Intermittently Open Estuaries: Science & Management Perspectives

Workshop Notes: DRAFT - January 2017

September 28, 2016 | 9:30am - 3pm

Southern California Coastal Water Research Project
Costa Mesa, CA 92626

NATIONAL ESTUARINE RESEARCH RESERVE SYSTEM SCIENCE COLLABORATIVE

Tijuana River National Estuarine Research Reserve

Coastal Conservancy

The San Diego Foundation

Southern California Wetlands Recovery Project

SCCWRP Established 1969

Agenda

Objectives

Increase our common understanding of:

- Mouth dynamics and their relationship to estuarine conditions;
- Existing management approaches regarding mouth management;
- Data and knowledge gaps; and
- Trade-offs associated with mouth state and management.

Workshop discussions will inform: (1) ongoing and future data analyses; (2) regional objectives; and (3) the development of guidance to be given to the Board of Governors.

9:30 – 10:00	**Registration & Refreshments**
10:00-10:15	**Welcome & Introductions** *Jeff Crooks, Tijuana River National Estuarine Research Reserve*
10:15-10:25	**Framing the Discussion** *Megan Cooper, State Coastal Conservancy*
10:25-10:50	**Science Background of Mouth Dynamics** *John Largier, UC Davis*
10:50-11:05	**Bar-Built Estuary Monitoring and Management of Habitats** *Ross Clark, Moss Landing*
11:05-11:15	**Break**
11:15-11:30	**Fisheries Management & Mouth Dynamics** *Mark Capelli, National Marine Fisheries Service (NMFS)*
11:30-11:45	**Water Quality & Mouth Dynamics** *Martha Sutula, SCCWRP*
11:45-12:00	**San Diego Case Histories: Data and Management** *Jeff Crooks, Tijuana River National Estuarine Research Reserve*
12:00-1:00	**Lunch**
1:00-1:50	**Breakout I: Ecosystem Services & Mouth Dynamics** *Objective: Brainstorm a list of ecosystem services within the context of mouth dynamics.*
1:50-2:45	**Breakout II: Key Management Issues & Mouth Dynamics** *Objective: Brainstorm a list of key management considerations for multiple management issues within the context of mouth dynamics.*
2:45-3:00	**Wrap-Up & Next Steps** *Jeff Crooks, Tijuana River National Estuarine Research Reserve*

Breakout I:
Ecosystem Services & Mouth Dynamics

Objective: Given then background information from the morning, brainstorm a list of ecosystem services within the context of mouth dynamics.

Instructions: List the ability of each estuary type to provide different ecosystem services or attributes: open vs. closing / opening.

Guiding Questions
- What attributes does an open vs. a closed system have?
- Are there ecosystem services that a particular state (open vs. closed) increases?
- Are there ecosystem services that a particular state (open vs. closed) inhibits or lessens?

This is a brainstorming session. It is simply to advance the dialogue around important aspects of open vs. closing systems, and is not intended to be comprehensive or to prioritize.

Participants were provided with the list of ecosystem services (first column) and asked to fill in their thoughts in columns two (open) and three (opening/ closing).

Ecosystem Services	**Estuary Type**	
	Open	**Closing / Opening**
Waste Treatment & Water Purification: • Nutrient breakdown & sequestration • Water purification • Contaminant dilution	• Less pollution contained within estuary, but more transport to open coast • Dilution of contaminants with tidal influence	• Less transport to ocean, but concentration of pollutants within estuary. • Some breakdown and sequestration of pollutants possible during closed state • System more easily overwhelmed with closure
Human Health & Biological Control: • Limit pathogens or disease vectors • Control of agricultural or livestock pests	• Disease-bearing mosquitos inhibited in salt water • Open conditions favor some pathogens / diseases associated with more saline conditions (e.g. Vibrio cholerae and swimmer's itch) • Open systems allow pathogens / diseases to enter coastal waters	• Increased risk of diseases associated with freshwater mosquitos • Decreased risk of pathogens associated with marine systems • Ponding water increases risk associated with water contact • Breaching of closed systems with poor water quality can impact human health on beaches

Climate Regulation: • Carbon storage / sequestration • Effects on temperature, wind, rainfall … • Air quality improvement	• Tidal wetlands very effective at carbon sequestration • Less methane production in saline waters	• Increasing freshwater influence offers less carbon sequestration • More methane production in lower salinities • Potential for trapped sediments in closed systems to bury carbon
Water Regulation: • Groundwater recharge • Water supply for humans, livestock, & agriculture	• Higher salinities preclude use as a direct water supply • Lower groundwater recharge in tidal systems • Saltier groundwater limits use in agriculture	• Ponded freshwater increases possibility as direct water supply • More groundwater recharge when closed • Less saltwater intrusion into groundwater
Hazard & Erosion Control: • Flood amelioration • Shoreline & bank stabilization • Storm damage reduction • Sediment retention	• Decreased flood risk with tidal connection • Salt marsh provides living shorelines than stabilize banks and reduces storm damage • Less sediment retention (especially fines) within system, increased export to coastline	• Less water storage capacity and increased risk of flooding (during closed state) • Less bank stabilization and storm damage reduction associated with increased areas without marsh vegetation • Closure mitigates wave erosion • Increased sediment retention and potential availability for resupply
Food & Raw Materials: • Support for edible species • Provision of wood, fibers, and fuel • Support for pollinators	• Edible species available - more marine • Probably less favorable to pollinators	• Edible species available - range of species • More favorable to pollinators
Biochemical & Ornamental Resources: • Biochemical resources or natural medicines • Genetic resources • Ornamental resources (shells, drift wood, ...)	• Marine natural products, including bryostatin drug (anti-cancer and neurological treatment) from estuarine bryozoans • Potential for salt-tolerance genes for agricultural crops	• Potential prospects for biochemical / genetic resources in freshwater, brackish, and marine species

Biodiversity – Support of Native Species:	• Favors marine and tidal marsh species: Ridgway's Rail , Belding's Savannah Sparrow, flatfish, and elasmobranchs • Nursery for ocean-going fish • Could inhibit steelhead and tidewater gobies	• Higher biodiversity over time (integrates over open and closed states) • Favors anadromous fish (steelhead), tidewater gobies, waterfowl, and some migratory birds
Biodiversity – Control of Undesirable Invasives:	• Many marine invaders, including problematic species such as *Caulerpa* (eradicated), shipworms, and creek bank-destroying crustaceans • Susceptible to invasions from ballast water, aquaculture, biofouling • Less issue with problematic plants (fewer invasive halophytes)	• High diversity of invaders, including marine and freshwater • Higher prevalence of problematic plants in aquatic and transitional habitats
Cultural: ♦ Nature observation ♦ Outdoor recreation ♦ Aesthetics ♦ Scientific and education opportunities	• Eye of the beholder • Recreational fishing • Kayaking / boating • Surfing	• Eye of the beholder • Potential for algal blooms, fish kills, and nuisance conditions (odor) • Lake-ish recreation

Breakout II:
Key Management Issues & Mouth Dynamics

Objective: Brainstorm a list of management considerations for key issues within the context of mouth dynamics.

Instructions: Shift focus to management actions. Each group is an agency that has a specific management focus:

- **Hazards:** Flooding, storms
- **Species- fish:** Individual species, habitat support
- **Species- birds:** Individual species, habitat support
- **Water quality:** Eutrophication, pollution, anoxia
- **Climate change:** Blue carbon, management implications

Take the same two systems you just discussed in the first breakout group exercise: open and closing / opening, and given your assigned management topic, how can you best manage each system? This is a brainstorming session. It is simply to advance the dialogue around the importance of mouth states, and is not intended to be comprehensive or to prioritize.

Discussion Notes

Hazards: Group 1

- Increased flood hazards within closing systems (from exercise above).
  - Opening mouth is most direct action to lessen flood risk, but can compromise other services (as listed above).
  - Other approaches to lessen flood risk in closing systems include:
    - Increasing flood storage by improving hydrologic connectivity and reclaiming floodplains
    - Managed retreat and raising structures (which will also help address sea-level rise)
    - Partial mouth opening / notching to decrease water levels but not drain system

- Creation of living shorelines (beach / dunes, oysters, eelgrass, marsh) important hazard reduction in all systems

- Monitoring of water levels important for all systems

Species - Fish: Group 2

- For tidewater gobies and steelhead in closing systems:
  - Avoid extreme (off-season) flushing
  - Restore / maintain refugia for gobies

- Create refugia for tidewater gobies open systems (above tide zone)

- Consider programmatic breaching permits to allow breaching when needed

- Develop alternatives to breaching (i.e., levees; see also above)

Species - Birds: Group 3

- Hard to find consensus, even with a taxon as well studied as birds; not sure of even basic habitat requirements

- Open river mouth - favors Belding's Savannah Sparrows, Ridgway's Rails, and other marsh birds
    - Less species, but less issues
    - Create more diverse elevations and habitats

- Closing / opening systems support more species due to spatio-temporal complexity, and favors migratory birds, waterfowl, some endemics
    - High seasonality
    - Create high elevations (e.g. platforms) for nesting (systems flooding during high water periods, especially due to urban drool)
    - Capture / reduce freshwater to alleviate flooding issues
    - Protect some unvegetated areas (salt flat and pannes, dunes)
    - Protect transitional habitat

Water Quality: Group 4

- Opening a closed system definitely can help, but what else can be done?:
    - Mimic historic hydrograph – urban drool into naturally low-flow systems (especially summer)
    - Remove historic accumulation of sediment and other materials (many were former sewage dumps)
    - Capture water upstream & bypass most water
    - Restoration of channels / reconnection to floodplain (remove fills and berms)
    - LID, BMP retrofits in watershed
    - Fix infrastructure

- Develop monitoring programs for all systems – continuous / real-time measurements

Climate change: Group 5

- Focused on potential, but highly uncertain, effects of climate change

- Possibility for increased frequency of closure with elevated sea levels and coastal storms (i.e. large waves) pushing sediment into estuary mouths

- Less fluvial inputs due to changing rainfall would also tend to increase possibility of closure

- Saline waters will push further upstream with sea level rise

- El Niños can be a preview of sea level rise and wave impacts

- Need to better learn to manage for change
    - Make more intact systems
    - Change expectations for what a "healthy" system is
    - Manage with the system, not against it

Research Needs

Objective: Brainstorm a list of research needs throughout the day's discussions.

- How to describe and classify these systems
- Response of these systems to climate change and sea level rise
- Better understanding of blue carbon
- Need for new water quality objectives (ocean vs estuarine)
  - Biological focus (shift from chemistry to biology)
  - Risk assessment for Fecal Indicator Bacteria (reasonable to assume no risk on beach?)
  - Flow criteria? - Flushing vs containment
- Cost / Benefit Analyses: species & natural processes / people
- How to support species characteristic of closing systems in open systems; vice-versa
- Other species issues
  - Research on pollinators
  - Larval stages when system is being breached
  - How to provide nursery support for fish when it's closed (other than anadromous & tidewater gobies)
  - Effect of notching on tidewater goby
- Habitats
  - Salt flat / panne - functions & conditions
  - Role of non-tidal salt marsh
- Model plume movement in systems with open river mouth
- Understand synergy between eutrophication & Fecal Indicator Bacteria
- Efficacy of living shorelines for SLR & wave/ storm protection
- Improved and consistent monitoring
  - Early-warning / rapid response
  - Set baselines (take the "vital signs" of the estuary
  - Track changes to forcing factors and management interventions
  - Inform adaptive management

Conclusions / Next Steps

Overall, this workshop identified progress in understanding the complex estuarine systems of Southern California, articulated attributes of different systems with respect to mouth state, explored management considerations related to key issues, and identified how much we have yet to learn.

Some considerations that emerge from continued work on this topic include:

- The Mediterranean climate estuarine ecosystems of southern California represent a broad of range of conditions with respect to their mouth condition, from permanently open to natural cycling of opening and closure on different time scales
- Human influence has had dramatic and varied effects on the structure and function of these systems. In many instances, factors such as decreased tidal prism, filling of wetlands, creation of infrastructure that limits natural mouth movement, and increased sediment loading have led to increasing frequency of mouth closure and decreasing ability of systems to naturally open after closure
- The potential negative impacts occurring within closed systems, such as increased flood risk, eutrophication, pollution, and human health concerns, have been more readily apparent than the services provided by systems that are allowed to open and close, including maintenance of high biodiversity, support for sensitive and rare species (such as steelhead and tidewater gobies), and groundwater recharge.

- The increased frequency of closure coupled with the negative consequences associated with closed conditions have led to various management strategies, ranging from permanently fixing mouths in the open state to mechanically opening mouths after closure. This has compromised some services and functions that should be more fully represented in the region.
- Approaches that distinguish between mouth closures *per se* and the conditions associated with mouth closure, both of which are strongly influenced by human activity, are needed to maintain and restore the rich coastal wetlands of Southern California.
- More study is needed on these systems, including their basic physics, chemistry, and ecology, as well as how they will respond to climate change.
- Long-term monitoring programs are needed. These will set baselines, track trends, allow events such as El Niños to serve as windows into the future, and support data-driven management.
- Effective management of systems with respect to mouth condition will require more than just managing the mouth. In the short-term, it will require carefully considering tradeoffs associated with management action or inaction, and creatively working to enhance desired functions and services across system types. In the long-term, it will require addressing the coastal, estuarine, and watershed processes that shape these systems now and into the future

One of the primary aims of this workshop was to help advance the work of the Wetlands Recovery Project and its Regional Strategy Update. Under Goal 1 of the RSU, there will be measurable objectives relating to managing systems subject to intermittent opening and closures. These objectives include:

- Maintaining and restoring the historical distribution of archetypes
- Restoring tidal prism and residence times to be comparable with historic levels
- Restoring hydrologic and fluvial connections with associated watersheds at natural periodicities and magnitudes.

These objectives are meant to be regional and non-prescriptive in order to provide local land managers flexibility in managing a specific system with specific constraints and opportunities. Once the NOAA Ecological Effects of Seal Level Rise project has provided a better understanding of how IOE systems will function in the face of sea level rise, the Science Advisory Panel will develop an addendum (anticipated in Fall 2020) to the Regional Strategy with more specific IOE objectives and management recommendations.