What's it worth? GCDAMP economic surveys and their utility in decision making.

Lucas Bair, U.S. Geological Survey, Southwest Biological Science Center, Grand Canyon Monitoring and Research Center

GCDAMP Annual Reporting Meeting 2018

Flagstaff, Arizona

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Nonmarket Values for the Effects of Complex Dam Operations

AGU PUBLICATIONS

Water Resources Research

RESEARCH ARTICLE

10.1002/2017WR020729

Testing the Limits of Temporal Stability: Willingness to Pay Values among Grand Canyon Whitewater Boaters Across Decades

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Key Points:
- Whitewater boater willingness to pay was compared across two studies conducted 30 years apart
- The comparison included estimated trip values for four alternative flow levels
- No significant differences in trip willingness to pay were found between the two studies, although differences in WTP functions were found

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Abstract We directly compare trip willingness to pay (WTP) values between 1985 and 2015 stated preference surveys of private party Grand Canyon boaters using identically designed valuation methods. The temporal gap of 30 years between these two studies is well beyond that of any tests of WTP temporal stability in the literature. Comparisons were made of mean WTP estimates for four hypothetical Colorado River flow level scenarios. WTP values from the 1985 survey were adjusted to 2015 levels using the consumer price index. Mean WTP precision was estimated through simulation. No statistically significant differences were detected between the adjusted Bishop et al. (1987) and the current study mean WTP estimates. Examination of pooled models of the data from the studies suggest that while the estimated WTP values are stable over time, the underlying valuation functions may not be, particularly when the data and models are corrected to account for differing bid structures and possible panel effects.

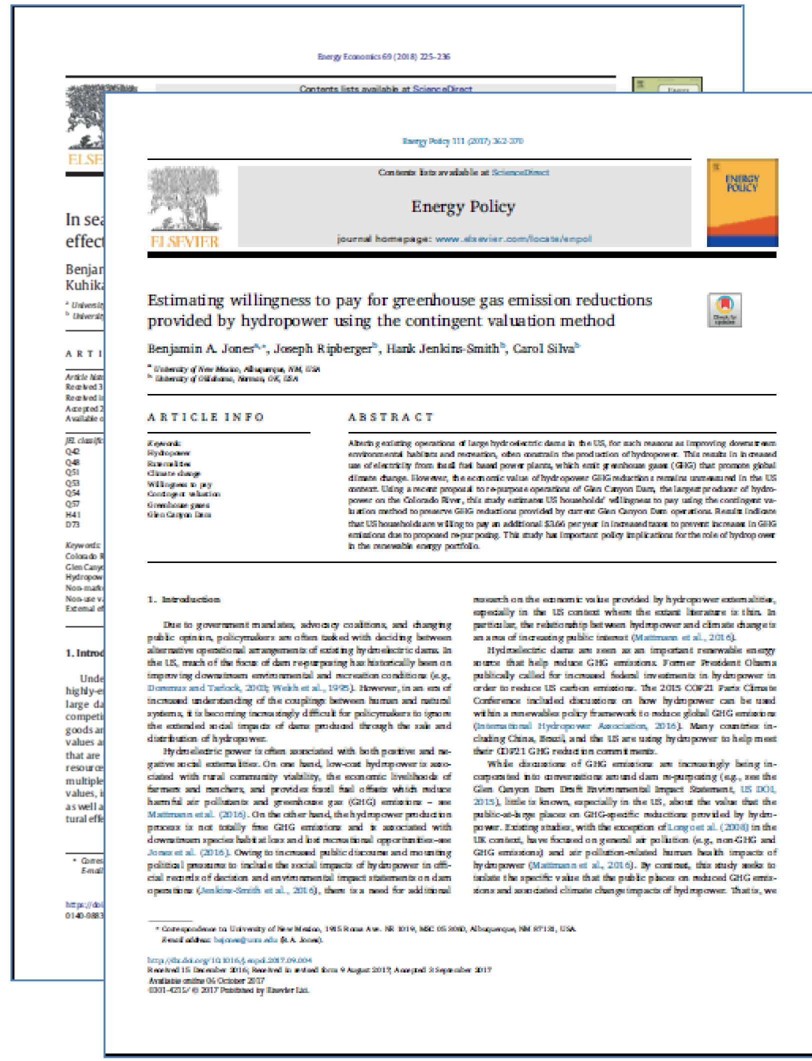
1. Introduction

The Grand Canyon is an iconic symbol of both the American West and the success of the National Park System. While most visitors view the Colorado River from the vantage point of either the North or South rims of the canyon, far removed from its waters, each year many people recreate on the river as well. One highly prized Colorado River activity is securing a coveted private party permit to boat the world class whitewater from Lees Ferry through the Grand Canyon. Grand Canyon National Park issues both private and commercial permits to boat the Colorado River through the Grand Canyon. Of the approximately 24,000 annual visitors, 7,000 are private party whitewater boaters (Grand Canyon National Park, 2006).

In the 1980s a suite of Colorado River user surveys, hereafter referred to as the Bishop study, was undertaken to estimate how different water flow levels in the Colorado River and different scenarios for releasing water from Glen Canyon Dam impacted the value Grand Canyon whitewater boaters (among other river user groups) placed on their recreational river experience (Bishop et al, 1987). Since the original Bishop study, there have been numerous changes in river flow management and the status of the resource (Grand Canyon Monitoring and Research Center, 2005). Recognizing the length of time since the original Bishop study (nearly 25 years), in 2009 the National Park Service (NPS) funded initial stages of a study design for a replication and extension of the earlier work. However, only preparatory work could be done until 2014, when the Glen Canyon Dam Adaptive Management Program provided the additional funding needed to complete our 2016 Grand Canyon private party whitewater boater study beyond the initial design stage.

While our study was intended to update the nearly 30 years old Bishop study willingness to pay (WTP) estimates, we also recognized the opportunity to test the temporal stability of recreational WTP values from a high-profile, high-quality study over a period much longer than had been reported previously in the literature. Our study design sampled individuals who participated in a private party whitewater trip down the Grand Canyon in 2014 and 2015. Randomly selected private party boaters received a recreational use and value survey containing valuation questions that used a dichotomous choice contingent valuation (DCCV) question format with the same wording as in the earlier Bishop study. The DCCV questions were designed so responses and estimated WTP per trip could be directly compared to parallel results estimated from data collected in the Bishop study 30 years earlier.

LONG-TERM STABILITY OF RECREATIONAL WTP 1



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Estimating willingness to pay for greenhouse gas emission reductions provided by hydropower using the contingent valuation method

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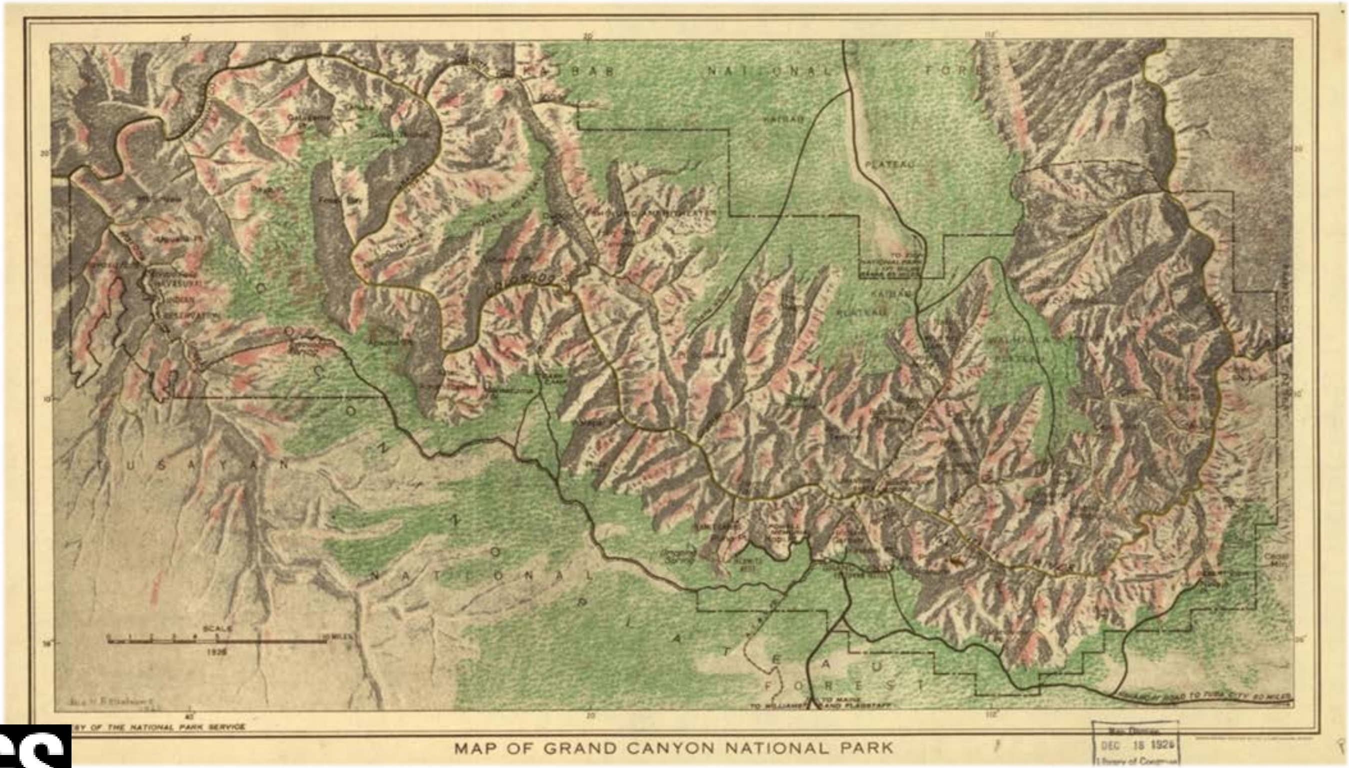
Keywords: Hydropower; Renewables; Climate change; Willingness to pay; Contingent valuation; Greenhouse gases; Glen Canyon Dam

ABSTRACT

Altering existing operations of large hydroelectric dams in the US, for such reasons as improving downstream environmental habitats and recreation, often constrain the production of hydropower. This results in increased use of electricity from fossil fuel based power plants, which emit greenhouse gases (GHG) that promote global climate change. However, the economic value of hydropower GHG reductions remains unmeasured in the US context. Using a recent proposal to re-purpose operations of Glen Canyon Dam, the largest producer of hydropower on the Colorado River, this study estimates US households' willingness to pay using the contingent valuation method to preserve GHG reductions provided by current Glen Canyon Dam operations. Results indicate that US households are willing to pay an additional $3.66 per year in increased taxes to prevent increases in GHG emissions due to proposed re-purposing. This study has important policy implications for the role of hydropower in the renewable energy portfolio.

http://dx.doi.org/10.1016/j.enpol.2017.09.004

The Grand Canyon Protection Act of 1992 states that, long-term monitoring of Glen Canyon Dam shall include necessary research and studies to determine the effect of the Secretary's actions on natural, recreational, and cultural resources.



http://commons.wikimedia.org/wiki/File:Map_of_the_Grand_Canyon_National_Park_1926.jpg

2009 GCRMC Socioeconomic Research Review Panel

- Hydropower modeling
  - Economic and financial
- Recreation surveys
  - Angling and whitewater
- Tribal surveys
- Passive use surveys

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Nonmarket Resources

- Nonmarket resources are goods and services not traded in markets.
  - Recreation
  - Fish and wildlife
  - Air quality
- Economic values for nonmarket resources are estimated through observational data or surveys.

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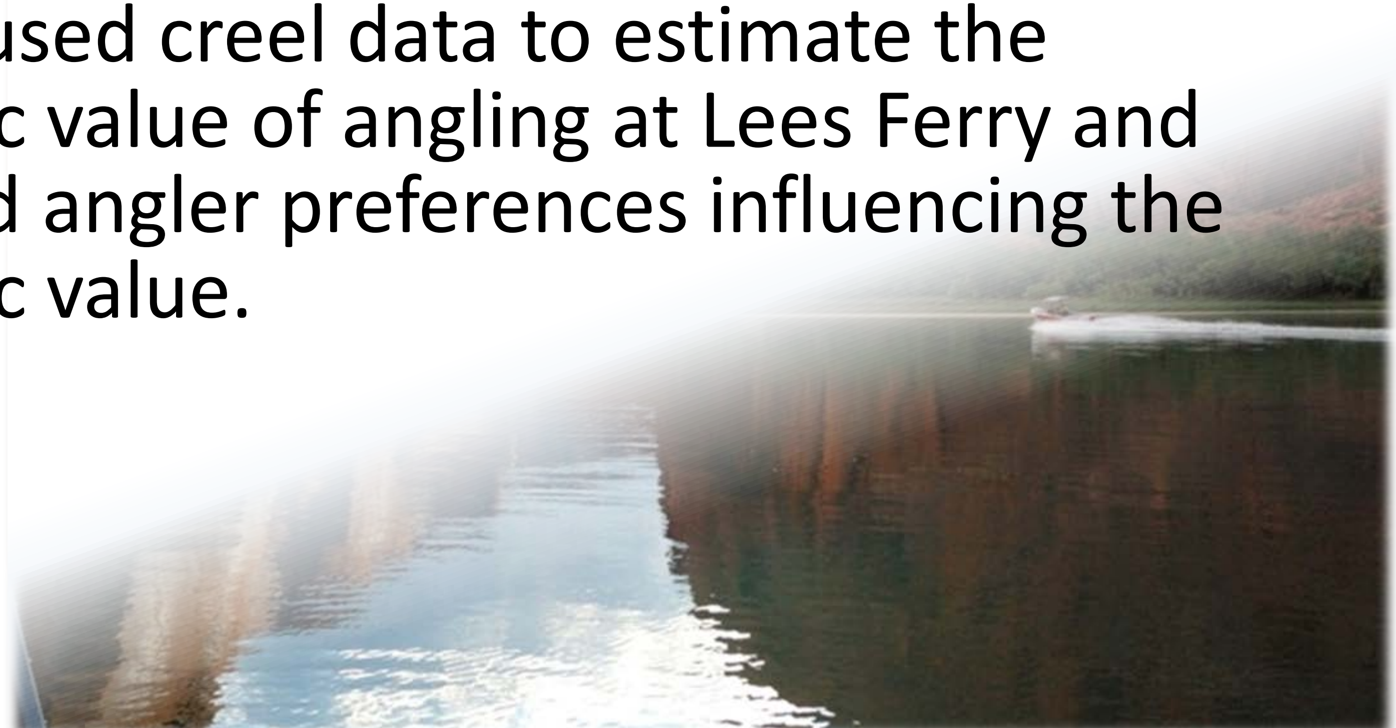
Revealed Preference Method

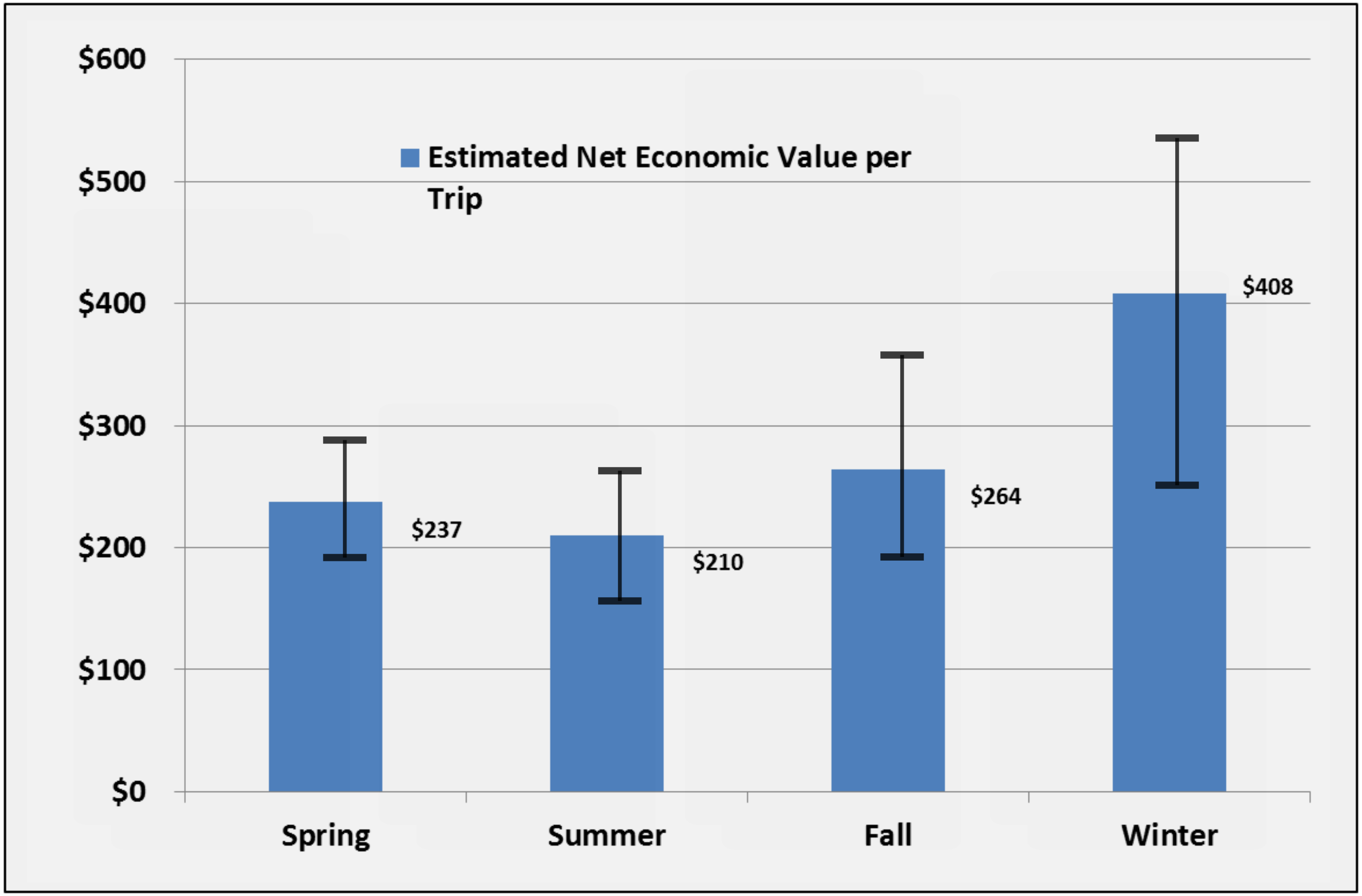
- Estimates economic value of resources through analyzing people's choices when those choices are observable.

- GCMRC used creel data to estimate the economic value of angling at Lees Ferry and identified angler preferences influencing the economic value.



http://fsflyfishing.com/lodge-lees-ferry-anglers-arizona-us

Angler Economic Value and Season



Bootstrapped aggregate model seasonal benefit estimates at Lees Ferry with confidence intervals at the 95% level (2014 dollars)

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Lucas S. Bair, David L. Rogowski & Chris Neher (2016) Economic Value of Angling on the Colorado River at Lees Ferry: Using Secondary Data to Estimate the Influence of Seasonality, North American Journal of Fisheries Management, 36:6, 1229-1239, DOI: 10.1080/02755947.2016.1204388

Stated Preference Method

- Estimates economic value for resources through analyzing people's choices as stated responses in a survey.
- GCMRC surveyed private whitewater boaters to estimate the economic value of a river trip and identified boater preferences influencing the economic value.

https://www.oars/grandcanyon/

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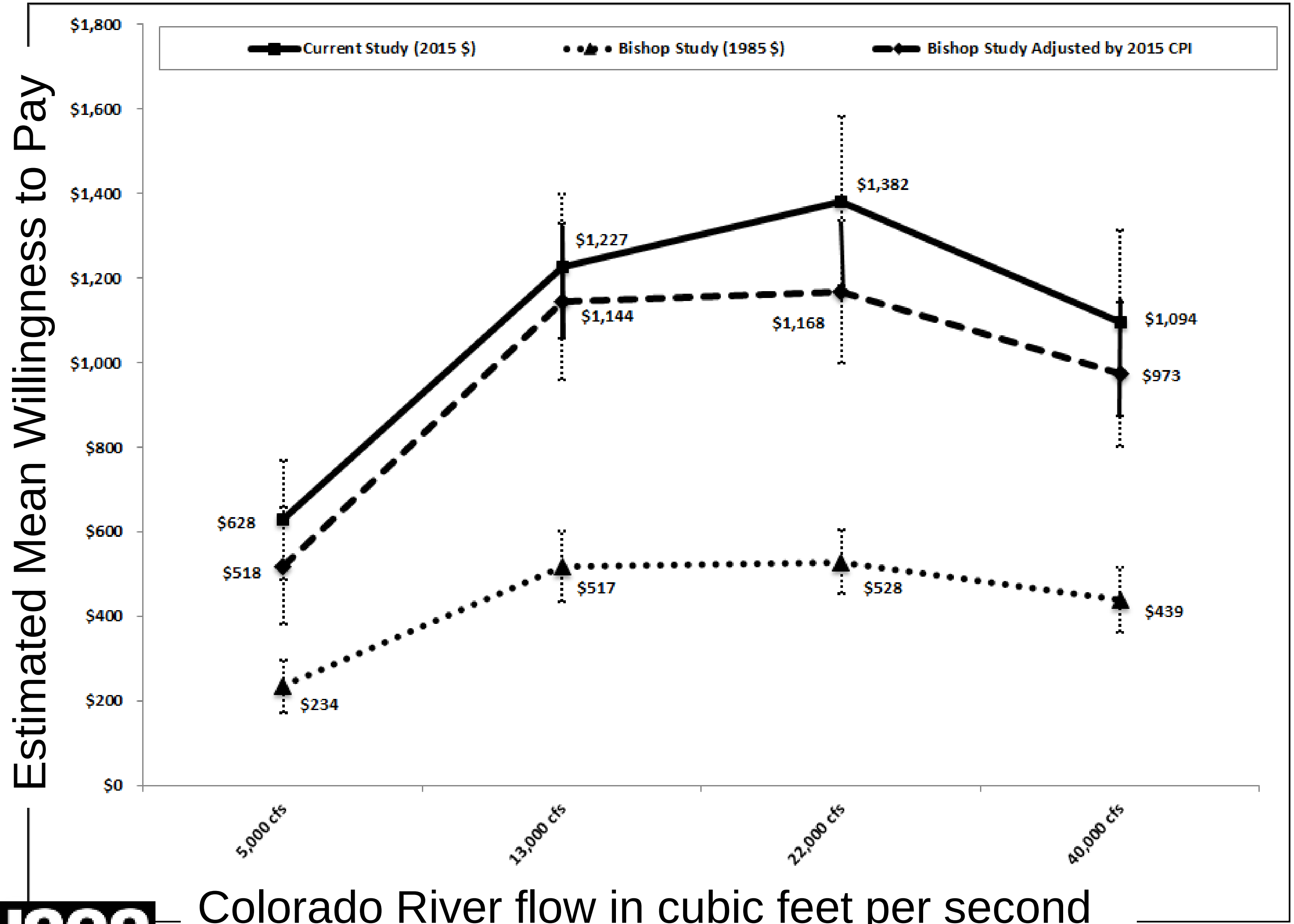
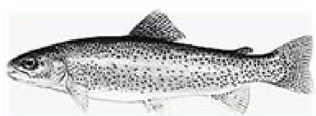
Whitewater Economic Value and Flow



Chris J. Neher, John Duffield, Lucas S. Bair, David Patterson, Katherine Neher. Testing the limits of temporal stability: willingness to pay values among Grand Canyon whitewater boaters across decades. Water Resources Research, 53, 2017, https://doi.org/10.1002/2017WR020729

Colorado River Total Value Study

Resources impacted by policies	Existing Management Plan—conditions over the next 20 years	Proposed Plan A—conditions over the next 20 years
River Beaches (Size and number) 	20% decrease in size and number	20% increase in size and number
Native fish (humpback chub) populations 	Remain at present levels	25% decrease in humpback chub populations
Trout populations 	Remain at present condition	50% increase in large trout populations
Cost to your Household $	$ 0	$40 per year for 20 years
I would vote for (check only one ✓)	❑	❑

Chris J. Neher, John Duffield, David Patterson. 2016. Colorado River Total Values Study. Final Report, University of Montana, Department of Mathematical Sciences, Prepared for the National Park Service, August.

Inclusive Approach to Nonmarket Valuation

COLORADO RIVER TOT
VALUE STUDY

August 2016 | **Final Report**

Prepared for: National Park Service

By:

Dr. John Duffield, Chris Neher, and Dr. David Patterso

University of Montana, Department of Mathematical Sciences

Energy Economics 69 (2018) 225–236

Contents lists available at ScienceDirect

Energy Economics

journal homepage: www.elsevier.com/locate/eneeco

In search of an inclusive approach: Measuring non-market values for the effects of complex dam, hydroelectric and river system operations

Benjamin A. Jones [a,*], Robert P. Berrens [a], Hank Jenkins-Smith [b], Carol Silva [b], Joe Ripberger [b], Deven Carlson [b], Kuhika Gupta [b], Wesley Wehde [b]

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Glen Canyon Dam
Hydropower
Non-market
Non-use values
External effects of hydropower

A B S T R A C T

Hydroelectric dams have social, cultural, and environmental impacts on society through both alterations of riverine effects (both downstream and in reservoirs) and the production and distribution of hydropower in a broader geographical area. Management of complex dam, hydroelectric, and river systems frequently requires tradeoffs between alternative operational profiles, each with its own set of heterogeneous external effects. Substantial evidence suggests that segments of the public hold non-market values, including non-use values, for both riverine environmental effects and a wide array of external effects of hydropower production and distribution. However, non-market non-use valuation exercises related to re-purposing dam operations continue to focus exclusively on downstream external effects, calling into question their usefulness in decision-making processes. Focusing on the Glen Canyon Dam (GCD), a critical source of hydropower and peaking capacity on the Colorado River, US, we measure non-market values, expected to be significantly composed of non-use values, using the contingent valuation (CV) method for two proposed management options inclusive of multiple social, cultural, and environmental effects of both downstream riverine effects and hydropower production and distribution in the broader basin. To provide a defensible basis for inclusion of relevant external effects in the valuation exercise, we undertook a multi-year study of the GCD policy domain. Using a nationally-representative, address-based CV internet survey, results from an advisory referendum voting format suggest that the average US household has a median net willingness to pay (WTP) to continue existing GCD operations of $21.51 per year [95% CI: $2.98, $40.04] after accounting for WTP to change operations under the US Department of Interior's preferred alternative. Net non-market value for continuing operations is $2.9 billion per year, aggregating across US households.

1. Introduction

Understanding public values for or against operational changes to highly-engineered river systems, such as hydropower production from large dams, requires sorting through complex patterns of often-competing dimensions. Non-market values are attached to changes in goods and services not reflected in market prices, including both use values and non-use values. Non-use (or passive use) values are those that are not directly related to an individual's in situ use of the valued resource. A recent meta-analysis by Mattmann et al. (2016) identified multiple externalities attached to hydropower, both use and non-use values, including downstream of dams and within the riverine reach, as well as beyond, such as greenhouse gas emissions, historical and cultural effects, and aesthetics.

Non-market hydropower benefits might include reduced health effects from air pollution and improved visibility, low carbon emissions, and enhanced reliance on renewable energy (Loomis, 2014). Klinglmair et al. (2015) found a significant willingness to pay (WTP) for employment and reduced air emissions benefits related to hydroelectricity in Austria, and argued for recognizing such external effects in energy policy. While not monetized, simulation modeling of the Western Electricity Coordinating Council (WECC) region in the US supports hydropower as a flexible, renewable resource facilitating integration of intermittent renewables (wind and solar) into the electrical grid (DOE, 2016; EPRI, 2013). This ancillary benefit of hydropower is recognized as a public good, with national interest implications, where quantification might alter benefit-cost evaluations, but is also recognized as potentially trading off with downstream ecosystem service effects (EPRI, 2013).

As part of broader economic analyses of proposed operational changes in the GCD, prior investigations have sought to estimate how non-market values with an expected non-use component are affected by these changes. Using stated preference survey approaches, the

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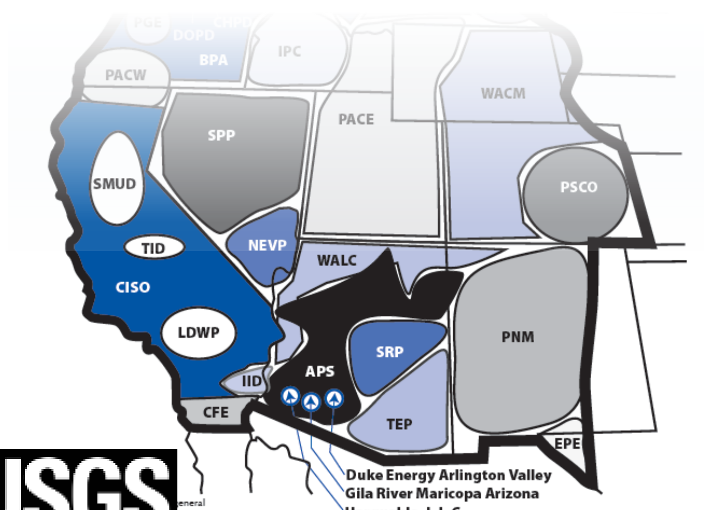
Survey Takeaways

‘There are significant values associated with environmental services provided by the Grand Canyon’ (Neher et al 2016).

‘Substantial evidence suggests that segments of the public hold non-market values…for both riverine environmental effects and…external effects of hydropower production and distribution’ (Jones et al. 2017).



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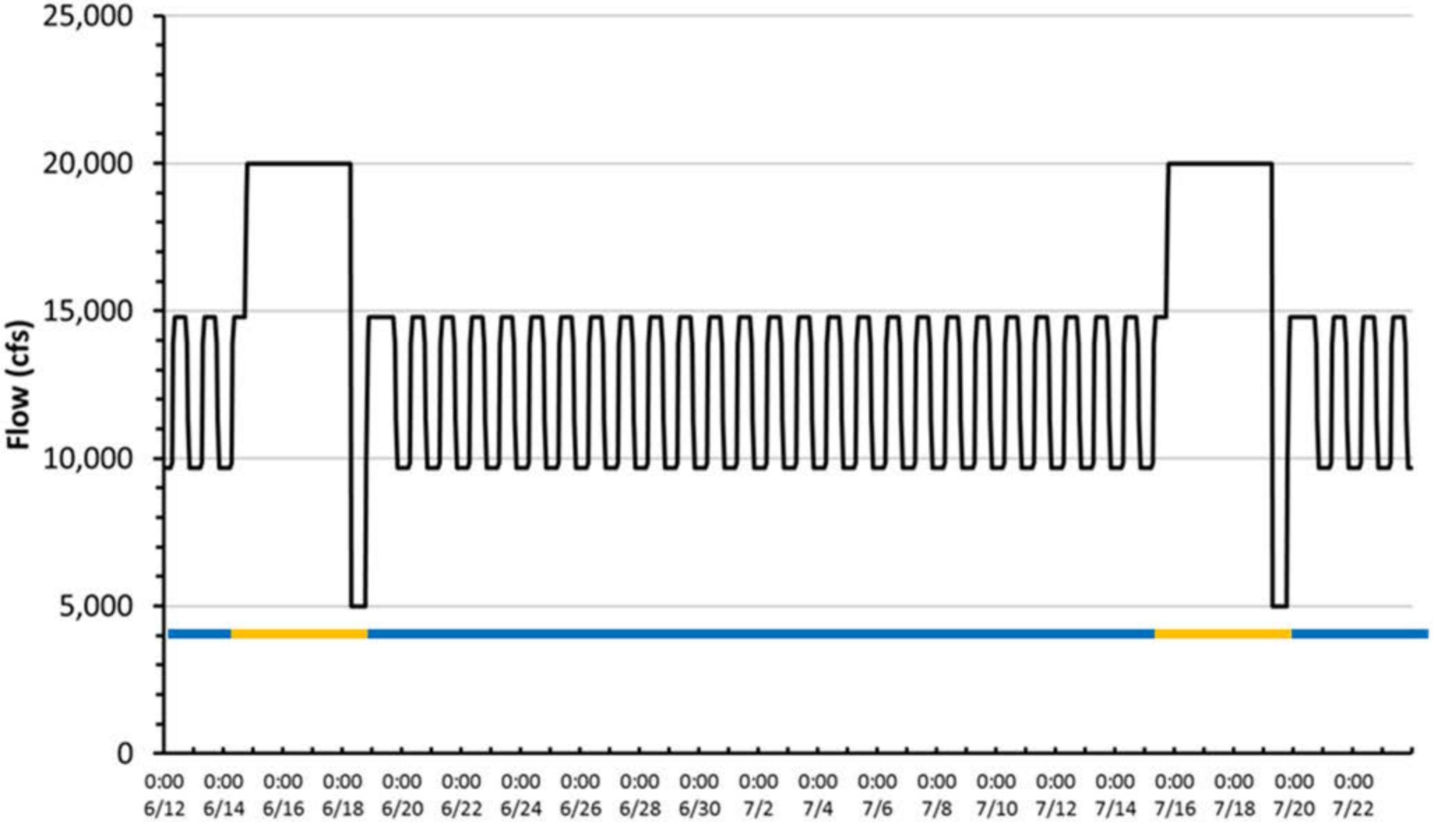
Trout Management Flows



Example implementation of a two-cycle TMF in June and July with resumption of normal fluctuations between cycles and afterward

Adapted from: Glen Canyon Dam Long-Term Experimental and Management Plan December 2015 Draft Environmental Impact Statement http://ltempeis.anl.gov/documents/draft-eis/vol1/Chapter_2-Alternatives.pdf

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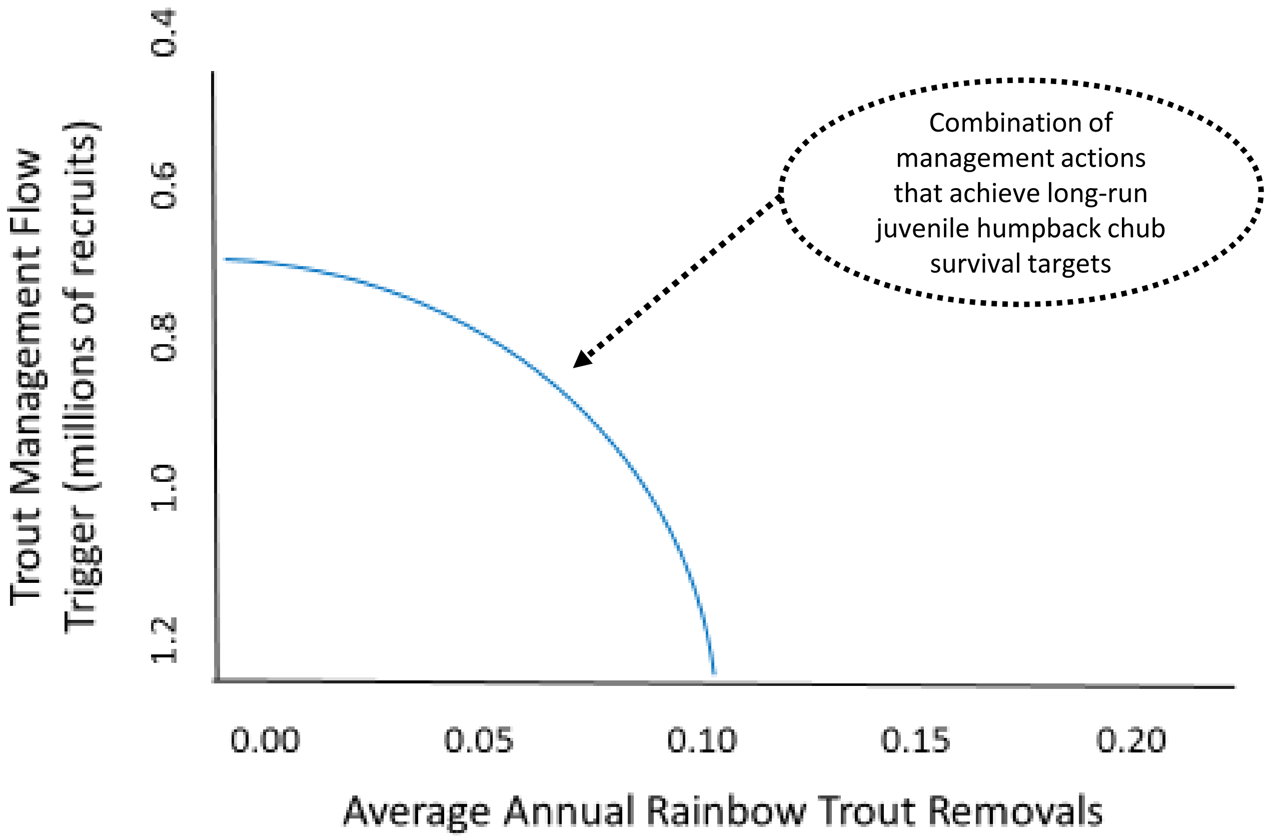
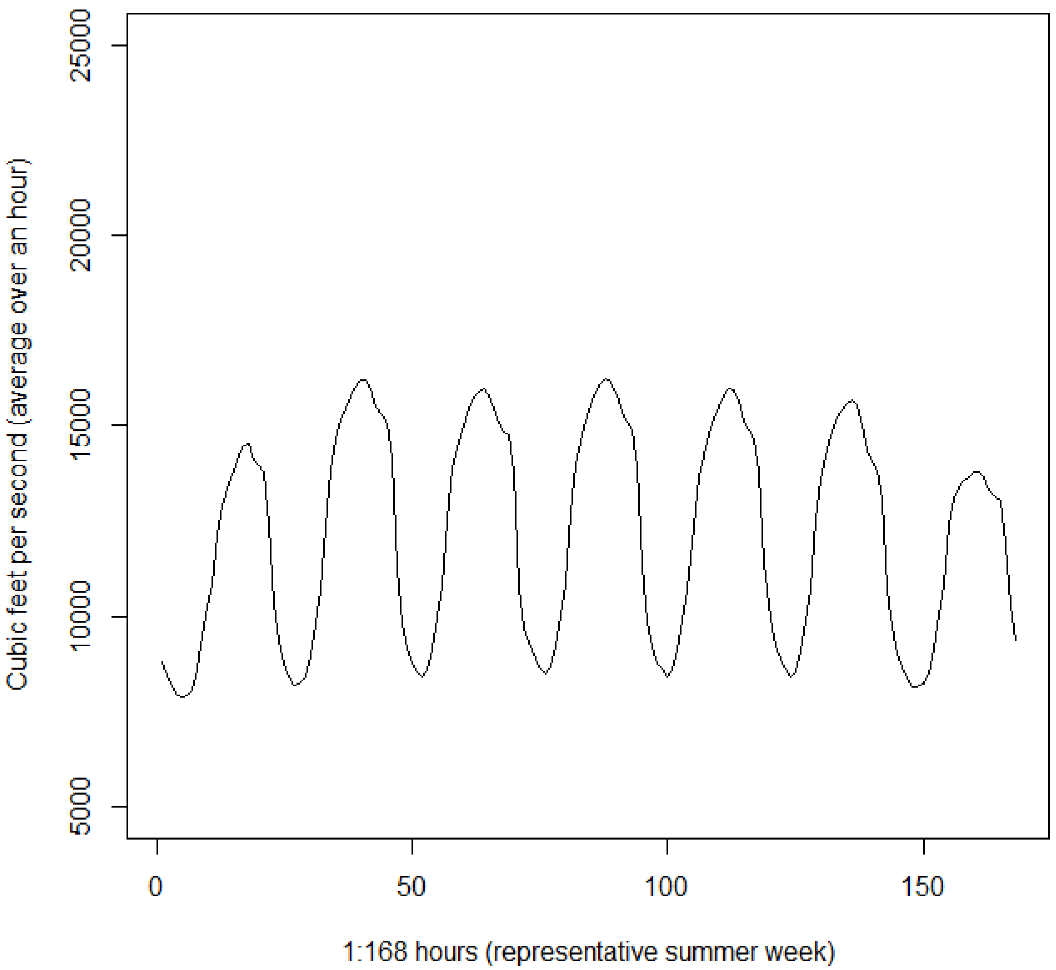
Humpback Chub Recovery



Preliminary data, do not cite

Hydropower Scenarios and Externalities



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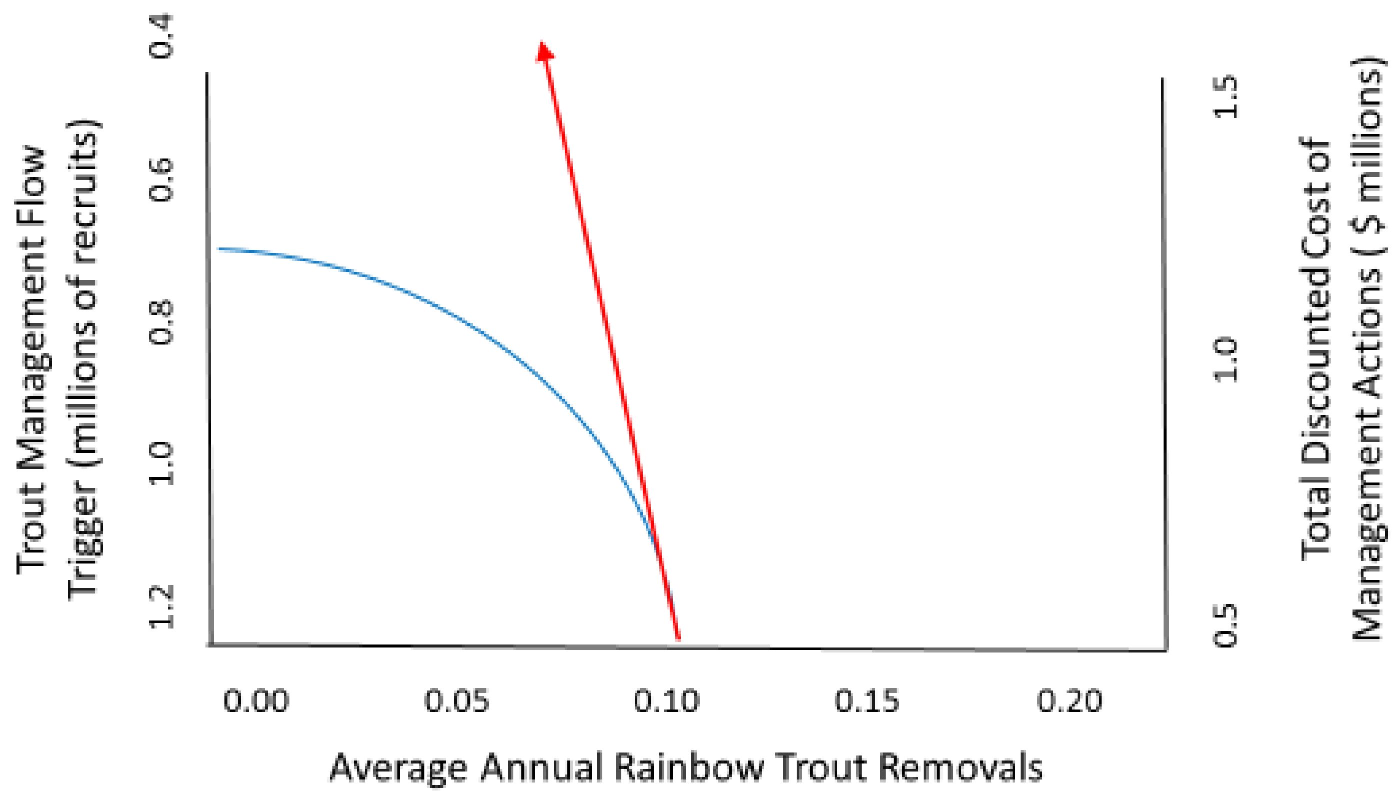
Humpback Chub Recovery



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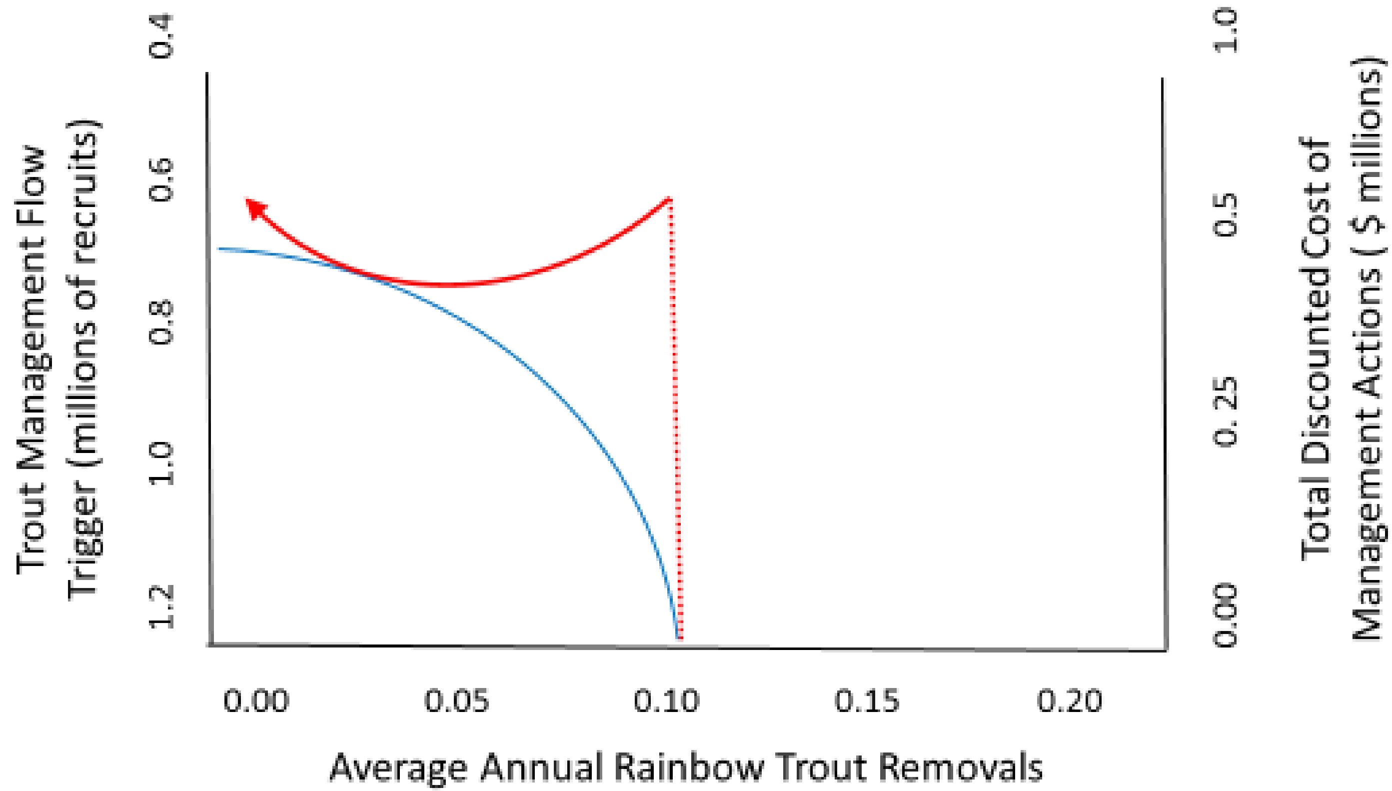
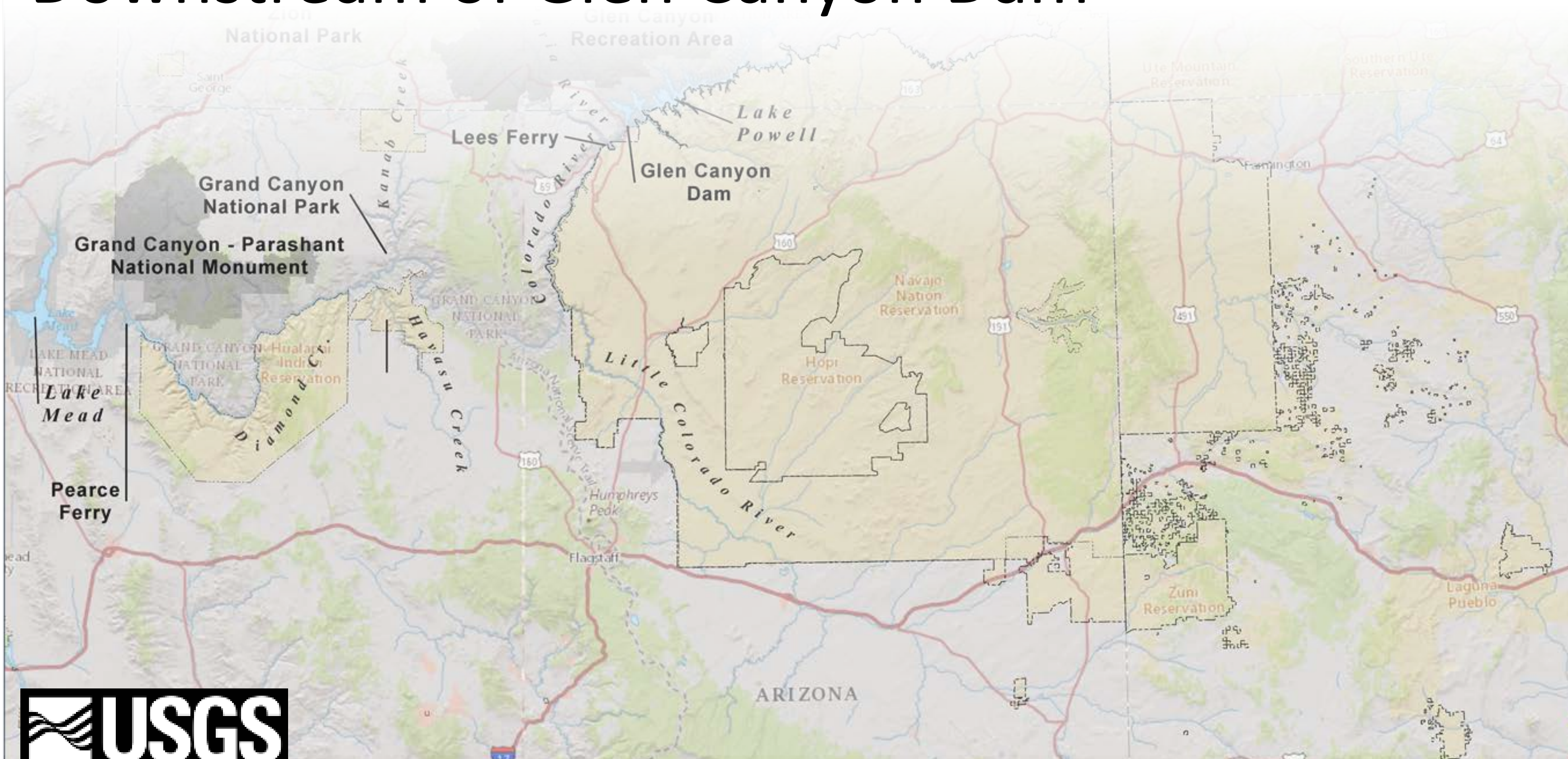
Humpback Chub Recovery



Preliminary data, do not cite

Tribal Surveys

Tribal Perspectives for and Values of Resources Downstream of Glen Canyon Dam



Incorporating Tribal Preferences

- Glen Canyon Dam Adaptive Management Program
- Federal, state and regional management
- Research and monitoring
- Preferences and values

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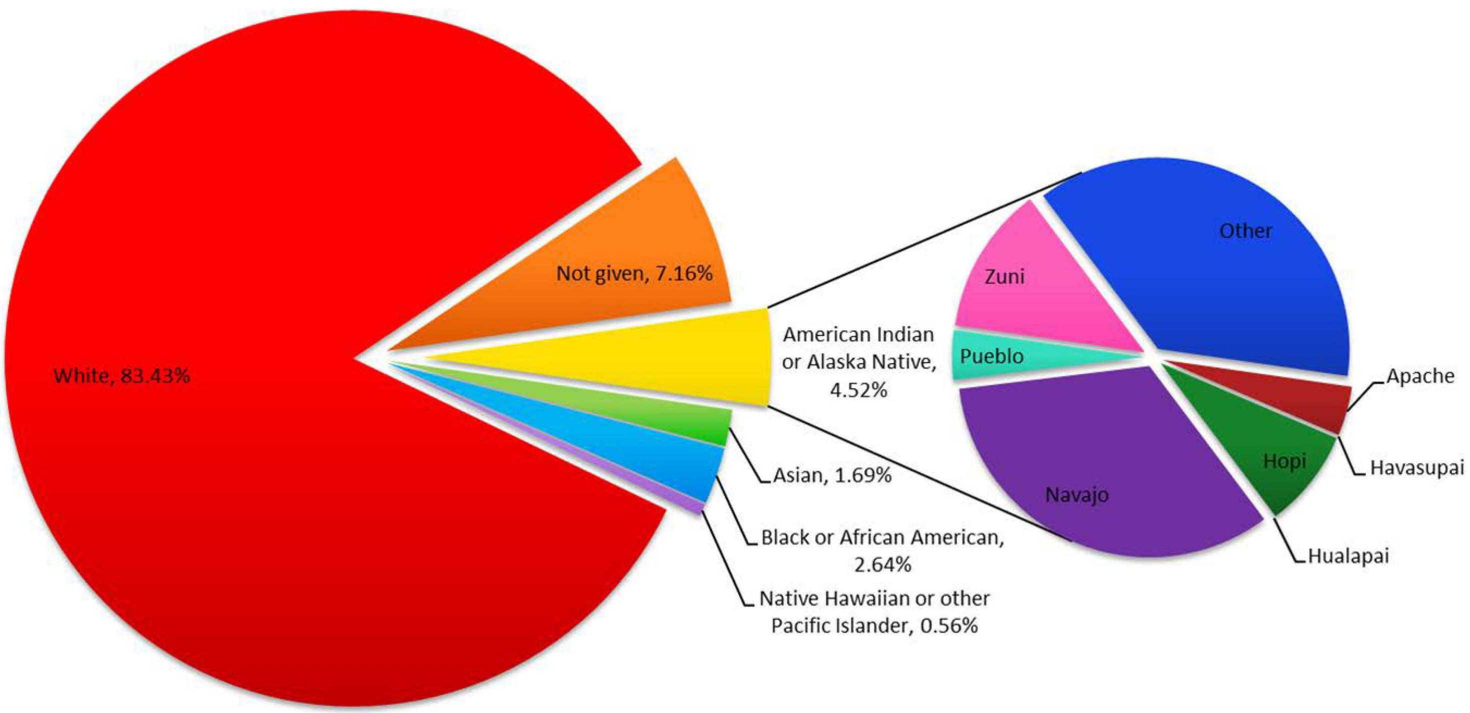
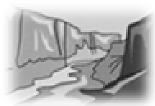
Representation of Tribal Preferences



Chris J. Neher, John Duffield, David Patterson. 2016. Colorado River Total Values Study. Final Report, University of Montana, Department of Mathematical Sciences, Prepared for the National Park Service, August.

Choice Experiments

Resources impacted by policies	Existing Management Plan—conditions over the next 20 years	Proposed Plan A—conditions over the next 20 years
River Beaches (Size and number) 	20% decrease in size and number	20% increase in size and number
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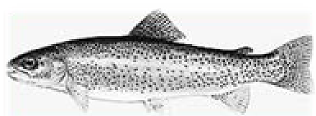
Trout populations 	Remain at present condition	50% increase in large trout populations
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Intention Based Preferences

River Resource Management Tool	Existing Management Plan—conditions over the next 20 years	Proposed Plan A—conditions over the next 20 years	Proposed Plan B—conditions over the next 20 years
High flow experiments to increase beaches (size and number) for recreation	= # of years HFEs are implemented	↑ # of years HFEs are implemented	↓ # of years HFEs are implemented
Low summer steady flows to enhance native fish populations	Low summer steady flows implemented in second decade	Low summer steady flows implemented in first decade	No experimental low flows implemented
Trout management flows to enhance native fish populations	Trout management flows implemented every five years	Trout management flows implemented annually	No experimental low flows implemented
Macroinvertebrate flows to enhance rainbow trout and native fish populations	Macro invertebrate flows implemented every other year	Macro invertebrate flows implemented every other year	No macroinvertebrate flows implemented
Percentage annual reduction in Tribal services as a result of decreased Tribal power allocation from Glen Canyon Dam	5% reduction in Tribal services	10% reduction in Tribal services	10 % increases in Tribal Services
I would vote for (check only one)	❑	❑	❑

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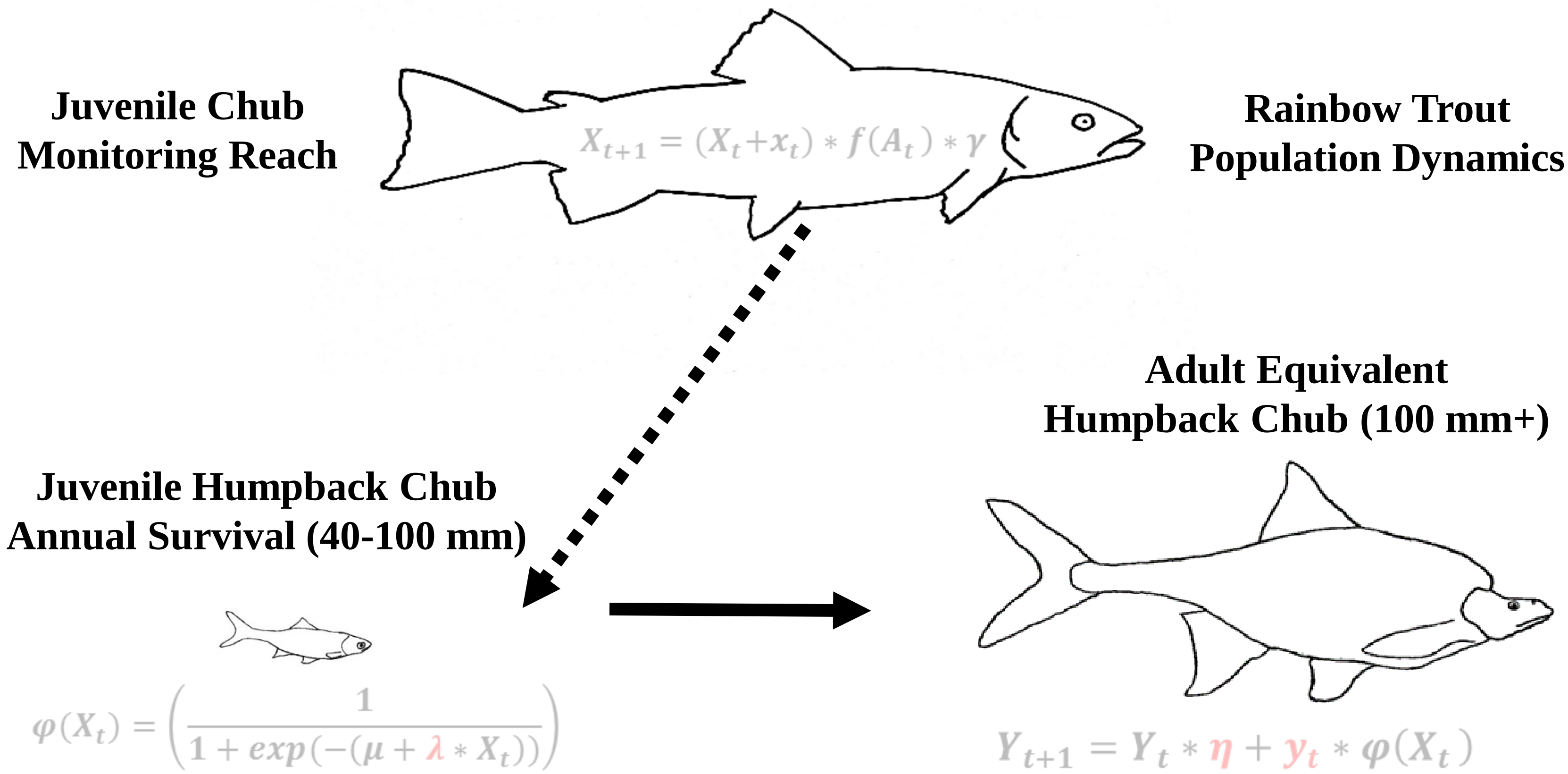
Adaptive Management



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- Questions?
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