Humboldt Bay Ecosystem-Based Management Program
Advisory Team Meeting – December 14, 2007

Subcommittee Reports:
Biological – Discussed pros and cons of combining Conceptual Model and Biological Resources subcommittees; decided a Conceptual Model is needed as a stand alone project to communicate overall EBM project to others and to understand where projects fit in the ecosystem. The conceptual model will also allow us to develop specific research questions and determine which research would give us the most or best information. Proposal topics include: bay description (conceptual, mapping, habitat inventory); primary productivity (carbon fixing, sunlight/energy flow, relative contribution of selected habitats); management implications of two topics. Time frame for these proposals: year one – Bayesian Belief Network (BBN) Conceptual Model; year two – habitat maps; year three – specific studies.

Cultural/Socioeconomic: no new information on economic impacts and benefits matrix proposal since November Advisory Team meeting. Talked to Carrie Pomeroy, Sea Grant Extension social scientist, she will provide input on proposal ideas.

Implementation: created chart of entities that have land use, regulatory authority characterized by local, state, or federal jurisdiction in the primary, secondary or tertiary EBM zone. These will be the initial signatories for the "EBM Principles of Participation" to continue the collaboration after this initial program has ended. The subcommittee will review EBM governance issues

Water Quality/Physical Processes: Met on Dec 5 to outline proposals to address sediment from an ecosystem based approach: circulation model, water quality sampling and temporal analysis of human effects and loading from watershed to the bay level, sediment budget (sampling), management tool.

Planwest Presentation on Cultural Resources Inventory Project: Tiffany Wilson, Jerry Rohde, Susan Ornelas described the cultural and historical resources inventory and characterization of Humboldt Bay through a NOAA grant. The initial phase of the project will include a roundtable of stakeholders discussing an inclusive sweep of resources (cultural, ethnicity, recreation, and festivals of the area) and how this information could be used.

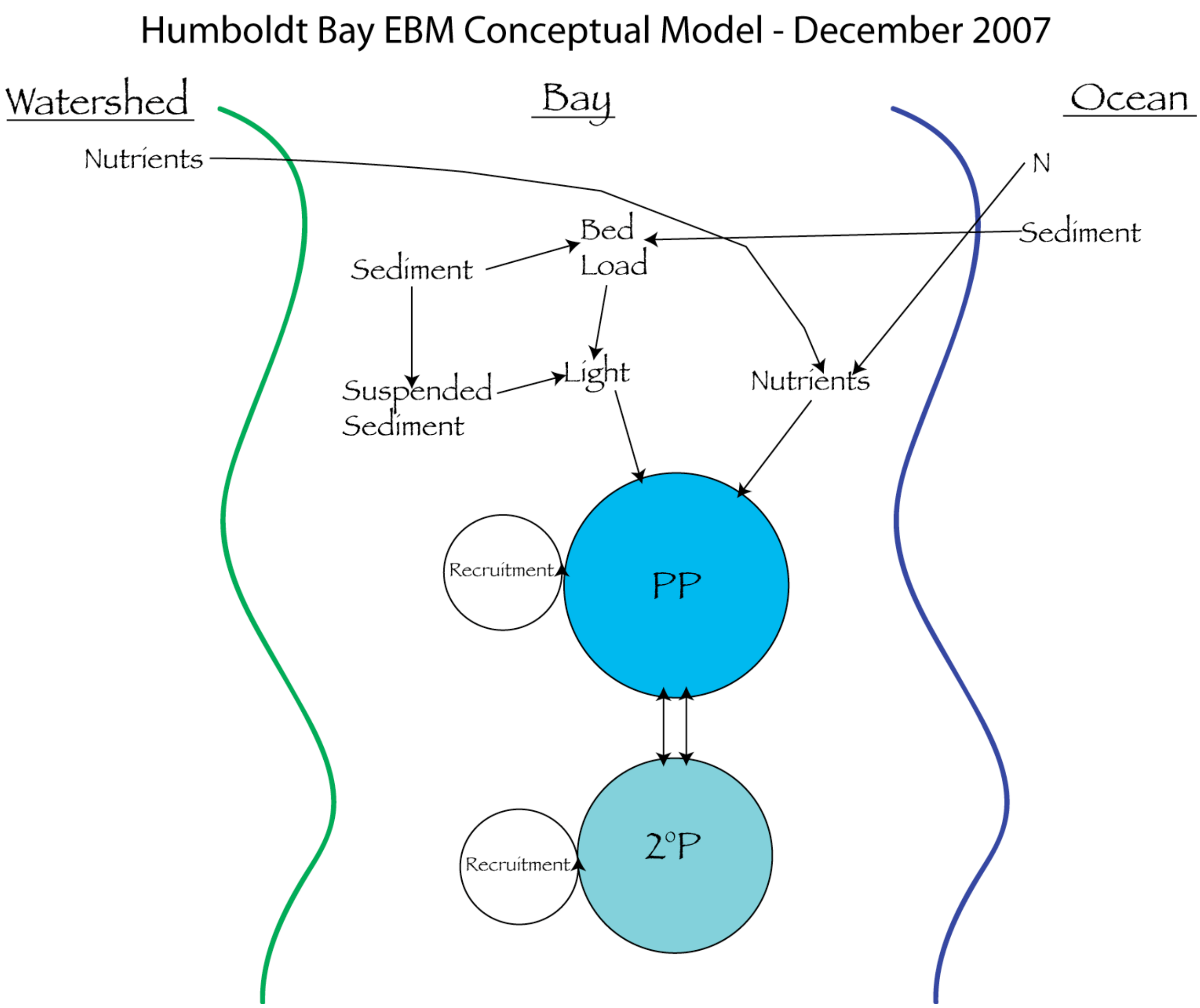
Research physical characteristics of bay prior to arrival of white people, historical impacts that need consideration
Discussion – information to include in report:

- Information on sites considered for estuarine restoration – McDaniel Slough, Faye Slough, South Bay; identify sensitive areas
- Use historical ecology as template for current functional ecosystem
- Map of public trust lands
- Dioxin in relation to past activities (logging) – historical impacts, constrains restoration, cost
- History of dump sites in relation to restoration projects
- Cultivating and supporting conservation stewardship, educating the public (beyond scope of current study)
- Geographic, geospatial historic tidelands
- Update on current restoration projects, slough projects
- Culture of restoration community
- Ethnic bay uses – Asian use of mudflats and concerns with pollution

Conceptual Model / Proposal Integration
Overview of Dec 11 meeting involving participants from all subcommittees

<u>Frank Shaughnessy – conceptual model and proposals generated from revised model</u>

- Proposal summary
  - Bay circulation model targeting sediment transport
  - Biological resources – monitoring specific trophic levels
  - Conceptual model – circles, arrows, flow
- Conceptual Model – primary productivity (PP) as fundamental feature for the health of Humboldt Bay: if PP healthy then ecosystem functions maximized
  - Trophic support PP healthy then secondary producer (crabs, bivalves, fish, birds, humans) functions are maximized
  - Vegetation PP healthy then refuge, nursery functions for juvenile species maximized
  - Vegetation present then sediment stabilization occurs and water clarity maximized
- PP affected by processes in the bay through the watershed and out in the ocean: monitor recruitment, environmental variability as effects on the condition of the bay



Eric Bjorkstedt – turning a conceptual model into a decision support tool

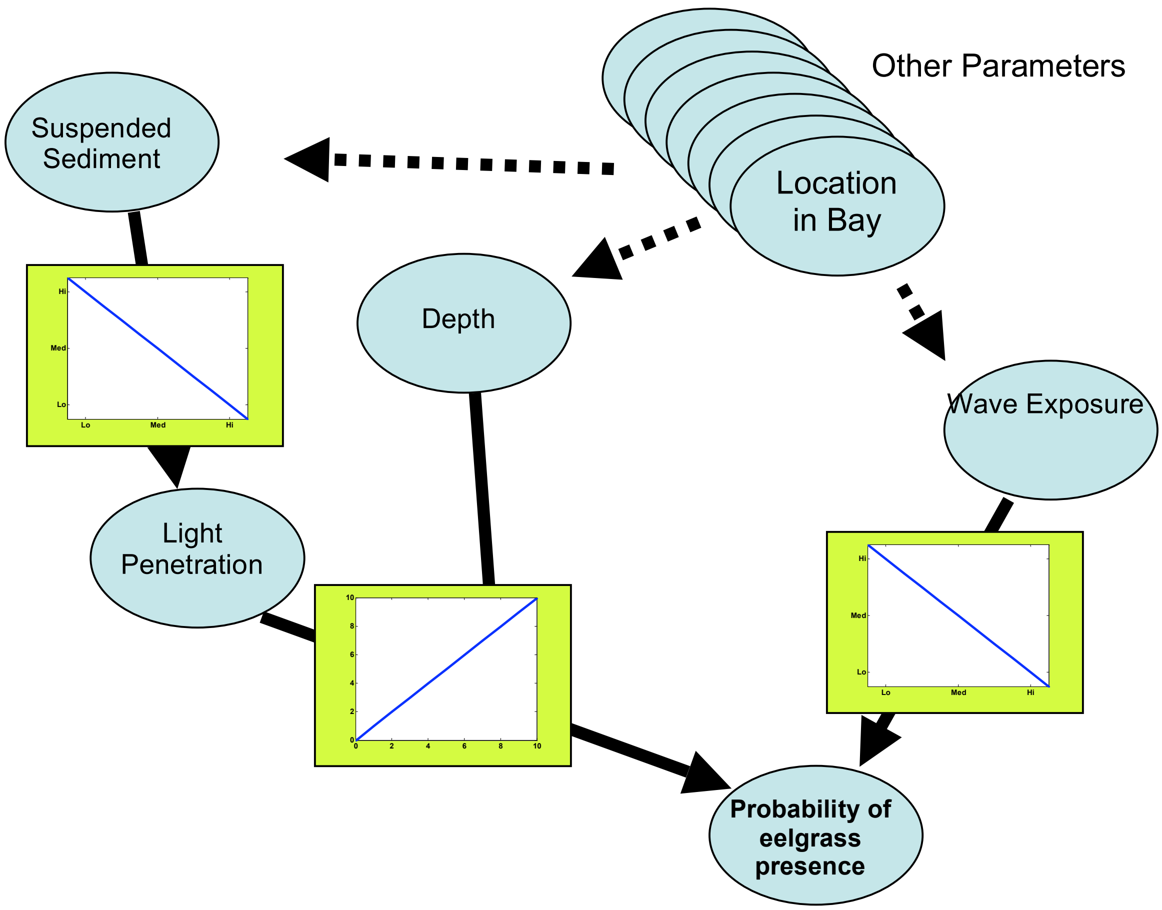
Bayesian Belief Network (BBN) is one approach to implementing the machinery behind a conceptual model.

- modeling framework broadly applied in diverse fields (e.g., finance, power management, risk analysis, etc.)—BBN are a demonstrated technology
- accommodates all types of information (hard data, literature surveys, expert opinion, etc.)
- incorporates functional relationships between various components of a system
- explicitly accommodates and propagates uncertainty in information or relationships into predictions
- scaleable, modular, extendable
- outputs are expressed as probability of an outcome (e.g., a state of the ecosystem or ecosystem component)
- BBN are 'trainable', i.e., can be fit to observations to make model more closely conform to system being described
- functional relationships don't need to be nice, neat equations—can be empirically-based functions, for example—but generally need to behave "nicely".
- can be implemented within a GIS framework to provide spatially explicit predictions of conditions and consequences of management actions or natural processes.

What follows are a few figures to describe a simple example of how a BBN could be constructed to capture the dynamics of (a subset of) factors affecting eelgrass distribution. Note that the BBN is basically the blocks (functional relationships) that have been laid over the conceptual model diagram of relationships, and would also include information on the uncertainty or probabilistic distribution of the input variables.

Depth might be a "fixed" input under a given management scenario. Sediment loads and wave exposure will vary on various time scales, and are probably most appropriately included as a climatology of annual average conditions (or average conditions during a critical period of the year) as this is a scale that links well to informing management decisions. Questions that might be asked might be similar to: "If we modify the dynamics of sediment inputs through a management action, how will this affect the year-to-year variability in sediment loads exhibited in the Bay, and how in turn will this propagate into changes in mean and variance of eelgrass cover?" Obviously the spatial distribution of various effects might be critical information for some management decisions, but even a non-spatial model or a model with relatively coarse resolution (e.g., a 'box model' of the Bay) could provide very useful first- or second-order insights to inform management decisions.

Schematic example of a BBN *without* uncertainty or probabilistic distributions (e.g., climatologies) in input data or functional relationships



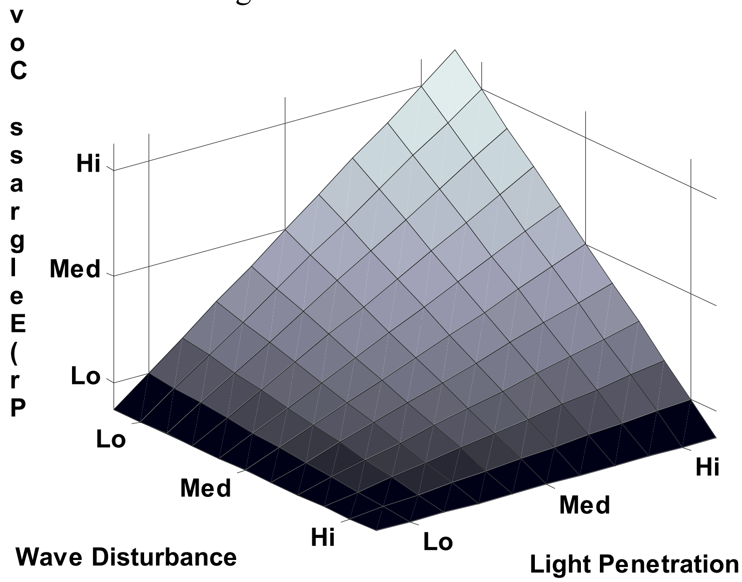
NOTE: such a model can be used to generate a prediction in a specific area, but will allow spatial predictions to assimilate spatial variability in input parameters and therefore will explicitly accommodate spatial correlation in environmental conditions.

Dotted arrows indicate that not all 'other parameters' will directly influence the three indicated parameters (sediment, depth, wave exposure).

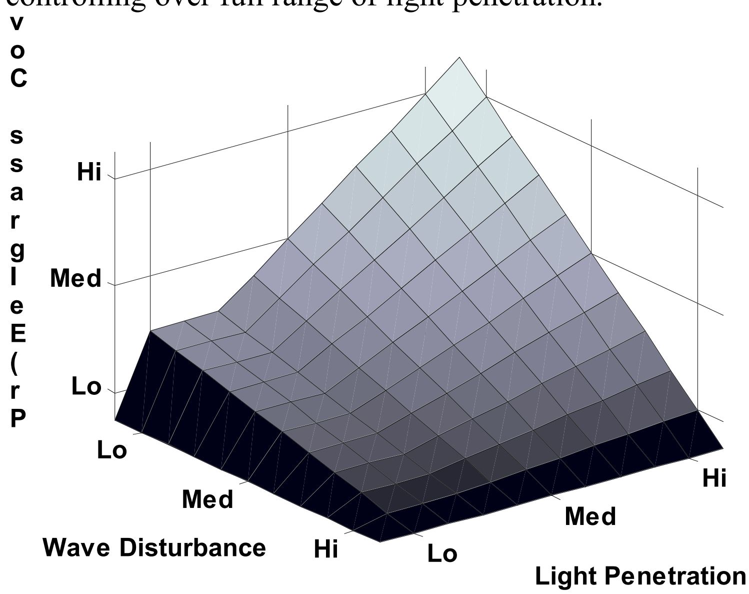
COMPLETELY HYPOTHETICAL OUTPUTS FOR DIFFERENT AREAS OF BAY

As an example of how the ‘depth’ parameter will affect how the light-eelgrass function actually manifests on the model landscape IMAGINE that for deeper areas, control through sediment limitation on light penetration might play a stronger role in controlling eelgrass than in shallower areas (subject numerous add’l caveats). Note interaction between controlling factors. Note: hi light + lo wave = hi eelgrass.

DEEP AREA: low light doesn’t reach bottom, so full range of response is observed; wave exposure is controlling under all illumination conditions.



SHALLOW AREA: low light is still limiting, but not completely so, because even lowest levels of light penetration reach bottom except at very lowest level. Wave energy still controlling over full range of light penetration.



<u>Greg Crawford – bay circulation model specific to water quality (WQ)</u>

- Issues regarding Humboldt Bay
    - Sources of pollutants
    - Transport of pollutants: creek flow, ocean current
    - Impacts on ecosystem
- Monitoring: what is out there now, changes over time
- Modeling: focus on sediment issues: need better models and observations; connect with watershed hydrologist – turbidity, bedload inputs from creeks
- Challenges: too many WQ issues to handle at once, focus on one – sediment and turbidity with connection to ecosystem; better understanding of management alternatives
- Capacity-building:
    - Monitoring: develop/enhance current observational capabilities for baseline data
    - Modeling: develop capabilities and expertise for future models of wastewater, storm water dispersion, etc.
- Sediment in Humboldt Bay: turbidity reduces light levels; impacts other organisms; what controls the sediments turbidity?
    - Higher turbidity at low tide: at low tide bay WQ influence by north bay; at high tide bay WQ influenced by ocean
    - Spatial variability of turbidity
    - Ecosystem-based management:
        - Is sediment a problem in Humboldt Bay?: ecosystem health, navigation
        - What can be done about it?: regulation/mitigation; dredging strategies, alternatives

<u>Discussion</u>:

- Higher trophic levels not considered
- Catastrophes hard to model; focus on normal factors of ecosystem
- Pulse (catastrophic events) vs. Press (chronic disturbances); spatial and temporal

Proposals and Leaders: each subcommittee develop one page description/bullets relating their component to these proposals

1. Conceptual model with Bayesian Belief Network management decision tool – Eric Bjorkstedt
2. Sediment circulation model – Greg Crawford, Jeff Anderson
3. Targeted biological resources monitoring – Frank Shaughnessy
4. Restoration Evaluation – Paula Golightly, Andrea Pickart
5. EBM Decision Tool

<u>Discussion</u>:

- Cultural component not part of proposals+
- Show use of model/tool through land use scenarios ("what if" situations)
- Include cultural component in model: cultural/economic information to justify science decisions; governance needed to make EBM successful
- Public outreach regarding model use
- Management agencies need to develop common thresholds regarding EBM; implementation subcommittee needs to continue beyond current contract
- Concern regarding denial of past monitoring/evaluation proposals; this proposal would include all restoration projects throughout the bay/watershed, not on an individual basis; integrate economic value of projects – return on investment; political stumbling block for restoration – need decisions based on good science; need dialog and bridging between science and policy