Freshwater Discharge and Protecting the Coastal Ecosystem in Biscayne National Park

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Overview

- Ecological & Hydrologic Targets for Western Biscayne National Park

- Consideration for downstream ecosystem in water management
  - Specific conditions and goals
  - Triggers for dry season flow

- Hydrodynamic Model results
  - Best use of available water
  - Quantity, timing, and distribution
Historical Conditions in Biscayne Bay

“...You could dip a tin cup in the Miami River and bring up a crystal-clear drink, and there were places in the Bay itself where fresh cold water bubbled up.”

J. Muir (1953)

Collecting fresh water from a spring in Biscayne Bay approx. 1.2 km offshore from the Cutler area in 1890*

*NOAA Technical Memorandum NOS NCCOS CCMA 145
Changes in the Nearshore Areas

Historic trend of increasing salinity in the nearshore zone

Shift from estuarine or mesohaline conditions (5 to 18 ppt) to brackish or polyhaline conditions (18-30 ppt).

Modern groundwater flow is limited

Lack of freshwater head in coastal system leads to groundwater springs that stop flowing as tide falls.

Figure 6 – Vertical component of spring flow and water height (Star-Odly) gathered during July 21 to 24.

***From John Proni and Hector Casanova’s NOAA-AOML study on groundwater flow study, 2008, expanded report.
Biscayne Bay Simulation Model (BBSM)

Predicting salinity regime under alternate discharge scenarios

BBSM 2D model with:
- Advection and diffusion
- Rain and evaporation
- Wind stress
- Bottom friction
- Tidal mixing
- Surface water inflows*
- Model or observation based boundary conditions
Model Output

October 1, 0 hrs
2004

Wind
5 ms⁻¹

Salinity

Current
1 ms⁻¹

Canal discharge

80 m³s⁻¹
Alternative flow options using existing water

Constant temporal distribution
- Steady flow rate Oct. 15 to March 30
- Limitation: stage in canal will show steady decrease through dry season

Changing spatial distribution
- 3 different model scenarios split the constant flow across different areas

Goals:
- Hypersalinity prevention
- Reduce variation in salinity
Modeled Scenarios:
What is the best way to use 63 kaf freshwater to benefit Biscayne National Park?

• **Slow_ag**
  – Release 63 kaf, split between two canals (S21A, S20F), over the period from Oct. 15 to March 30th

• **Culverts_ag**
  – Release 63 kaf at Slow-Ag rate through coastal region via planned culverts in L31E

• **Redistributed_ag**
  – Release 63 kaf at Slow-Ag rate through the above culverts and three canal structures (S20F, S21A, and Military Canal)
Modeled Results – Base Conditions
Plot shows reduction in salinity from release of fresh water from agricultural drawdown
Assessing Environmental Impact

- Diminishing returns with increasing flow rate
- Driven by mixing dynamics

Suggests, through observations, there is an optimum flow rate for salinity reduction
Modeled Results – Slow_ag
Modeled Results – Slow_ag

October 14, 0 hrs 2004

October 17, 0 hrs 2004

November 1, 0 hrs 2004
"Life support"
Maintains a pocket of productivity through dry season
Alternative approach to protecting the bay:

Suggest minimum flow rate of 82 cfs if salinity is above *mesohaline conditions* at BISC14 *late in the dry season*
Q & A Session

- Model related
- Storage, seasonality
- Acreage and bottom types
- Total flow to Biscayne Bay

- Other comments or concerns
References


And others referenced in:


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