Ecological Flow Modeling to Determine Habitat Availability During Low-Flow Periods In the Shenandoah River Basin

Jennifer L. Krstolic
Shenandoah Valley Water Conference
October 28, 2008

Northern Shenandoah Valley Regional Commission
Central Shenandoah Planning District Commission

In Cooperation with the US Geological Survey
What is an Ecological Flow? (MIF, Thresholds, Conservation Flows)

Set of streamflow conditions that support the needs of the biological community

Enhance understanding of low-flow conditions
Relate water-availability to habitat needs of fish

http://pubs.usgs.gov/sir/2006/5025/
Ecologically Focused Drought Assessment

Precipitation Deficits
Streamflow Statistics -> Fish Habitat Availability
Ground-Water Levels
Reservoir Storage

Fish photos: Jenkins, R.E. and Burkhead, N.M. (1993) and Google images

USGS science for a changing world
How are Ecological Flows Developed for Water Resources Management?

- Select a biological measure of concern
- Quantify river habitat characteristics
- Characterize flow regime
- Determine species habitat preferences
- Model flow scenarios to demonstrate ideal to unsuitable habitat conditions
Flow Duration: Monthly Statistics and 28-day Average Streamflow at Cootes Store

--- Provisional Data Subject to Revision ---

http://va.water.usgs.gov/duration_plots/htm_28/dp01632000.htm
Quantify Habitat Suitability Criteria for a Diverse Warm Water Fish Community

Measure *ecologically relevant* physical habitat characteristics and behaviors

- How are fish behaviors related to location in the water column (top, middle, bottom) or water velocity?

Measurements:

- Identification to species (30+)
- Total water-column depth
- Average water velocity
- Behavior (feeding, holding, fleeing)
- Bed material and cover (grass, bedrock, logs)

Photo from www.fishbase.org
Fish Habitat-Suitability Curve Field Methods

- Snorkeling
- Pre-positioned electro-shocking
- Habitat Suitability Curve

![Graph showing depth suitability vs. depth in feet]
Cootes Store Habitat-Discharge Relation and Low-Flow Statistics

![Graph showing fish guilds and discharge relation.](image-url)
1999, 2007 Habitat and Flow Conditions: Riffle and Fast-Generalist Fish

1999 Drought Conditions: July Flows = 1st Percentile

2007 Normal Conditions: July flows = 25\textsuperscript{th} Percentile

Below Normal Conditions: October flows = 24\textsuperscript{th} Percentile
How do we Establish Thresholds Indicate both Habitat and Water Availability?
Evaluate Ecological Flows Against 1999 Drought Year
Evaluating Ecological Flows: Drought Thresholds Used in Local Plans

Upper Shenandoah River Basin
Draft Drought Response and Contingency Plan
Drought Watch Indicators for Broadway:
“Cootes Store USGS gage between 25th and 10th percentile”

Watch = 15 cfs – 4.6 cfs

Ecological Flow Thresholds presented in the last slide:
Watch = 40 cfs
Warning = 14 cfs
Emergency = < 4.4 cfs
Questions?

Northern Shenandoah Valley Regional Commission
Central Shenandoah Planning District Commission
Virginia Water Science Center
Jennifer L. Krstolic
jkrstoli@usgs.gov
Model Development to Identify Ecological Flows

- Mesohabitat Classification
- Fish Community Assessment
- River Hydraulics
- Habitat Simulation Model
- Habitat Area
- Discharge