Trading joules for fish? Opportunity costs in the adaptive management of regulated rivers

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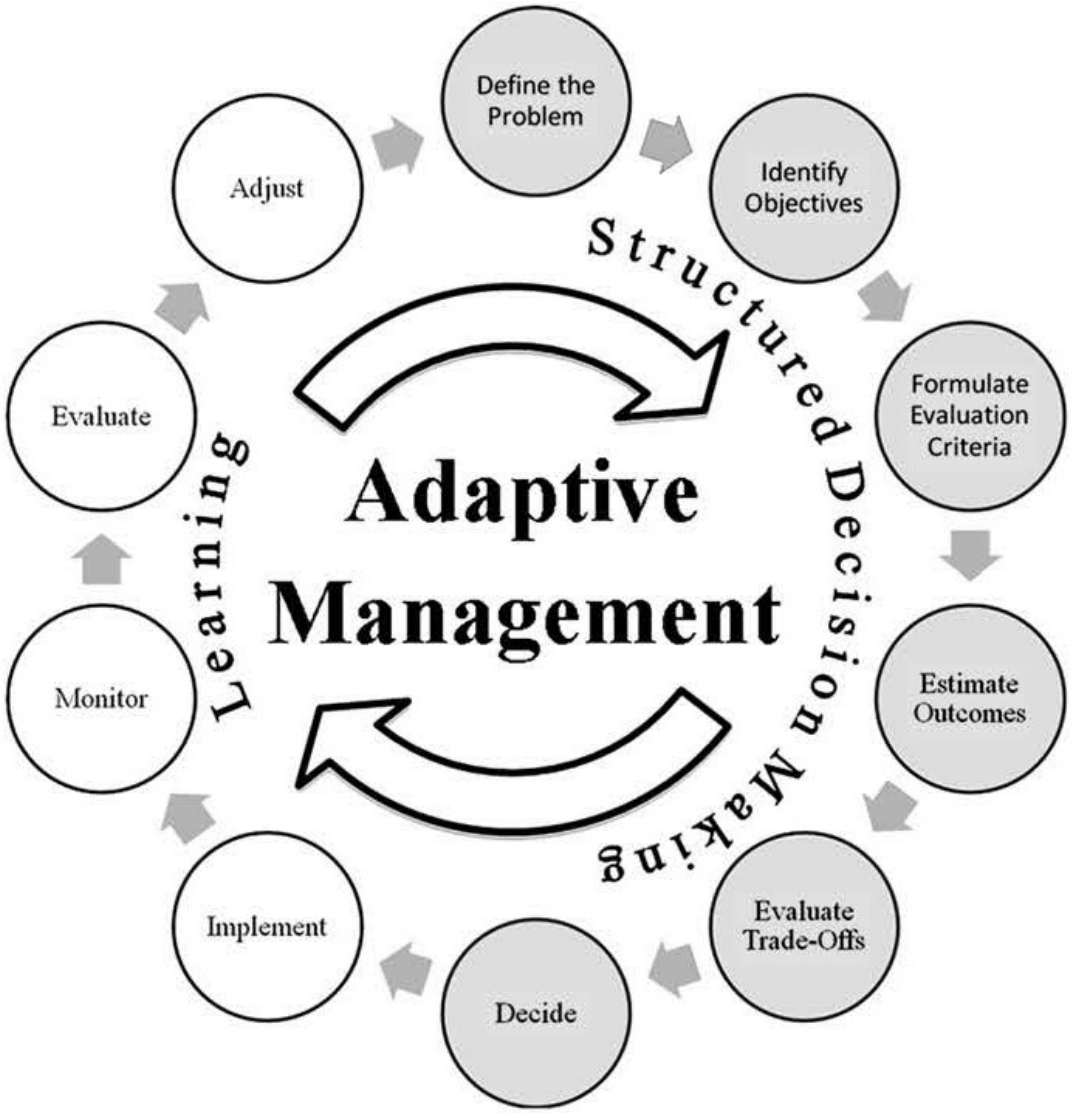
Adaptive Management



Allen et al. 2011 J. Environ. Manage

Value of Information

- In adaptive management, the value of information (VOI) refers to the benefit derived from reducing uncertainty through learning and using that information to make better decisions over time.
- VOI quantifies how obtaining additional information can improve decision-making outcomes by enhancing the effectiveness and efficiency of management actions.

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Value of information in adaptive management

- Value of Information (VOI): Information matters only if it improves decisions and outcomes.
- Justifying costs: In adaptive management, VOI often supports investing in monitoring, experiments, or research.
- Future impact: VOI applies to both current and future decisions in iterative management.
- Trade-offs: The benefit of more information must outweigh its costs and the risks of delaying action.

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- Challenge: Balancing dam operations between hydropower and humpback chub goals.
- Objective: Maintain a viable population of a threatened species at the lowest cost.
- Trade-off: Ensure humpback chub viability while accounting for lost hydropower value from trout management flows.

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Bioeconomic model

- Population Dynamics: Focus on rainbow (brown) trout and humpback chub.
- Management Actions:
  - Mechanical Removal
  - Trout Management Flows
- Objective: Implement cost-effective strategies to reduce trout competition and predation on juvenile chub while maintaining a viable adult chub population within a defined time horizon and confidence level.

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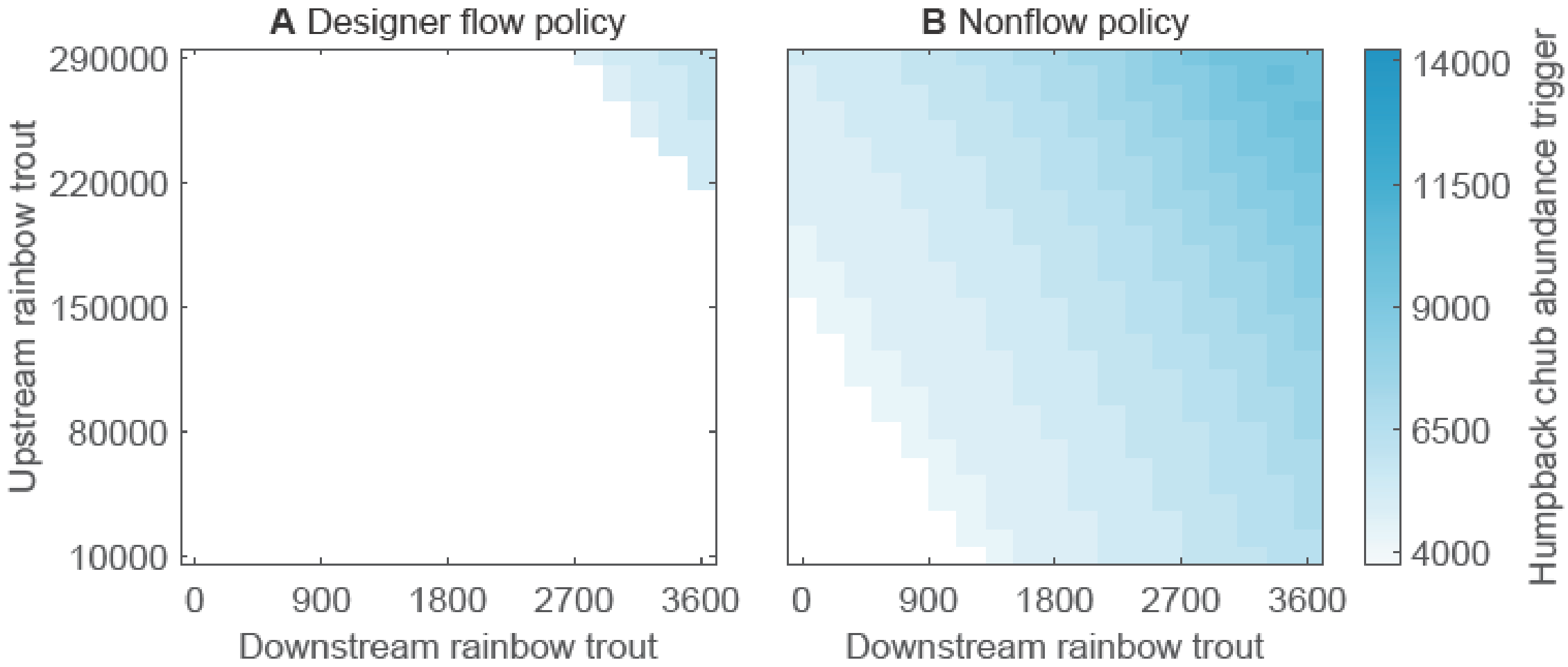
https://www.flyfisherman.com/editorial/all-about-rainbow-trout/454217



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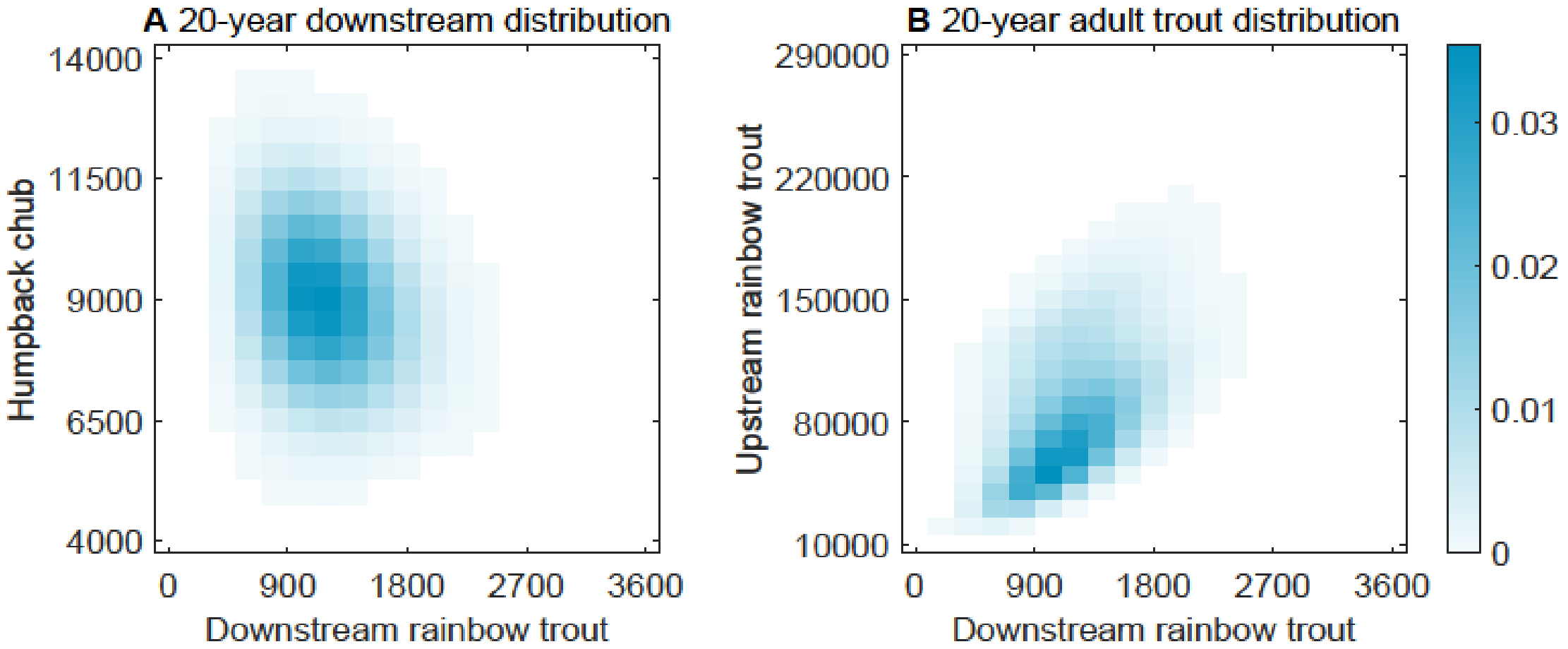

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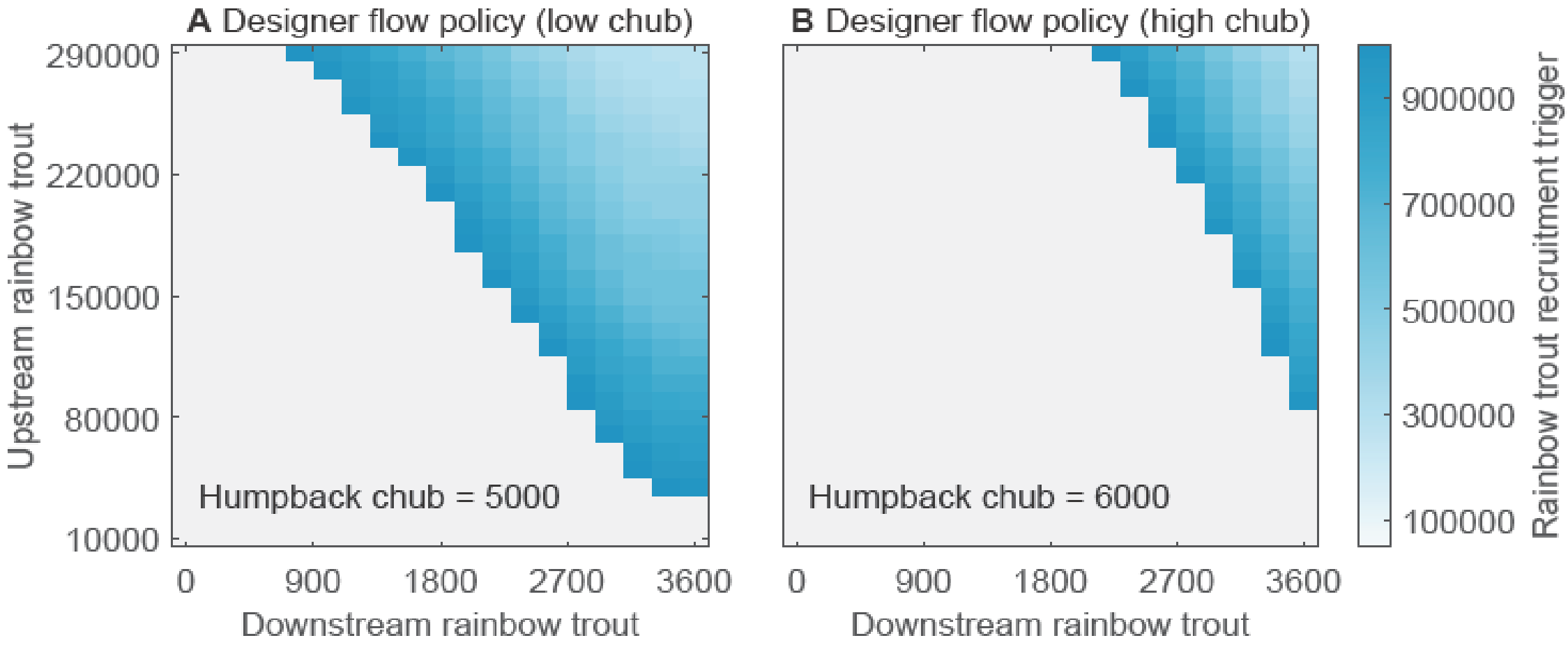

Observing Recruitment

- Trout management flow use is sensitive to current trout recruitment levels.
- Allowing informed trout management flow use reduces total costs slightly, as these flows remain infrequently prescribed.
- Including upstream trout recruitment monitoring does not significantly lower expected operating costs.

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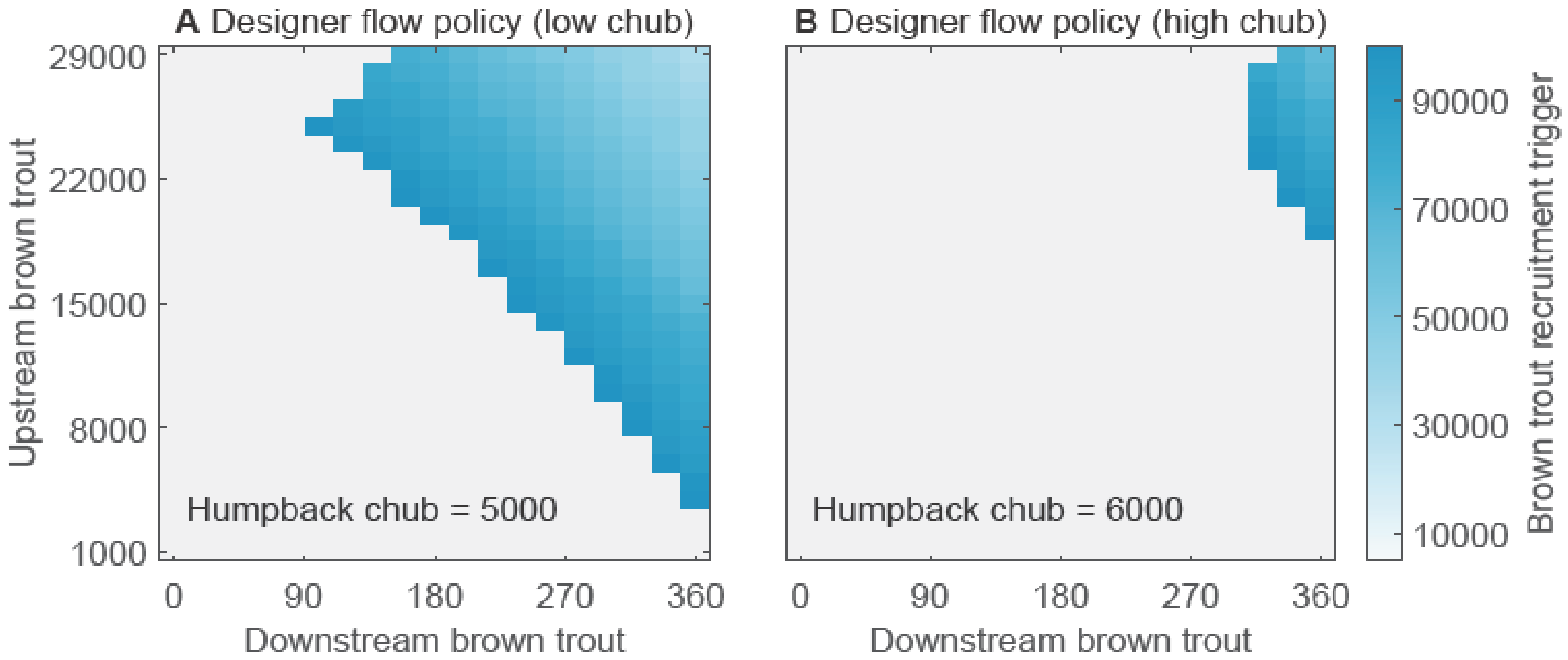
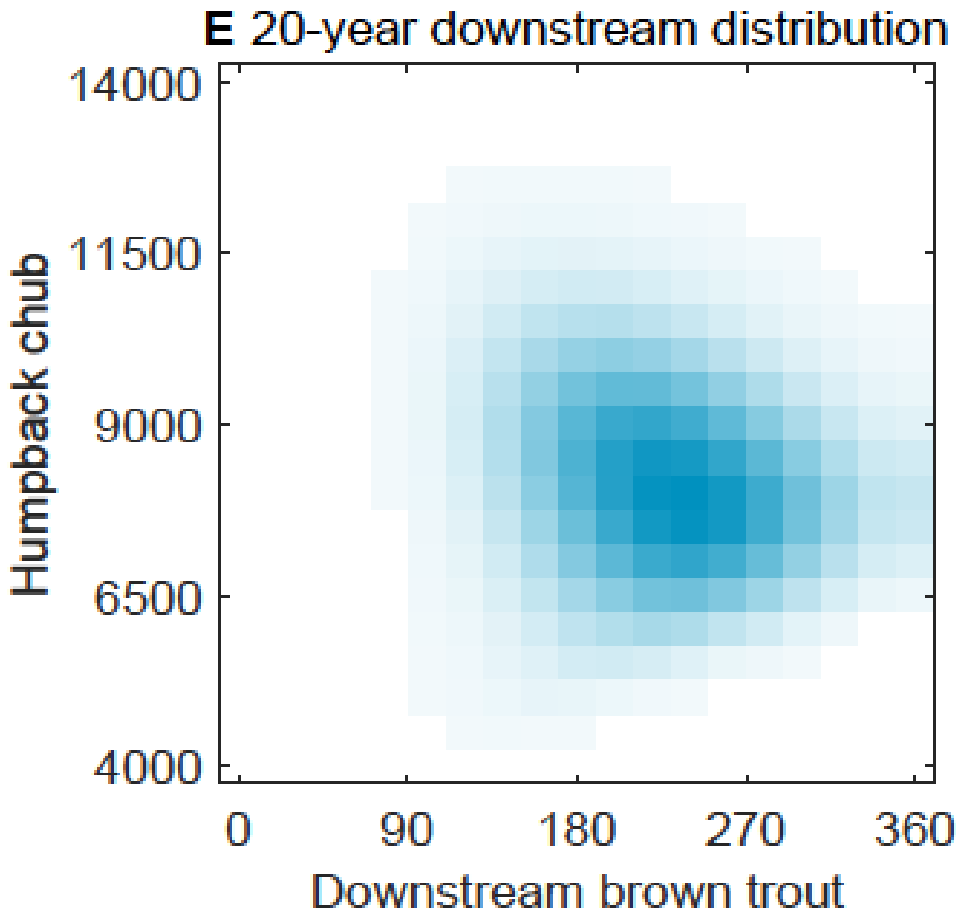
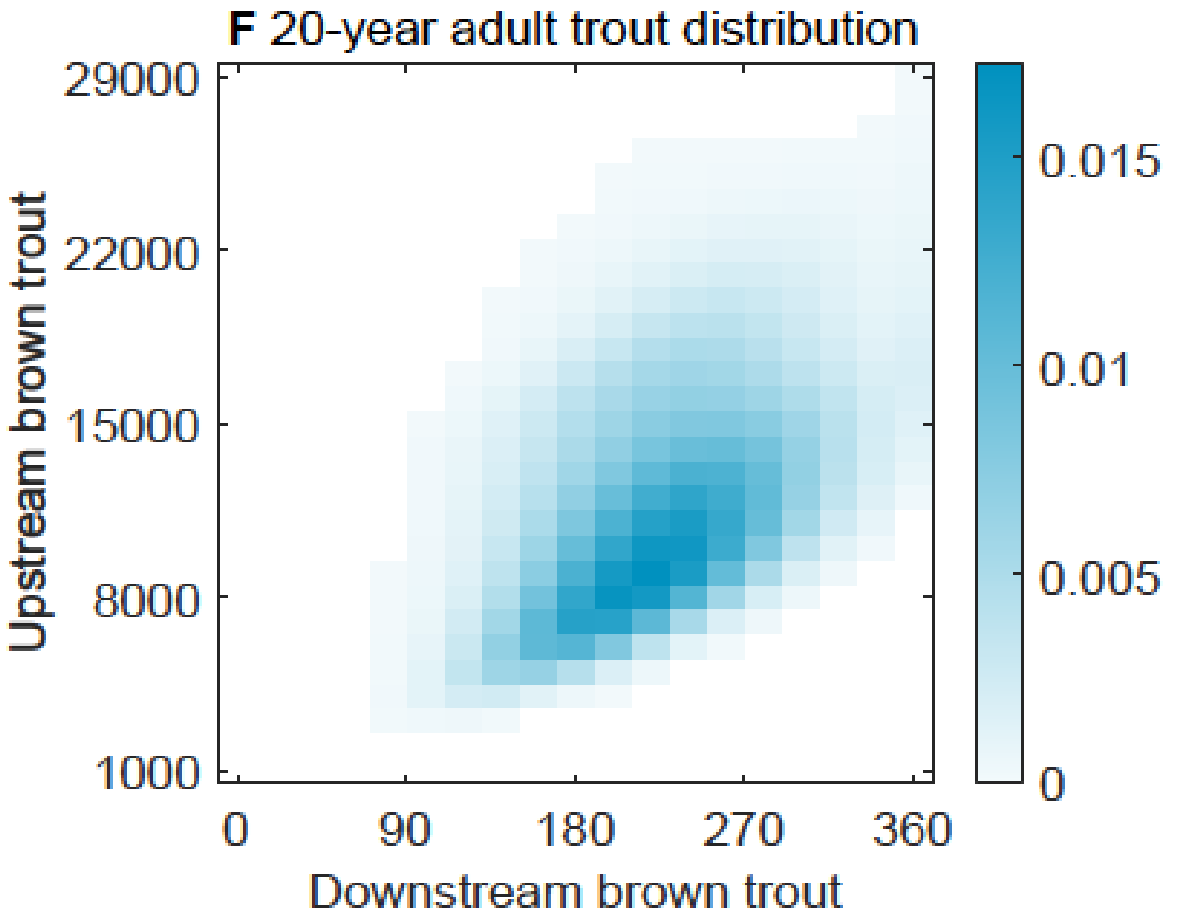
https://www.flyfisherman.com/editorial/all-about-brown-trout/454242







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Brown Trout

- Designer flow policy is strongly influenced by brown trout recruitment, while the nonflow policy is not, and its use is limited when designer flows are available.
- Increased natural survival of brown trout disfavors removal actions, leading to a slightly ‘earlier’ reduction of brown trout populations through flows, compared to rainbow trout.
- Designer flows are used more frequently in a brown trout-dominated system than in a rainbow trout-dominated system.

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Adaptive Management

- The objective is to identify economic conditions that justify a short-term experimental regime to improve understanding of trout management flow efficacy.
- An adaptive management approach is applied to a brown trout-dominated system with recruitment monitoring.
- Flow Action Options:
  - Selective Implementation – Trout management flows used only in high trout recruitment years.
  - Annual Implementation – Trout management flows used every year.
- The approach balances experimentation costs against the speed of learning.

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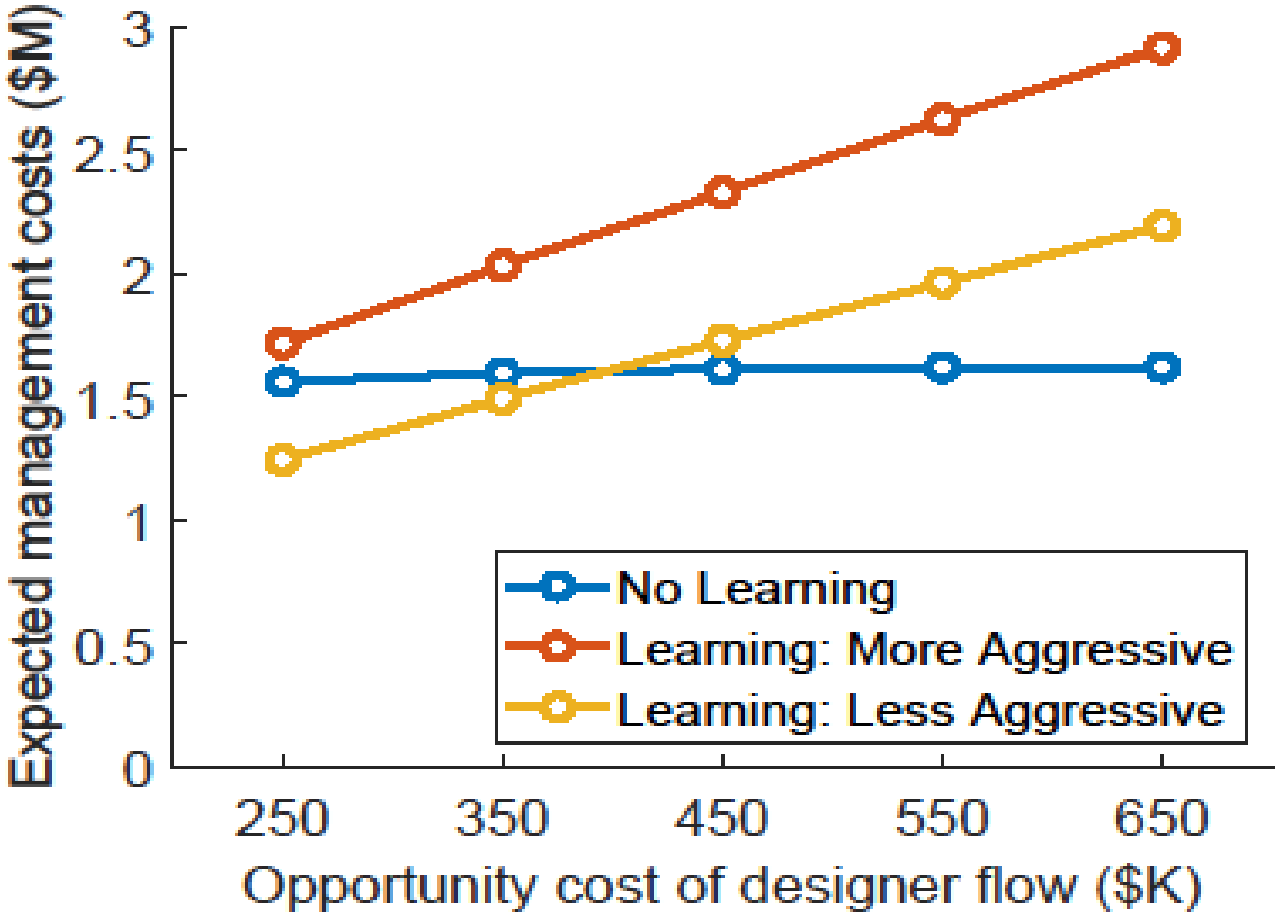

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Conclusion

- **Baseline results**: trout management flows are too costly for managing rainbow trout when nonflow actions (e.g., trout removal) are available.
- **Monitoring impact**: Observing rainbow trout recruitment helps target trout management flows in high-recruitment years, improving efficiency.
- **Brown trout threat**: Increased risk to humpback chub supports broader use of trout management flows.
- **Management strategy**: Given manageable energy costs, adaptive experimentation in high-recruitment years is preferable to a non-experimentation approach.

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