Water Quality in the North Fork Shenandoah River during the Drought of 1999: Implications for Minimum Instream Flow

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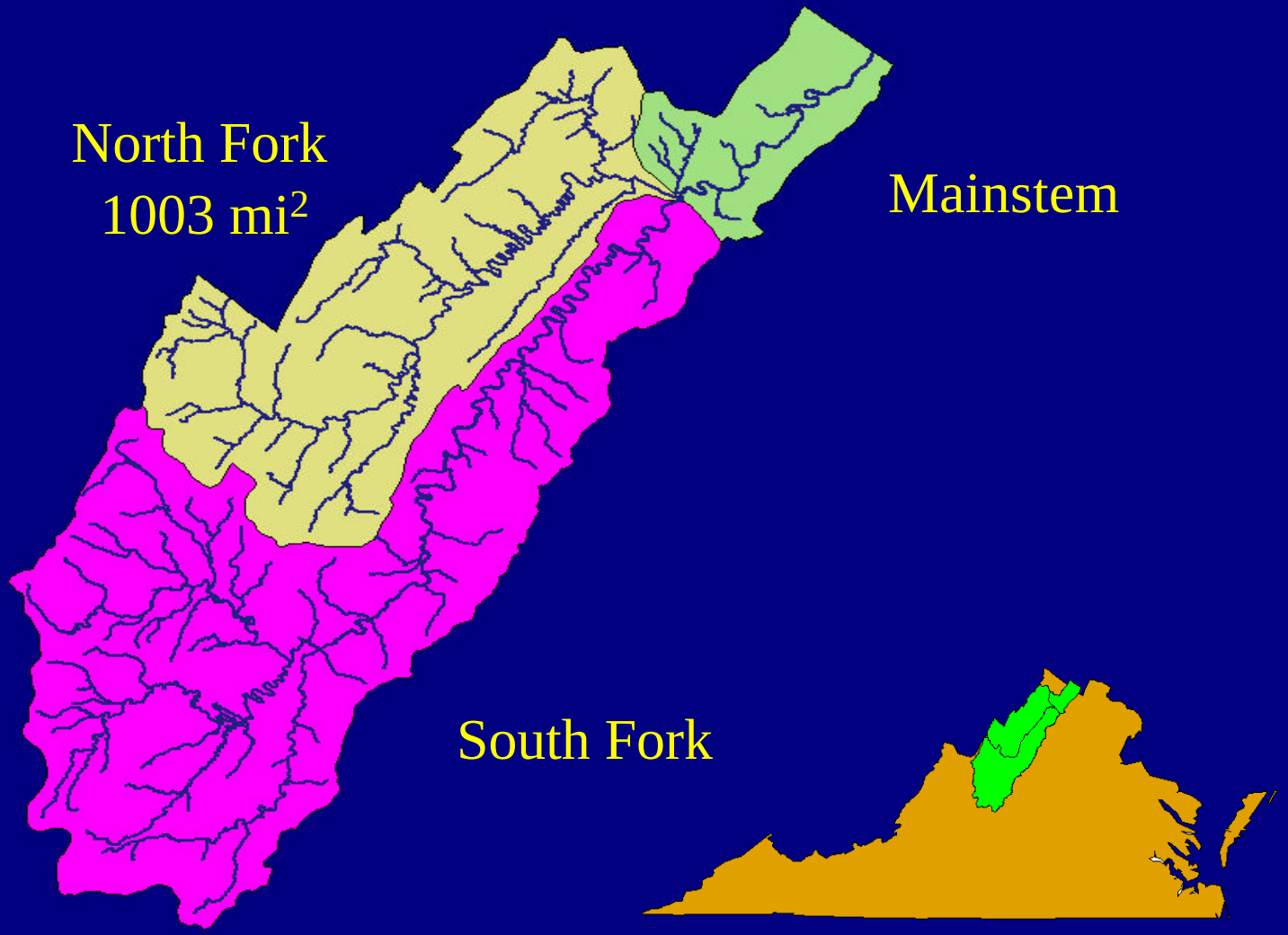
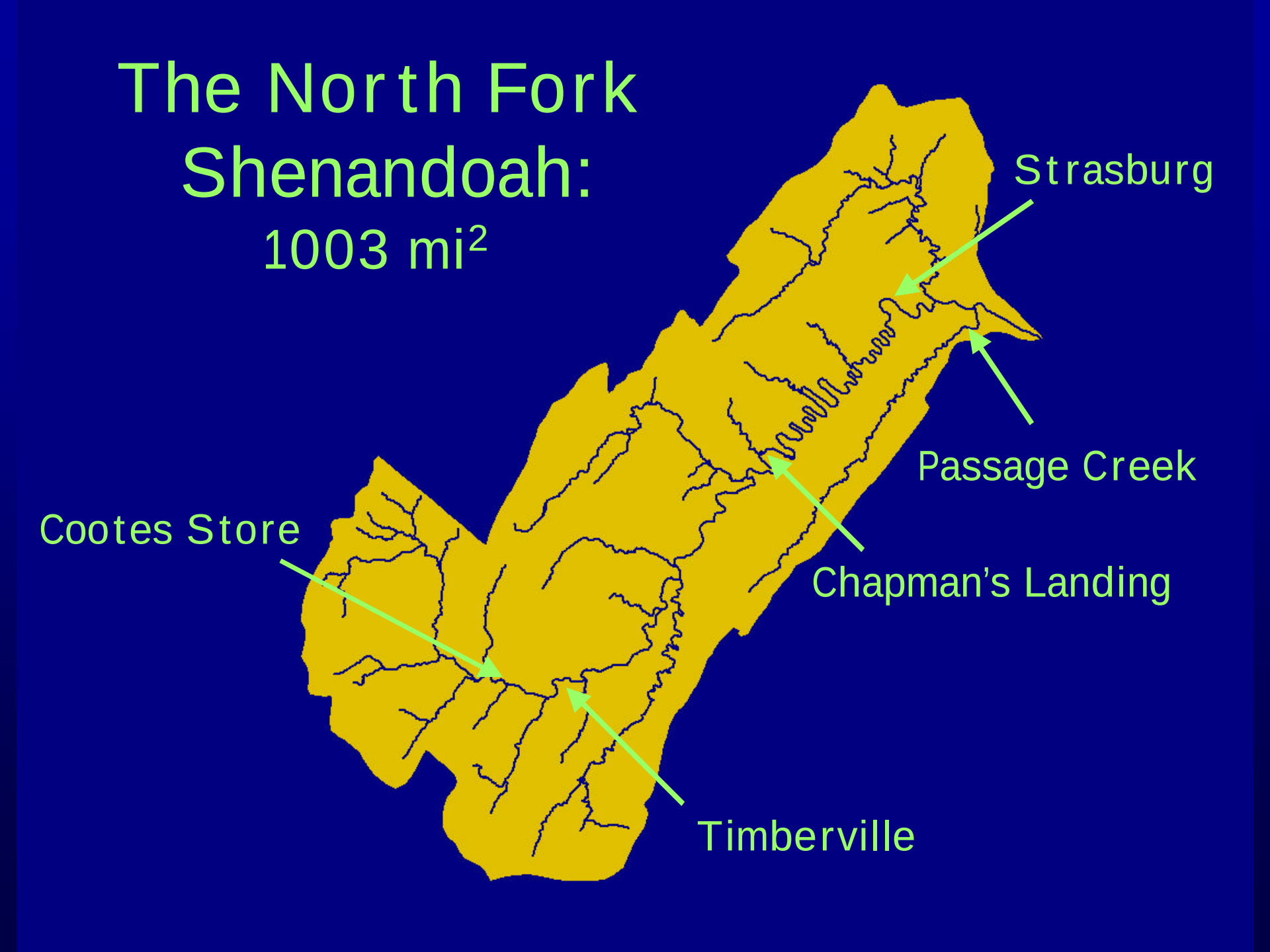
Donald J. Orth and Tammy Newcomb

The Shenandoah River Drainage

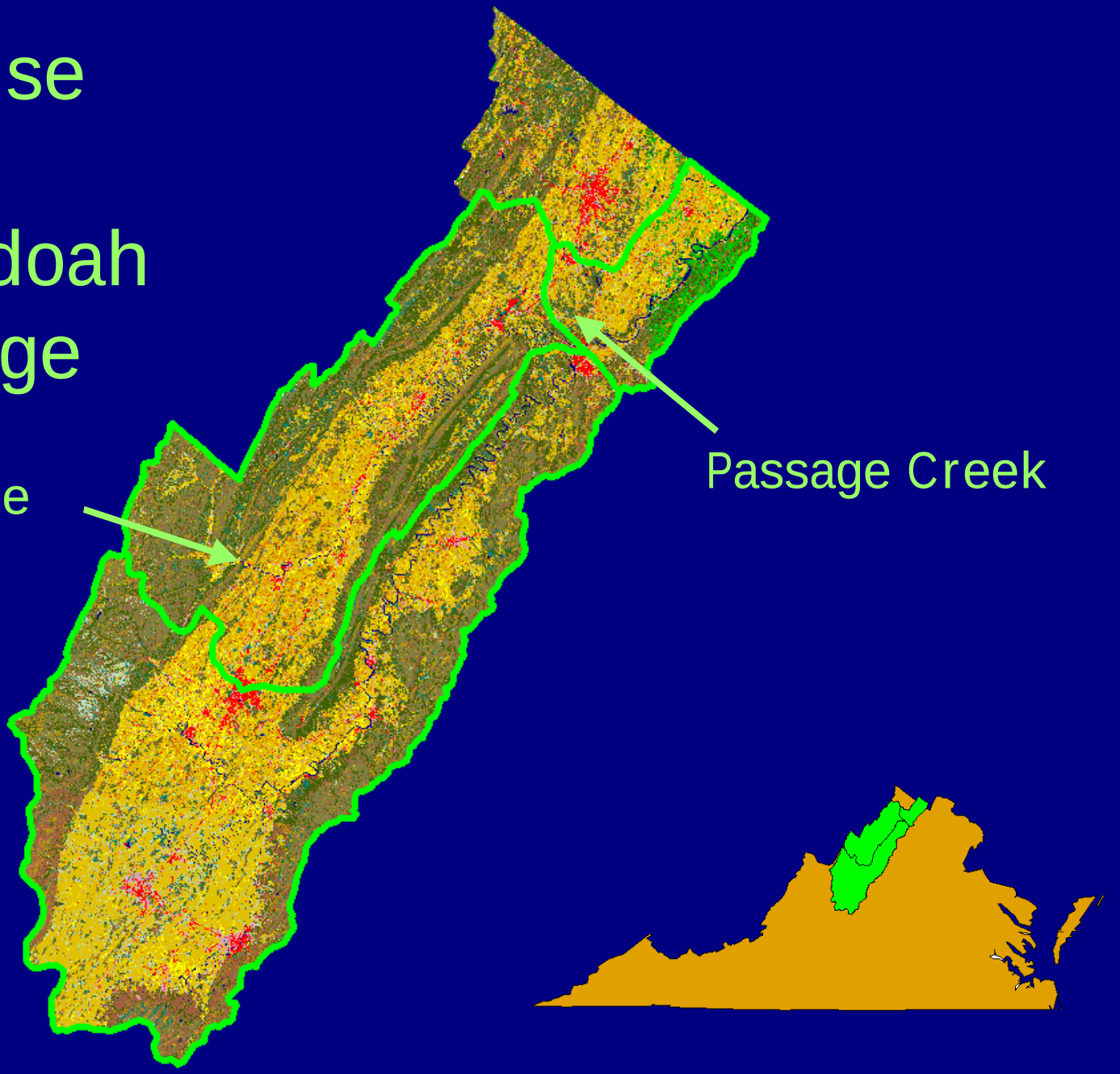


The North Fork Shenandoah:

1003 mi^2



Land Use in Shenandoah Drainage

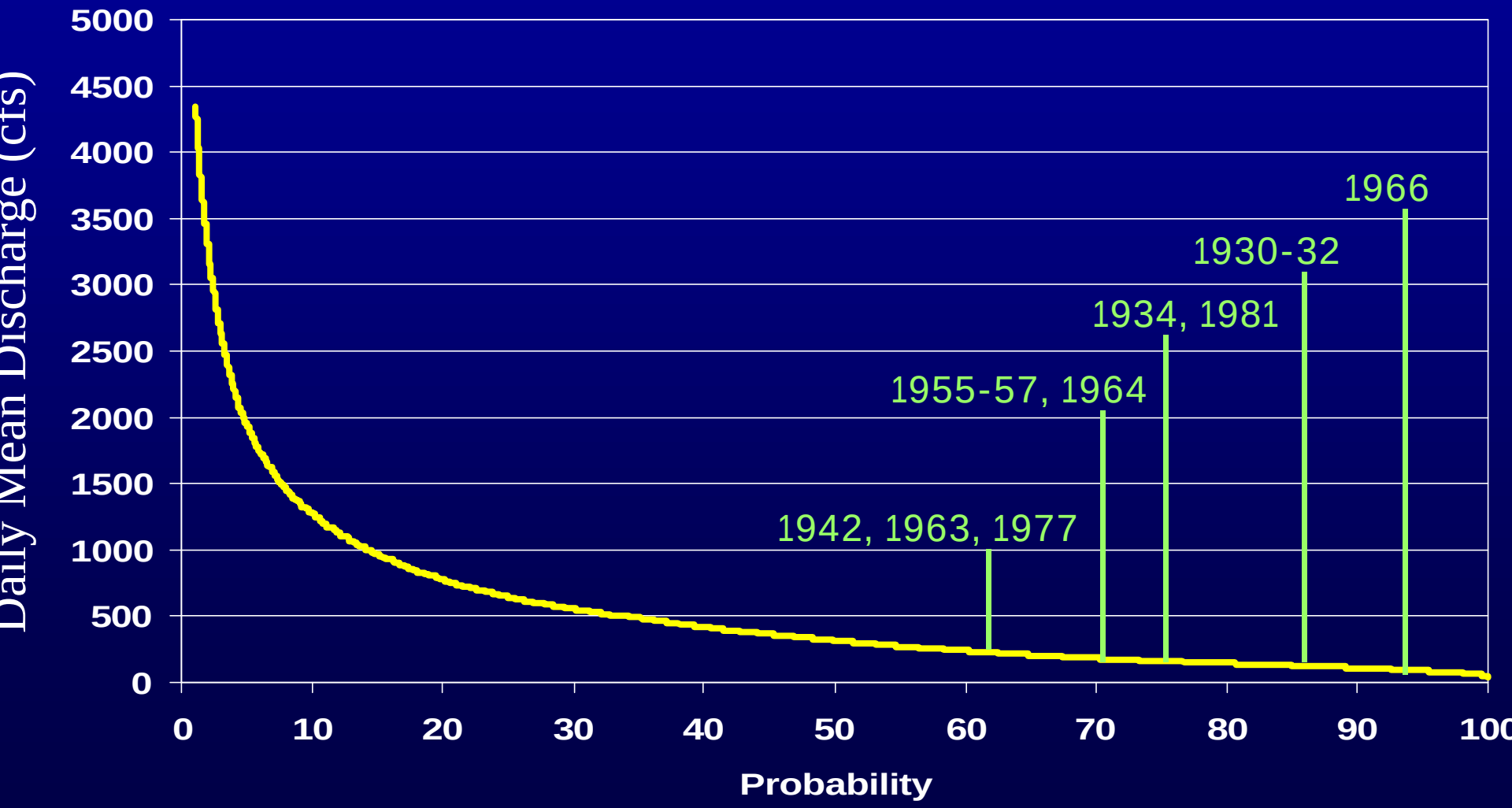


The North Fork Shenandoah River

The Shenandoah River: Water Issues

- Water Demand (Supply/Irrigation/Interbasin Transfer)
- Water Quality - Instream Needs (Smallmouth bass & other fish growth/abundance)
- Water Distribution (Recurring Drought)

N. F. Shenandoah, Strasburg (VA) Gauge, Flow Exceedance Curve (1925-1998)



Cooperators

Lord Fairfax Planning District Commission

U.S. Geological Survey, Water Resources Division

Virginia Department of Game and Inland Fisheries

Virginia Tech, Fisheries & Wildlife Sciences Department

and others

N. F. Shenandoah: Management Needs

1. Develop reliable set of tools for assessing instream flow needs

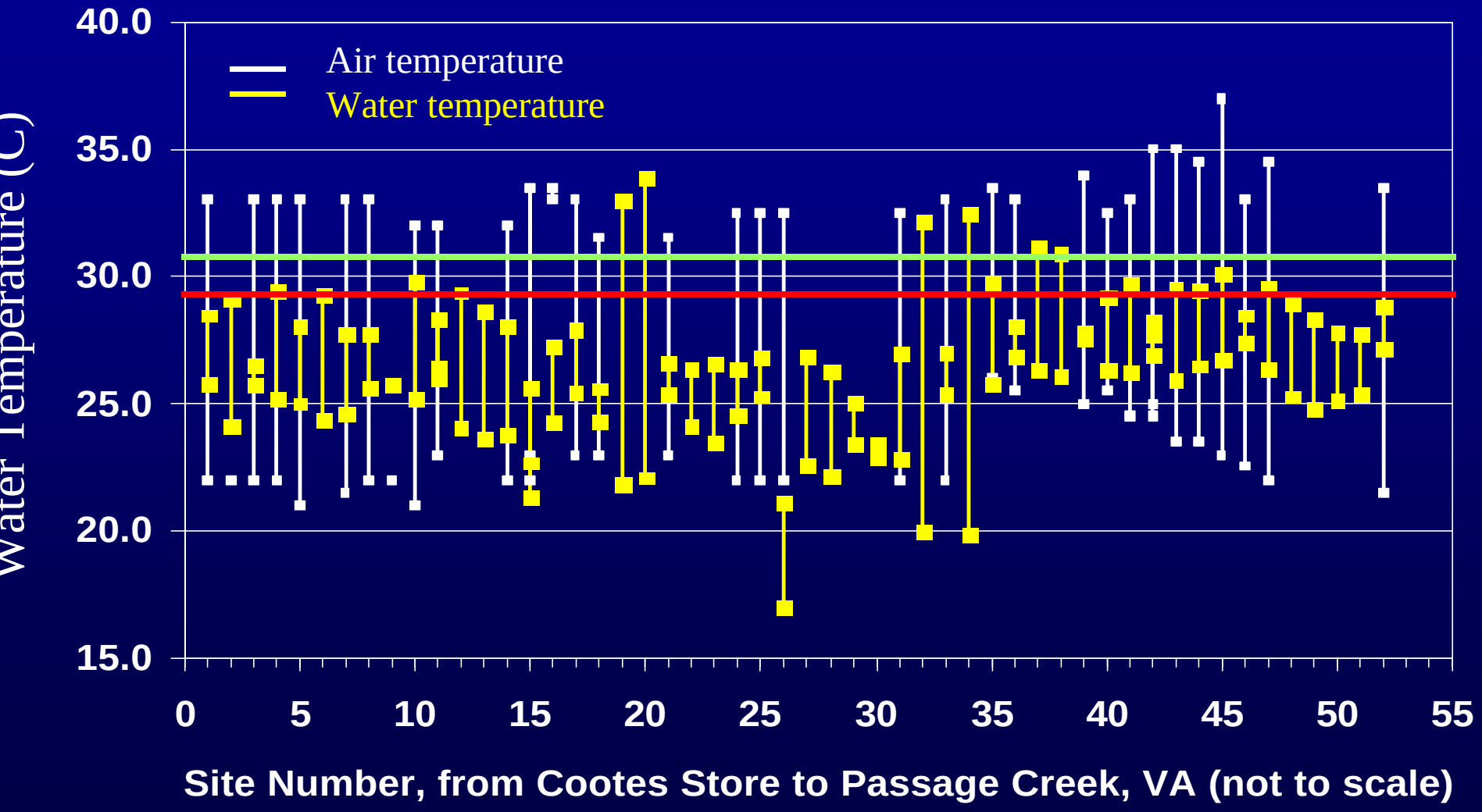
2. Relate population dynamics of smallmouth bass and other fishes to habitat variability

3. Include land-use and flow effects on water quality and quantity

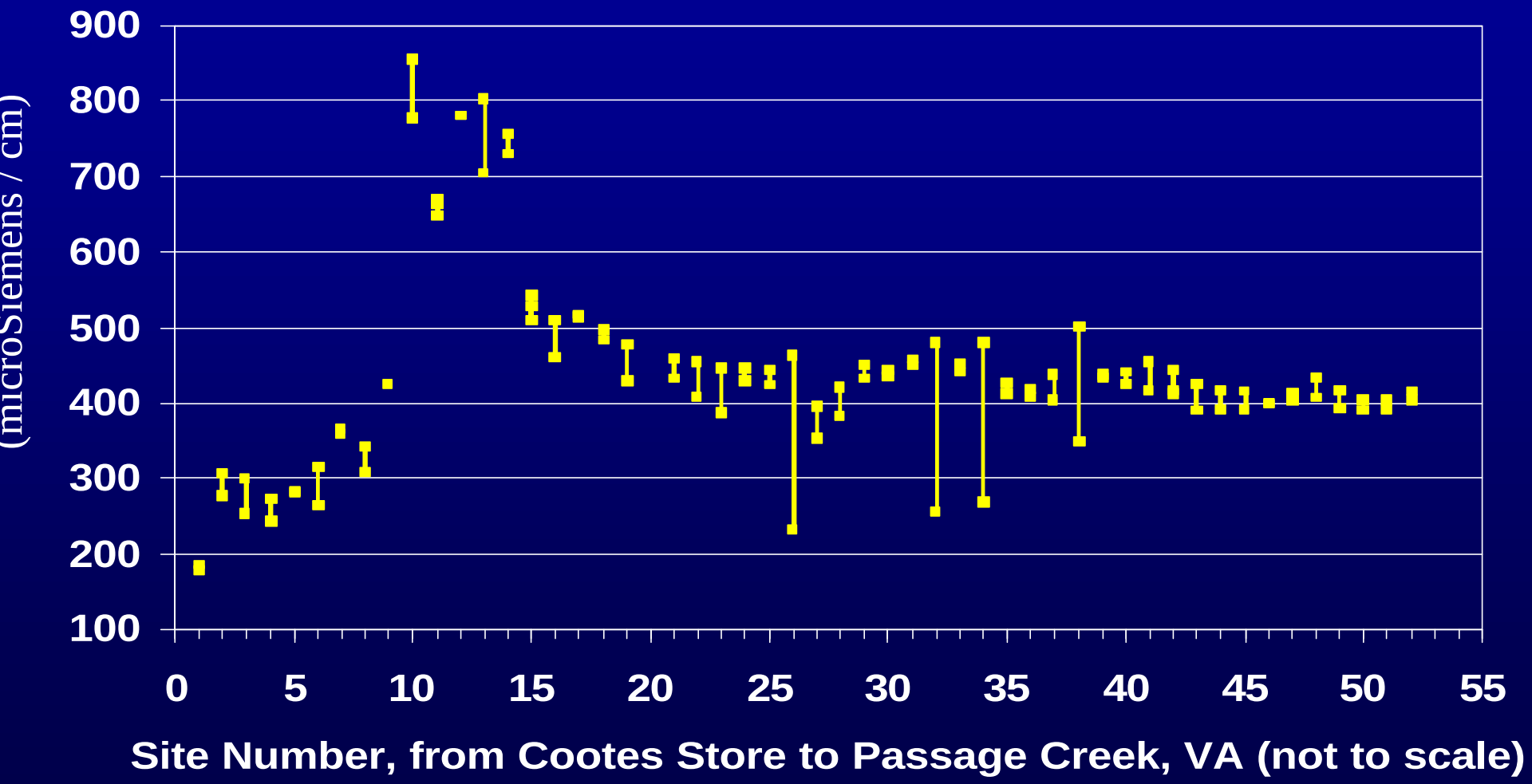
Methods

- Water Quality Investigation, July 12-30, 1999
- Examined Temperature, pH, Conductance, D.O.
- Combination Effort
  - Pre-Dawn & Mid-Afternoon Point Sampling
  - Continuous Water Monitoring (1-8 days)
- Data was collected by USGS
- YSI 6-Series Multiparameter Meters

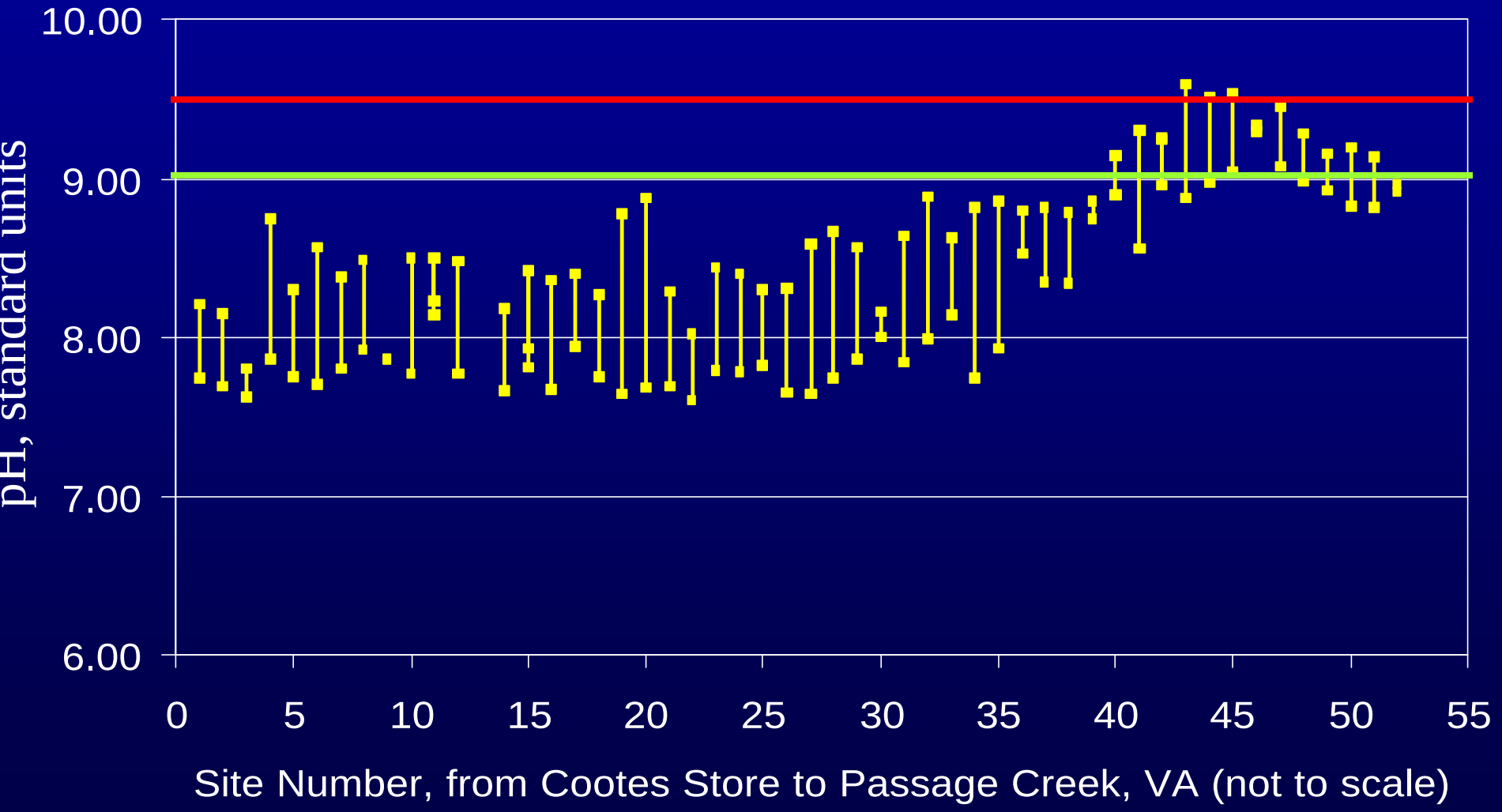
N.F. Shenandoah, July 12-30, 1999
High/Low Temperature



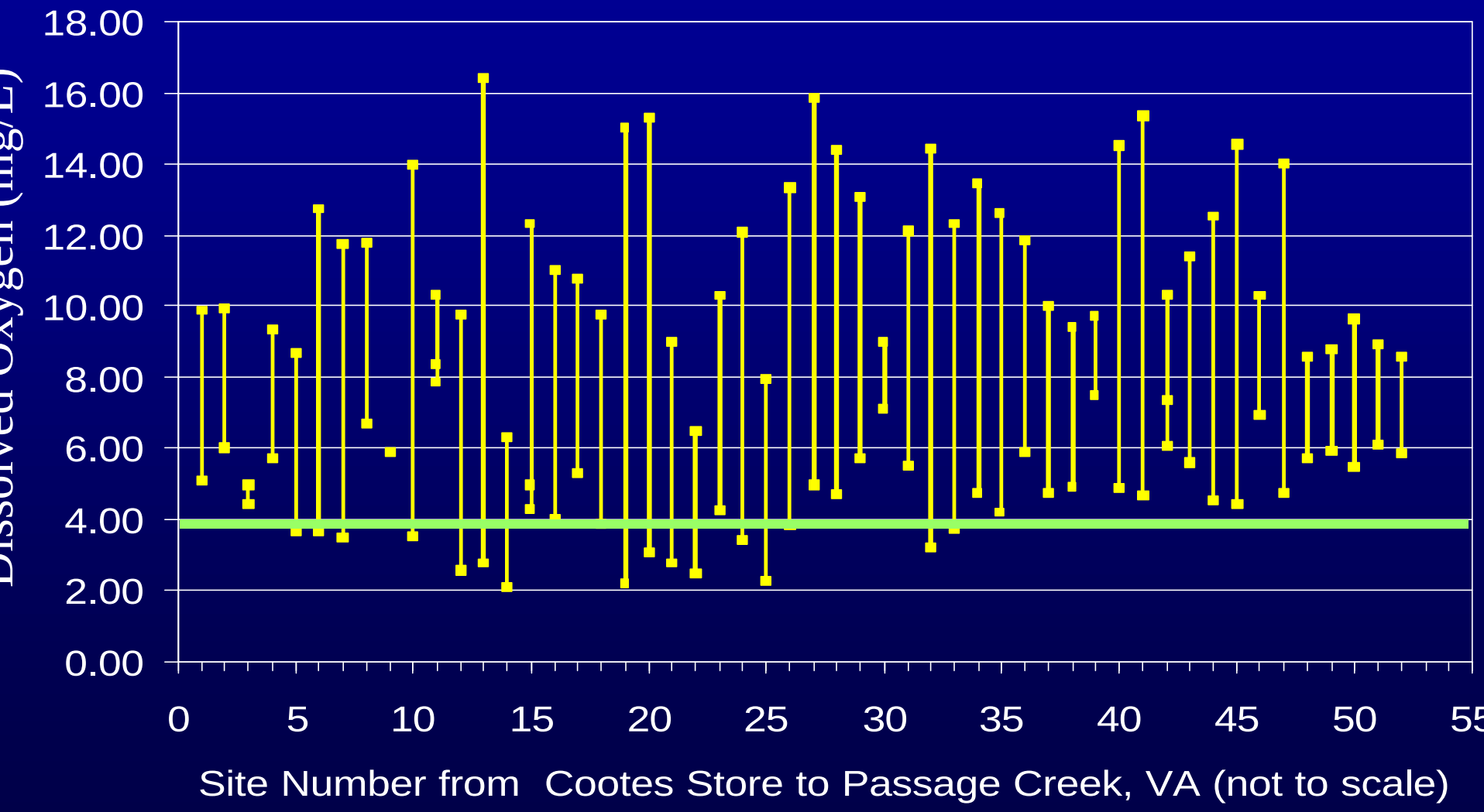
N.F. Shenandoah, July 12-30,1999 High/Low Specific Conductance



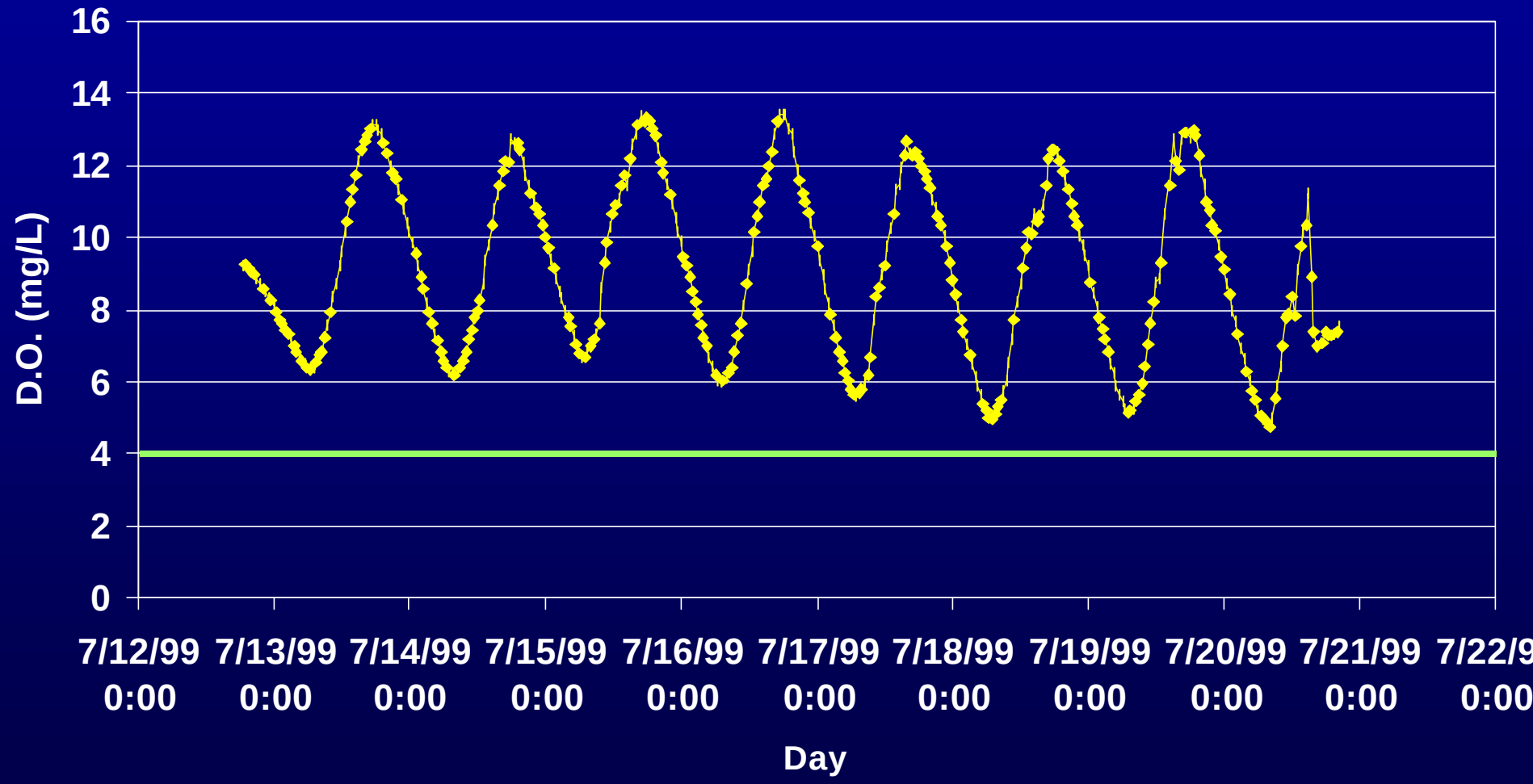
N.F. Shenandoah, July 12-30,1999
High/Low pH



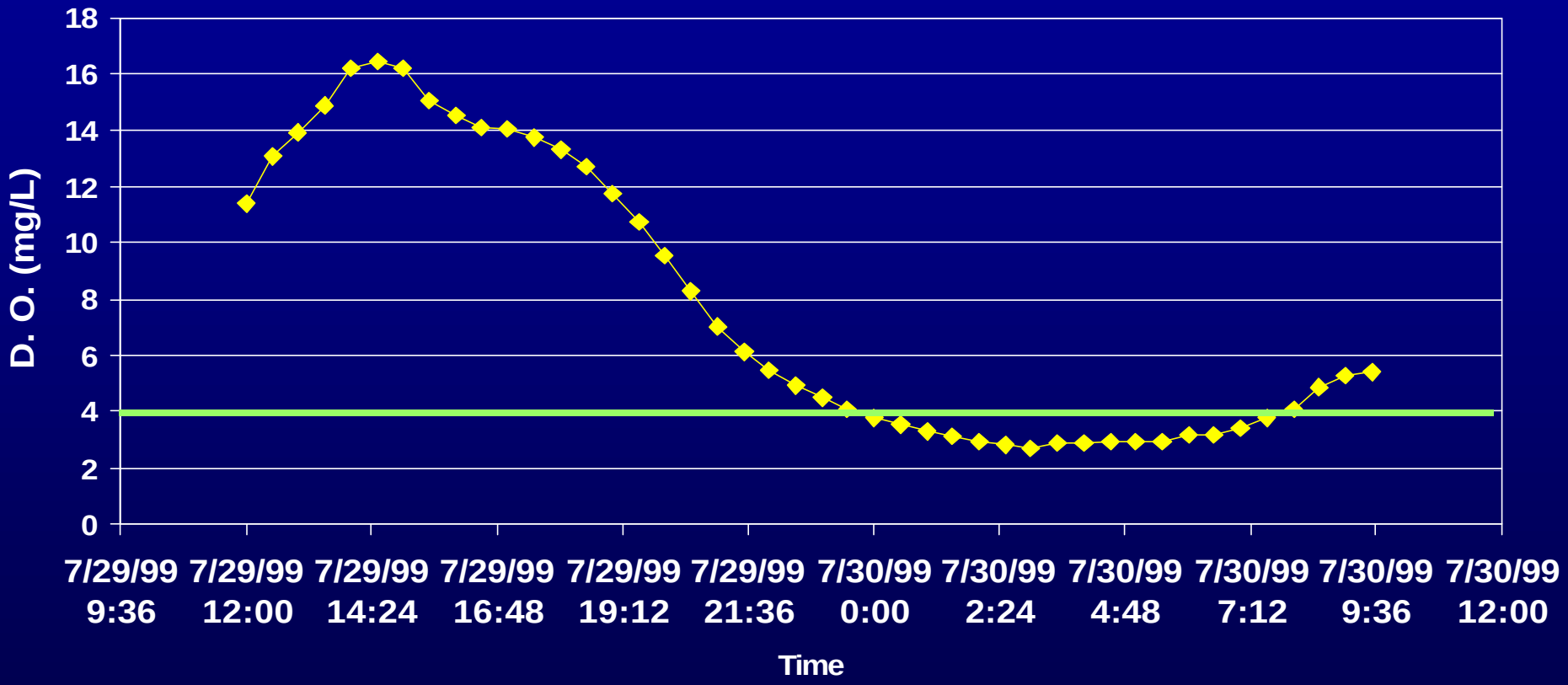
N.F. Shenandoah, July 12-30, 1999
High/Low Dissolved Oxygen



Dissolved Oxygen at Chapman's Landing, N.F. Shenandoah, VA



Dissolved Oxygen downstream of Timberville, VA, in N.F. Shenandoah



Implications for Instream Flow Regulation

What are the critically limiting resources?

When are these resources in short supply?

When and where are these resources at risk?

How low can we go?

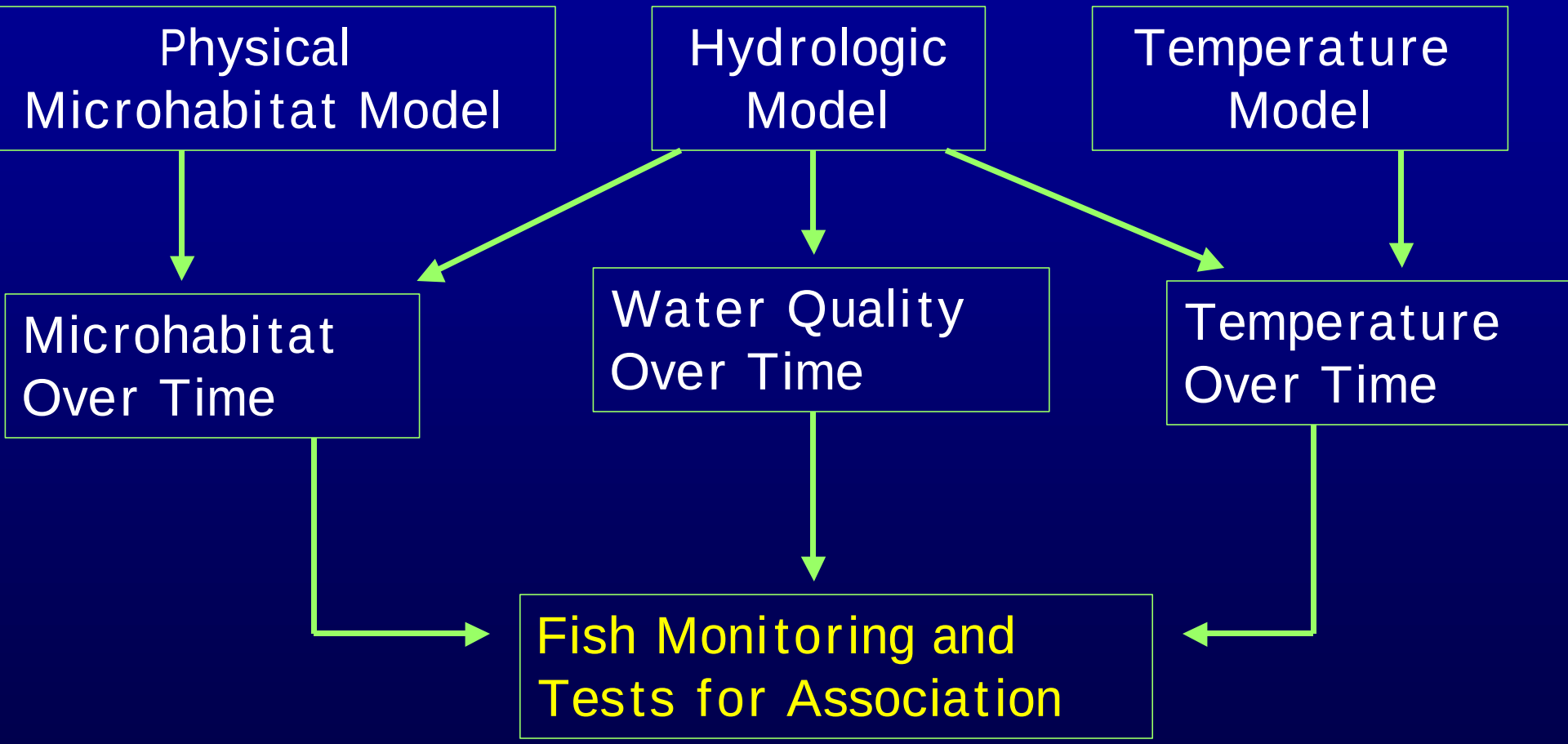
Tests For Associations

Biological Metrics

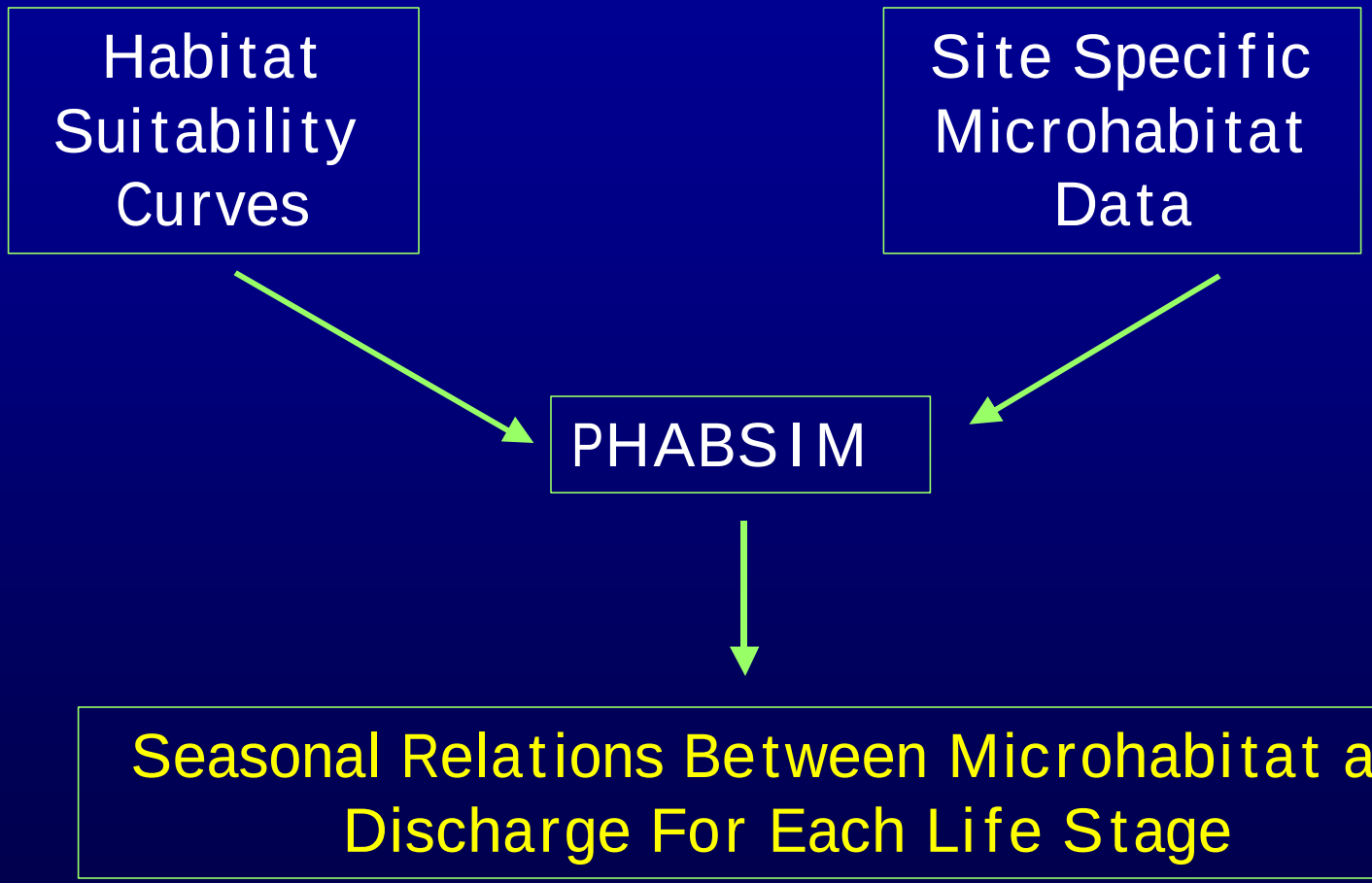
- Year-Class Strength
- First Year Growth
- Species Richness
- Biological Integrity

- Water Quality
  - DO flux, BOD, nutrients
  - extreme event analysis
- Physical Habitat
  - usable habitat
  - extreme event analysis
- Temperature
  - extreme event analysis

Study Plan


Physical Microhabitat Model
Hydrologic Model
Temperature Model
Microhabitat Over Time
Water Quality Over Time
Temperature Over Time
Fish Monitoring and Tests for Association

Microhabitat Model



Study Plan Components

- **Physical Habitat Component 1999-2001**
- **Water Quality Sampling - 1999**
- Microhabitat Suitability Criteria Development & Testing ?
- Temperature Modeling ?
- Water Quality Modeling ?
- GIS-LandUse-Nutrient Loading Modeling ?
- Time Series Analysis ?

The Goal: Available Instream Habitat

limate

River Physical Habitat (Discharge)

iology

Smallmouth bass Suitable Physical Habitat

andUse/Climate

Temperature

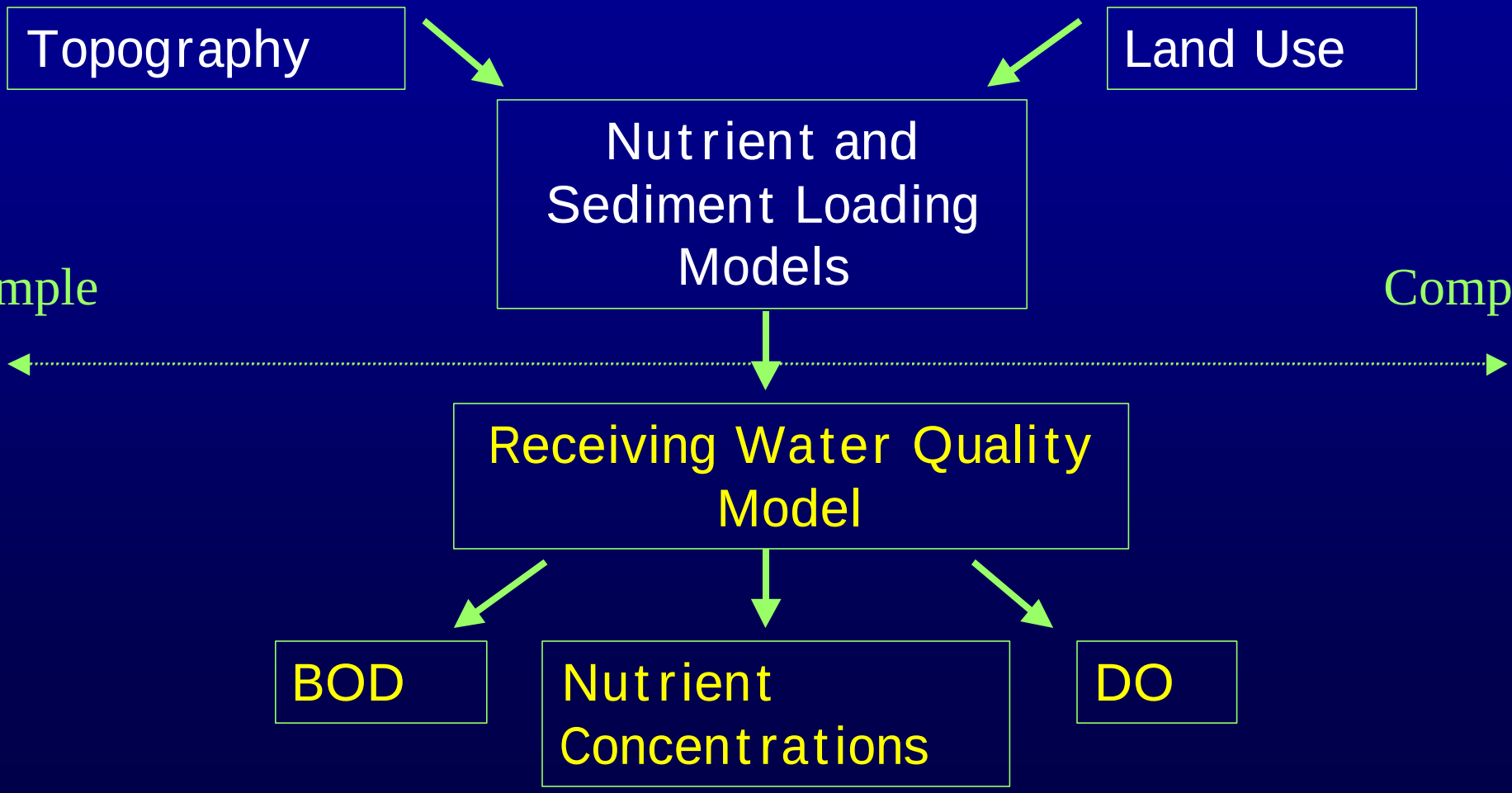
andUse/Climate

Dissolved Oxygen

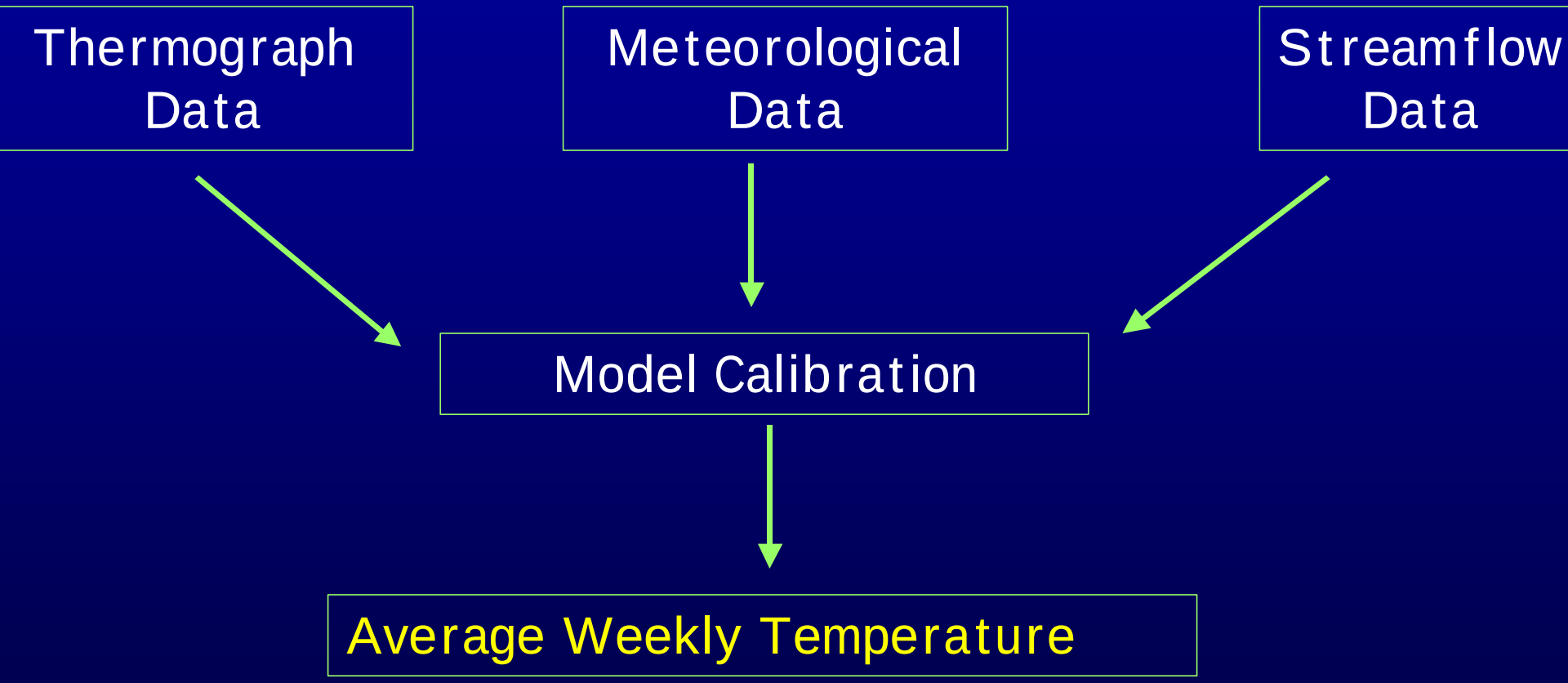
Available

Habitat

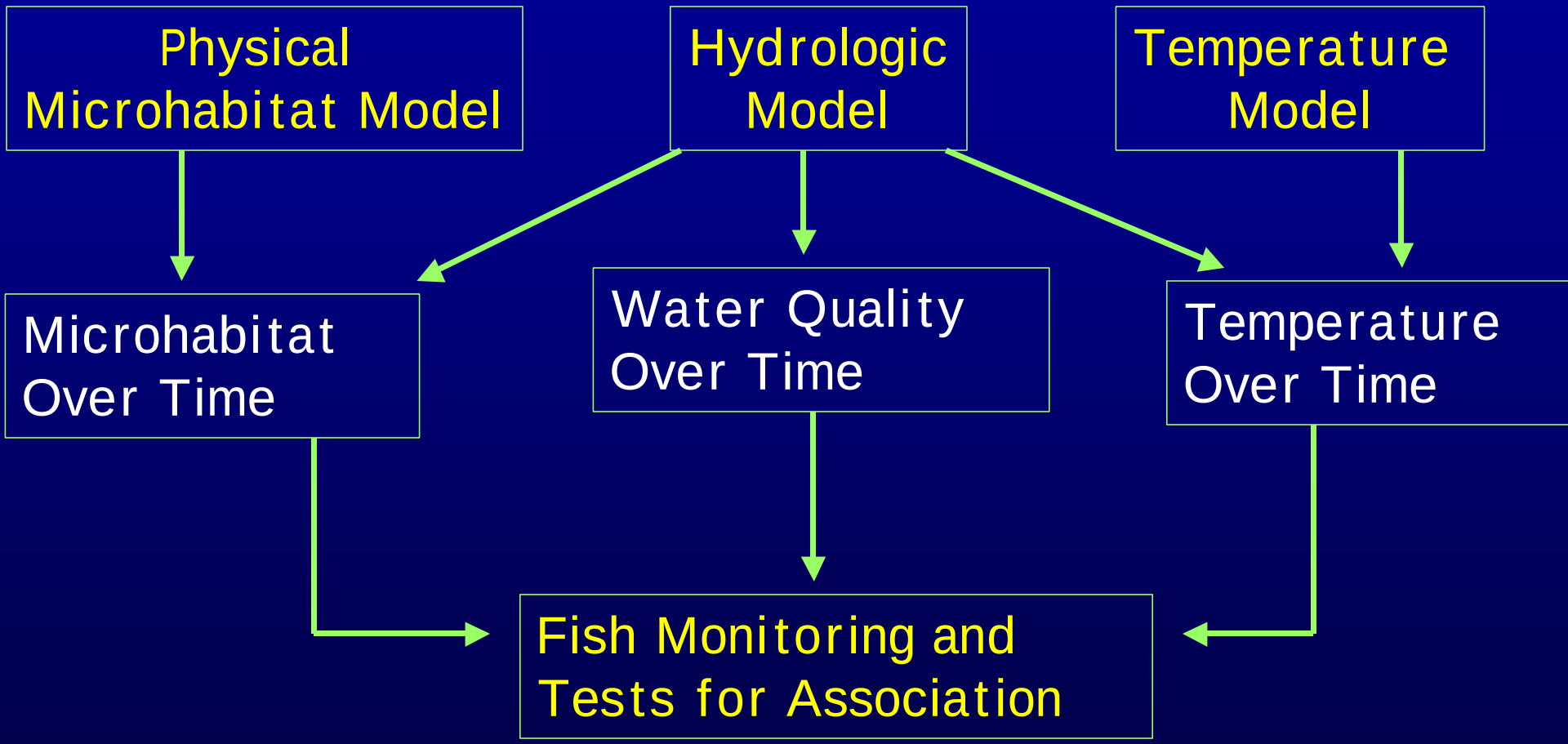
Watershed-scale Loading and Water Quality Models



Temperature Model



Study Plan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Acknowledgments

- Friends of the North Fork (Pat Mayer)
- Landowners along the North Fork Shenandoah
- Funding of this component by VDEQ
- Funding of Physical Habitat component by Virginia General Assembly