



Balancing the Lees Ferry Sport Fishery, Humpback Chub, and Hydropower: Investigations into Experimental Flows and Incentivized Harvest

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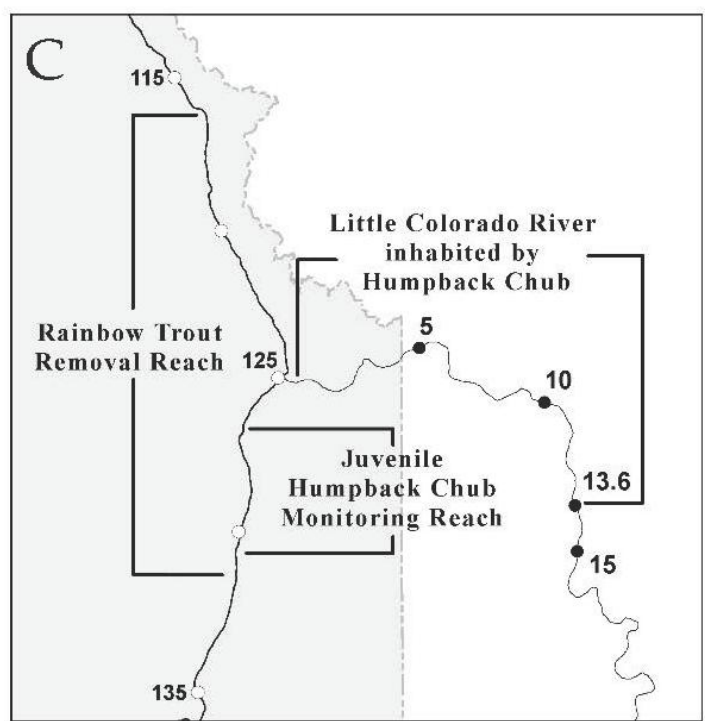
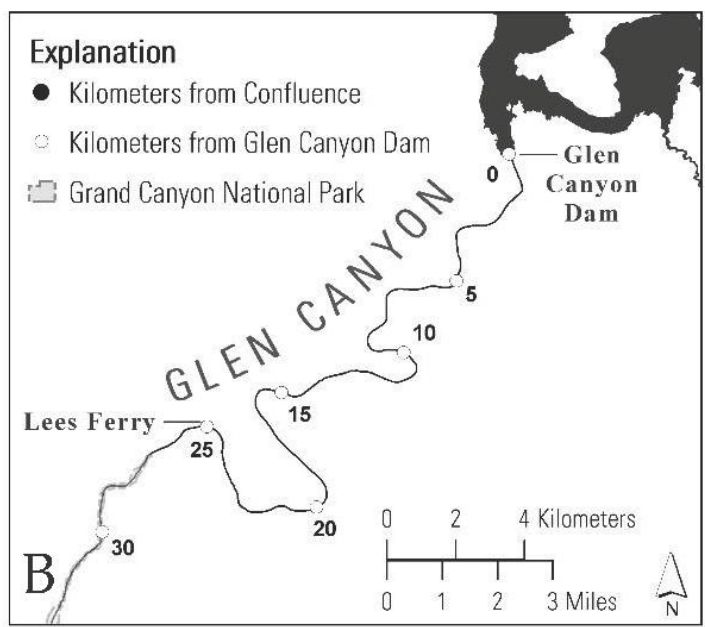
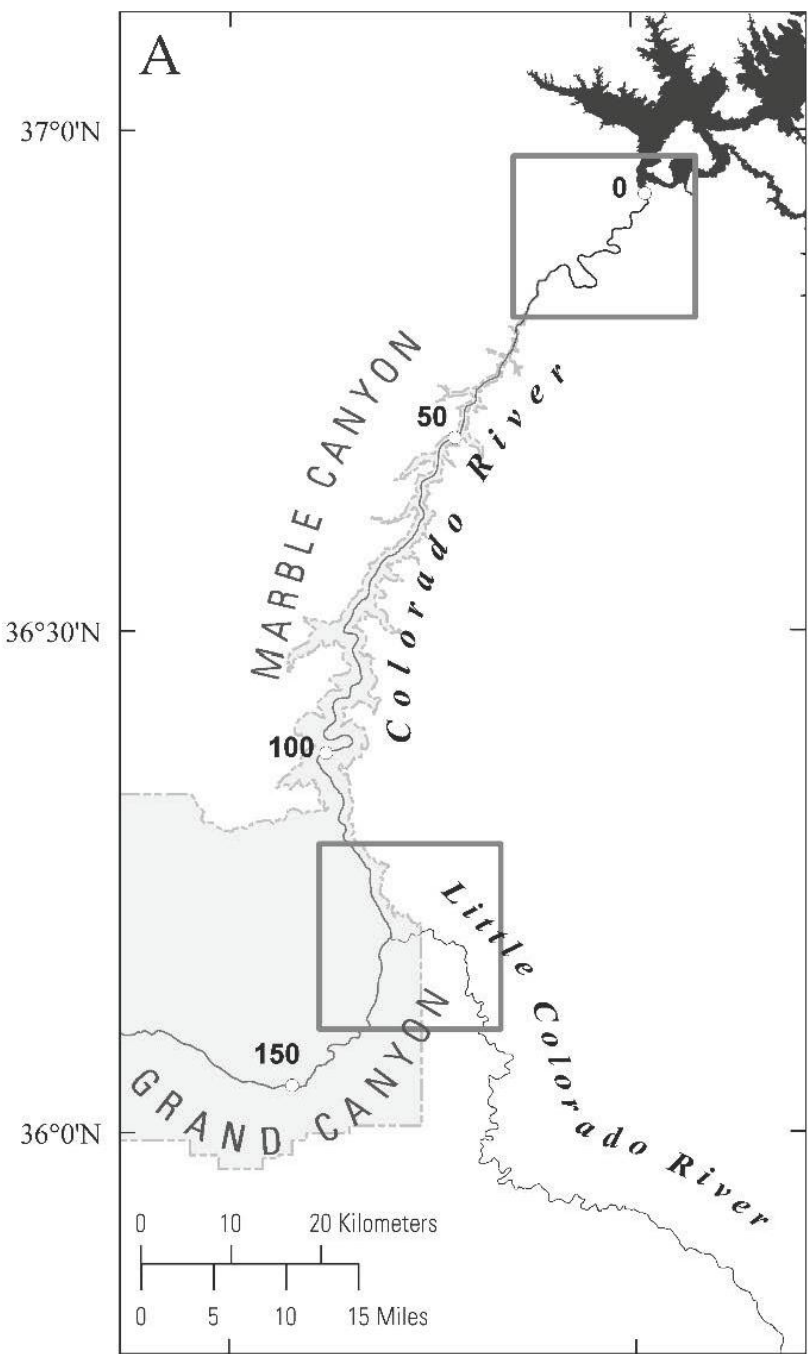
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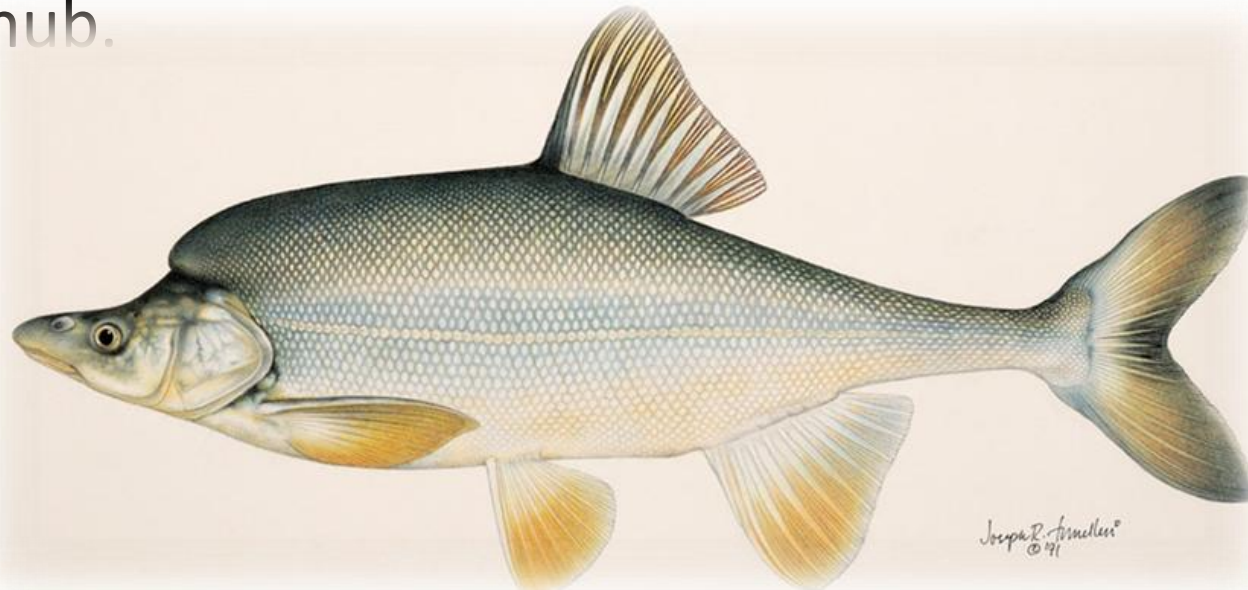
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Predictive bioeconomic models for adaptive management

- Problem: Balancing dam operations and targeted management actions to meet multiple ecological and economic objectives.
- System Focus: Population dynamics of rainbow and brown trout and humpback chub.

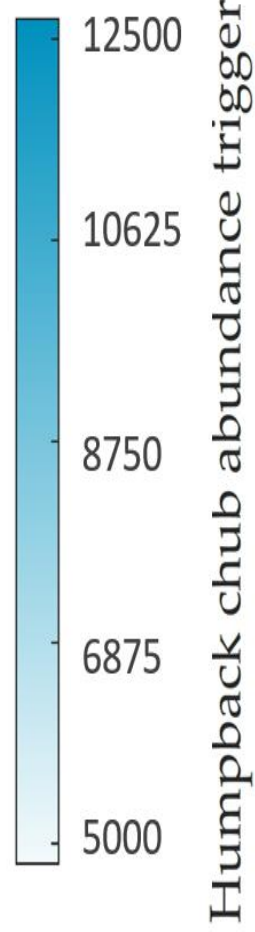
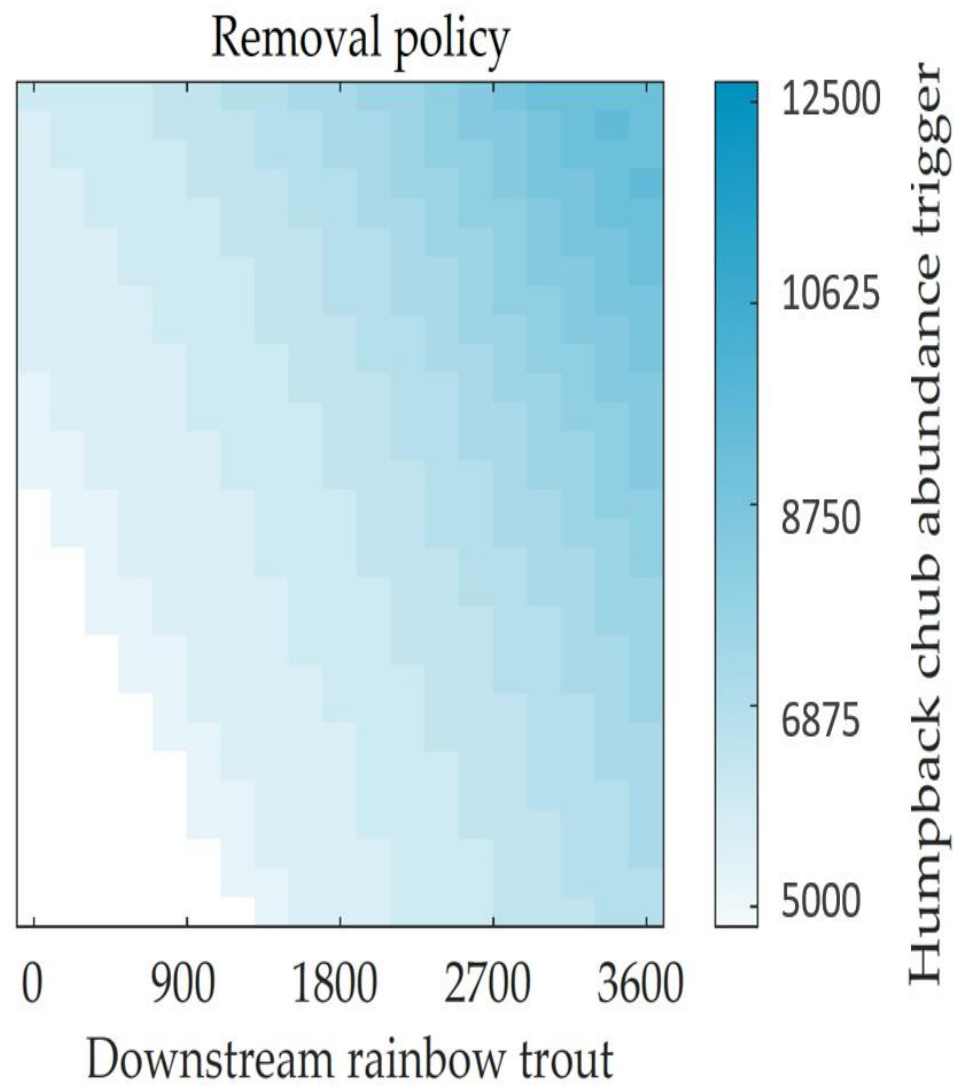
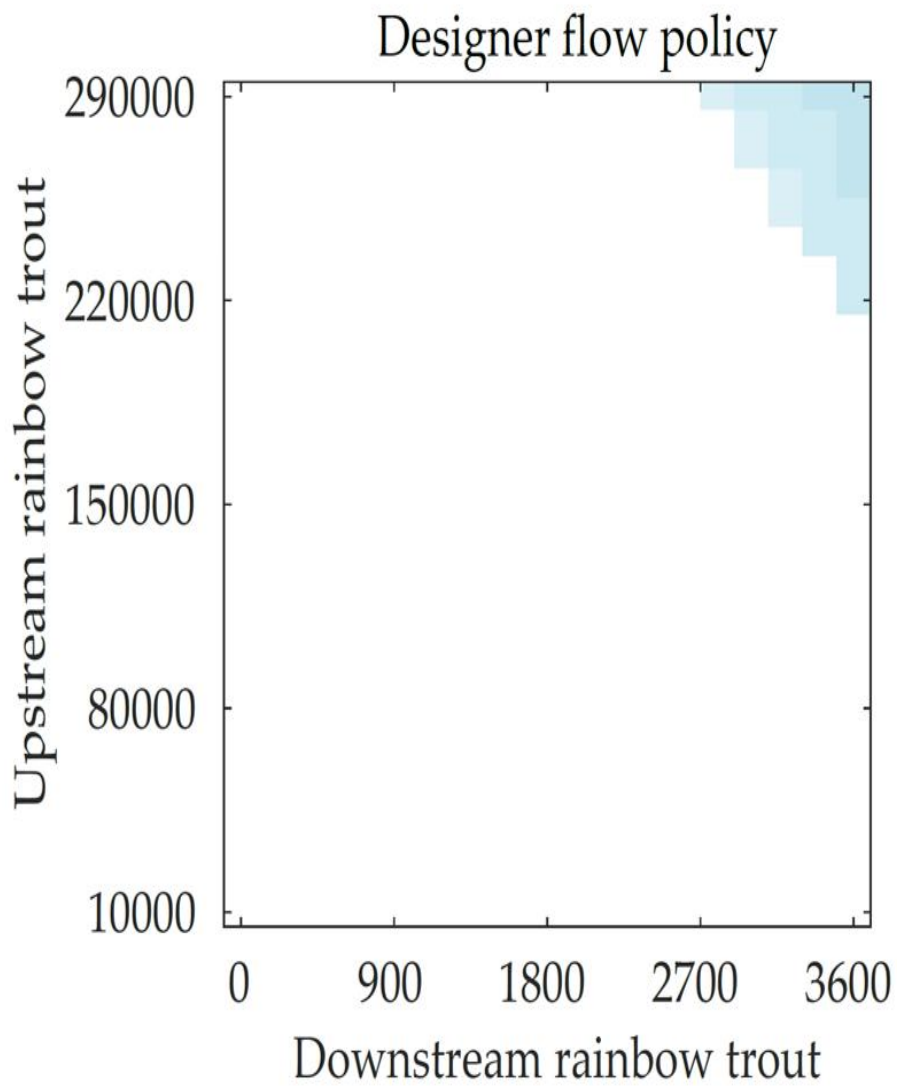


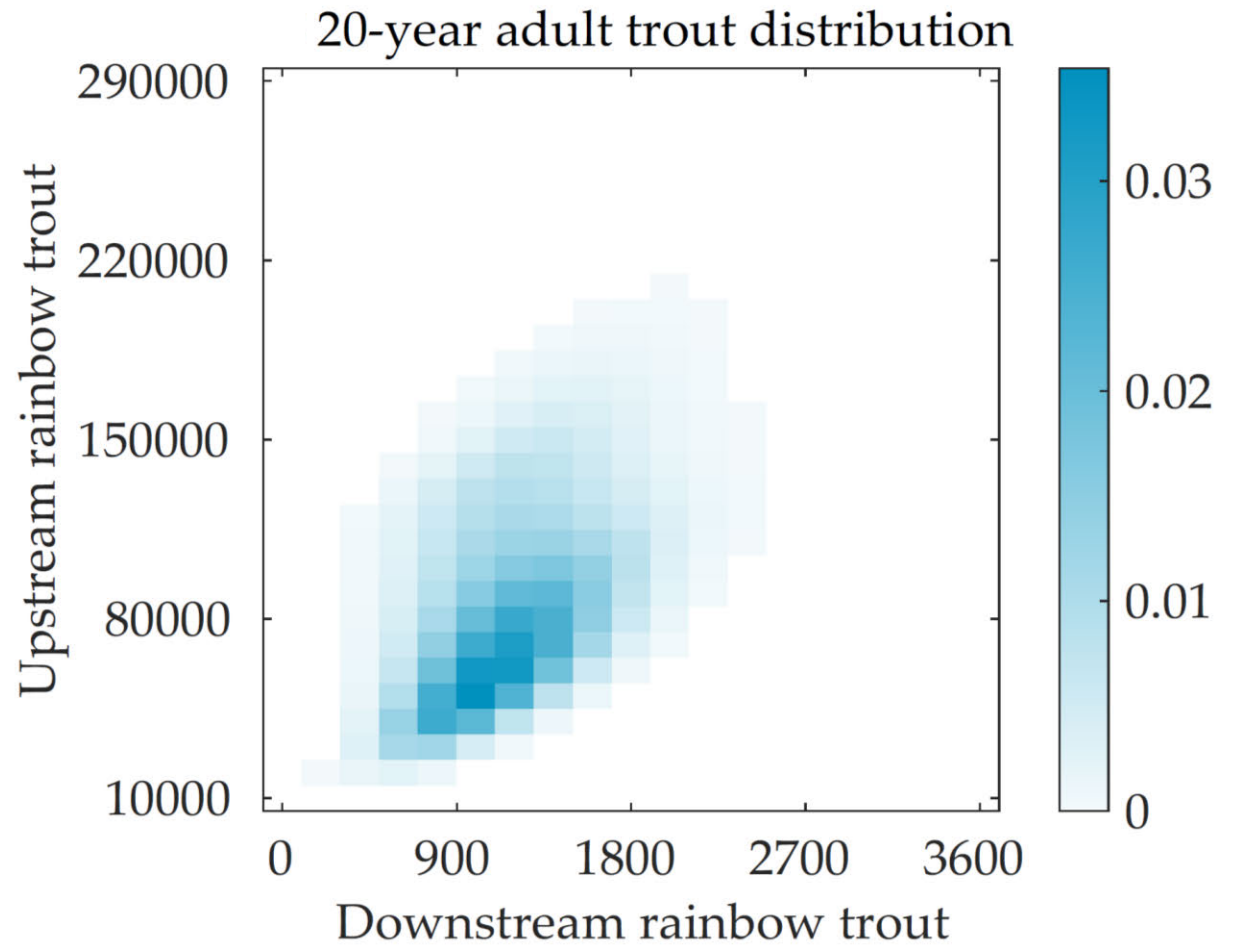
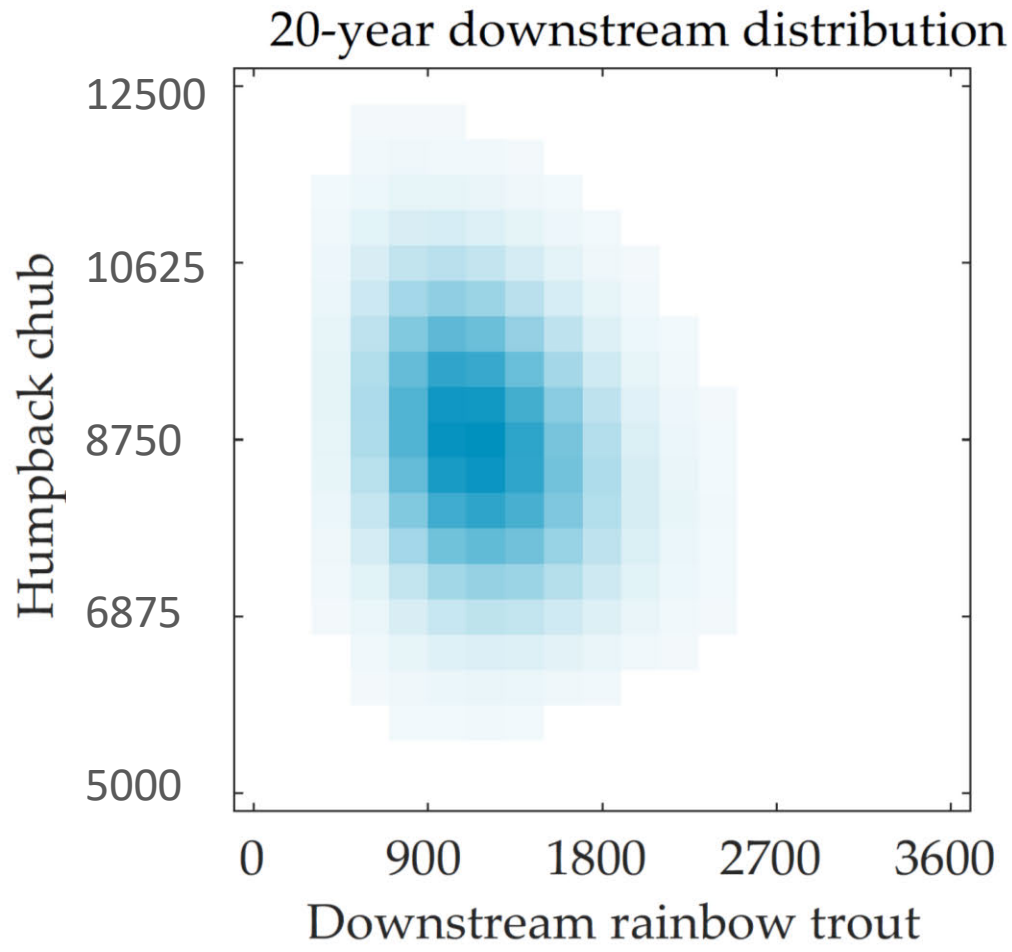
Predictive bioeconomic models for adaptive management

- Management Actions: Trout management flows and mechanical removal of trout
- Objective Function: Implement cost-effective strategies that reduce trout competition and predation on juvenile chub while maintaining a viable adult chub population within a defined time horizon and confidence level.

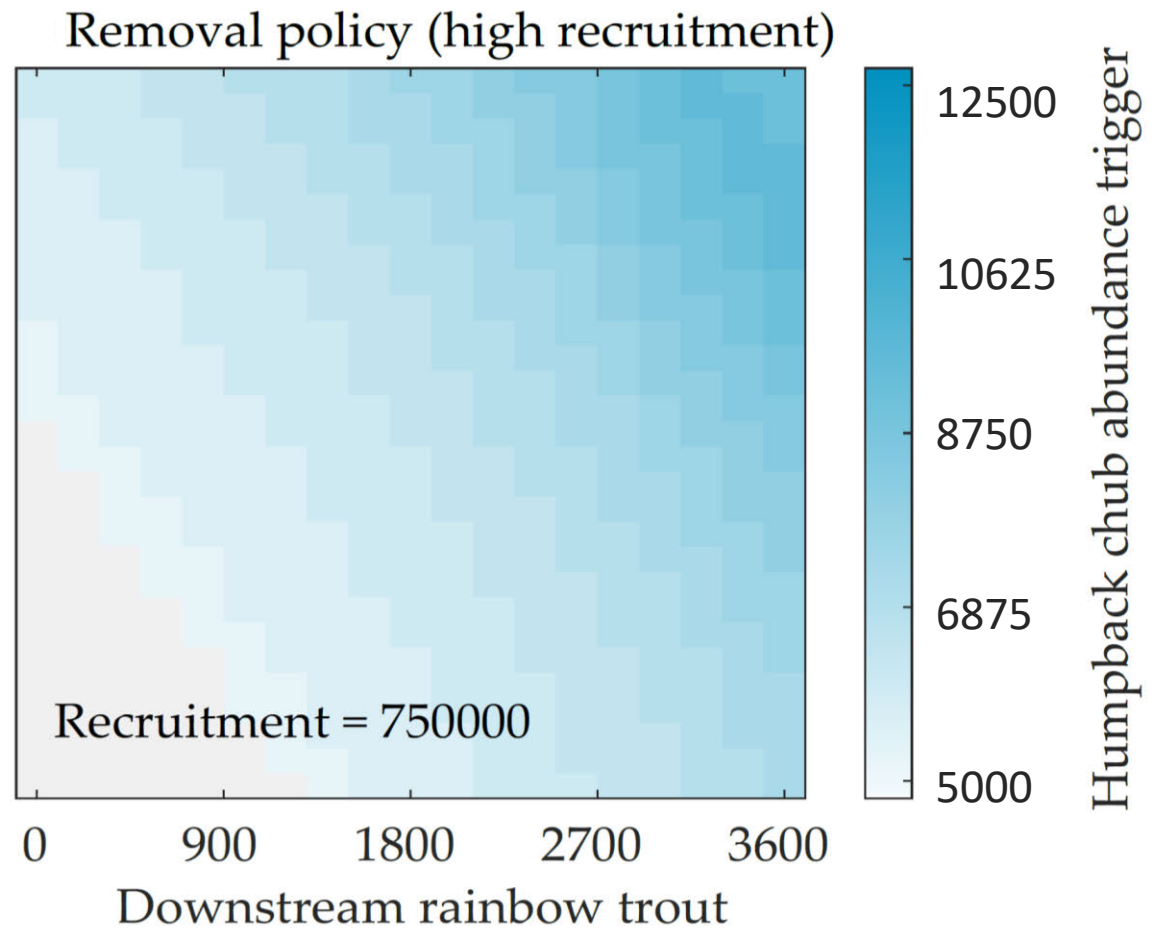
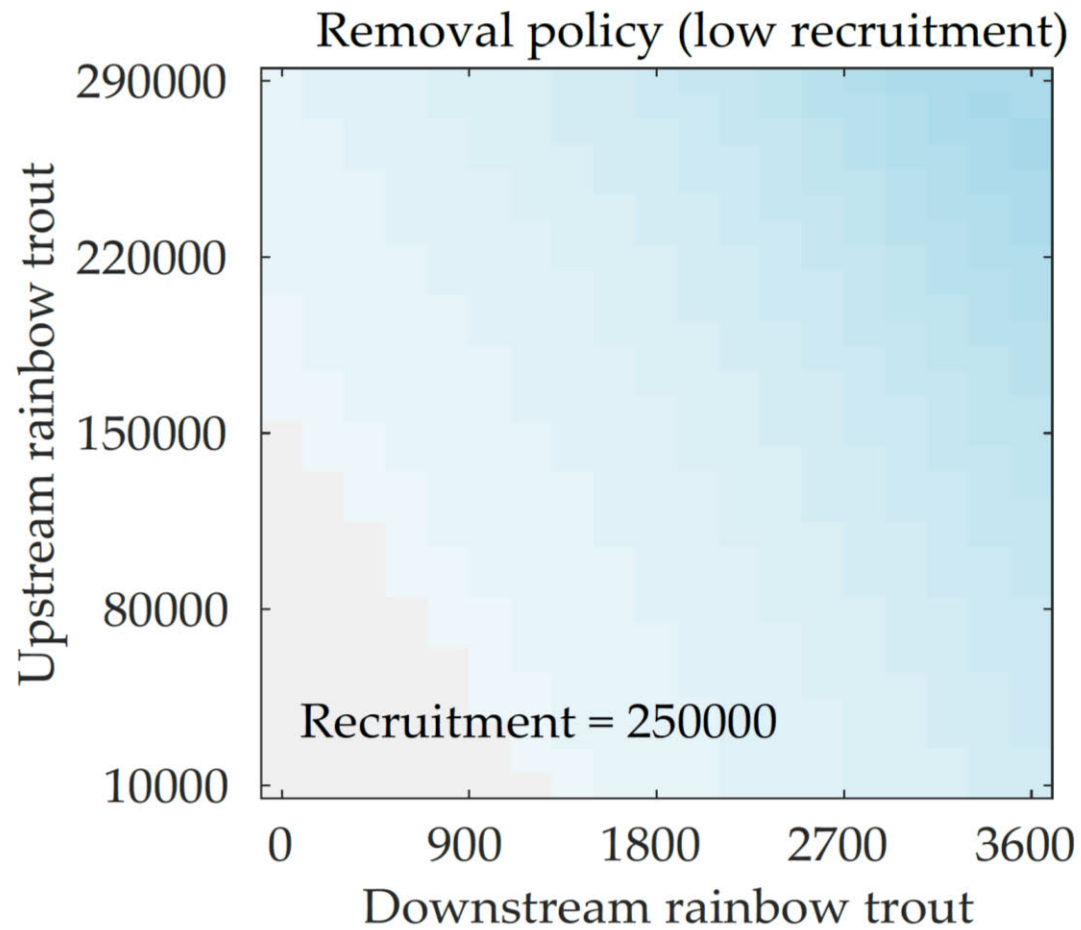


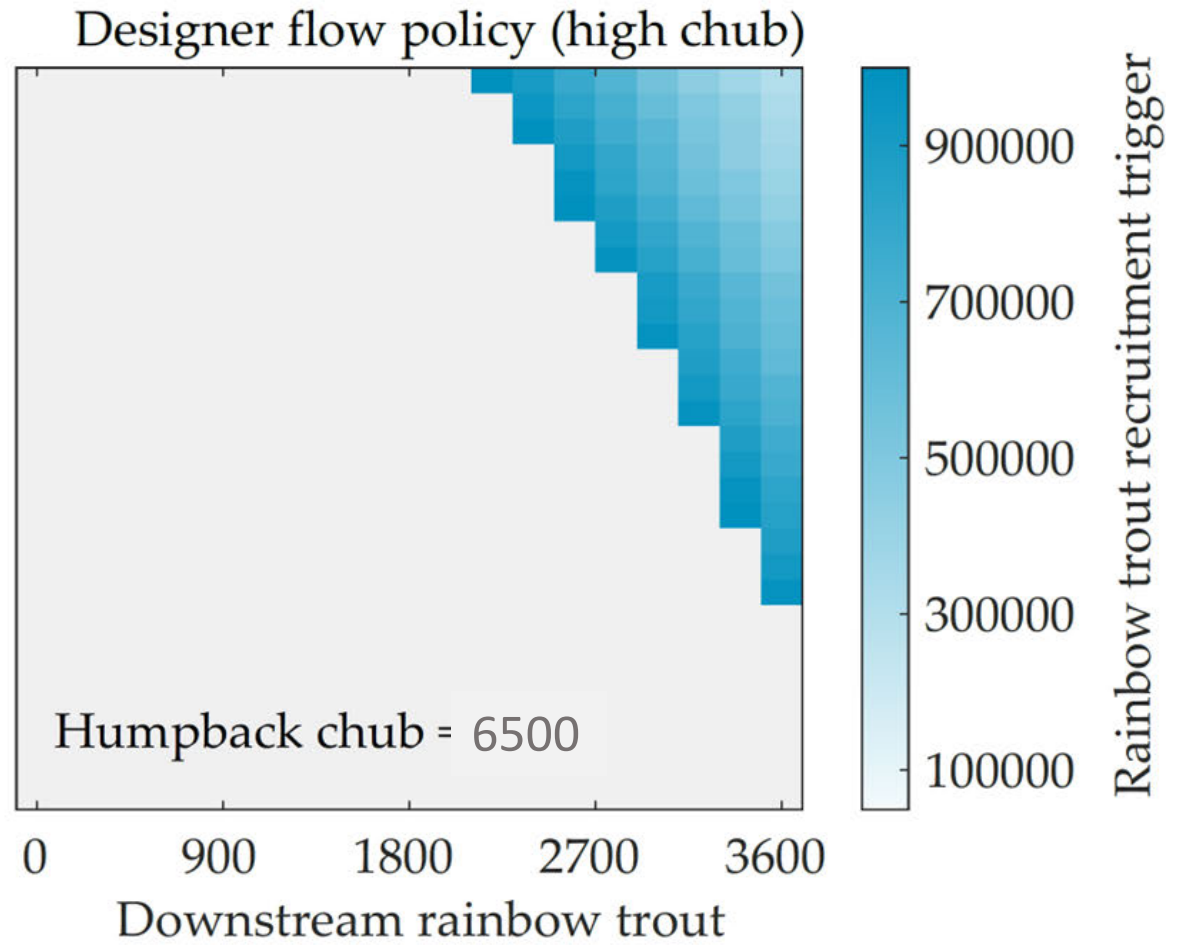
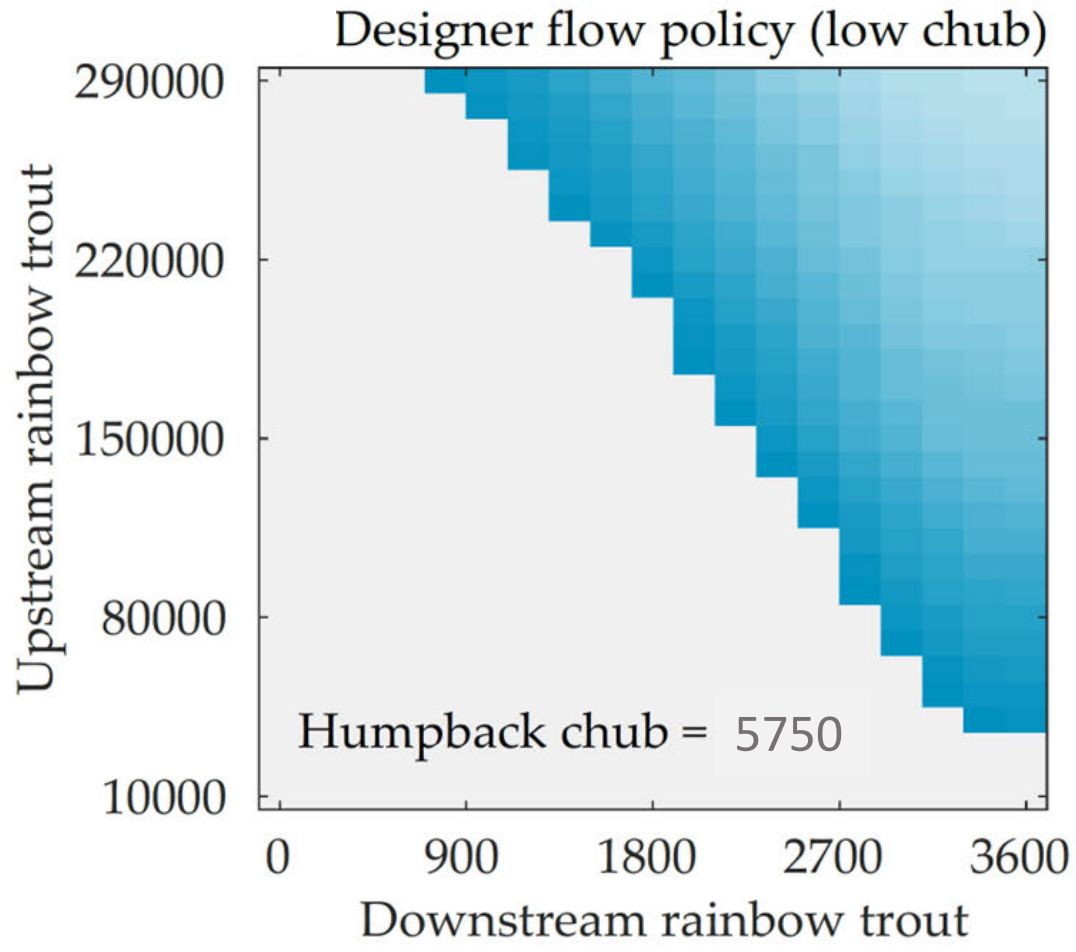
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Observing Rainbow Trout Recruitment





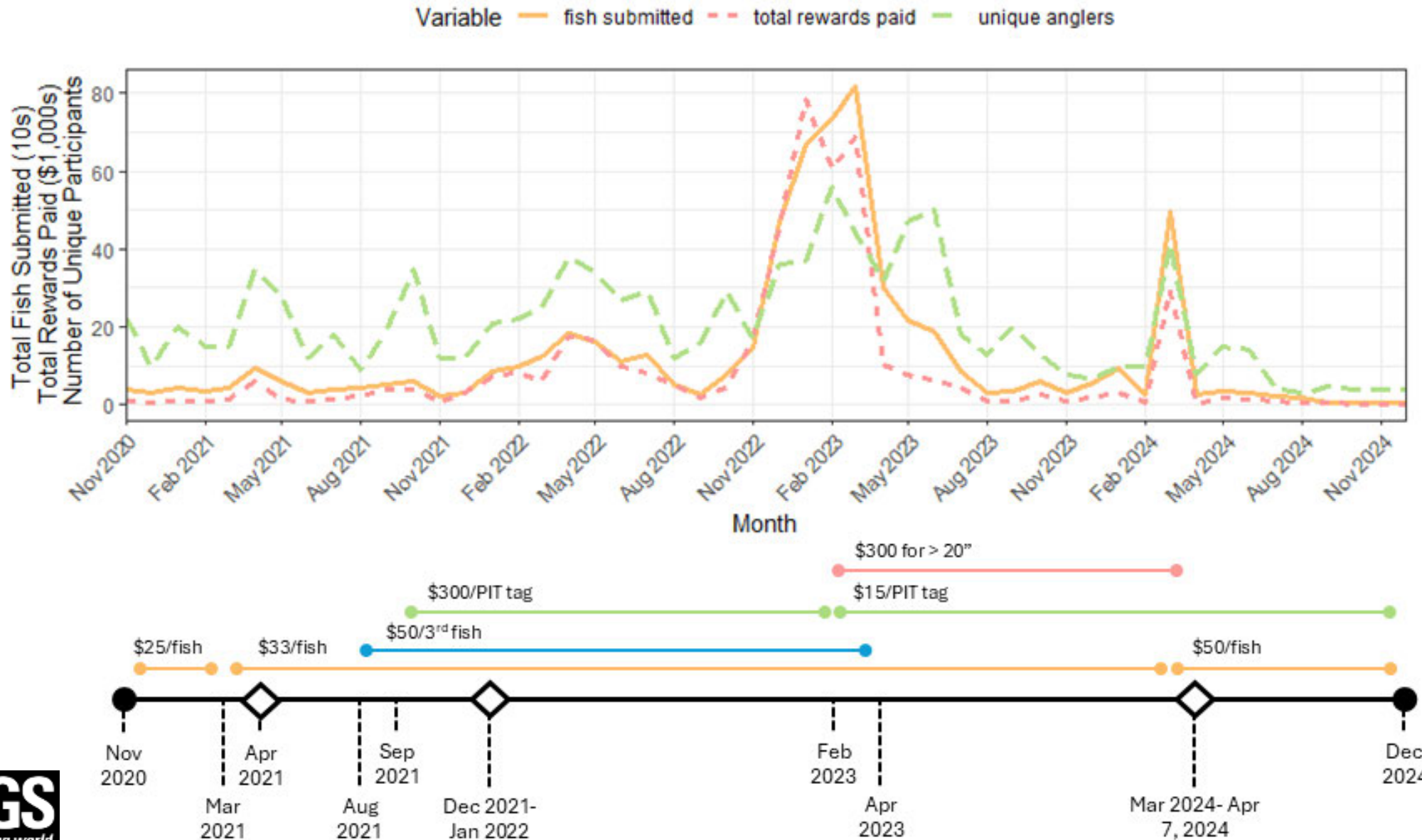
Observing Rainbow Trout Recruitment

- **Flow decisions are responsive to current trout recruitment levels.**
- **Using recruitment-informed trout management flows slightly reduces total costs**, though these actions remain infrequent.
- **Upstream recruitment monitoring provides limited additional economic benefit**, with little impact on long-run expected operating costs.

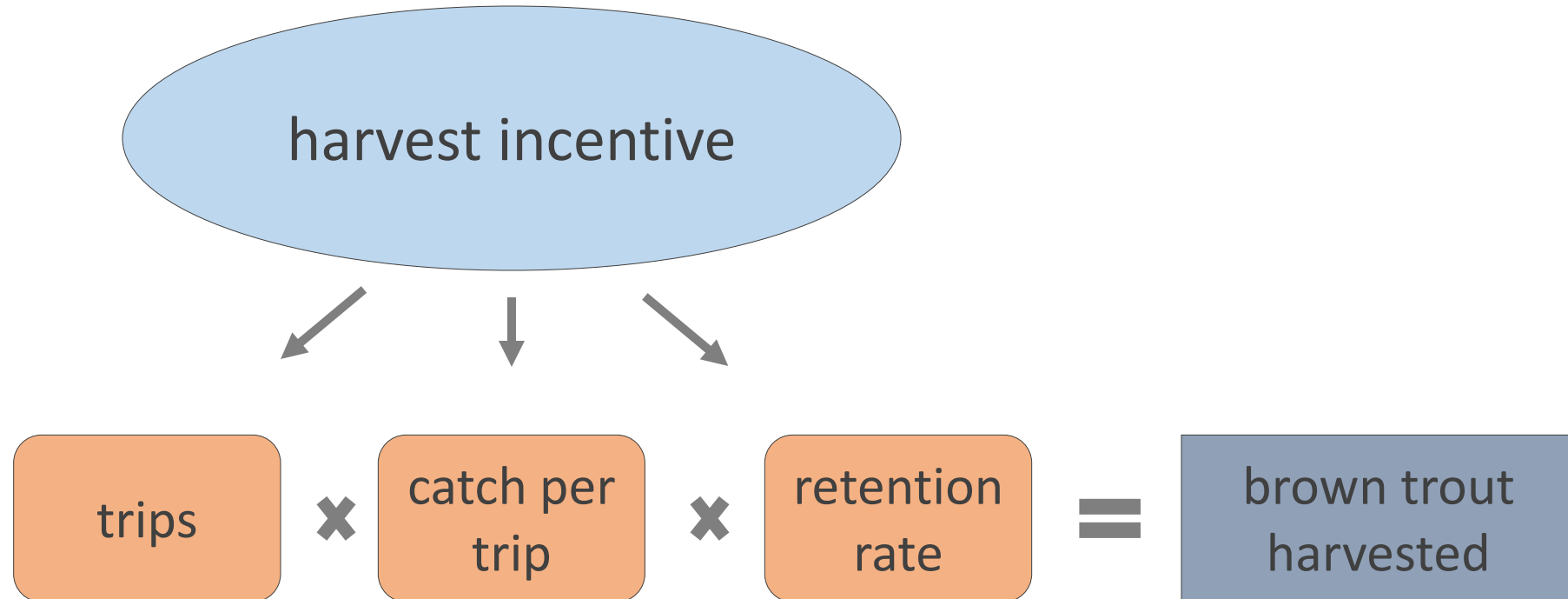


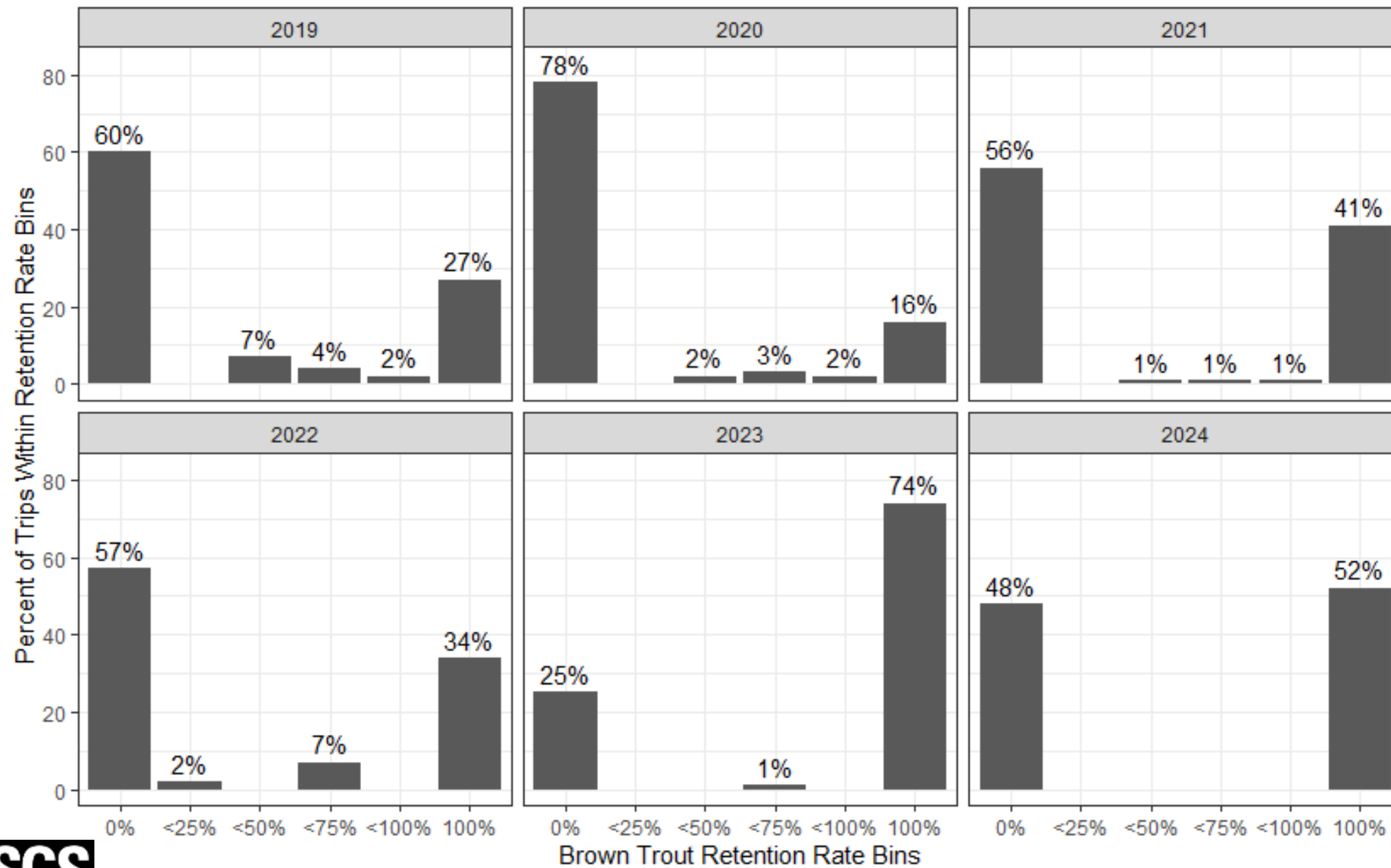
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Brown Trout Incentivized Harvest



Brown Trout Incentivized Harvest Program Evaluation



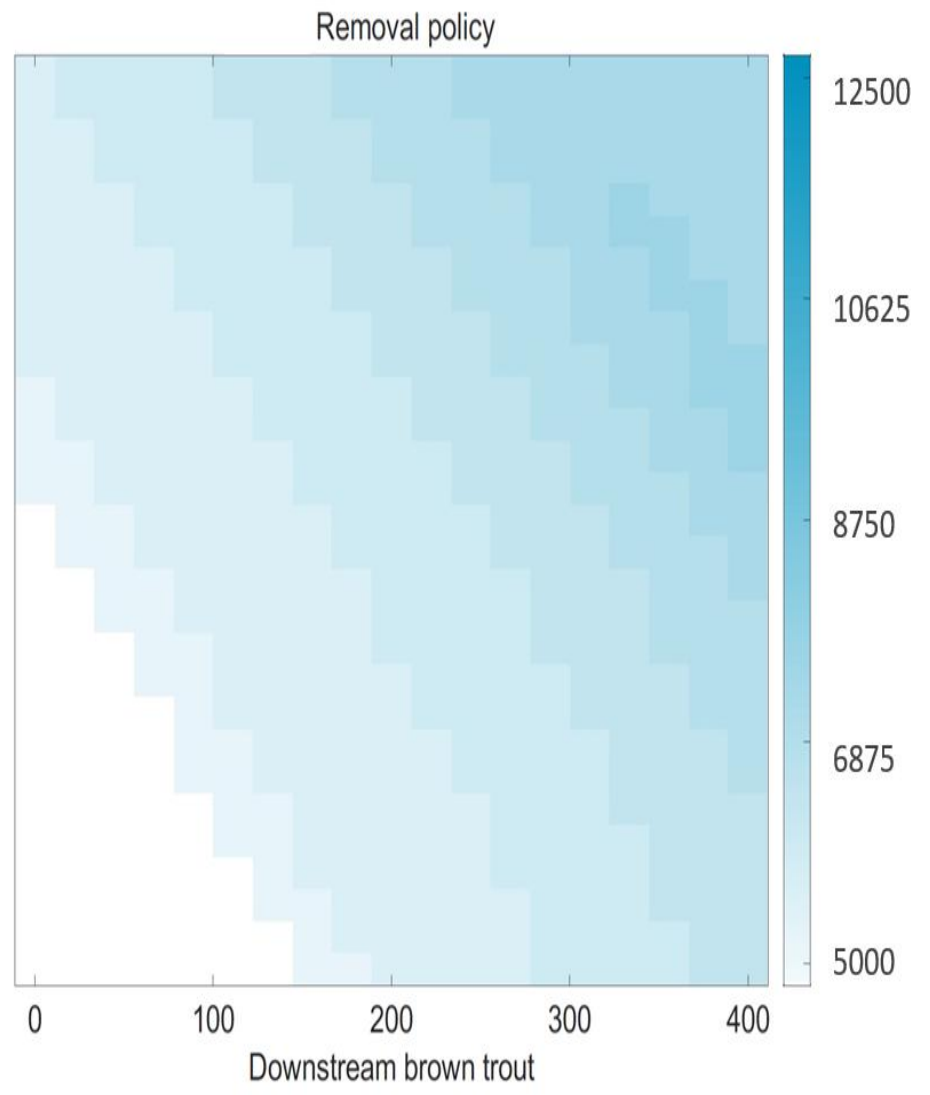
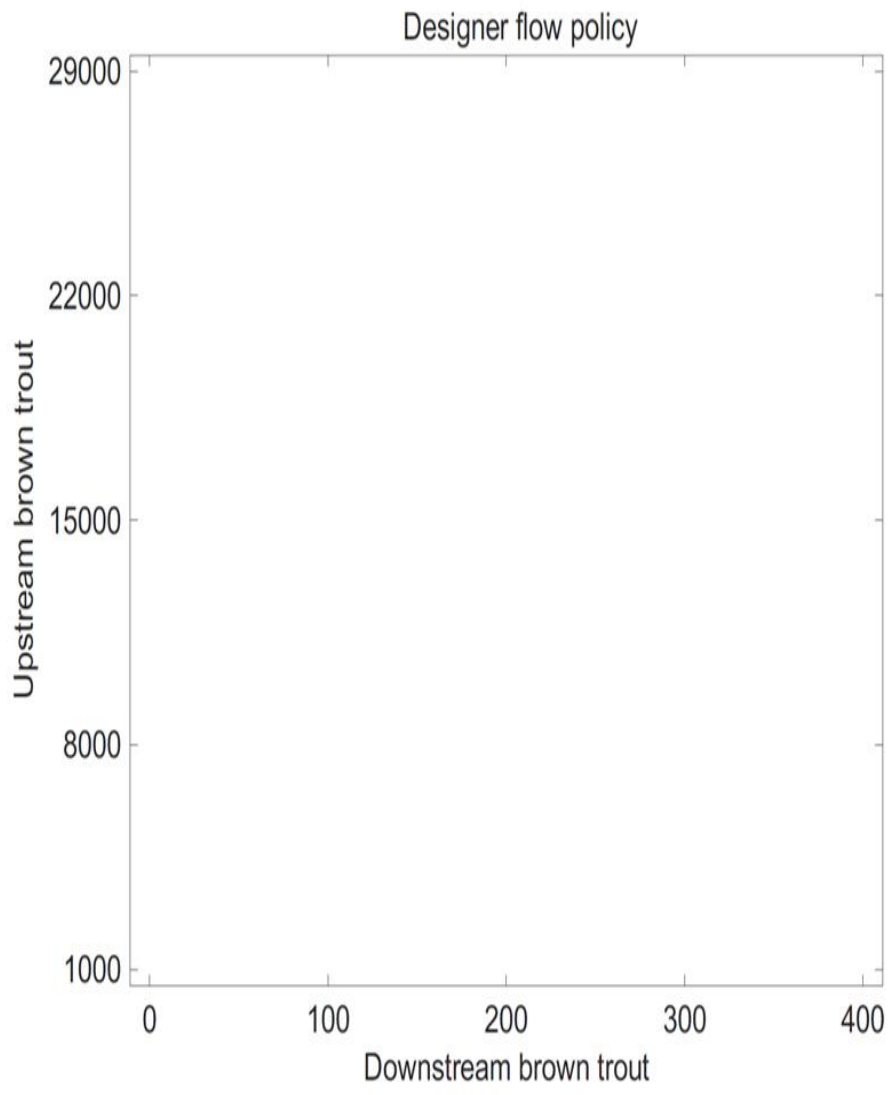


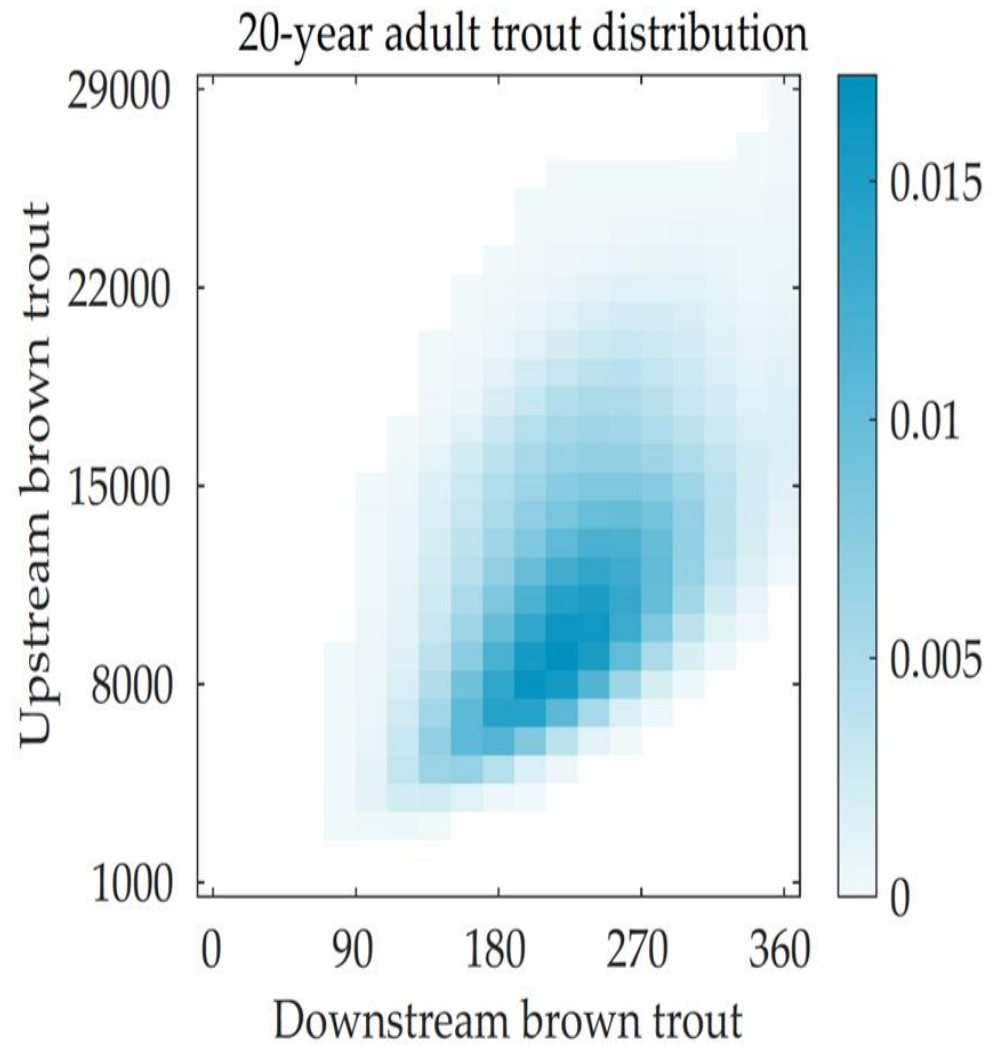
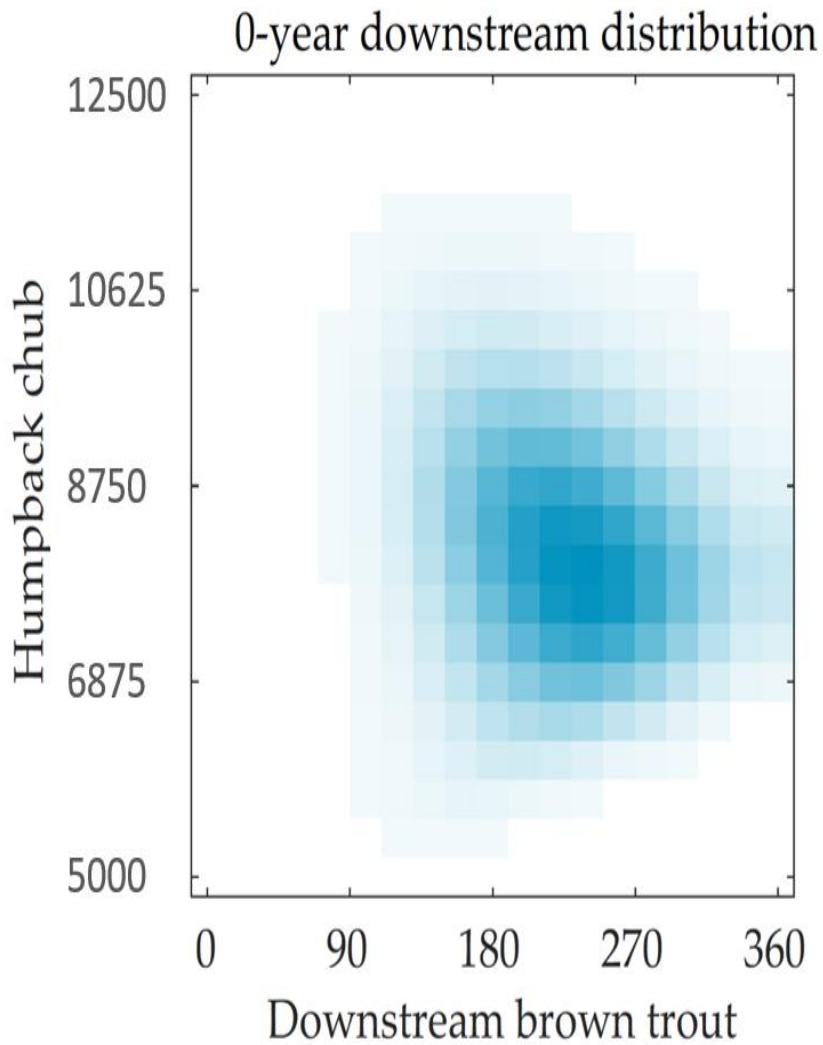
Brown Trout Incentivized Harvest Outcomes

- A small subset of local anglers effectively became “professional” harvesters, driving most brown trout removals.
- The program substantially increased trout harvest but was not clearly more cost-effective than alternative management strategies.
- Incorporating angler behavior into program design can improve the performance of future IHPs and overall program goals.

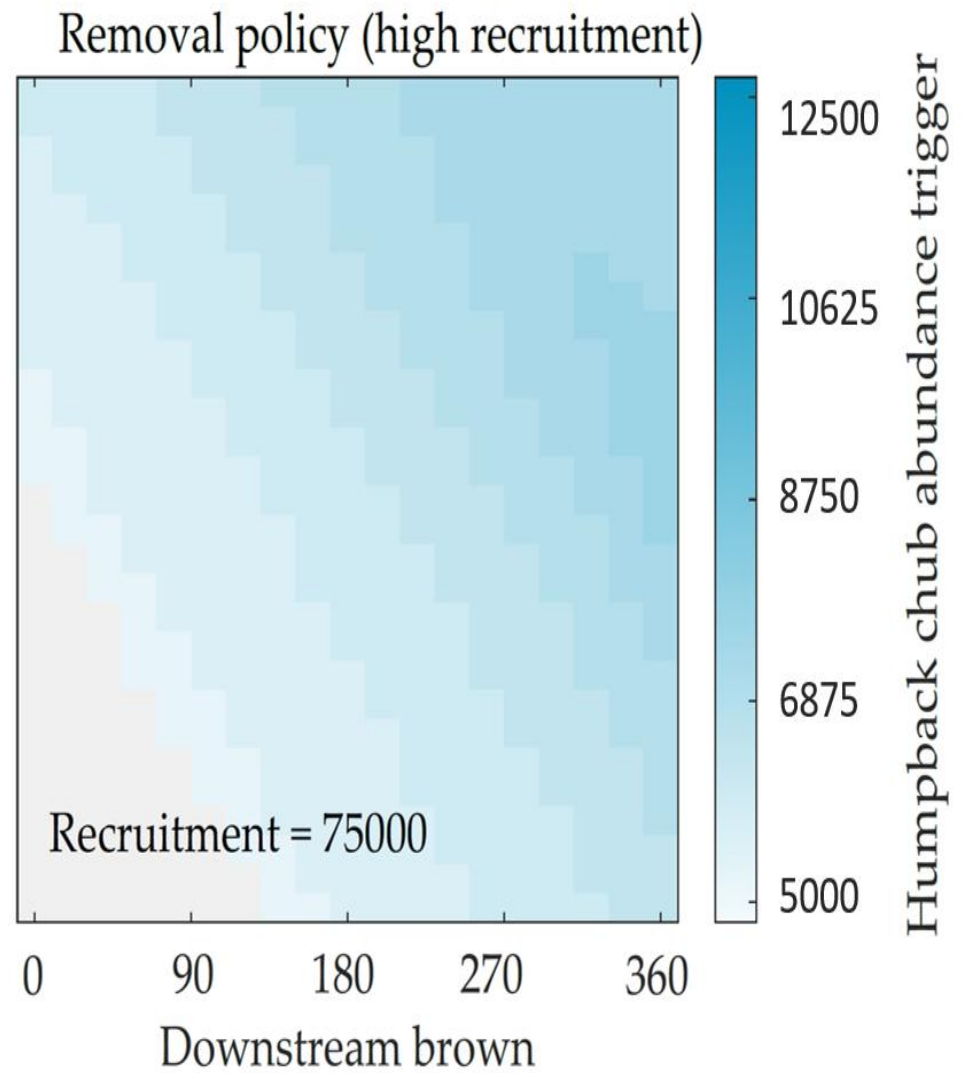
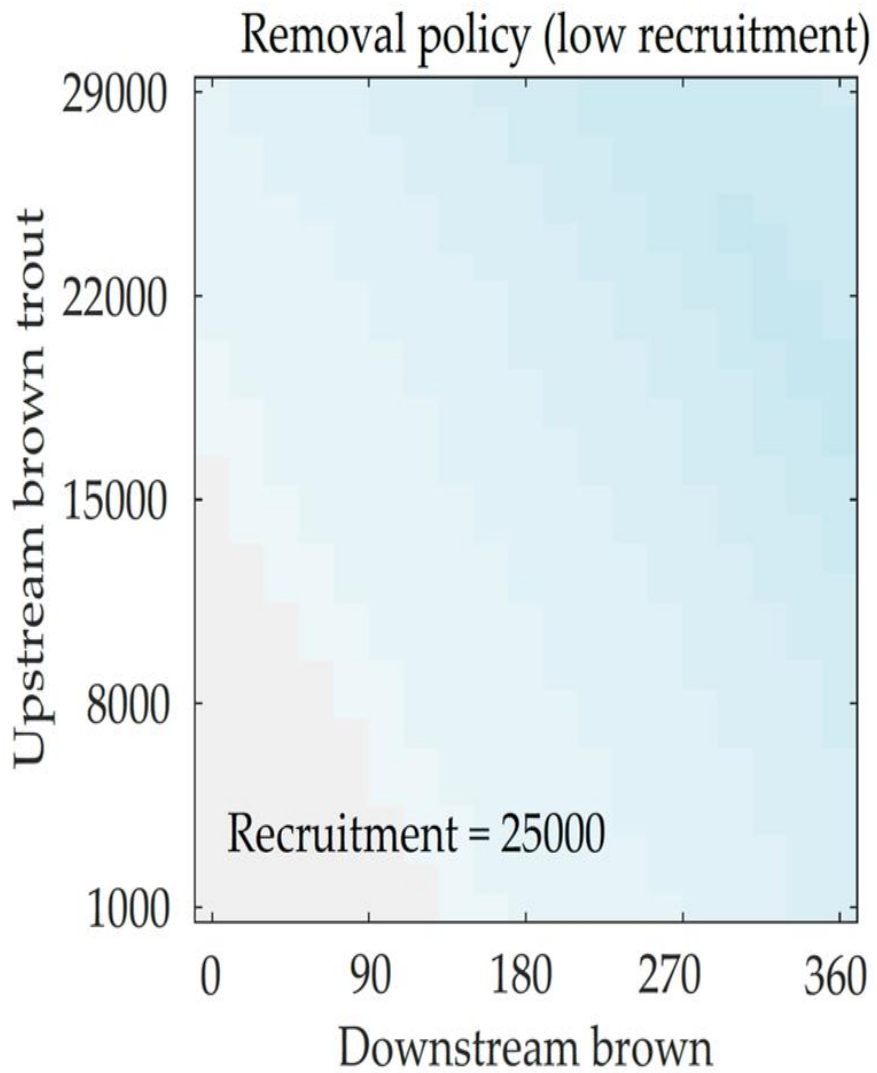


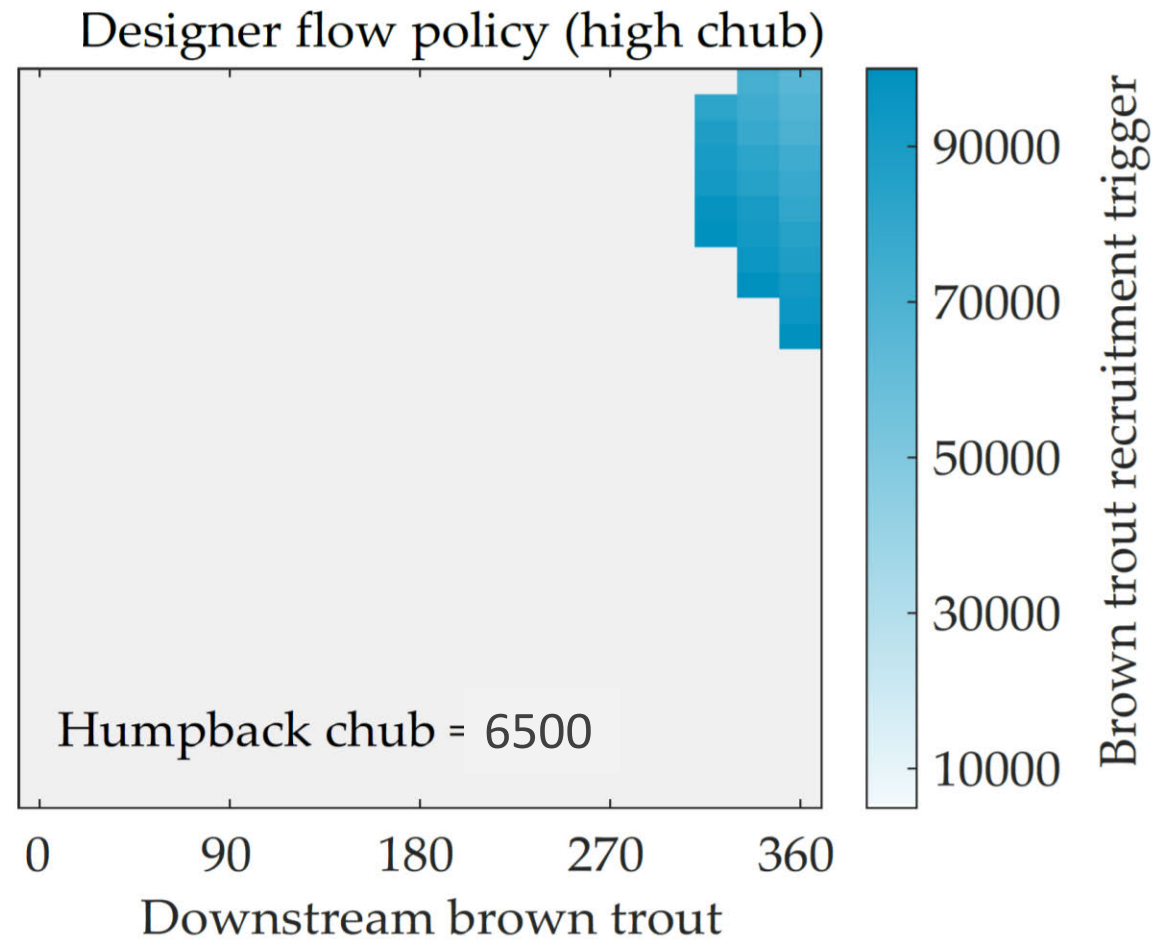
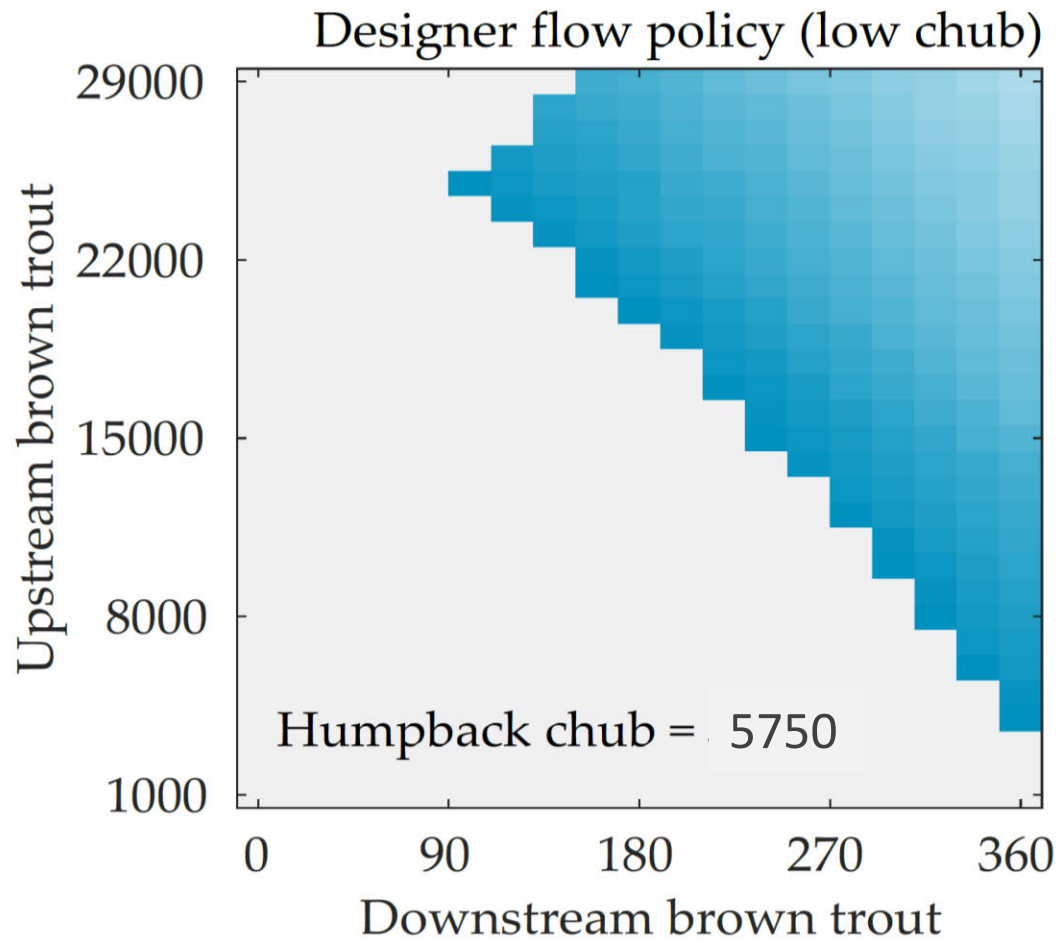
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Observing Brown Trout Recruitment



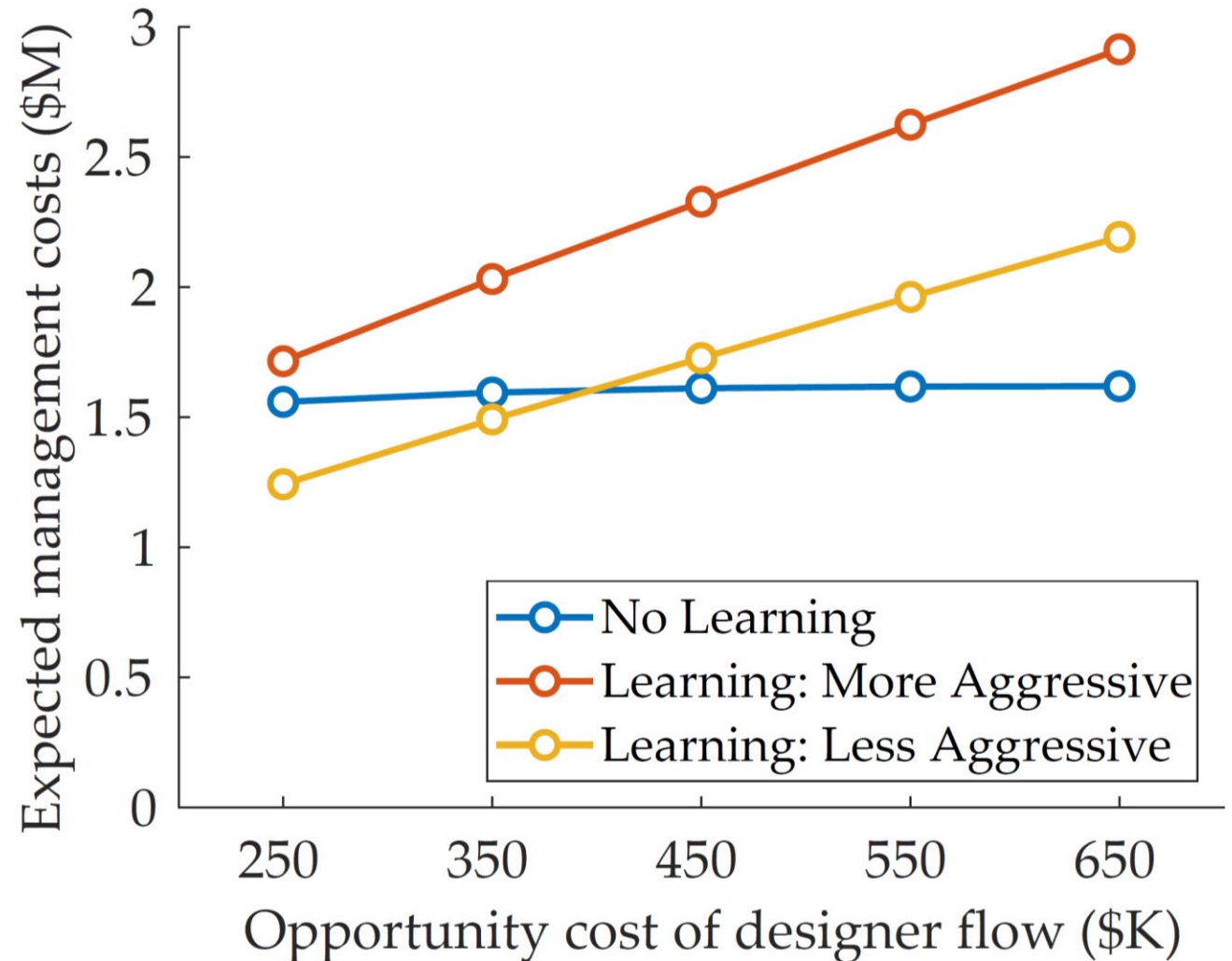


Observing Brown Trout Recruitment

- Designer flow decisions are highly responsive to brown trout recruitment, while nonflow removal actions are used less when flows are available.
- Higher natural brown trout survival shifts management toward earlier population control via flows, rather than later mechanical removals (relative to rainbow trout).
- Designer flows are deployed more frequently in brown trout–dominated systems than in systems dominated by rainbow trout.

Experimental Flow Decision Framework

- Objective: Identify economic conditions under which short-term experimental flow regimes are justified to improve understanding of brown trout management flow effectiveness.
- Approach: Apply an adaptive management strategy in a brown trout-dominated system with recruitment monitoring to guide experimental deployment.



Trout Management Flows

Baseline: Trout management flows are generally too costly for controlling rainbow trout when nonflow actions (e.g., mechanical removal) are available.

Monitoring: Observing rainbow trout recruitment improves the timing and efficiency of flow use in high-recruitment years, though not enough to reduce long-run operating costs.

Species risk: Greater threat from brown trout justifies broader and more frequent use of trout management flows to protect humpback chub.

Adaptive Management Strategy: When energy costs are manageable, **adaptive experimentation during high-recruitment years outperforms a no-experiment approach.**

Conclusion

- Bioeconomic models quantify the risk that increased trout populations pose to key resources, particularly humpback chub and hydropower.
- These tools identify when and where monitoring improves management outcomes under different ecological and economic conditions.
- They also reveal when learning about management effectiveness is cost-effective, supporting targeted adaptive experimentation.