Challenges in Assessing Flow Mitigation Effectiveness

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Past DOE-funded Mitigation Effectiveness Studies

Environmental Mitigation Studies:

- Vol I. Current Practices for Instream Flow Needs, Dissolved Oxygen, and Fish Passage (Sale et al. 1991)

- Vol II. Benefits and Costs of Fish Passage Mitigation Practices (Francfort et al. 1994)

- Vol III. Mitigation Effectiveness of Instream Flow Requirements at Hydropower Dams (Bevelhimer & Jager 2006)
  - Jager and Bevelhimer. 2007. How run-of-river operations affect hydropower generation and value. Environmental Management 40:1004-1015.

Flow Mitigation Effectiveness Study

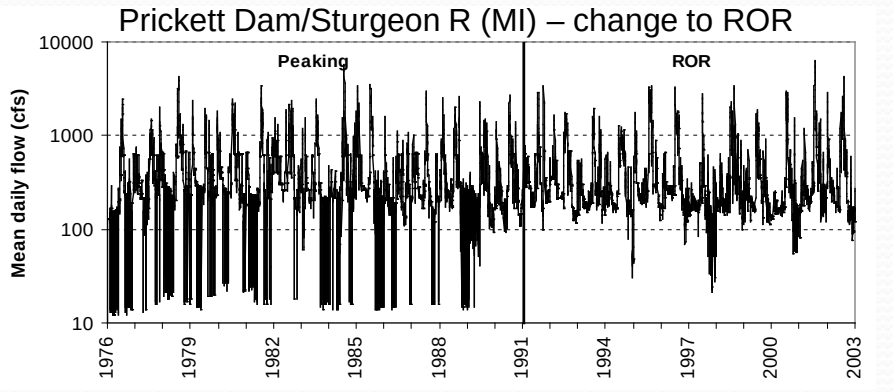
- Objective - conduct a detailed analysis of the costs, benefits, and effectiveness of instream flow alterations through a review of projects with recent flow-related changes in operations.

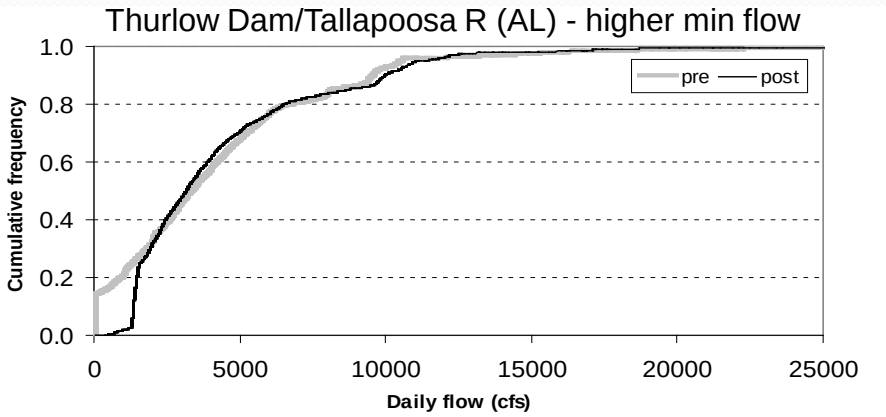
- We evaluated
  - Hydrologic changes
  - Power generation effects
  - Biological responses

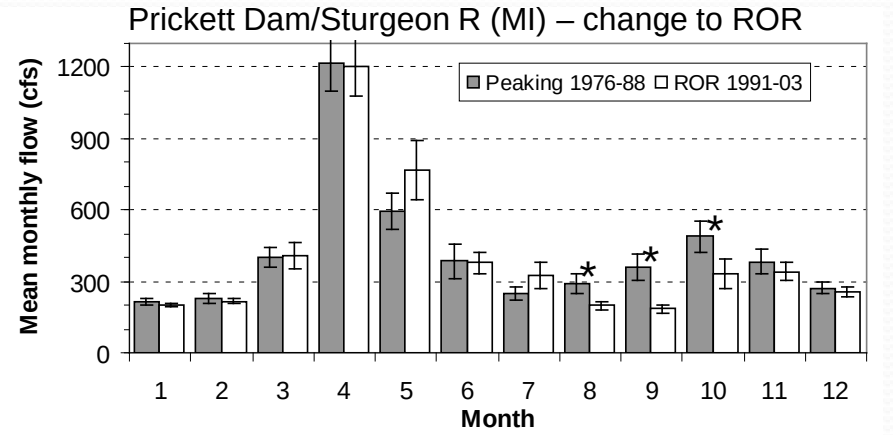
Flow Mitigation Effectiveness Study

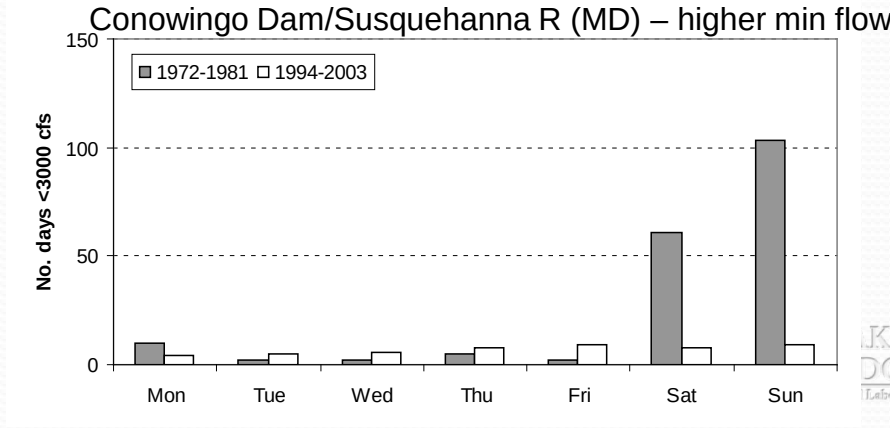
Results: Hydrologic Change

- Fairly easy to quantify on various temporal scales





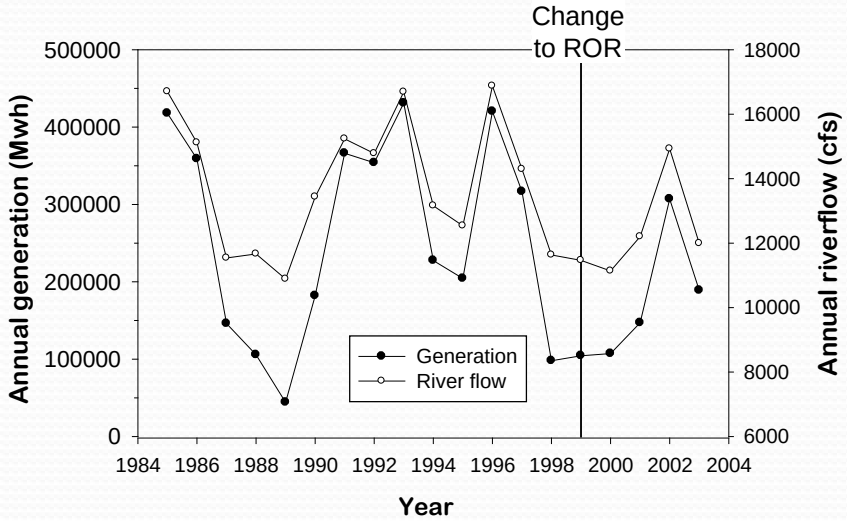




Flow Mitigation Effectiveness Study

Results: Economic Costs/Benefits

- 222 FERC-licensed projects relicensed 1987-2000
- Records indicate that revised operations would result in virtually no industry-wide change in generation capacity
- Average annual generation expected to
  - decrease at 78 projects,
  - increase at 28, and
  - insignificant change at 116.
- However! Effects on value of power is difficult to assess (but likely decreased)



No change in generation after switch to ROR operation was typical

Flow Mitigation Effectiveness Study

Results: Biological Response

- Identified 25 monitoring studies at hydroelectric projects with recent changes in instream flow requirements
- Population- or community-level metrics
- Sufficient post-enhancement data and data for comparison (either pre-enhancement or reference data)
  - at least 1 yr prior to flow improvement and 1 yr after,
  - 2+ yr immediately following flow improvement, or
  - at least 2 yr from study site and 2 yr from a reference site.

Flow Mitigation Effectiveness Study

Results: Biological Response

- 14 of 25 studies had enough data to subjectively conclude that some kind of biological response to flow enhancement had occurred.

- In all 14 cases the response was positive, suggesting successful mitigation.

- A discernable biological response was not found for the remaining 11
  - no consistent trends,
  - results were mixed (some metrics positive, but not all)
  - data were inadequate (i.e., variability too high), or
  - other factors made it difficult to relate changes to flow enhancement
    - Concurrent mitigation
    - Significant differences in background conditions
    - Inability to differentiate mitigation-related change from natural variation

Present DOE-funded Environmental Flow Studies

Environmental Flow Task

- Assess industry needs.
- Develop analytical approaches that can be used to characterize flow regimes to better assess the ability to provide efficient power and environmental services.
- Advance the science of environmental flow development to more fully include hydropower operation considerations.

Flow Optimization Task

- Develop suite of models to shape flow releases and project operations to optimize power production within various flow constraints.

Industry Needs Assessment

Administered online survey to 22 environmental flow experts

- Questions related to operational and regulatory constraints, environmental flow methodology, and research needs

Common Needs Identified

- More and better information on the relationships between biotic responses and various components of the hydrologic regime.
- More holistic models that incorporate hydrological, water quality, power production, and ecological dynamics.
- Water routing models to better understand env flow possibilities and ramifications.
- Better direction on when and how to existing models and methods .
- Methods that can utilize information from similar rivers or that are based on watershed or basin characteristics.
- Tools that are scientifically rigorous and practical to use.

Characterization of Operational Flow Regimes

- Pressure from many regulators to provide more natural flows for environmental benefits.
- Lots of hydrologic metrics available to describe different components of the flow regime (e.g., Indicators of Hydrologic Alteration).

Task Objective: to develop new analytical approaches for characterizing flow regimes to better assess the importance of different components to efficient power production and environmental services.

Evaluation of Flow Assessment Methodologies

- Various methods available for selecting appropriate flow requirements (e.g., min flows, ramping rates, and flood flows).
- Holistic processes have been developed to incorporate flow tools and methods into a framework that includes a broader arena of water needs (e.g., IFIM and ELOHA).
- Most of these processes and tools have been developed with natural resource conservation as the driving force with little consideration for the effects on other water users, such as hydropower production.

Task Objective: to advance the science of environmental flow development to more fully include hydropower operation considerations.