



# Structured Decision-Making Framework for Managing Cyanobacterial Harmful Algal Blooms in New York State Parks

Jennifer L. Graham<sup>1</sup>, Gabriella Cebada Mora<sup>2</sup>, Rebecca M. Gorney<sup>1,3</sup>,  
Lianne C. Ball<sup>1</sup>, Claudia Mengelt<sup>1,4</sup>, and Michael C. Runge<sup>1</sup>

Society of Decision Professionals Conference  
April 15-18, 2024

<sup>1</sup>U.S. Geological Survey

<sup>2</sup>New York State Office of Parks, Recreation, and Historic Preservation

<sup>3</sup>New York State Department of Environmental Conservation

<sup>4</sup>U.S. Fish and Wildlife Service

U.S. Department of the Interior  
U.S. Geological Survey



New York State  
Parks, Recreation and  
Historic Preservation



Department of  
Environmental  
Conservation

# Acknowledgements

## USGS

Anne Kinsinger  
Robert Breault  
Ellie Brown  
Karen Jenni  
Mary Anne Evans  
Reed Green  
Paul Heisig  
James Larson  
Peter Murdoch  
Emily Pindilli

## NYS OPRHP

Ronald Rausch  
Floyd Armlin  
Alane Ball-Chinian  
April Brun  
Emily DeBolt  
Lindsey DeLuna  
Andy Damon  
Scott Flanagan  
Max Garfinkle  
Irene Holak  
Casey Holzworth  
Jesse Jacox  
Amy LaBarge  
Alan Trepper

## NYS DEC

Jacqueline Lendrum  
Natalie Brown  
Karyn Hanson  
Stephanie June  
Julie Reuther  
Karen Stainbrook  
Lauren Townley

## NYS DOH

Richard Hess  
James Maurer

## Other Participants

Harry Gibbons, Lake Advocates  
Riley Buley, Auburn University

# Structured Decision Making



Prepared in cooperation with the U.S. Fish and Wildlife Service

**Optimization of Salt Marsh Management at the Petit Manan National Wildlife Refuge of the Maine Coastal Islands National Wildlife Refuge Complex, Maine, Through Use of Structured Decision Making**



Open-File Report 2021-1123

U.S. Department of the Interior  
U.S. Geological Survey

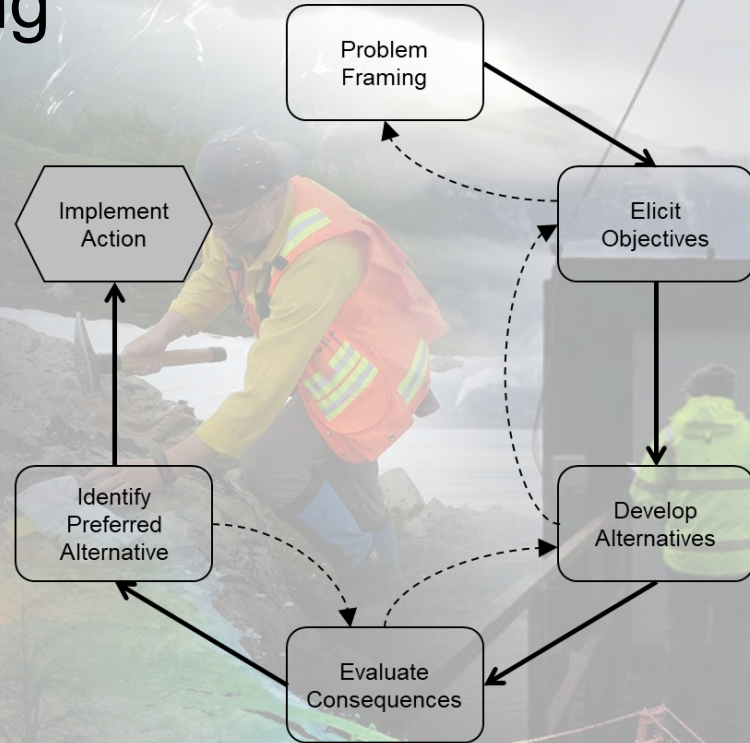


Prepared in cooperation with the Bureau of Reclamation, National Park Service, and Argonne National Laboratory

**Decision Analysis to Support Development of the Glen Canyon Dam Long-Term Experimental and Management Plan**

Scientific Investigations Report 2015-5176

U.S. Department of the Interior  
U.S. Geological Survey



from Runge MC, Grand JB, Mitchell MS. 2013. Structured decision making. Chapter 5 in Krausman PR, Cain JW III, eds. Wildlife Management: Contemporary Principles and Practices.



New York State  
Parks, Recreation and  
Historic Preservation









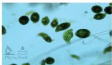



# What is a Harmful Algal Bloom (HAB)?

## Harmful Algal Blooms

### The “H,” “A,” and “B” of a HAB: A Definitional Framework

Rebecca M. Gorney, Jennifer L. Graham, and Jennifer C. Murphy

Algal Group (Taxonomic Kingdom)	Field Example of Bloom	Potential Harmful Effects
Cyanobacteria (prokaryotic Eubacteria)		
Diatoms & Dinoflagellates (eukaryotic Chromista)		
Golden Algae (eukaryotic Chromista)		
Green Algae (eukaryotic Chlorophyta)		
Euglena (eukaryotic Protozoa)		

### Legend


Human & Animal		Toxin production
		Human illness via ingestion, skin contact, or inhalation
		Illness and/or mortality of pets, livestock, or wildlife
		Shellfish uptake of toxins
Ecological		Water discoloration/shading
		Reduced biodiversity; Food web alteration
		Hypoxia (low or depleted oxygen) may cause fish kills
		Benthic habitat alteration
Economic		Loss of recreation or tourism revenues; decline in property value
		Increased drinking-water treatment costs; Cleanup costs
		Loss of subsistence fisheries; other fisheries or aquaculture impacts
		Increased medical and veterinary care costs

Photo Credit: B. Rosen, USGS

Photo Credit: J. Graham, USGS

Photo Credit: NASA

# Structured Decision-Making Framework for Cyanobacterial Harmful Algal Blooms

**Purpose:** Develop a template decision framework for preventing and managing HABs in freshwater bodies in New York State Parks

**Approach:** Two workshops – August 7-8, 2019; February 10-14, 2020  
Use two parks as case studies to motivate and test the template

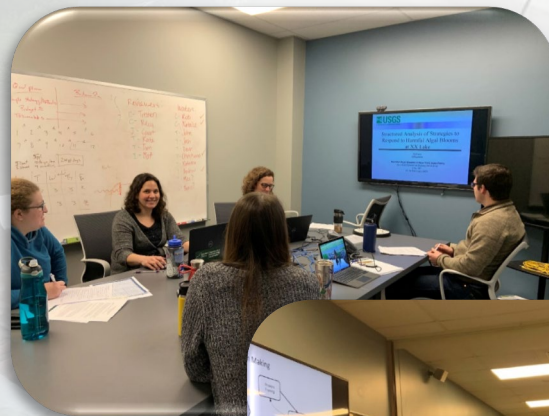


Photo Credits: J. Graham, USGS

# Moreau Lake State Park

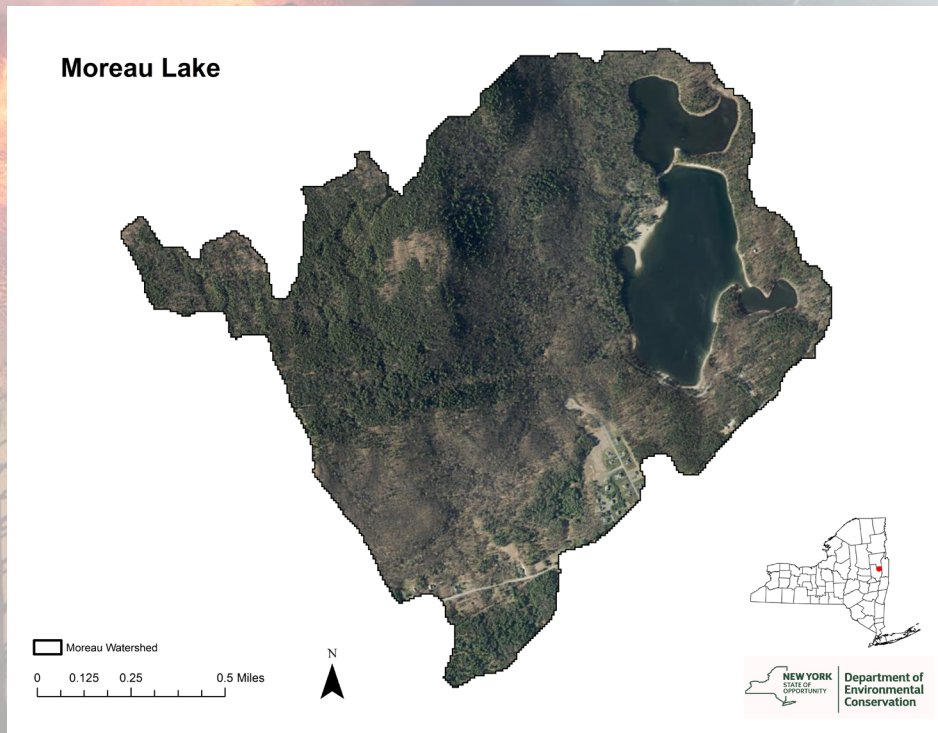


Photo Credits: New York State Parks, Recreation, and Historic Preservation

# Rockland Lake State Park

## Rockland Lake

Surface area (ha/ac): 101/277  
Max depth (m/ft): 10.5/34  
Mean depth (m/ft): 4.8/15.9  
Trophic status: Eutrophic



0 0.125 0.25 0.5 Miles



NEW YORK  
STATE OF  
OPPORTUNITY

Department of  
Environmental  
Conservation



Photo Credits: New York State Parks, Recreation, and Historic Preservation

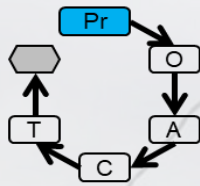


# The Problem

- Full suite of management alternatives is not known
- Consequences of HABs and management options on multiple outcomes of interest aren't fully understood
- Legal framework for management/treatment not always clear
- Fiscal resources are limited
- Balancing benefits and risks across multiple outcomes is challenging
- Overlapping jurisdiction for management of lakes

## Problem Statement

The New York State Office of Parks, Recreation and Historic Preservation (OPRHP) owns and manages parks throughout the State, with a mission, "to provide safe and enjoyable recreational and interpretive opportunities for all New York State residents and visitors and to be responsible stewards of our valuable natural, historic and cultural resources." Many of the parks include lakes or other freshwater bodies, which can be susceptible to harmful algal blooms (HABs). In addition to indicating a decrease in water quality, HABs can also affect many of the recreational and natural purposes of parks, such as fishing, swimming, boating, camping, dog-walking, native fish and wildlife, as well as imperil drinking water supplies and decrease the value of neighboring real estate. Management responses to HABs can include watershed management to decrease nutrient inputs; in-water chemical, biological, or mechanical treatment to reduce HABs; access and use restrictions to limit the exposure to HABs; and education to change human behavior in response to blooms. Parks, however, face difficult decisions regarding prevention of and response to HABs for a number of reasons: the full suite of alternative management responses is not known; the consequences of HABs and treatments for them on the multiple outcomes of interest are not completely understood; the legal framework to allow management or treatment is not always clear; the fiscal resources for implementation of management are limited; and it is challenging to know how to balance the benefits and risks across multiple outcomes. Further, there is overlapping jurisdiction for the management of lakes on State Park lands with other State and Federal agencies. For example, the New York State Department of Conservation (NYSDEC) regulates environmental issues in the State and has responsibility for issuing permits for many of the types of treatment for HABs; and the New York State Department of Health is responsible for ensuring a healthy environment for people, such as the conditions at swimming beaches. OPRHP works with these and other agencies to carry out its responsibilities.





# Fundamental Objectives

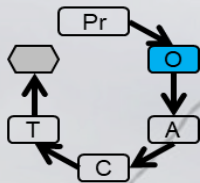


Photo Credits: New York State Parks, Recreation, and Historic Preservation

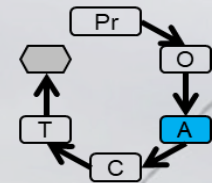


New York State  
Parks, Recreation and  
Historic Preservation



Department of  
Environmental  
Conservation

# Alternative Strategies



## Alternative 1 – Let It Be

- ✓ Beach closures during HABs
- ✓ Effective communication
- ✓ Enhanced monitoring to determine causes

## Alternative 2 – Day Tripper

- ✓ Keep the beach open using bubble curtain and nanobubble treatment
- ✓ Monitor effectiveness of treatments
- ✓ Effective communication
- ✓ Enhanced monitoring to determine causes

## Alternative 3 – Long & Winding Road

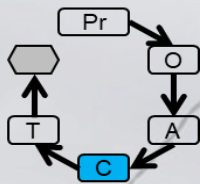
- ✓ Develop a 9-element plan for watershed
- ✓ Flow manipulation, biomanipulation
- ✓ Research: food web, adaptive implementation

## Alternative 4 – Get back

- ✓ Develop a 9-element plan for watershed
- ✓ In-lake treatments: selective dredging, algicide applications (peroxide), biomanipulation
- ✓ Bubble curtain to keep beach open
- ✓ Research: food web, treatment efficacy

Photo Credits: New York State Parks, Recreation, and Historic Preservation

# Consequences Analysis - Moreau



- Evaluation of the alternatives against the objectives may depend on the cause of the blooms
- Potential hypotheses:
  - HABs are part of a natural pattern → Alternative 1
  - HABs are part of a new norm driven by climate change → Alternative 2
  - Historic activities changed flow patterns and aquatic community → Alternative 3
  - One-time combination of events allowed establishment of HABs → Alternative 4

Photo Credit: New York State Parks, Recreation, and Historic Preservation



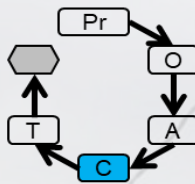
Photo Credit: USGS



New York State  
Parks, Recreation and  
Historic Preservation



# Consequences Analysis - Rockland

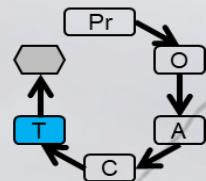
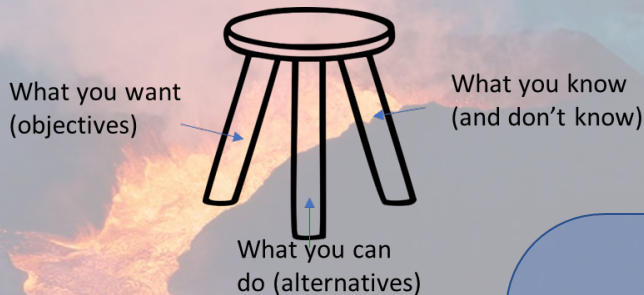


**Table 3.2.** Consequence analysis of the four alternatives developed for CyanoHAB management in Rockland Lake State Park. The table shows the expected performance of each alternative for each fundamental objective (**Figure 3.3**). The goal was to maximize the outcome for all objectives, except for objective 8 (cost), which the group wanted to minimize. Green shading indicates the alternative that performs best for a particular objective and pink shading indicates the alternative that performs the worst for a particular objective. [Rec. Opport. = recreational opportunities, Econ. Benef. = economic benefits; \* indicates substantial external support is required]

Alternative	Objective 2 Rec. <u>Opport.</u>	Objective 3 Aesthetics	Objectives 4 and 9 Outreach	Objectives 5 and 7 Ecosystem	Objective 6 Econ. <u>Benef.</u>	Objective 8 Cost	Objective 10 Monitor and Learning
1: Status quo	Low	Low	Medium	Medium	Low	Low	Low
2: In-lake treatment	High	High	Medium	Med/High	High	High	Medium
3: Nutrient interception	Medium	Medium	High	High	Medium	Medium	Medium
4: Intensive management	Med/High	Medium	High	Med/High	Med/High	High*	High

[Mengelt and others, 2022](#)

# Trade-Offs



## Rockland

- Communication challenges
- Jurisdictional challenges
- Difficult trade-offs to navigate
- Resource limitations
- More careful consequence analysis
- Time before effects are observed
- Maximizing recreational opportunities vs. overcrowding

## Moreau

- There are possibly some tradeoffs among objectives, but they aren't the impediment
- The uncertainty about the cause of the HAB blooms impedes a choice of action

# Implementation

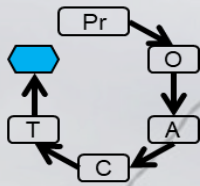


Photo Credit: USGS



Land Management Research Program and National Water Quality Program

**Appendix 2. A Structured Decision Analysis for Prevention, Management, and Mitigation of Cyanobacterial Harmful Algal Blooms at Moreau Lake State Park, New York—Results From a Structured Decision Making Workshop, February 10–14, 2020, Troy, New York**



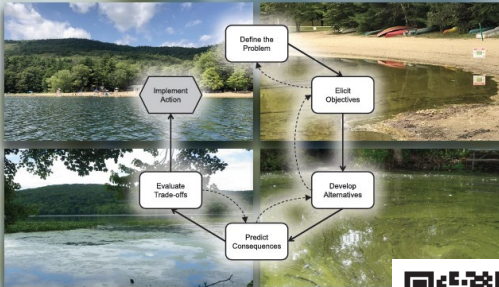
Scientific Investigations Report 2022–5053, A

<https://doi.org/10.3133/sir20225053>



Land Management Research Program and National Water Quality Program

**A Structured Decision-Making Framework for Managing Cyanobacterial Harmful Algal Blooms in New York State Parks**



Scientific Investigations Report 2022–5053



New York State  
Parks, Recreation and  
Historic Preservation



Department of  
Environmental  
Conservation



**Jennifer Graham**  
**jlgraham@usgs.gov**  
**518-285-5706**



New York State  
Parks, Recreation and  
Historic Preservation

