Assessing human benefits of healthy waterbodies

Project leads

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Background

Watershed managers make decisions that have the potential to affect multiple uses of waterbodies, such as supporting aquatic life, recreation, drinkable water, and other uses. These decisions can benefit some uses while degrading others. However, without effective tools to assess these uses, watershed managers cannot evaluate these potential tradeoffs, nor can they effectively communicate potential benefits of their decisions to the public.

As an example, urban streams often undergo restoration efforts that have limited potential to benefit aquatic life due to intensive upstream development or other constraints. However, these restorations provide other benefits, such as improved opportunities for nature-based recreation or mitigation of urban heat islands. Without tools to quantify these benefits to neighboring communities, it is difficult to evaluate the effectiveness of waterbody management efforts, which makes it challenging for managers to justify their expense to the public.

Nature-based recreation (NBR), such as bird-watching, nature education, and tide-pooling, is an example of a benefit that many management programs aim to support. Several basin plans in California explicitly identify NBR as a form of non-contact recreation (REC-2), and yet this beneficial use is mostly assessed in terms of health risks (e.g., concentrations of toxic metabolites from harmful algae). Thus, while managers know if a waterbody could make people sick, they do not know whether people can partake in intended recreational activities.

For this project, we propose to develop a framework (e.g., an index or set of metrics) for assessing NBR, which can serve as a template for evaluating other community benefits of healthy waterbodies. We will apply this framework to southern California's coastal watersheds to identify NBR "hotspots" where this benefit is supported, and "cold spots" where support is low. We will examine the factors that influence levels of support including factors directly under the purview of management agencies (such as water quality and flow), as well as other factors (such as local demographics and land use). We will then develop a tradeoff framework to explore how changes in one factor (e.g., flow) affects multiple benefits (specifically, aquatic life use and nature-based recreation). We will evaluate the frameworks in case studies to pilot and refine tools to make them most effective for decision-making.

Tasks

This project consists of several tasks described below. Tasks 1 through 3.1 will be completed as part of the first phase of the study, whereas the remaining tasks will be completed pending funding availability.

Task 1: Project governance and administration

The project will be led by a technical team of SCCWRP scientists. The initial action of this team will be to hold a kick-off meeting in which project goals, roles, responsibilities, timelines, and budgets are reviewed.

The technical team will assemble two advisory groups, a stakeholder advisory group (SAG) and a technical advisory group (TAG).

Questions for SAG:

- Relevance and current practice:
    - We are choosing to focus on nature-based recreation (specifically, nature viewing) for this project, with the assumption that this is an important goal for water managers. How is nature-based recreation related to your management goals or priorities?
    - Do you currently evaluate nature-based recreation (NBR) and if so, how?
    - Which programs or initiatives would benefit from tools to evaluate NBR?
- Drivers:
    - We plan to evaluate potential drivers of NBR (e.g., water quality, accessibility, flow), and we've developed a list as a starting point. Are there other factors we should consider?
    - Which factors do you think are particularly important in your region?
    - Which of these drivers does your agency have the most influence over? Which ones should we prioritize in our study?
- Tradeoffs and multi-benefits:
    - Are there recent, ongoing, or upcoming cases where your agency needs to evaluate tradeoffs among multiple benefits (not necessarily NBR)? Which competing uses most often come up in these cases?
    - What competing uses are you most concerned about when you evaluate tradeoffs both now and in the future?
    - How are you currently approaching these tradeoffs? Where does the greatest uncertainty come from?
    - Are you aware of a potential case study we could examine in this study?

Questions for TAG:

- Conceptual understanding:
    - What are the main challenges for evaluating or quantifying nature-based recreation?

    - What factors or processes might influence nature-based recreation? We plan to evaluate potential drivers of NBR (e.g., water quality, accessibility, flow), and we've developed a list as a starting point. Are there other factors we should consider?
- Data needs:
    - What data sources are currently available to assess nature-based recreation or its drivers?
    - What are the limitations or pitfalls of working with these data?
    - If we need to collect new data, where and how should we focus efforts?
- Data analysis:
    - How do we evaluate the relative influences of environmental and socio-economic factors on nature-based recreation?
    - Are there examples of other studies that can inform our approach?

The technical team will convene with each advisory group at a minimum of 3 points in the project:

- At the initiation of the project, to provide an overview of the project goals, roles and responsibilities, and approach. (December 2025)
- At a key midpoint, to review progress and identify any necessary changes in direction (March 2026)
- At the end of research, to share results and interpretations prior to the generation of any final reports (June 2026)

In general, the technical team will first meet with the SAG, which can generate questions that can subsequently be directed to the TAG. Following TAG meetings, feedback can be provided to the SAG via email or through an additional meeting, if necessary.

Additional stakeholder outreach may be achieved through the SMC and SCCWRP's CTAG.

Deliverables: Advisory meeting notes and presentations (ppt)

Task 2: Literature review on nature-based recreation

We will review scientific and technical literature on elements related to the study goals. We will identify examples of studies where nature-based recreation was measured or evaluated, as well as studies that have used novel data sources (e.g., community science databases, social media) to evaluate environmental conditions. We will emphasize literature that focuses on waterbodies or water management. Search terms and strategies will be developed in collaboration with the TAG and SAG.

Deliverables:

- *A list of relevant studies*
- *An oral presentation (ppt) summarizing available literature*

Task 3: Develop a tool to assess NBR

This task is subject to change based on guidance from the advisory groups.

Task 3.1: Data aggregation and metric calculation

We will develop an assessment tool for NBR. We will access public datasets on nature observations, such as iNaturalist and eBirds, as well as other data sources suggested by the SAG and TAG. Observations will be associated with individual assessment reaches (e.g., basin plan reaches), and then evaluate potential metrics to assess NBR. These metrics are intended to quantify the level at which NBR is occurring in different reaches. Potential metric formulations include number of unique observations within a reach, number of unique observers, and number of dates with observations. Metrics focused on particular taxonomic groups (e.g., birds, aquatic taxa) may also be evaluated. Metrics focused on the diversity captured by these observations (e.g., number of bird species) do not necessarily quantify levels of NBR and therefore will not be considered as metrics of NBR. Candidate metric-types are listed below:

- All taxa
- Birds
- Aquatic birds
- Amphibians
- Herptiles
- Aquatic herptiles (amphibians, turtles, snakes)
- Dragonflies
- Aquatic invertebrates
- Fish
- Mammals
- Aquatic mammals
- Algae
- All Plants
- Wetland plants
- All aquatic animals and wetland plants
- Native/sensitive/rare taxa

We will apply these metrics to evaluate all reaches within southern California's coastal watersheds.

In collaboration with the TAG, we will develop a method for evaluating the suitability of potential metrics, including criteria like accuracy, precision, and responsiveness.

Deliverables:

- *A list of candidate metrics for evaluating NBR*
- *An evaluation of metric suitability*
- *An evaluation of NBR support in different watersheds of southern California*

Task 3.2: Evaluation of drivers

We will develop a list of potential drivers of NBR in collaboration with advisory groups (Table 1) that influence the distribution of NBR.

Table 1. Potential drivers of NBR.

Drivers related to water management	Other drivers
Eutrophication indicators (TN, TP, AFDM, Chl-a, DO, pH) Other water quality indicators (Cl, SO4, Sp. Cond, TDS, turbidity) Flow and flow alteration Biointegrity indicators (CSCI, ASCI, richness/diversity metrics) Habitat quality indicators (CRAM, PHAB, channel engineering status)	% open space % accessible recreation % protected land Distance to nearest road or trail Distance to nearest park Crime rates Population Housing Median income Other enviroscreen or social vulnerability data Distance to major natural history institution (e.g., NHM, San Diego Zoo) Antecedent and long-term climate

We will develop univariate and multivariate models to relate NBR metrics to drivers. We will identify steps to reduce the potentially confounding influence of natural history institutions and "bioblitz" events that can greatly influence the location and timing of natural history observations in the project's data sources.

Deliverables:

- *A model that describes spatial and temporal patterns of NBR support in southern California.*

Task 4: Development of a tradeoff framework

We will combine assessments of multiple benefits (NBR and aquatic life) into a tradeoff framework to understand the benefits and risks of various water management decisions (e.g., changes in flow and water quality). We will leverage existing regional response models that relate the drivers related to water management (Table 1) to aquatic life uses, such as the California Stream Condition Index and the model developed in Task 3.2. Such a framework can allow managers to weigh decisions of various management actions based on the costs and benefits across multiple ecological and NBR uses. Figure 2 provides a conceptual example combining models for NBR (blue curve) and aquatic life (orange curve) to compare two management scenarios. Scenario A provides large benefits for NBR but low benefits for aquatic life, while scenario B provides large benefits for both uses.

This tradeoff framework will be tested and refined in a pilot case study identified in collaboration with the SAG illustrating how the framework can be used to inform future management decisions.

Note: This task will be completed in a future phase of the project.

Deliverables:

- *Framework and tool that enables managers to evaluate tradeoffs.*

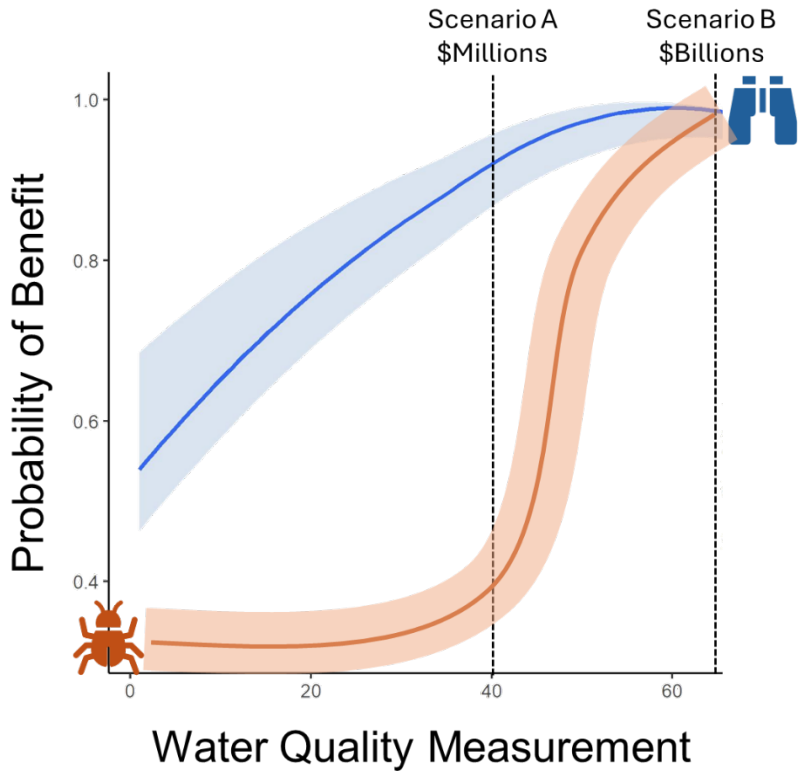

Figure 1. Conceptual example combining response models for aquatic life (orange) and NBR (blue) into tradeoff framework to evaluate relative benefits of two management scenarios.

Task 5: Reporting

A technical memo, that can serve as a draft manuscript to be submitted to a peer-reviewed journal, will be developed that describes the data, approach, and findings of the case study application in southern California. Limitations and data gaps will also be highlighted.

Deliverables:

- *Technical report and draft manuscript ready for submittal*

Project schedule

The overall project is expected to last 3 years, and funding has been secured for the first year (FY2526). By the end of this first phase, we expect to complete tasks 2 (the literature review) and 3.1 (development of an assessment tool for NBR). Tasks 3.2 (evaluation of drivers of NBR) and Task 4 (development of a tradeoff framework) will occur pending future funding.

We will draft a report that summarizes completed work at the conclusion of the first year of this study.