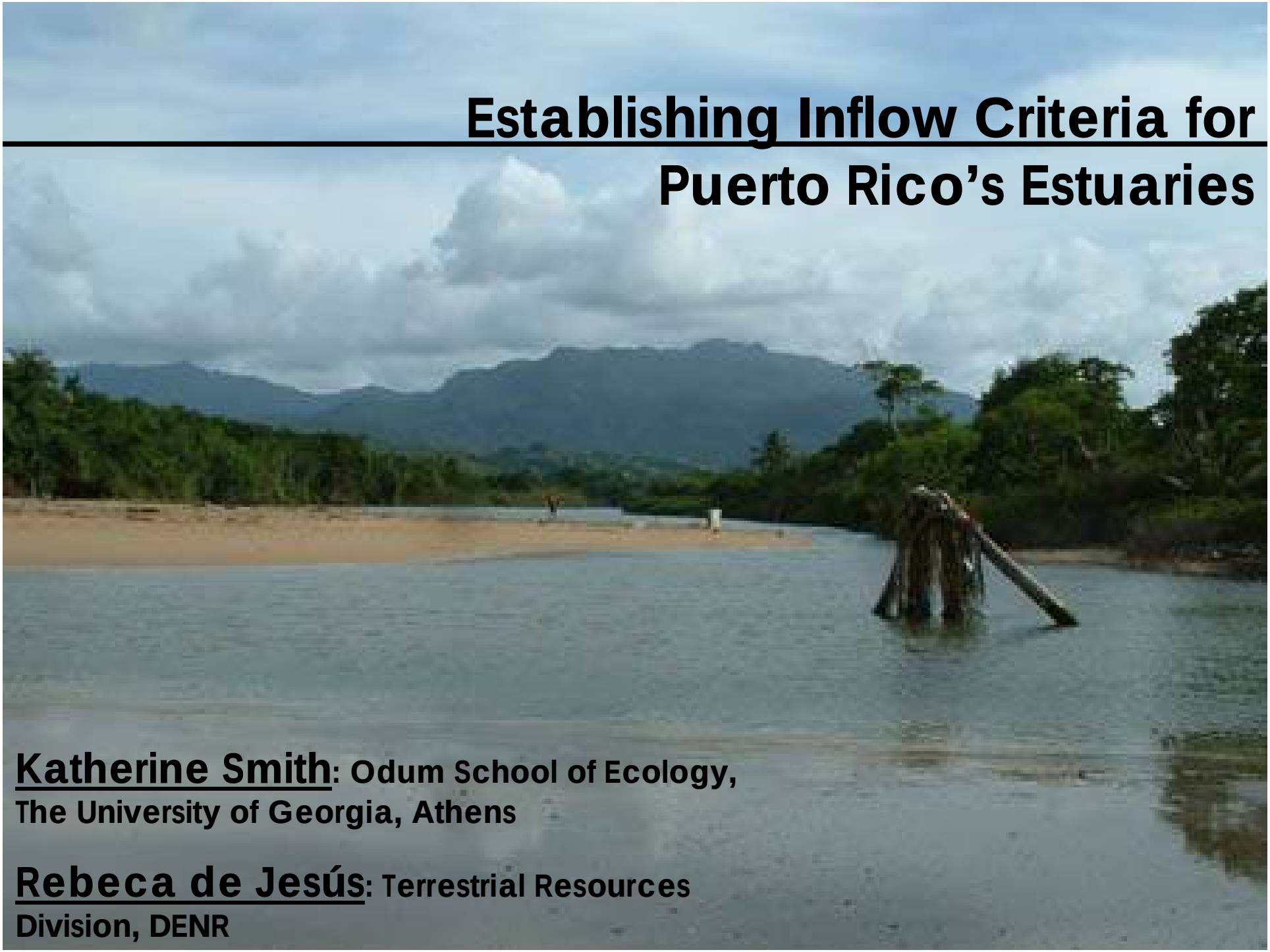


Establishing Inflow Criteria for Puerto Rico's Estuaries

Katherine Smith: Odum School of Ecology, The University of Georgia, Athens

Rebeca de Jesús: Terrestrial Resources Division, DENR

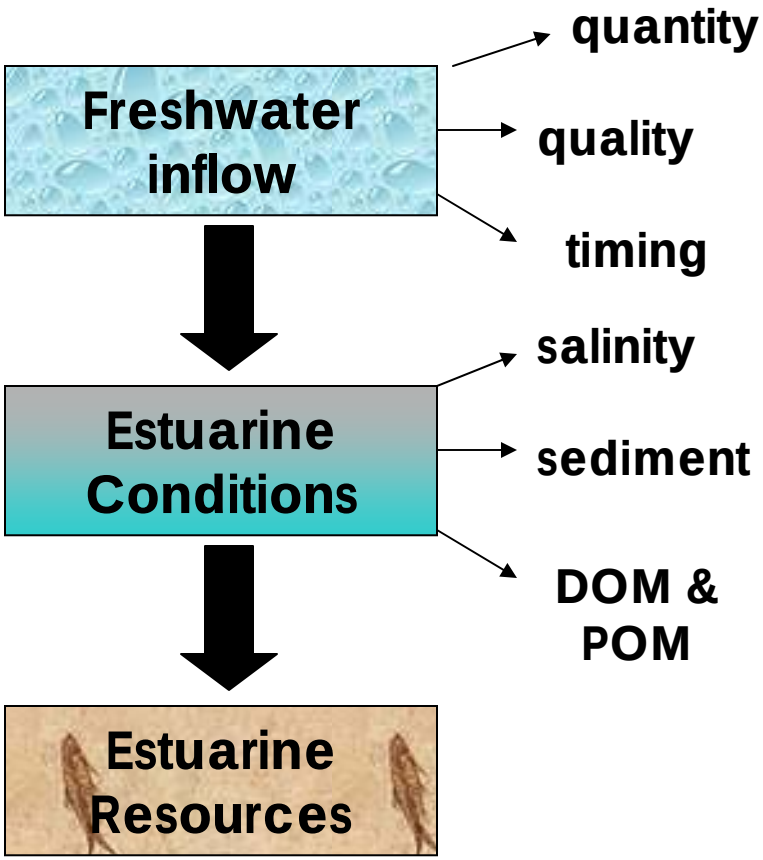
Outline

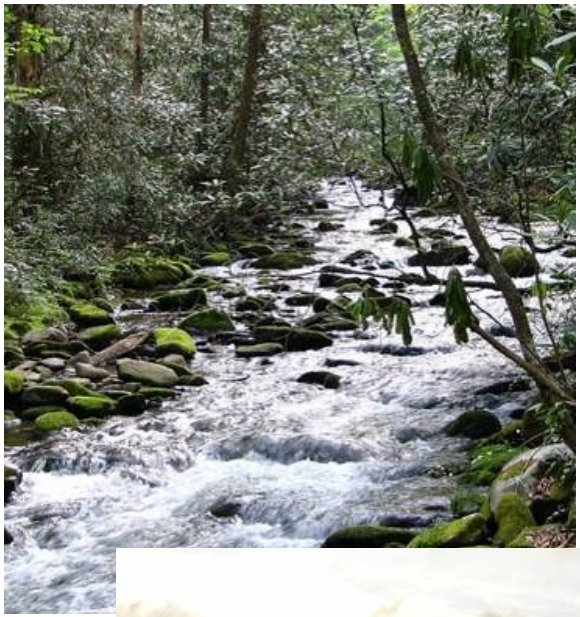
- Importance of Inflow to estuaries
- Studies from Puerto Rico: The Espiritu Santo and Mameyes estuaries
- Management of inflow to estuaries: Case Studies from other regions
- Recommendations for Puerto Rico
- Research needs

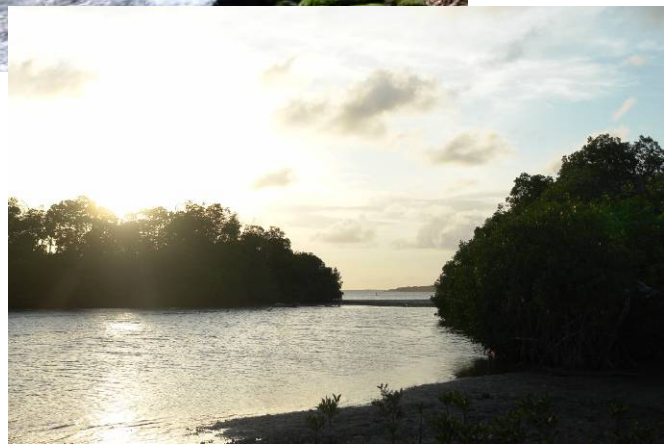
Estuaries

The inflow of freshwater to the mixing zone is fundamental to estuarine ecosystem function.

Inflow and Estuaries







Alber 2002. Schematic diagram of the effects of freshwater inflow on estuaries

Limited inflows to estuaries

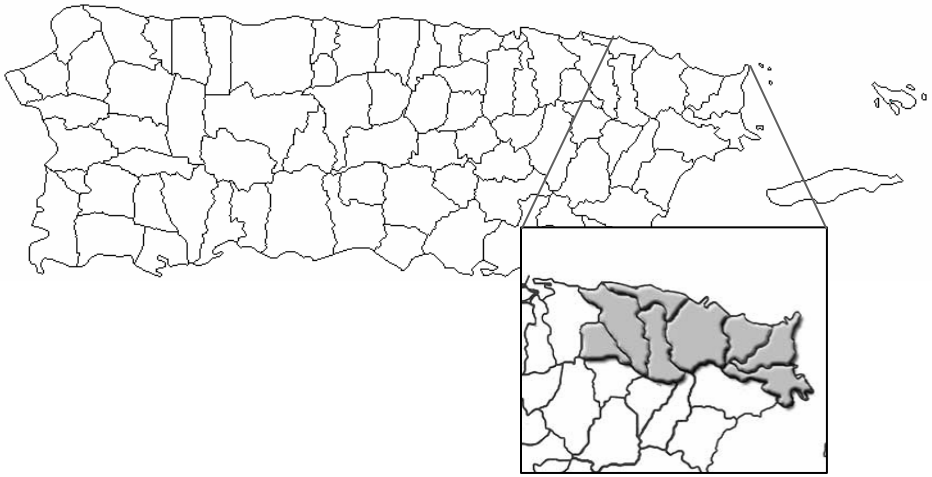
The hydrology of rivers has been affected by dams, diversions and withdrawals

Studies in NE Puerto Rico

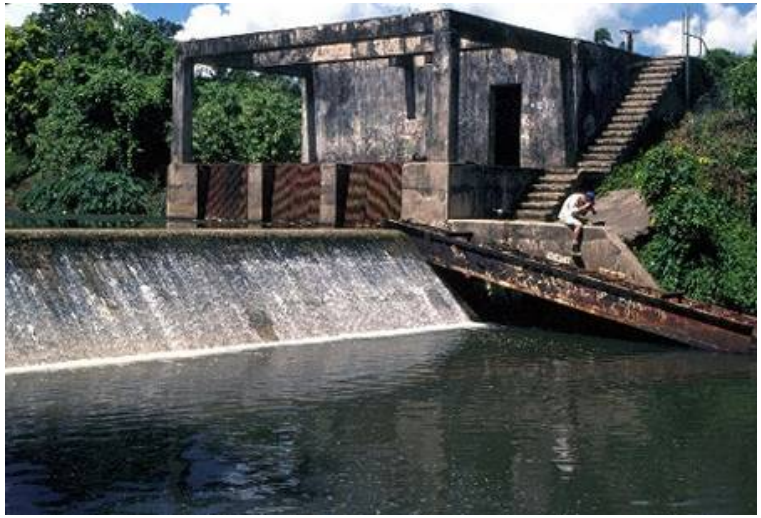
Few studies of inflow to estuaries in PR

- Fish community change after construction of the Espiritu Santo Dam

- Importance of riverine organic matter to fishes in the Espiritu Santo and Mameyes

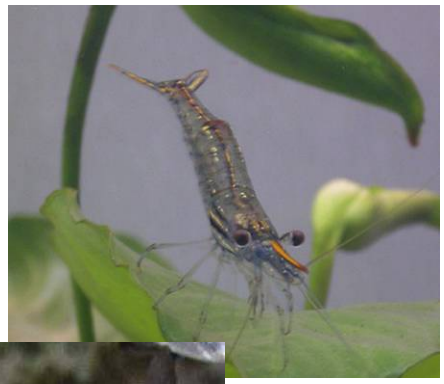


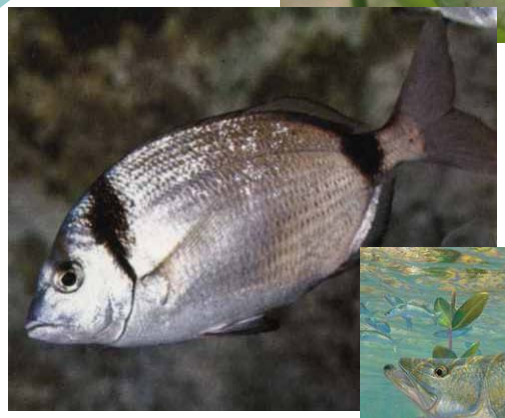
Inflow and the Espiritu Santo estuarine fish community

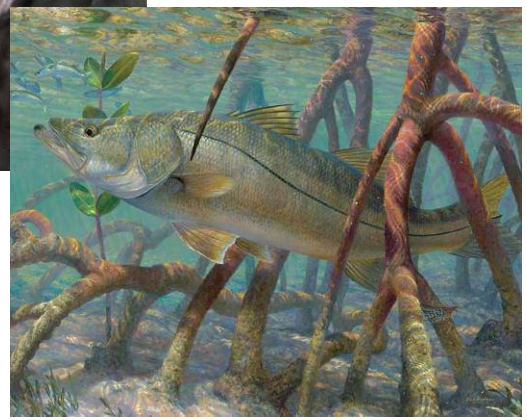


- Increased salinity between 1977 and 2004
- Decreased fish abundance over the same time period
- Decreased species richness, particularly for freshwater oriented species

Contribution of Riverine Organic Matter: Espiritu Santo and Mameyes Estuaries







Diadromous freshwater shrimp

Important food source for the examined fish.

Riverine organic matter

Important food source for benthic fish. Limited importance for pelagic fish.

Inflow Management Approaches: Examples

Inflow criteria based on established relationship with:

- Valued Resources
  - Texas Water Board (fisheries)
  - Suwannee River Water Management District (key habitats)
- Indicator Species (S. Florida WMD)
- Thresholds (e.g., S.W. Florida WMD's percent of flow approach)

Inflow and Values Resources: Texas Bays and Estuaries

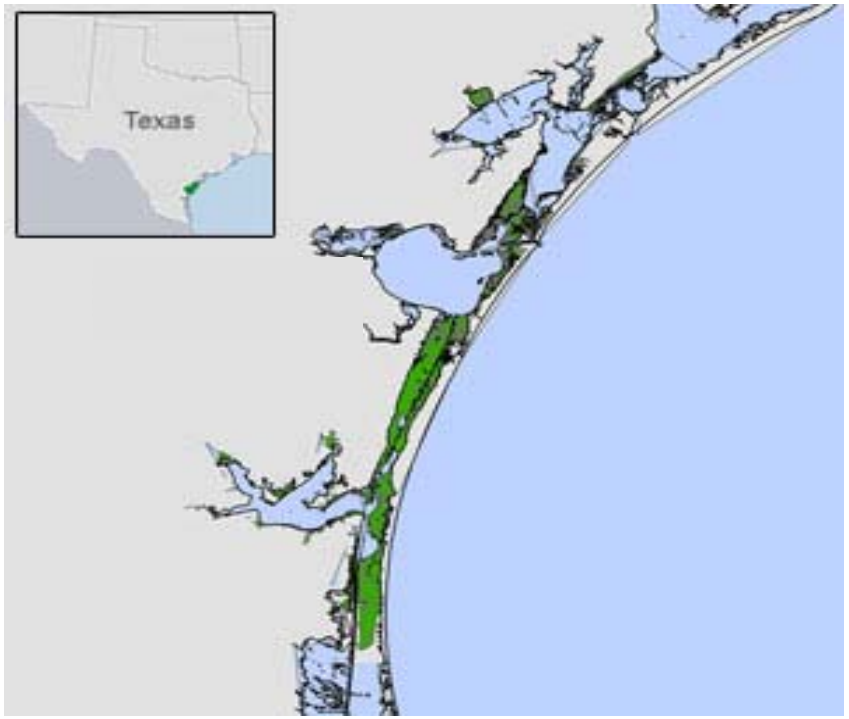
The arid areas were among the first to address this issue

- The case of Texas, USA
- Drought and legislative mandates

San Antonio Bay and the Guadalupe Estuary, Texas (1977).
http://hyper20.twdb.state.tx.us/data/bays_estuaries/b_nEpage.html

The Texas Study

- USGS Gage Records
- Studies included:
  - Circulation & salinity
  - Sediment & nutrients
  - Fisheries harvests
- Determined relationship between inflow, salinity, and fisheries harvest

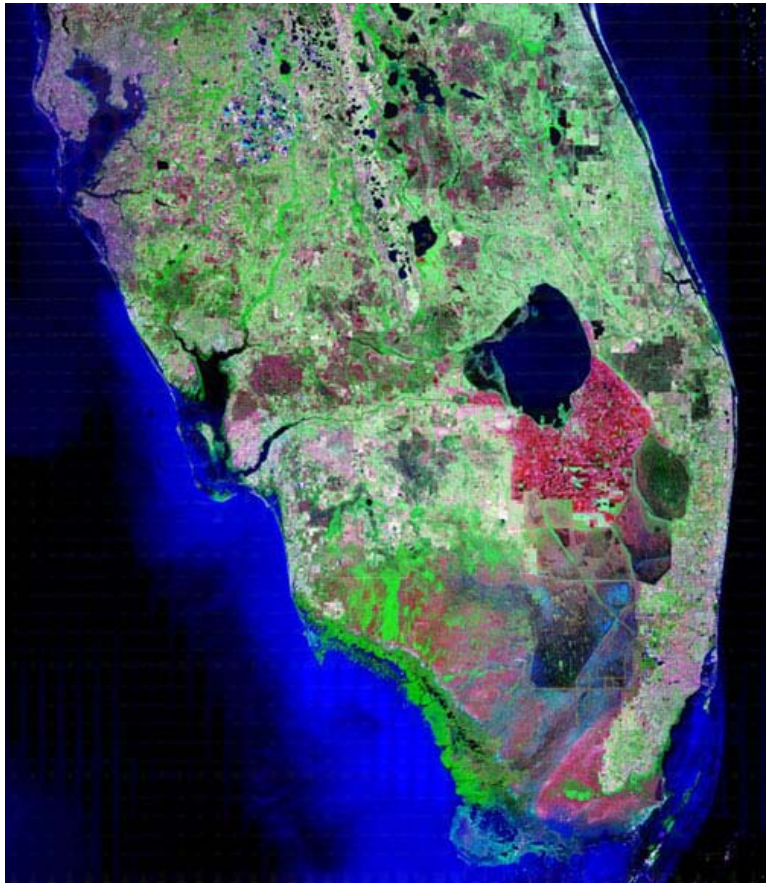


Approach

- Set management objectives related to harvest and estuarine health
- Optimization Analysis – set inflow to achieve these objectives
- Texas Estuarine Mathematical Programming Model
- Continued monitoring and adaptive management

Example 2:
South Florida Water Management District

- Inflow to maintain populations of an indicator species
- Examined salinity tolerance for key species of SAV
- Protect species= Protect habitats= protect dependent species
- *Proposed* approach



Approach

- Assessed distribution, salinity tolerances, and preferences of common SAV species
- Determine optimal salinity ranges
- Relate inflow to salinity
- Set inflow

Example 3: South West Florida Water Management District

Percent of Flow Approach:

- Suitable for un-impounded rivers
- Based on identification of non linear response of key variables to inflow
- Scale withdrawals to rate of inflow

Approach

- Average withdrawals < 10% of the average stream flow
  - No withdrawals during low flow
- Adjust by estuary to address specific issues (e.g. hypoxia)
  - Adaptive management

Recommendations for Puerto Rico: Establishing inflow to Estuaries

- Need legal authority and clear management objectives
- Studies needed to establish inflow relationships
- Consider approaches used elsewhere
- Different approaches for different regions & an adaptive approach

Research Needs

- Assess relationship between inflow and valued resources (e.g., fisheries; water quality) – Studies and monitoring of key estuaries
- Importance and timing of inflows for migrations of diadromous shrimps and fishes?
- Are environmental flows for rivers adequate for estuaries?

Thank you