

Financing Future Forests: Evaluating ecosystem services for forest restoration in the Tahoe-Central Sierra

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ENVIRONMENTAL PROBLEM

Wildfire is part of a healthy forest ecosystem in the California Sierra Nevada. However, historical forest management policies suppressed wildfire and disrupted this natural process. Without frequent, small-scale fires, excessive trees, brush, and dead plants have overcrowded forests and become fuel for dangerous, high-severity wildfires. Hotter temperatures and drought conditions from climate change have compounded this problem. In fact, 10 of the 20 largest wildfires in California's history have burned in the past five years. High-severity wildfires not only threaten forests, homes, and communities, but also destroy the many ecosystem services, or natural benefits, that forests provide to society, such as timber products, water services, and recreation opportunities. Forest management practices that remove excessive plant material and create conditions for small-scale wildfire can restore Sierra Nevada forests back to healthy conditions. However, the high upfront costs of forest restoration prevent many projects from occurring at the pace and scale necessary to protect forests and the many important benefits they provide to communities.

RESEARCH QUESTION & OBJECTIVES

Blue Forest Conservation (BFC) sees an opportunity to expand the application of their financial tool, the Forest Resilience Bond (FRB), to improve forest health and resilience across the Tahoe-Central Sierra region (Figure 1). The FRB aligns the interests of forest beneficiaries and project investors by bringing them together to finance large-scale restoration projects more efficiently than through public funding alone. The development of new FRBs requires intimate knowledge of local community values and the distribution of corresponding ecosystem services across the landscape to motivate organizations to participate. Building on the momentum of two existing FRBs in the

northern portion of the Tahoe-Central Sierra, BFC hopes to identify and assess important forest benefits and threats among stakeholder organizations to prioritize regions for future FRBs that are both crucial to stakeholders and contain numerous forest benefits.

Research Question: What are the most important ecosystem service benefits and concerns among stakeholders and how can changes to these benefits be measured to increase the salience of the FRB?

Objectives: (1) To quantify and assess the interests and preferences of stakeholders regarding services provided by the forest ecosystems of the Tahoe-Central Sierra. (2) To model and evaluate key ecosystem services under future restoration and climate scenarios.



Figure 1. Map of the project region for the Tahoe Central-Sierra Initiative (TCSI), a partnership of forest organizations.

FINDINGS & IMPLICATIONS

A forest that is healthy, and is therefore not at risk of a high-severity wildfire, will naturally provide many of the other forest benefits and ecosystem services that stakeholders care about, such as water supply and biodiversity. Based on surveys and interviews with stakeholders, the team modeled priority ecosystem services in the region—biodiversity, water yield, sedimentation, and recreation. As shown in the maps to the right (Figure 2), the forest ecosystem services stakeholders prioritize are highly concentrated in the northern and central portions of the study region. This generally aligns with the important regions identified by stakeholders. In addition to the physical ecosystem services modeled under future restoration and climate change, the team also calculated the economic impact a wildfire could have on recreation within the region through the use of geo-tagged Flickr photo data. The location of future benefits, as well as an example of potential economic loss from disturbance, are both convincing arguments for future partners to finance restoration in the region. Understanding where these additional benefits are located on the landscape can strengthen the argument for restoration.

IMPACTS

This research illustrates a methodology to understand the types and locations of ecosystem services stakeholders are interested in and to then mirror that information with models of where these ecosystem services might be located on the landscape in the future. The methods of this study can be replicated to further the development of future FRBs in other regions. This research examined four focal ecosystem

service benefits that were most commonly indicated in survey and interview responses: water supply, sediment retention, biodiversity, and recreation. Our hope is that BFC can use these modeling results to better articulate the need for beneficiaries of healthy forests to participate in future FRBs.

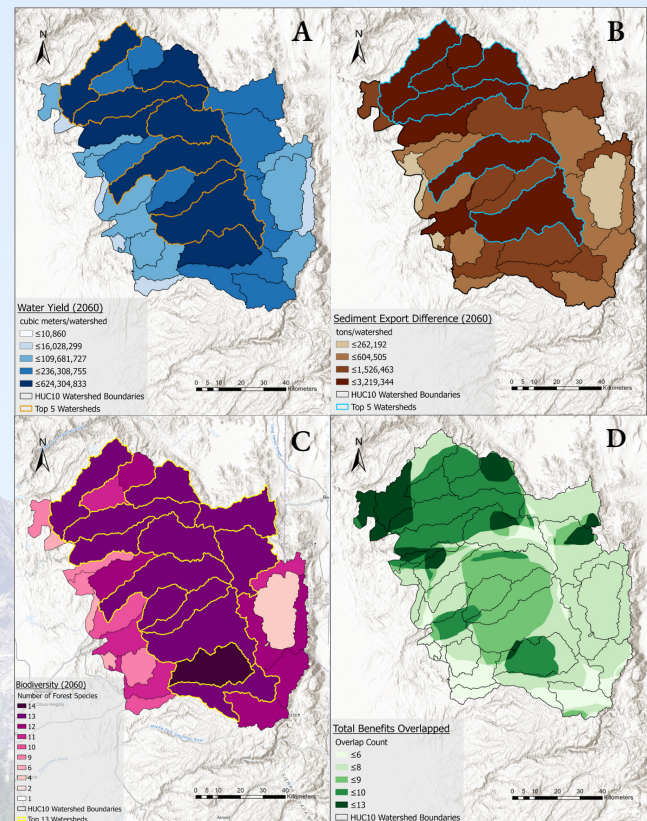


Figure 2. Modeled outcomes of water yield (A), sedimentation difference (B), and biodiversity (C) by watershed in the Tahoe-Central Sierra in 2060, with the highest-provisioning watersheds highlighted. Comparison with stakeholder-identified locations of ecosystem services in current forest conditions (D) illustrates broad agreement between stakeholder interests and modeled locations of importance for each ecosystem service.

RECOMMENDATIONS

- BFC should explore opportunities to expand the FRB into the *Rubicon River and Upper North Fork American River watersheds*, which are among the top five watersheds for *water yield and sedimentation* in 2060. Portions of the Yuba River watershed, where BFC already has active projects, are also high-provisioning.
- BFC can use the high *biodiversity* across the forested watersheds of the north and central TCSI to strengthen arguments for restoration in the *Rubicon River and Upper North Fork American River watersheds*.
- Sediment export modeling results should be tied to economic dredging and remediation costs to further incentivize water utilities to participate in forest restoration. *New Bullard's Bar and Slab Creek dams* are key for restoration.
- Flickr visitation modeling can be used to *directly connect past wildfires to economic losses from reduced recreation*, which could be an effective way to motivate contributions from the recreation sector to a future FRB.
- *Participatory GIS mapping is a powerful tool* to identify regions of important ecosystem service benefits and highlight stakeholder interest in particular areas. BFC could expand the use of this tool to include more stakeholders.