Estimating the Delaware Inland Bays Watershed Seasonal Population Using Wastewater Flows

By: Brittany Kiessling
Outline

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  – Hypotheses
  – Goals
• Overview of previous estimates
  – Delaware Visitor Profile Study
  – Demoflush
• Application of Demoflush
  – Visitor estimation formula
• Results
• Conclusions
Introduction

- **Questions:**
  - How much does the population of the DIB watershed fluctuate seasonally?
  - What are the trends from year to year?
- **Hypothesis:**
  - Seasonal population increases from 1990 to 2005, relative to permanent residents.
- **Goals:**
  - Gather wastewater flow data from 1990, 2000, and 2005
  - Use OC, MD “demoflush” formula to calculate population
  - Graph monthly visitor population fluxes
Why is this important?

- Seasonal population numbers as environmental indicator
- Population as ecological stressor
- Seasonality of human impacts
- Data can inform legislation, future development, assessment of facilities
2005 Delaware Visitor Profile Study

- Quarterly tourism data for the 3 Counties
- On-going mail and internet survey
- Tracks American travel behavior
- 60,000+ households surveyed
- Margin of error of +/-0.4 percentage points
- Focus areas
  - Visitor volume
  - Trip characteristics
  - Demographics
Correlates of Population

- Water pumped
- Wastewater flow
- Electricity consumption
- Volume of mail handled
- Sales tax revenue
Demoflush

• Ocean City, MD needed method of estimating seasonal population
  – Census data only described permanent residents
  – Peak summer population estimates had wide range
  – More accurate estimate needed for health services plan

• Why wastewater flow?
  – Specific for OC
  – Convertible to population
  – Less responsive to outside variables
  – Data easy to obtain
Application of Demoflush

- Demoflush model successful
- Delaware inland bays watershed similar to Ocean City resort community
  - Seasonal population flux
  - Neighboring Coastal communities
- Wastewater data attainable
- Larger scale
- Multiple wastewater facilities
- Multiple municipalities
Visitor Estimation Formula

\[ z = \frac{(s-a-bv)}{c} \]

- **Z**: mean total visitor population (in a given period)
- **S**: mean total wastewater flow (mgd)
- **A**: mean groundwater infiltration (gal/day)
- **B**: avg. wastewater per permanent resident (gal/day)
- **C**: avg. wastewater per visitor (gal/day)
- **V**: mean number of permanent residents
Constant Values

- $a = 570,000$ gal/day (infiltration)
- $b = 70$ gal/day (permanent resident)
- $c = 36.04$ gal/day (visitor)
- Values based on Ocean City’s data
Wastewater Facilities

- Rehoboth Beach
- Georgetown
- Lewes
- South Coastal Regional
- Millsboro
- Inland Bays Regional
- Piney Neck Regional
- Wolfe Neck Regional

(Wolfe Neck Regional WWTP)
Assumptions

- No differentiation between day visitor and overnight visitor (simplified formula)
- Permanent residents stay year-round
- Infiltration is the same for each facility and same as Ocean City’s
- 2005 population estimates reliable
- Service area of Rehoboth is same as Rehoboth census data
2005 Wastewater Flows for Five Treatment Facilities
Estimated Number of Visitors to Rehoboth Beach in 2005

- Permanent residents: 1,556
- Oct. - Mar.: 5,830 avg. visitors
- Peak # of visitors: July, 48,056
- Apr. - Sept.: 28,832 avg. visitors
Potential Next Steps

- Must consider WW flow of septics.
- Day vs. overnight visitor?
- Specific infiltration for each facility?
- Seasonal water use rates?
- Determine service area of each facility still needed.
Conclusions

- Wastewater flows increase during summer months at most facilities; suggest drastic fluctuation in population
- 2005 has greater wastewater flows than 1990, showing increase in population from year to year
- Seasonal population of entire watershed will be estimated

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Land Use and Nutrient Load Changes</th>
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<tbody>
<tr>
<td>Type</td>
<td>Condition and communication (not stressor b/c doesn’t show cause and effect relationship</td>
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<tr>
<td>Spatial Scale</td>
<td>Entire wetland</td>
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<tr>
<td>Temporal Scale (min) (rpt)</td>
<td>Once every 5 years to compare seasonal changes</td>
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<tr>
<td>Validity</td>
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<tr>
<td>Defensibility</td>
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<td>Communicability</td>
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<tr>
<td>Potential for Public Involvement</td>
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<tr>
<td>Existing Data</td>
<td>Time period- 15 years Additional data- low</td>
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<tr>
<td>Funding Reliability</td>
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<tr>
<td>Reference (now) (future)</td>
<td>Now- no Future- yes (carrying capacity)</td>
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<tr>
<td>Merit</td>
<td>High</td>
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</tbody>
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Questions?