A framework for coastal ecological flows

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Ecological Flows Science Advisory Board (2010-2013)

- Help NC DENR with planning efforts on future water flow modifications and impact.
- For state-wide, decadal-scale, and basin-level planning
- Designed to tie ecology to hydrologic modeling
Legislation defined **ecological flows**

- A flow regime that protects ecological integrity is often referred to as an **ecological flow**.

- Target flows may vary across seasons and are designed to minimally disturb aquatic populations, communities, and ecosystems.
Final Report
(http://www.ncwater.org/?page=366)

Recommendations for Estimating Flows to Maintain Ecological Integrity in Streams and Rivers in North Carolina

Submitted to the North Carolina Department of Environment and Natural Resources by the North Carolina Ecological Flows Science Advisory Board

November 2013
Challenges of Coastal Waterways
Summary of Challenges

• Coastal plain waterways are potentially different:
  – Hydrogeomorphological issues influencing modeling
  – Ecological issues influencing ecological integrity choices
  – Kinds of water withdrawals

• All of these contribute to the challenge of applying procedures from inland to the coastal plain.

• We formed a Coastal Ecological Flows Working Group to contribute to the EF SAB.
Overall Objectives

- Identify
  - factors limiting EF protocols
  - needed research within coastal systems
- Assess applicability of previous coastal work
- Develop stream typology
- Advance spatial modeling & mapping
- Establish relevant ecological & biological variables dependent on flow
- Develop frameworks for potential coastal EF criteria & protocols if possible
GEOMORPHIC TYPOLOGY AND ASSOCIATED IN-STREAM HABITATS

- originating in Piedmont
  - coastal rivers
    - originating in Coastal Plain
      - upper Coastal Plain
      - lower Coastal Plain
        - medium gradient, non-tidal
          - snag
          - sand
          - mud
          - riffle
        - low gradient, non-tidal
          - floodplain swamp
          - snag
          - sand
          - mud
          - backwater
          - submerged aquatic vegetation
        - wind or lunar-driven tidal freshwater
          - "natural" or engineered (e.g., ditched, canal)
          - floodplain swamp
          - snag
          - sand
          - mud
          - backwater
          - submerged aquatic vegetation

Legend:
- discharge-stage-habitat approach applicable
- discharge-stage-habitat approach **not** applicable; primary effect of river discharge is to control salt water intrusion

by Scott Ensign
Link between waterway category and key assemblages that could be used for ecological flow assessment.

<table>
<thead>
<tr>
<th>Origin</th>
<th>Slope</th>
<th>Anadromous Fish</th>
<th>Resident fish</th>
<th>Vegetation (Foundation species)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piedmont</td>
<td>Medium gradient</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper Coastal Plain</td>
<td>Medium gradient</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper Coastal Plain</td>
<td>Low gradient</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Lower Coastal Plain</td>
<td>Low gradient</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Lower Coastal Plain</td>
<td>Wind or tidal driven flow</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
## Link of Stream Typology & Potential EF Determination

<table>
<thead>
<tr>
<th>Origin</th>
<th>Slope</th>
<th>EF determinant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EFSAB extension</td>
<td>Discharge &amp; Habitat</td>
</tr>
<tr>
<td>Piedmont</td>
<td>Medium gradient</td>
<td>X</td>
</tr>
<tr>
<td>Coastal Plain</td>
<td>Medium gradient</td>
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Ecological flows in APES

• The EF SAB and coastal EF working group efforts provided frameworks for future development
• APNEP has this issue as part of their Comprehensive Conservation Management Plan. It has formed a working group to continue work.
APNEP’s Flows Workgroup Charge within the CCMP

- **Action A3.3**: Develop and refine ecological flow requirements for each major river. Many of the fish, aquatic plants, and other species that live within the estuarine system depend on flowing water to survive. Identifying these ecological flows will help ensure that these species and ecosystems are protected.

- **Action D3.2**: Facilitate the development and implementation of basinwide water management plans to ensure no less than minimum in-stream flows are maintained. APNEP will work to provide scientific information and engage regional stakeholders to develop and implement water management plans that fully account for both human and ecological demands.