Connecticut River, view from Gillette Castle, East Haddam, CT
Photo: © Jerry and Marcy Monkman/www.ecophotography.com

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The Connecticut River Watershed Study:

A Basin-Scale Approach to Finding Water Management Solutions for People and Nature

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Introduction: Connecticut River Watershed

- 410 miles
- 7.2 million acres
- 20,000 tributary miles
- 19,600 cfs
- 2.3 million people
- 3,000+ dams

Map: P. Stickler, NH TNC, 2011

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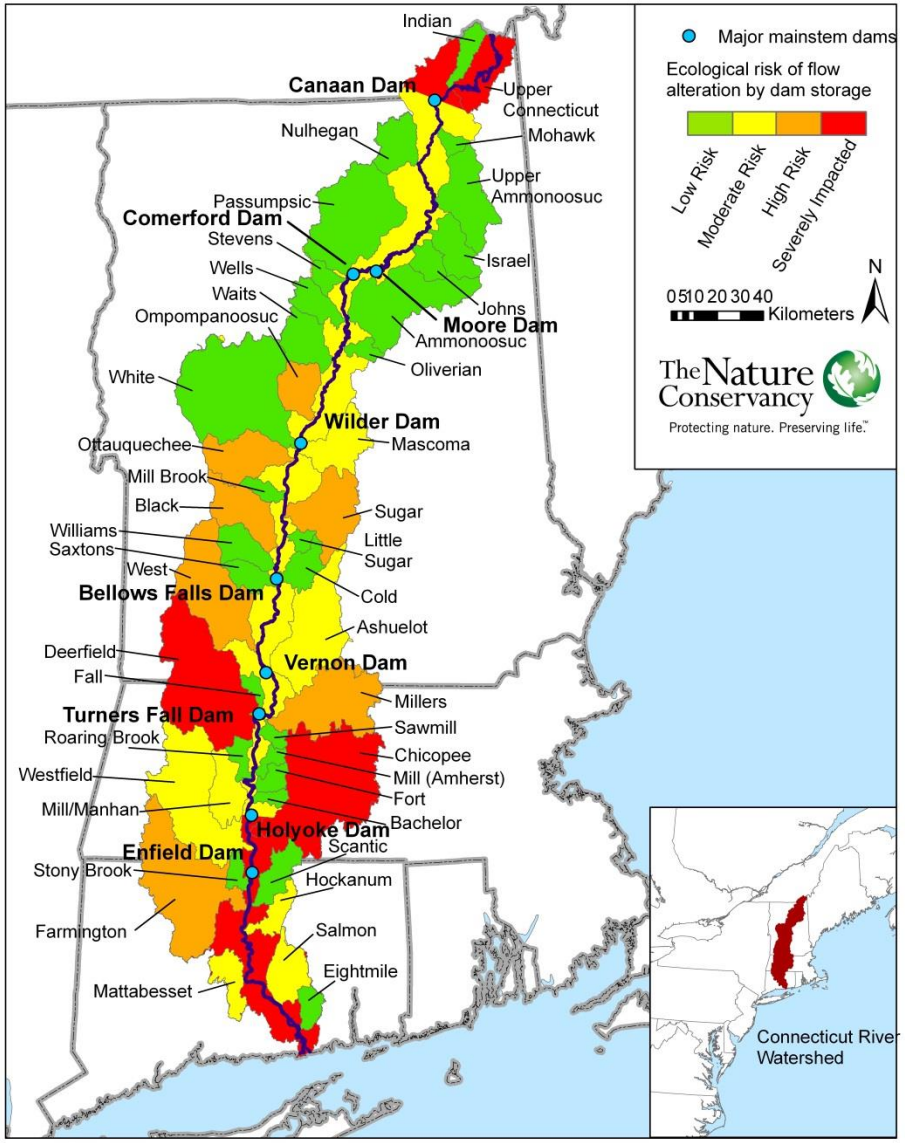
Ecological Risk of Flow Alteration by Dam Storage

- Spatial assessment of risk of flow alteration for tributaries to the Connecticut River
- Detailed hydrologic analysis of West and Ashuelot Rivers
- Summary report of links between flow, physical processes, and ecological targets for the Connecticut River and tributaries
- Analysis of hourly flow variability downstream of hydro and flood control dams
- Analysis of floodplain sites – potential sites and sites that still flood, categorized by land use



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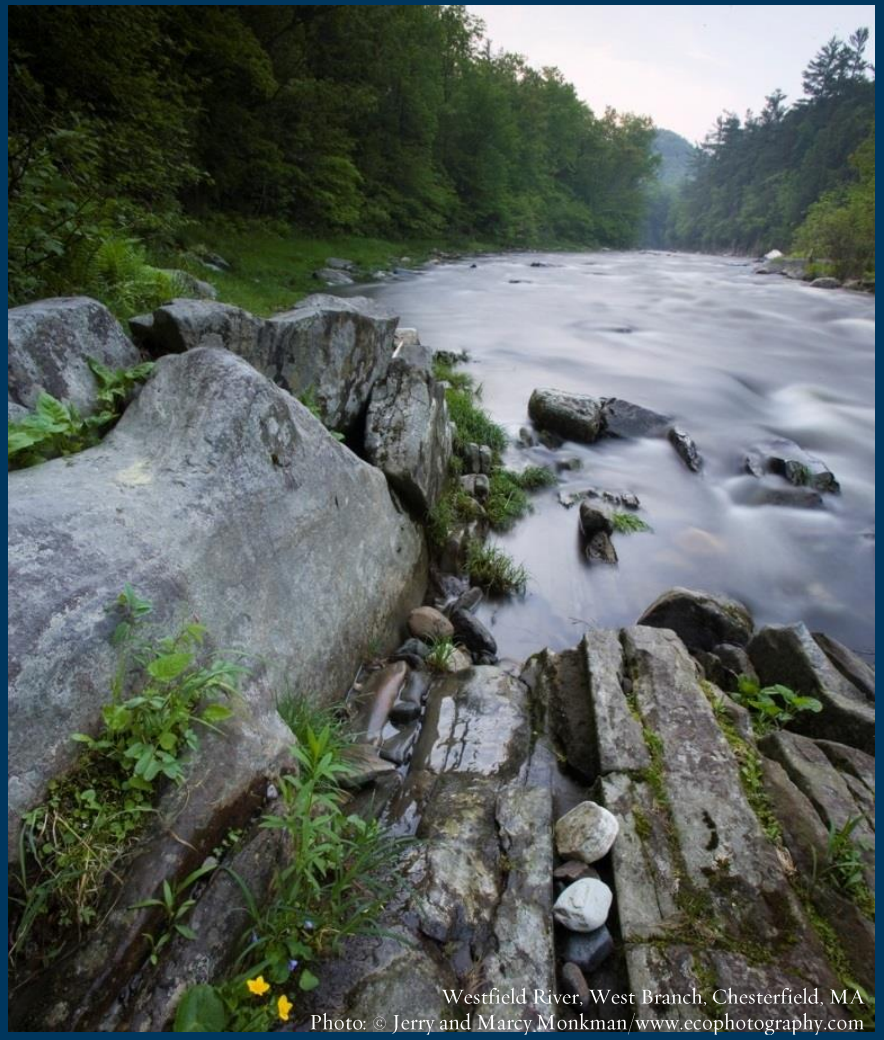
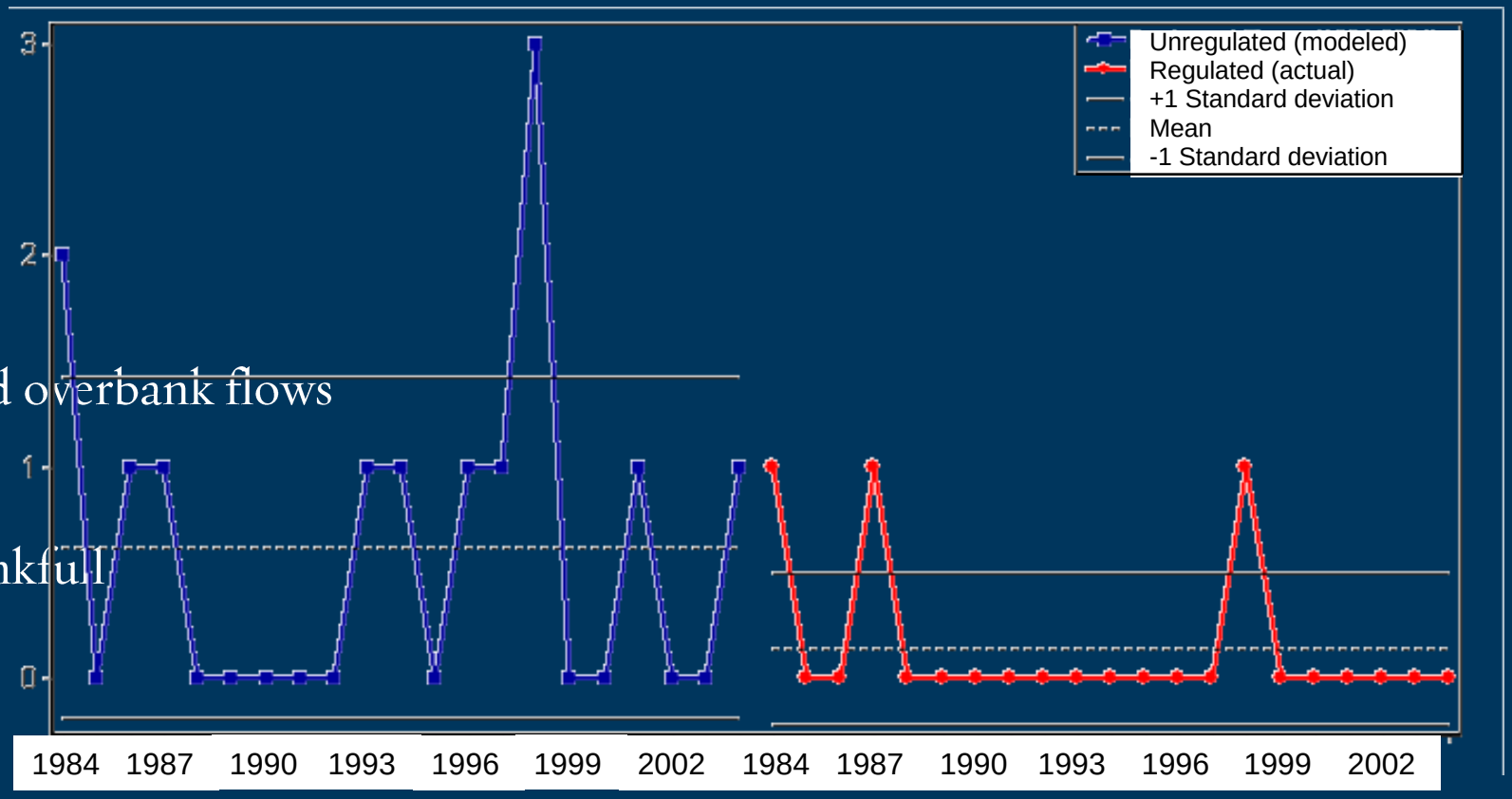
Ecological Role of the Natural Flow Regime



Westfield River, West Branch, Chesterfield, MA
Photo: © Jerry and Marcy Monkman/www.ecophotography.com

- Nutrient transfer
  - Lateral – to and from floodplains
  - Longitudinal - downstream
- Reproductive/dispersal cues
- Habitat structure and composition
  - Depth, velocity, shear
  - Temperature
  - Substrate
  - Woody debris
  - Vegetation
- Habitat availability
  - High flows: floodplain nursery habitat
  - Low flows: shallow spawning habitat
- Community structure
  - Floodplain
  - In-stream

Ball Mountain Dam, West River



and overbank flows

bankfull

Frequency of

Flows above 4350 cfs

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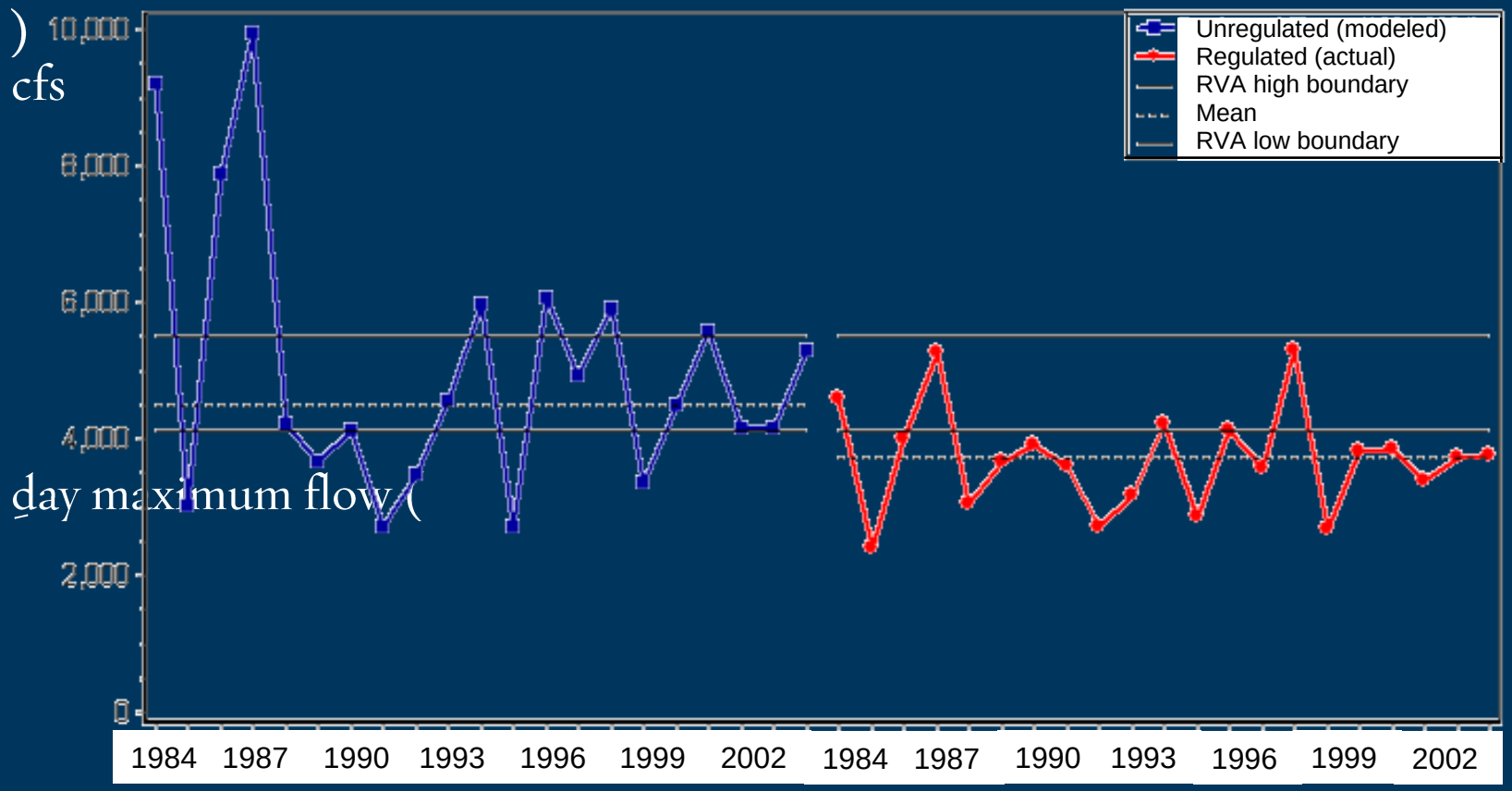
Ball Mountain Dam, West River



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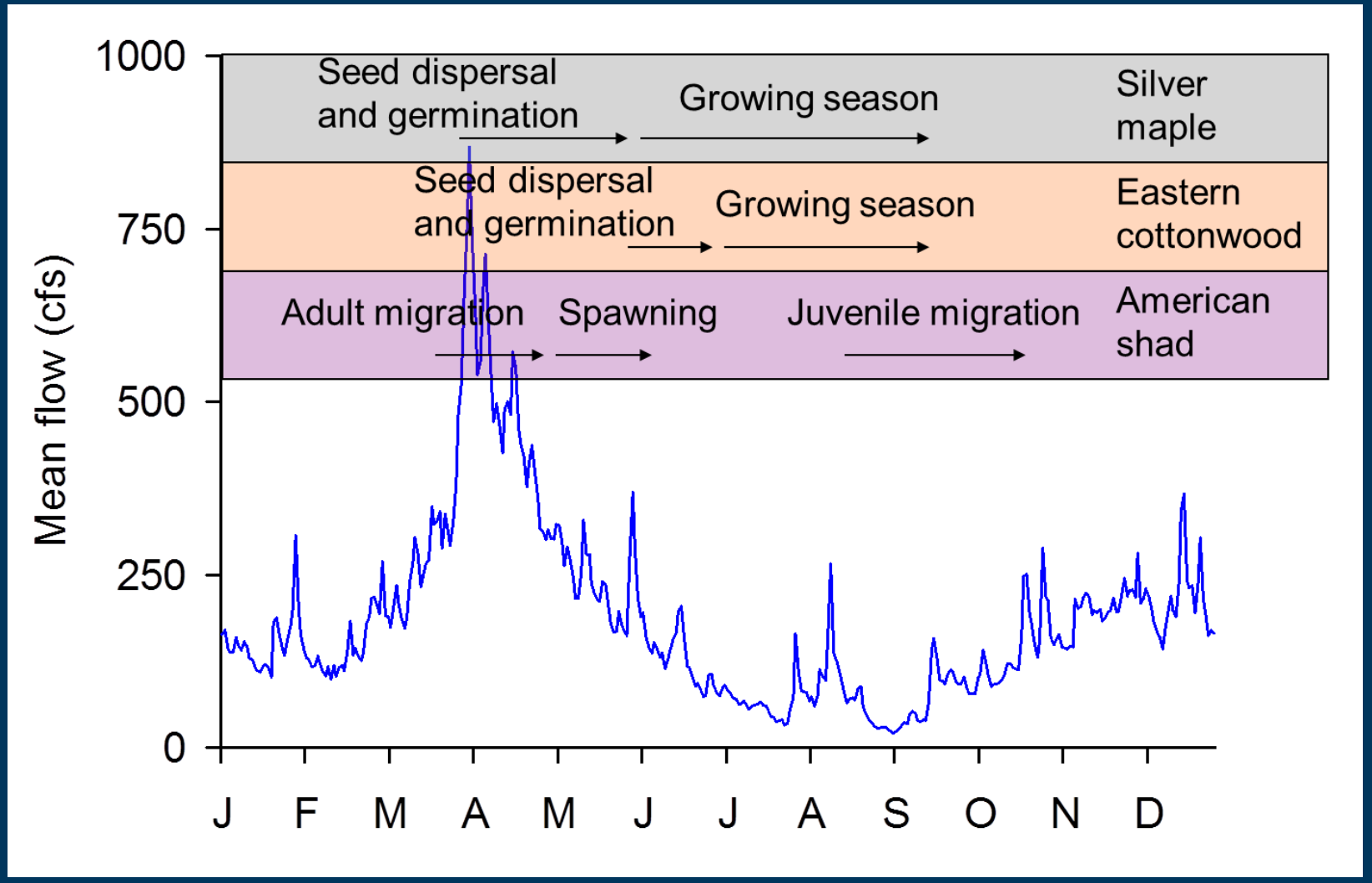
Connecticut River Natural Flow Regime



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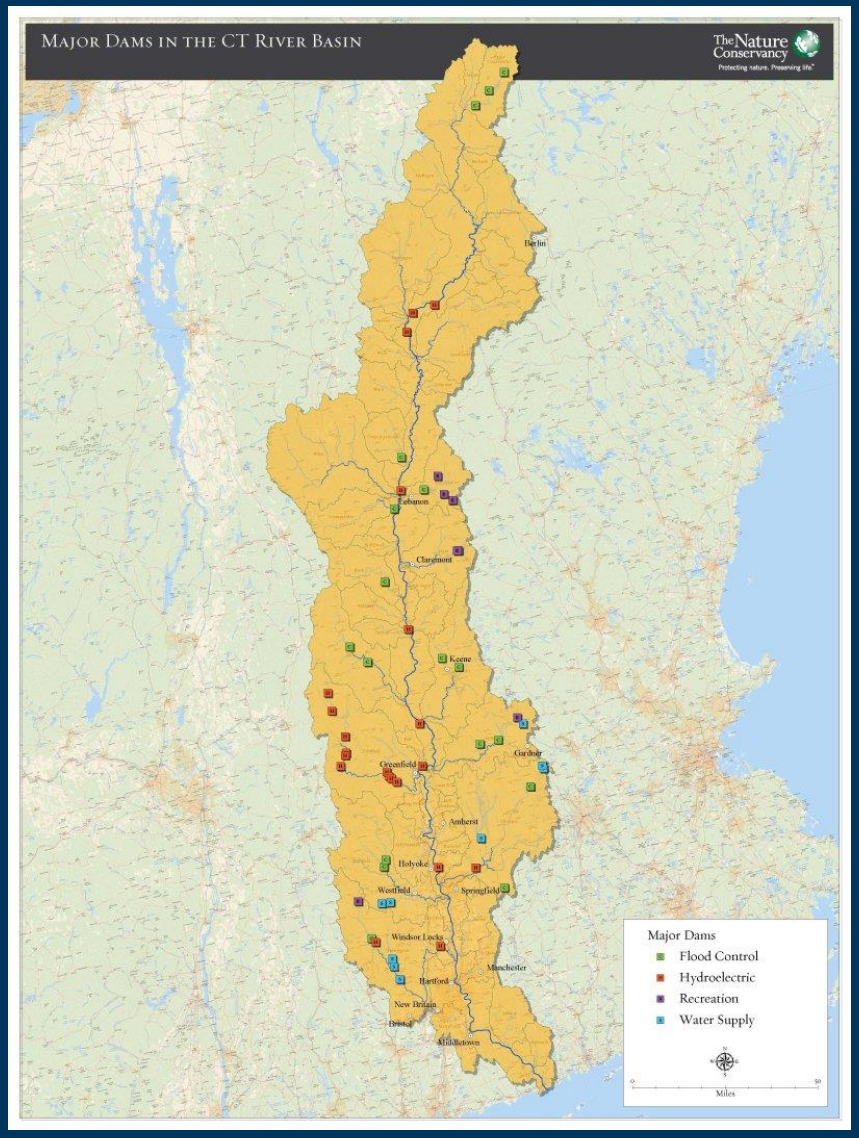
65+ Major Dams in the CT River Watershed



Ball Mountain Dam, Connecticut River, Jamaica, VT
Photo: © Jerry and Marcy Monkman/www.ecophotography.com

Holyoke Dam, Connecticut River, Holyoke, MA
Photo: © Jerry and Marcy Monkman/www.ecophotography.com

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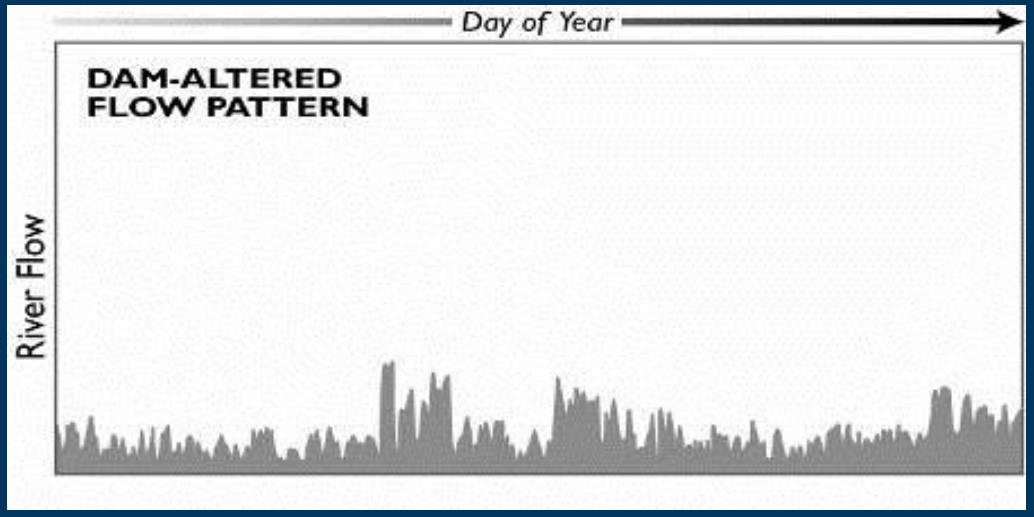
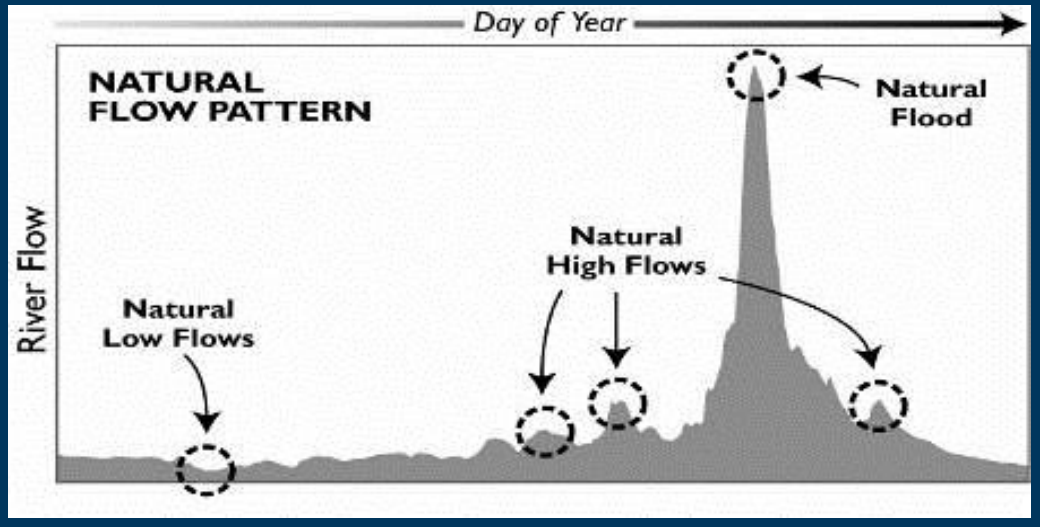
The Natural Flow Regime





Postel and Richter (2003)

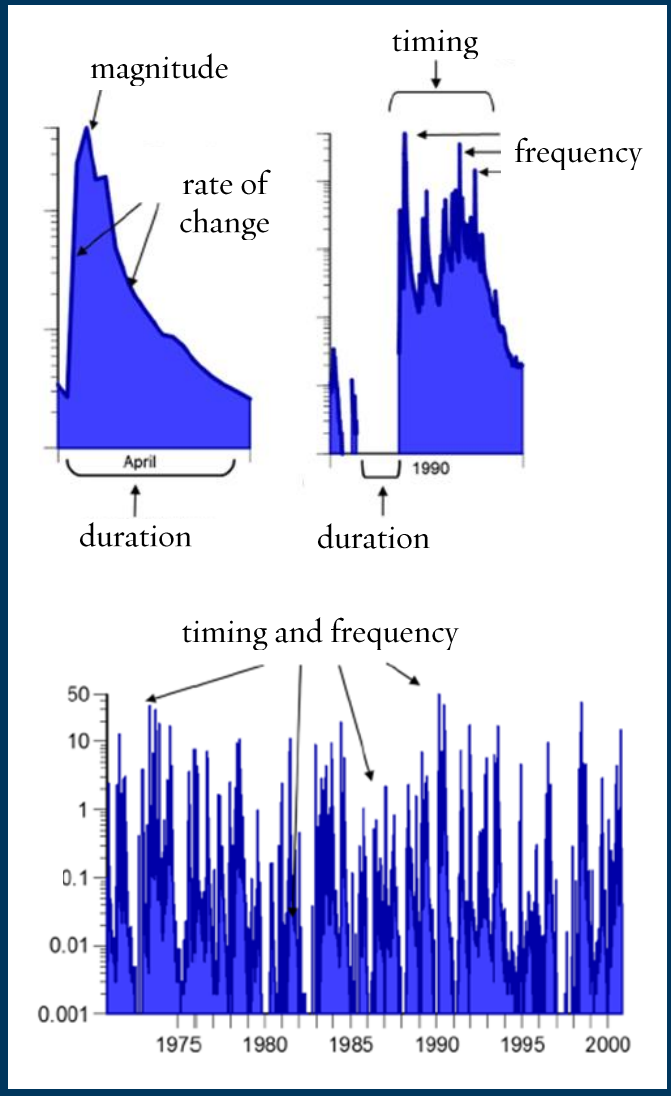


Figure modified from Olden (2012)

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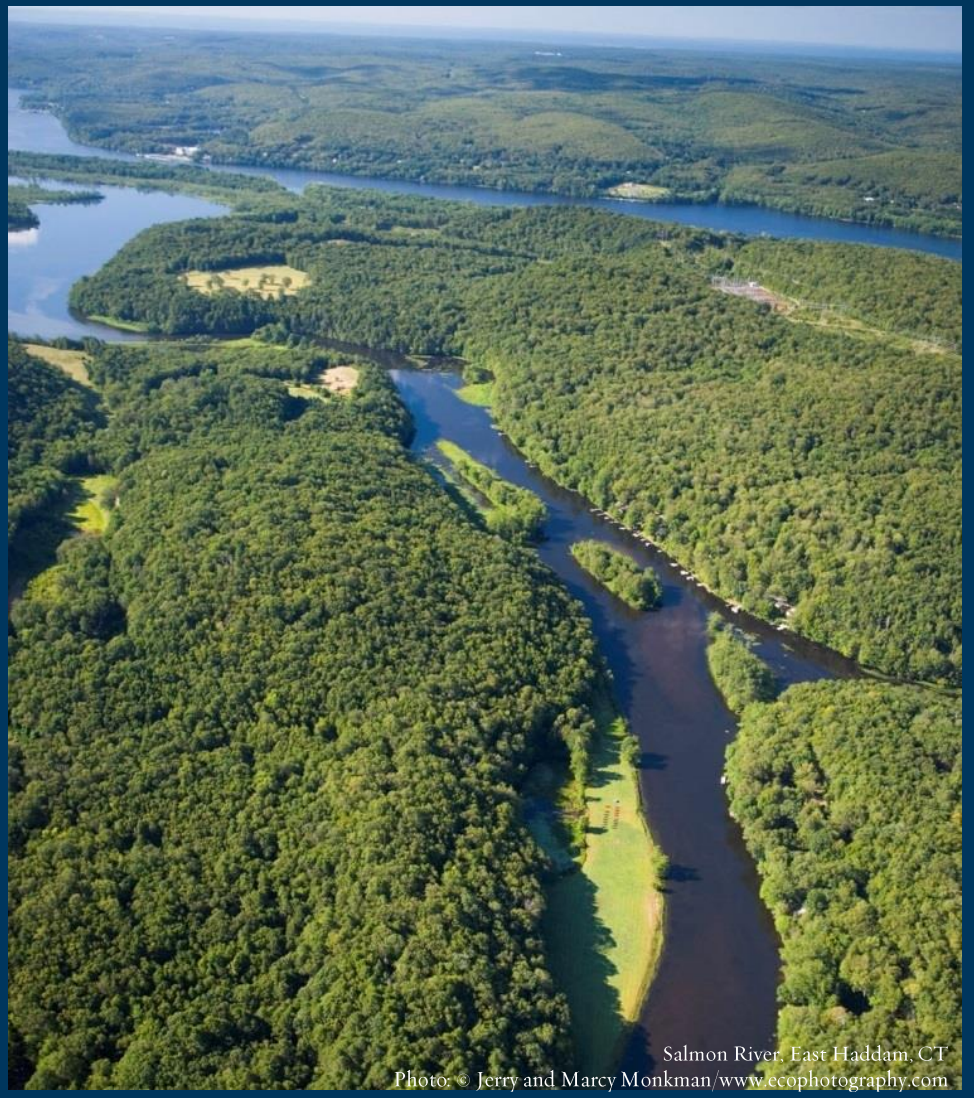
Study Purpose

To determine how management of various dams and water systems can be modified for *environmental benefits* while maintaining human uses such as *water supply*, *flood control*, and *hydropower generation*



Salmon River, East Haddam, CT
Photo: © Jerry and Marcy Monkman/www.ecophotography.com

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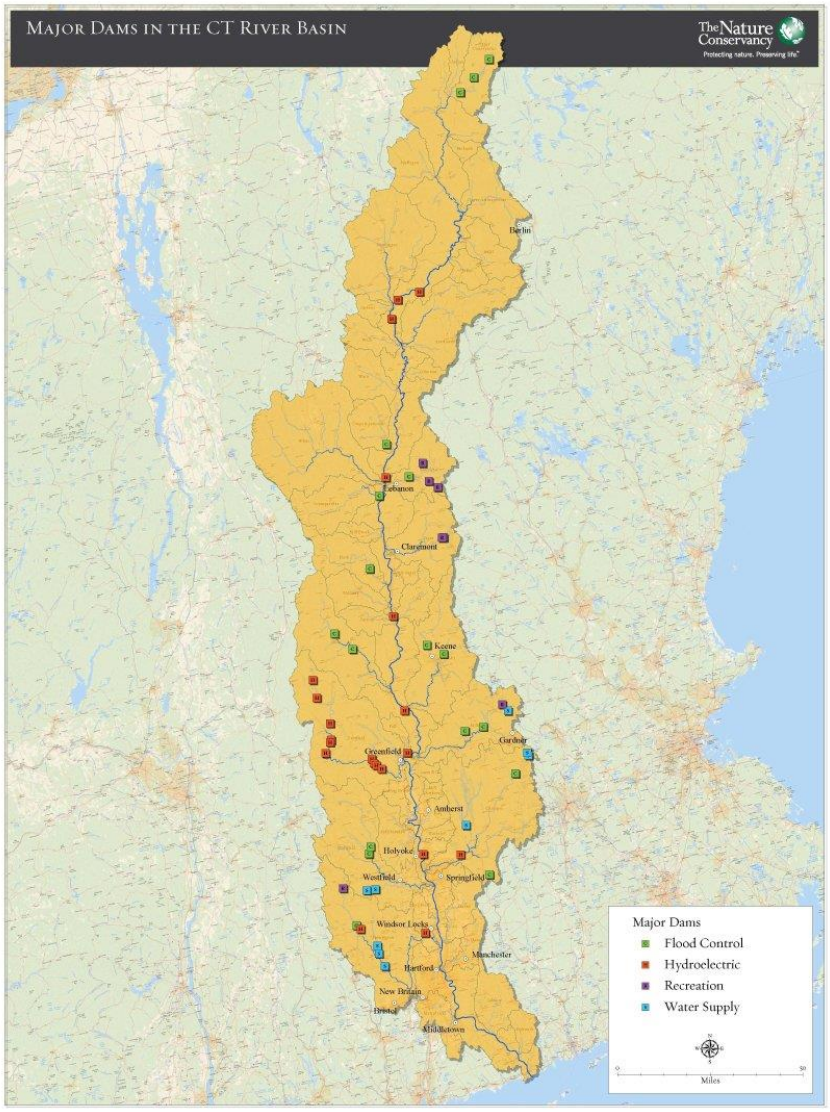
Study Methods: Hydrological Models



- Basin-wide hydrologic model decision support tool
- For managers and other key stakeholders
- To evaluate environmental and economic outcomes of management scenarios

Connecticut River, view from Mount Sugarloaf, South Deerfield, MA
Photo: © Jerry and Marcy Monkman/www.ecophotography.com

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Connecticut River Watershed Study Models

- Connecticut River Unimpacted Streamflow Estimator (CRUISE)
- Optimization model (LINGO)
- Simulation model (RES SIM)
- Hydrology model (VIC) and climate-impacted stream flows

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USGS
science for a changing world

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CRUISE tool

Geosci. Model Dev., 6, 101–115, 2013
www.geosci-model-dev.net/6/101/2013/
doi:10.5194/gmd-6-101-2013

Geoscientific Model Development

Towards a publicly available, map-based regional software tool to estimate unregulated daily streamflow at ungauged rivers

S. A. Archfield[1], P. A. Steeves[1], J. D. Guthrie[2], and K. G. Ries III[3]

[1]New England Water Science Center, US Geological Survey, 10 Bearfoot Road, Northborough, MA 01532, USA
[2]Rocky Mountain Geographic Science Center, US Geological Survey, P.O. Box 25046 MS 516, Denver Federal Center, Denver, CO 80225, USA
[3]Office of Surface Water, US Geological Survey, 5522 Research Park Drive, Baltimore, MD 21228, USA

- Daily unregulated streamflow for ungaged locations across the CT River basin
- GIS-based
- Publicly available

http://webdmamrl.er.usgs.gov/s1/sarch/ctrtool/

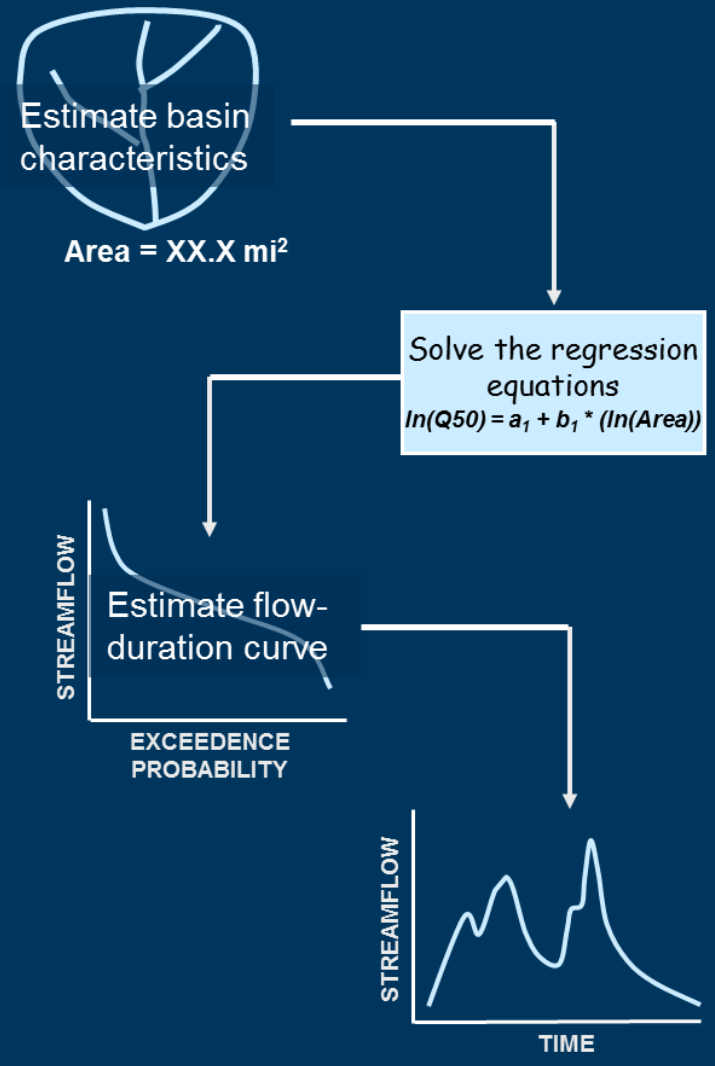
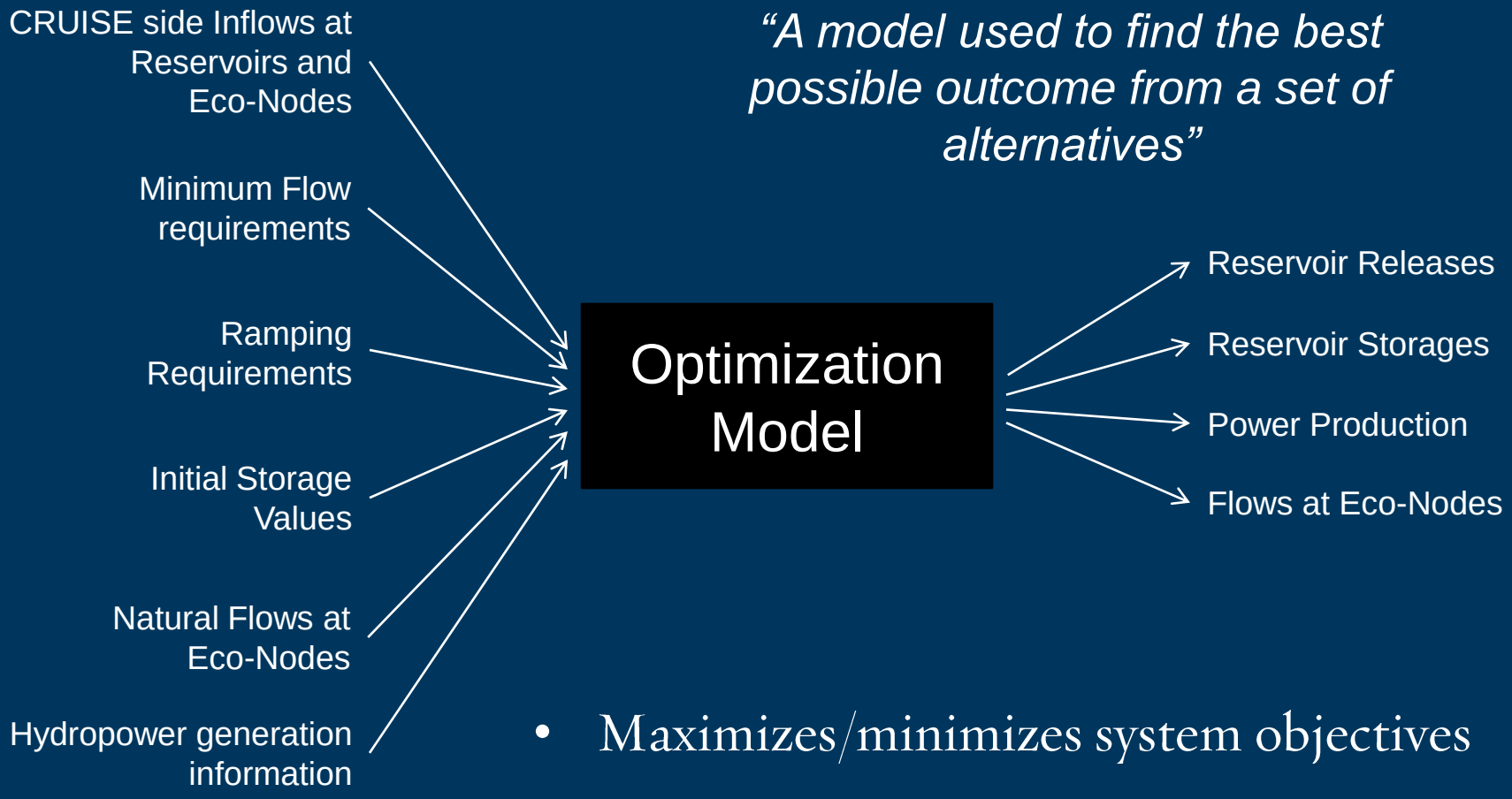


Figure: S. Archfield, USGS

Optimization model

"A model used to find the best possible outcome from a set of alternatives"



- Maximizes/minimizes system objectives
- Can evaluate trade-offs among objectives

Figure: R. Palmer, et al., UMass

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Simulation Model

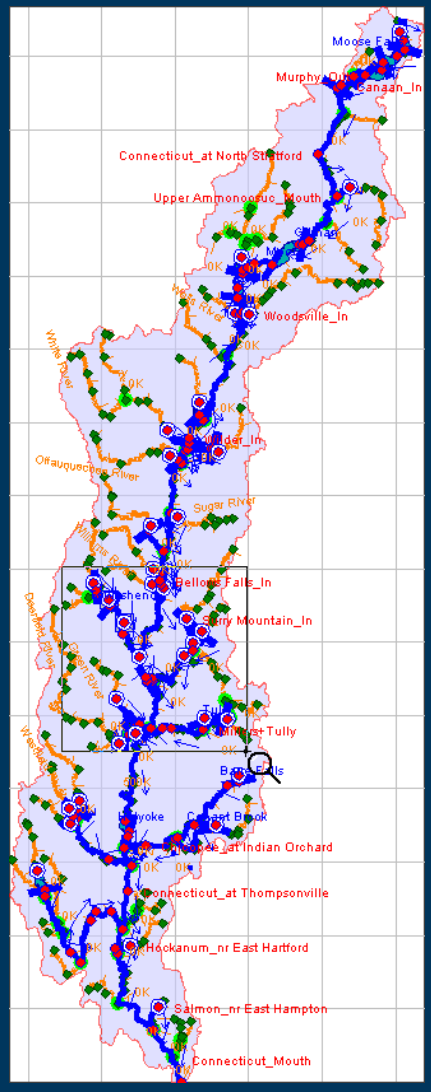

Figure: W. Fields, USACE

- Answers "what-if" questions about a system
- Replicates existing operation rules to simulate reservoir management
- Is easily adjusted to examine and compare different scenarios
- Scenario development will be informed by results of the optimization model

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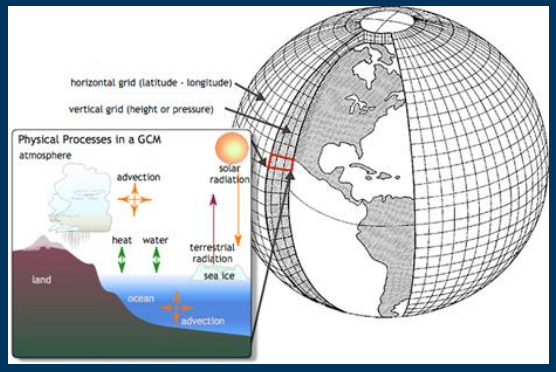
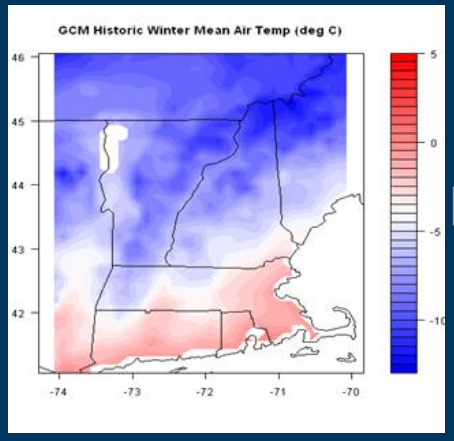
Climate-Altered Flows

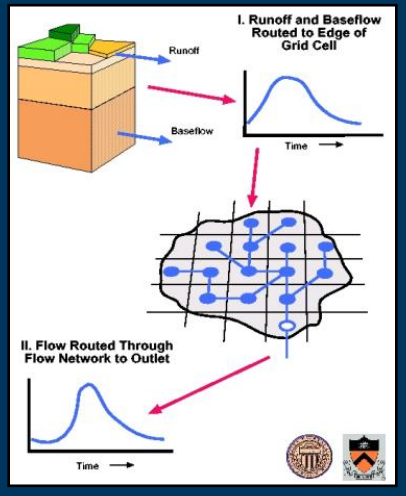
GLOBAL CIRUCLATION MODELS



WATER RESOURCES SYSTEMS MODEL

DOWNSCALED METEOROLOGIC DATA





HYDROLOGY MODEL

Figure: R. Palmer, UMass

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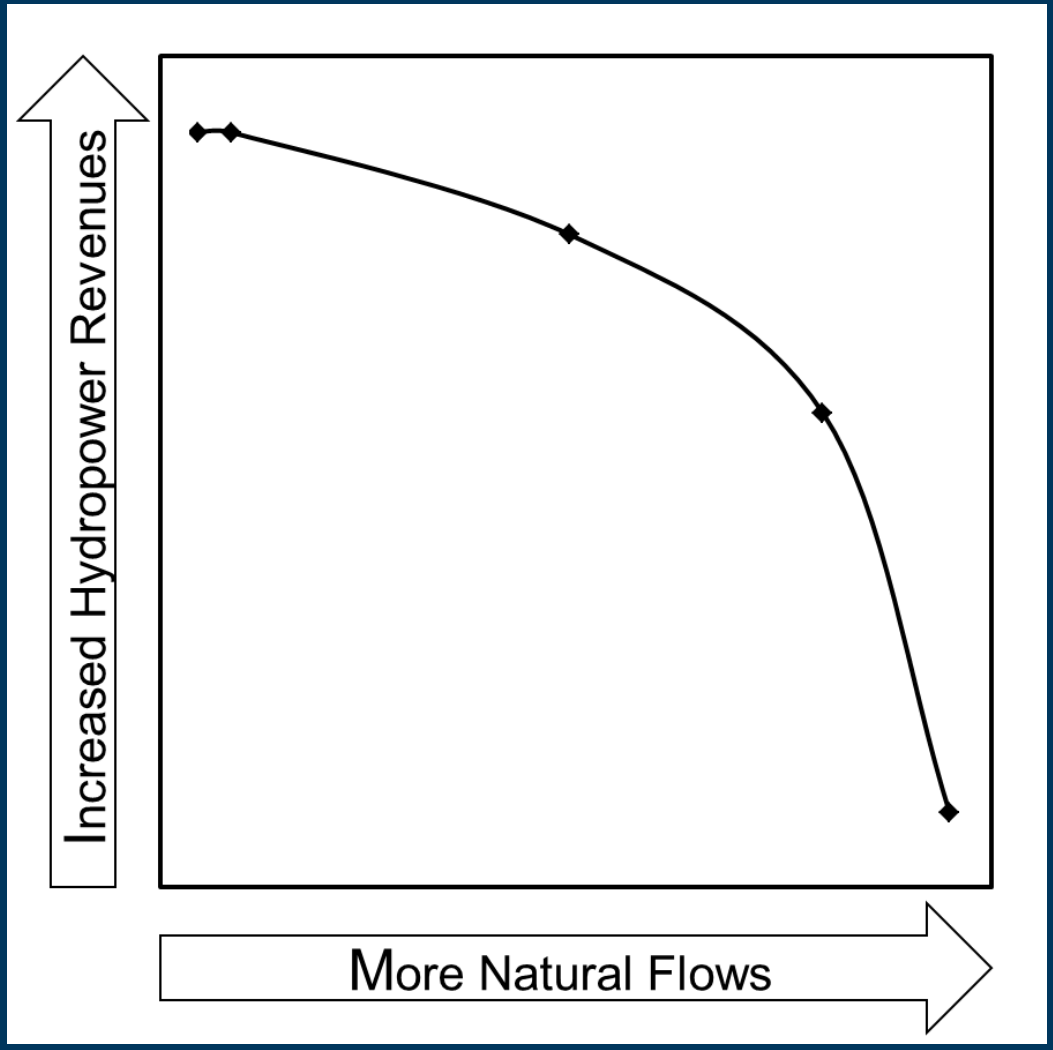
Application

1. Begin with CRUISE or climate-altered data
2. Estimate "allowable deviation" from natural
3. Estimate flows optimizing hydropower alone
4. Include ecological flow objectives
5. Evaluate trade-offs
6. Help to find balanced solutions for people and nature



Figures: R. Palmer, UMass

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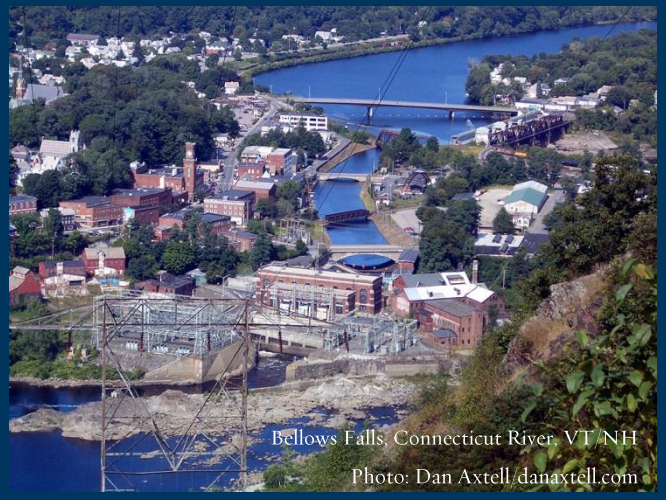
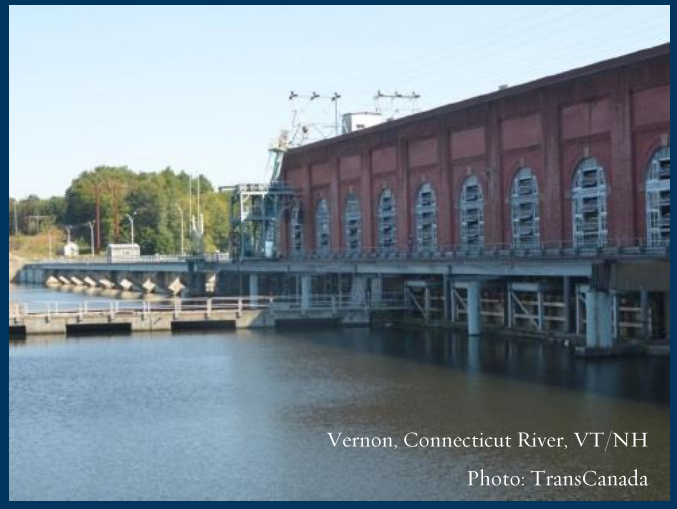
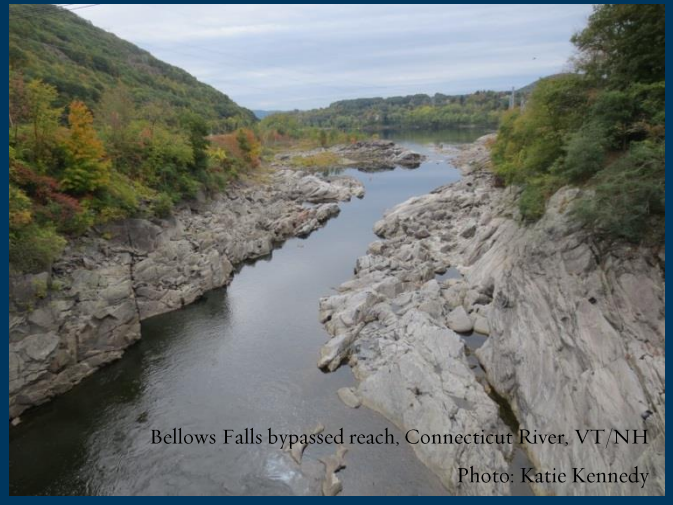
Relicensed Hydropower Projects: TransCanada


Wilder Dam, Connecticut River, VT/NH
Photo: Katie Kennedy


Bellows Falls, Connecticut River, VT/NH
Photo: Dan Axtell/danaxtell.com


Vernon, Connecticut River, VT/NH
Photo: TransCanada


Bellows Falls bypassed reach, Connecticut River, VT/NH
Photo: Katie Kennedy

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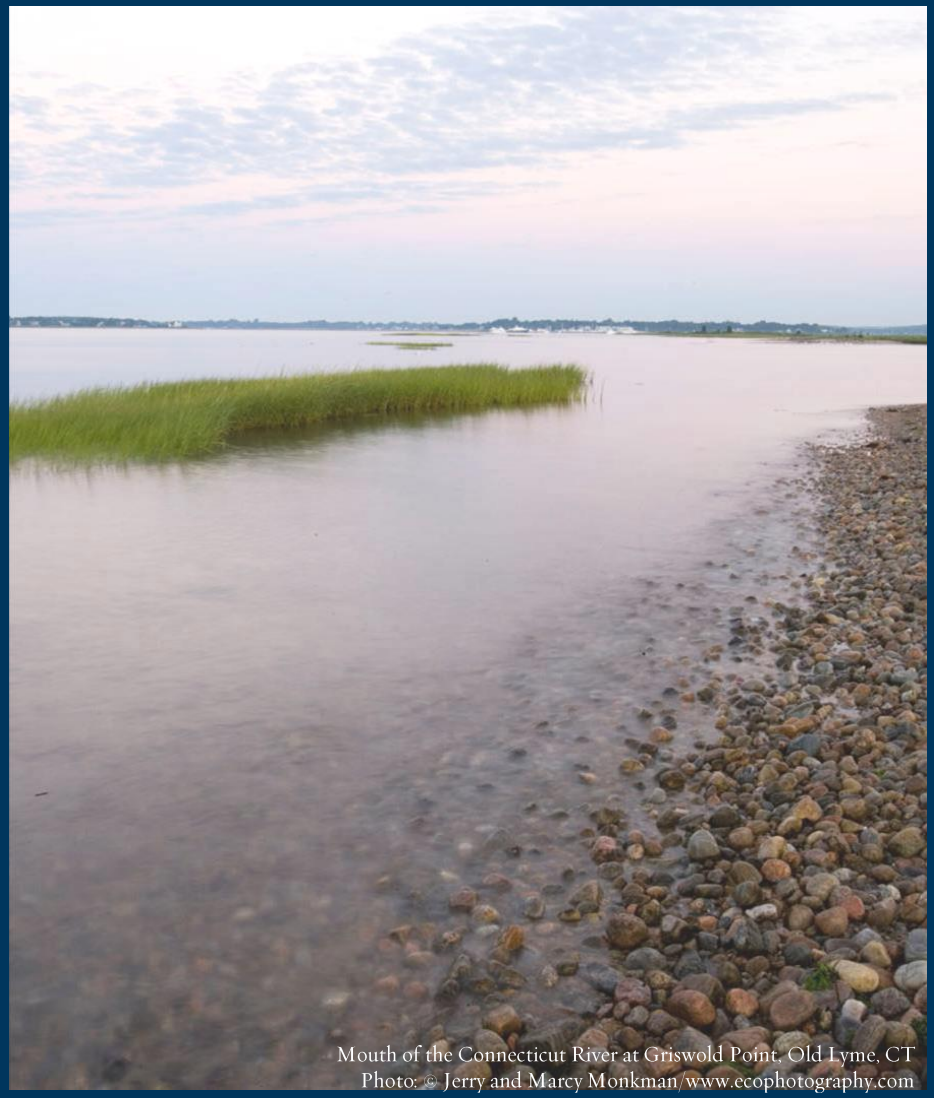
Summary



Mouth of the Connecticut River at Griswold Point, Old Lyme, CT
Photo: © Jerry and Marcy Monkman/www.ecophotography.com

- Watershed-scale challenges require watershed-scale solutions
- Multiple benefits can be managed explicitly
- Solutions can be found that optimize competing objectives
- Because the future is uncertain, we must manage for change.

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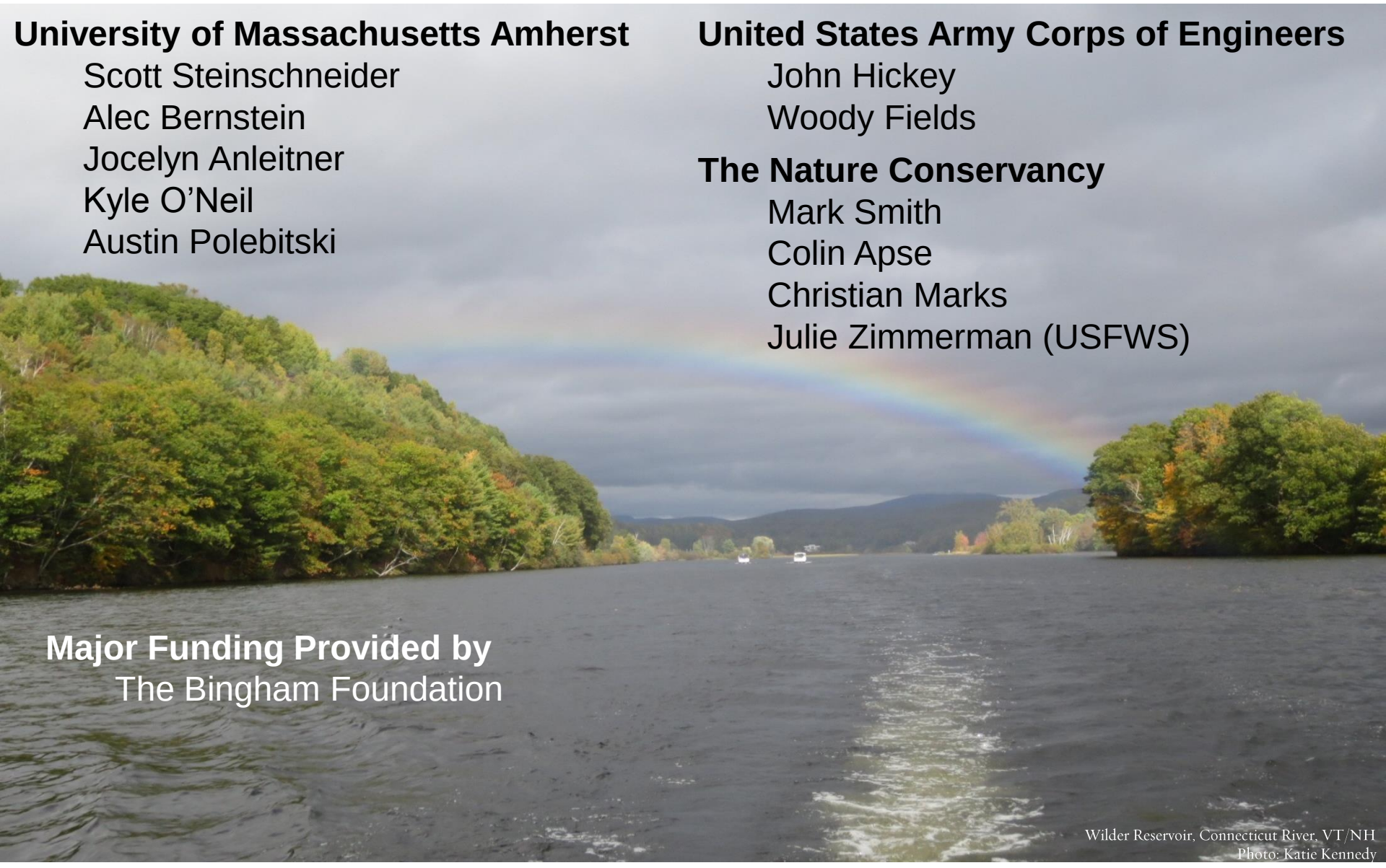

Wilder Reservoir, Connecticut River, VT/NH
Photo: Katie Kennedy