary Budget & Schedule above): The Strategic Planning Workshop scheduled for Jan. 12-16, 2009. A consultant will be hired from February to June to complete necessary arrangements, contracts or memorandums of understanding to establish the institute. The HBEP Advisory Team will hire a part time interim staff in June who will complete tasks to begin HBI operations, develop initial projects and lead the effort to develop permanent funding. It is expected that by June 2011 a director will be hired and an Advisory Committee established.

6. Proposed Final Products: The final products of this project include: 1) Formation of the Humboldt Bay Institute and governing board; 2) development and execution of founding documents and agreements; 3) development of the documents, plans and systems for institute operations; 4) development of initial projects; and 5) plan for funding ongoing operations.