

# SCCWRP's fact sheet series

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# Background

- We're producing a fact sheet every quarter for you
- They're designed to supplement conversations you're having with your board, staff, partners, etc.
- We've published 3 so far
- We have 2 new fact sheets for you today
- Drafts are in your agenda packet

## Rapid beach testing methods

**SCCWRP FACT SHEET**

### Using DNA technology to protect beachgoers from fecal contamination

DNA-based methods provide faster, more insightful information about when it's safe vs. risky to enter the water

For decades, the public health community has tested beach water for fecal contamination using established bacterial culturing methods. But advances in DNA technology are paving the way for faster, more insightful ways to assess water quality and warn beachgoers when it's potentially unsafe to enter. In 2022, San Diego County became the first coastal community in the nation to end reliance on bacterial culturing in favor of a DNA-based method.

**Key advantages of DNA technology**

The traditional way to test beach water for fecal contamination is via cell culturing, where bacteria cells from a water sample are grown in a laboratory overnight and then analyzed. DNA-based methods, by contrast, focus on analyzing the bacteria's only "DNA."

- **Faster:** Whereas cell culturing typically takes 24-72 hours after beach water samples reach a laboratory, DNA methods can provide same-day results. Speed is of the essence when it comes to protecting the health of beachgoers, especially following unexpected transient sewage spills. Public health agencies need to close beaches and/or post warning signs as soon as a potential risk to human health has been confirmed – and then reopen beaches and/or rescind advisories as soon as the risk has passed.
- **More insightful:** Cell culturing cannot determine if fecal contamination originated in the gut of a human or another animal, such as a pet or dog. By contrast, DNA methods can make this distinction. These additional insights help the environmental management community prioritize remedial actions that represent the greatest threat to public health. (It is primarily human feces that sicken swimmers and surfers.)
- **Standardized:** DNA methods have been published in peer-reviewed scientific journals.
- **EPA approved:** In 2012, the U.S. EPA approved use of an initial DNA testing beach water quality.
- **Adopted by end users:** About 30 of agencies across Southern California have adopted DNA methods and demonstrated proof-of-concept exercises.
- **Accreditation-eligible:** Laboratories perform DNA methods through California Laboratory Accreditation Program.

**DNA methods agree with culturing methods**

For DNA methods to be approved as a replacement for culturing methods, the two methods must produce results that lead public health agencies to take consistent similar actions to close beaches and/or post warning signs. Scientists have conducted extensive side-by-side testing of the two types of methods across Southern California. The testing found about 90% agreement in the beach closure and notification decisions that public health agencies make based on the two methods.

When decision-making differs for a beach, scientists have multiple ways to probe why and determine which set of results is the more appropriate predictor of illness risk.

**DNA methods are ready for prime time**

Scientists have spent the past two decades working to adopt and transition DNA technology for routine use in beach water quality testing across Southern California.

- **Evaluated side by side:** DNA methods have been evaluated side by side with traditional culture methods to show that results are consistently equivalent.
- **Predictive of health risk:** Epidemiologists confirmed that DNA methods are more of illness risks for beachgoers who enter the water.

**DNA methods are ready for prime time**

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**SCCWRP FACT SHEET**

### Modeling as a tool to support coastal water-quality decisions

A primer on how computer modeling is used to understand the effects of discharging nutrients to Southern California's ocean

When coastal communities face water-quality problems, they often struggle to understand the extent of the problem across space and time. Environmental monitoring programs can provide some insights, but only for a limited number of sites or discrete time points.

However, as communities identify possible solutions over time to solve water-quality problems, they need assurances they'll get tangible environmental benefits – before investing millions or even billions of dollars in a particular solution. Monitoring programs can quantify the success of these solutions once implemented, but do not provide insights about the likelihood of success for solutions that have yet to be implemented.

**Modeling helps communities make informed choices**

For decades, managers have relied on computer modeling to generate a more comprehensive picture of coastal ecosystem health and to evaluate if proposed interventions to protect water quality will be effective. Through modeling, stakeholders can:

- Weigh the benefits vs. costs of different possible interventions
- Consider the risk of taking no action vs. taking action that turns out to be wrong or inadequate
- Use a common set of facts and data to reach consensus on the best course of action

**Examples: Modeling informing decisions**

Managers routinely use proven computer models as a basis for taking action:

- During hurricanes, weather forecasting models help public officials determine when and where to issue evacuation orders to move millions out of harm's way
- When a body of water needs to go on a "solution diet," water-quality models help predict how much pollution levels need to be reduced to restore healthy conditions for plant and animal communities.
- Policymakers rely on global climate models to understand how Earth's climate will change in the future and how reducing carbon emissions could slow these changes.

**How modeling uncertainty is quantified**

Scientists commonly quantify modeling uncertainty in multiple ways, including:

- Comparing the model's predictions to field data: any difference represents the model's "uncertainty," which is a combination of error in the model's predictions and error in field measurements
- Conducting a sensitivity analysis, where the data that are fed into the model are intentionally tweaked to determine how vulnerable the model's outputs are to various modeling assumptions
- Running a model comparison analysis, where the model is compared to other models that predict similar variables to identify differences in their predictions

The more ways that modeling uncertainty gets quantified, the more confidence that managers can have in the model's predictions – and thus the more likely managers are to make informed decisions based on modeling insights.

**SCCWRP FACT SHEET**

### How SCCWRP adds value to aquatic ecosystems management

The applied-science research agency builds a rigorous technical foundation for management decision-making

The Southern California Coastal Water Research Project (SCCWRP) is an applied sciences institute working to incorporate rigorous, fully vetted research into the decisions and actions of Southern California's environmental management community. Since its founding as a public-sector research agency in 1969, SCCWRP has been developing strategies, tools and technologies that both regulatory and regulated agencies rely on to more effectively protect and enhance the health of Southern California's coastal oceans and the watersheds that drain to it.

**SCCWRP mission**

To enhance the scientific foundation for management of Southern California's ocean and coastal watersheds.

**SCCWRP's value proposition**

**Establishing an unbiased scientific foundation for action:** SCCWRP helps managers decide when and how to take action based on the findings and recommendations of a single organization, not multiple agencies or entities in conflict.

**Building broad scientific consensus:** SCCWRP works proactively to build broad consensus among working scientists across the subject, so that managers are unlikely to take action based on the findings and recommendations of a single organization.

**Aligning to number agencies' needs:** SCCWRP research agency is developed collaboratively with SCCWRP's 24 member agencies, ensuring SCCWRP is providing services, especially in the form of research, that meet the present-day needs as well as long-term and priorities.

**Elevating emerging science:** SCCWRP research agency is developed collaboratively with SCCWRP's 24 member agencies, ensuring SCCWRP is providing services, especially in the form of research, that meet the present-day needs as well as long-term and priorities.

**Cost-leveraging research findings:** Each dollar that SCCWRP's 24 member agencies invest in SCCWRP – whether through direct funding, in-kind support, or in-kind support – is leveraged through SCCWRP's 24 member agencies, ensuring SCCWRP is providing services, especially in the form of research, that meet the present-day needs as well as long-term and priorities.

**Ways that SCCWRP supports adoption of emerging science**

SCCWRP works closely with the environmental management community to maximize adoption and use of emerging science. SCCWRP provides guidance and assistance in the form of:

- **Training:** SCCWRP provides training to environmental management community members on the use of emerging science.
- **Quality assurance:** SCCWRP provides quality assurance to environmental management community members on the use of emerging science.
- **Technology transfer:** SCCWRP provides technology transfer to environmental management community members on the use of emerging science.
- **Peer-to-peer:** SCCWRP provides peer-to-peer support to environmental management community members on the use of emerging science.

## Water-quality modeling

## SCCWRP's management value

# eDNA Monitoring fact sheet

- We've been working on our eDNA fact sheet over the past 3 quarters
  - CTAG helped us significantly improve this fact sheet
  - We also circulated it to our eDNA research partners and got more useful feedback
- CTAG reviewed/signed off on this fact sheet last month
  - We will publish it as soon as you approve it

## eDNA monitoring

**SCOWRP FACT SHEET** **DRAFT**


### eDNA: An approach to monitoring organisms using their genetic traces

Environmental DNA (eDNA) technology is in the process of being incorporated into routine monitoring programs

One of the key ways that environmental managers evaluate the health of an ecosystem is by monitoring the organisms living in it. These biology-based assessments – or bioassessments – traditionally rely on directly sampling or observing organisms. But some organisms are not feasible to sample or observe because they are:

- » Difficult to identify visually
- » Elusive, rare and/or pass rapidly through their environment
- » Threatened or sensitive, making their capture ecologically destructive

Thus, scientists have developed a complementary approach for monitoring aquatic life that relies on the DNA that organisms shed into their environment, known as environmental DNA (eDNA). By analyzing eDNA in water samples (as well as soil and air samples), managers can detect the organisms that were present and gain insight into ecological health.



A SCOWRP field crew retrieves water samples from a stream to identify the organisms living in it via their eDNA signatures.

#### Insights provided by eDNA monitoring

Targeted analysis Figure out if one or a handful of specific species is present	Community analysis Identify the species present within a major category of organisms (e.g., all bacteria, all fish, all diatoms)
<b>Uses</b> Presence/absence » Example: Are any Delta smelt present in my sample? » Technology: DNA barcoding	<b>Uses</b> Quantification » Example: How much steelhead DNA is present in my sample? » Technology: Quantitative or droplet digital polymerase chain reaction (PCR)
<b>Use</b> Community surveys » Example: How diverse are the fish communities in my sample? » Technology: DNA metabarcoding, genomics/metagenomics	


#### Monitoring programs that are piloting eDNA methods in California

- California Surface Water Ambient Monitoring Program (SWAMP) eDNA Metabarcoding Monitoring and Analysis Project (SeMMAP) + similar regional efforts
- Estuary Marine Protected Area (EMPA) Monitoring Program
- Southern California Bight Regional Monitoring Program
- California Cooperative Oceanic Fisheries Investigations (CalCOFI)
- California Freshwater Harmful Algal Blooms (F HABs) Monitoring


#### Using eDNA to extend monitoring's reach

In many cases, eDNA monitoring can serve as an effective complement to traditional bioassessment monitoring. But in other cases, eDNA can extend monitoring to places and applications where traditional monitoring isn't viable or effective. Examples include:


- Sensitive species and habitats**  
Species with protected legal status and/or that live in ecologically sensitive habitats are often infeasible to observe or sample. eDNA-based monitoring offers a non-invasive alternative.
- Invasive and nuisance organisms**  
Unwanted and nuisance species like harmful algal blooms and invasive fish can go undetected until after they've already harmed ecosystems. eDNA monitoring could provide an early-warning system for these threats.
- Community surveys**  
Often, managers want to survey more than just a handful of species in a community – which can quickly become cost-prohibitive and impractical. eDNA makes it feasible to monitor entire communities at once with just one eDNA sample.



California steelhead, a species of special concern



Harmful algal blooms in a Southern California lake



Pacific hake, one of many common species targeted during regional fisheries stock assessments

# Regional Monitoring fact sheet

- Last quarter, you asked for a fact sheet on regional monitoring
  - The fact sheet provides a high-level overview of regional monitoring's value + programs here
- CTAG reviewed/signed off on this fact sheet last month
  - We will publish it as soon as you approve it

## Regional monitoring

**SCOWRP FACT SHEET** **DRAFT**

### Tracking the health of aquatic ecosystems through regional monitoring

*Southern California managers rely on regional monitoring to understand changing environmental conditions*

Regional monitoring is a type of environmental monitoring that focuses on holistic evaluation of ecosystems across time and space. Unlike site-specific monitoring that tends to focus on smaller areas, regional monitoring often calls on multiple agencies with overlapping responsibilities for protecting ecosystem health to pool their resources and work together on more ambitious, comprehensive scientific investigations. In Southern California, the insights provided by regional monitoring help environmental managers to better direct resources and maintain focus on the areas and issues that pose the greatest risks to ecosystem integrity.

**Complement to site-specific monitoring**

Southern California's water quality management community spends tens of millions of dollars every year to monitor aquatic environments affected by pollution and other human-caused stresses. Much of this monitoring is focused on understanding the ecological effects of specific human activities, such as wastewater and stormwater discharges. While this type of monitoring provides critical management insights, the data cannot be combined to produce a holistic picture of regional ecosystem health. Regional monitoring helps fill this data gap. Through regional monitoring, managers can contextualize site-specific monitoring insights and answer big-picture questions like:

- Which water bodies in Southern California are most polluted?
- Is the overall condition of Southern California's water bodies declining or improving?
- How safe is it to swim at Southern California beaches and consume fish from Southern California waters?

**Closing a knowledge gap**

In 1990, the National Research Council – the scientific advisory arm of the prestigious National Academies of Sciences, Engineering, and Medicine – cited Southern California as a poster child for a densely populated region that, despite its high-quality investments in monitoring, could not answer broader-scale questions about how human activities have impacted the health of its aquatic ecosystems. Southern California also could not assess overall compliance with the federal Clean Water Act.

- In 1994, Southern California responded by developing the Southern California Bight Regional Monitoring Program – a coordinated, cyclical monitoring collaboration that is now one of the nation's premier coastal marine monitoring programs. Other regional monitoring programs have since followed.

**Signature regional monitoring programs**

Southern California is home to two expansive, cyclical regional monitoring programs that probe multiple aspects of regional ecosystem health.

- **Southern California Bight Regional Monitoring Program:** Conducted in five-year cycles, the Bight program examines the health of about 1,500 square miles of coastal waters and includes more than 90 participating organizations. The seventh and newest cycle – Bight '23 – features seven major study elements: Sediment Quality, Water Quality, Harmful Algal Blooms, Trash, Microplastics, Microbiotics, and Submerged Aquatic Vegetation.
- **SMC Regional Watershed Monitoring Program:** Founded in 2009 by the Southern California Stormwater Monitoring Coalition (SMC), this cyclical five-year program probes multiple aspects of the ecological condition of more than 4,000 miles of streams that drain to Southern California's coastal ocean. The SMC's stream survey serves as the Bight program's freshwater counterpart, and is aligned with California's statewide stream assessment program.

*A field crew for the Southern California Bight Regional Monitoring Program collects sediment samples in San Diego Bay.*

*Southern California coastline sediment and a California halibut.*

*A field crew for the SMC stream monitoring program.*

# Prioritizing future fact sheets

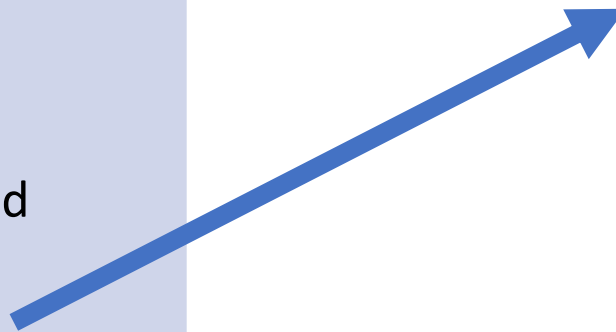
- In June, you used ranked-choice voting to prioritize the next 6 fact sheets
- In August, CTAG recommended a change to this list

## Commission's priorities for future fact sheet topics

1. Regional monitoring ✓
2. PFAS
3. Microplastics
4. HF183
5. Ocean acidification and hypoxia
6. Harmful algal blooms

## CTAG's priorities for future fact sheet topics

1. Regional monitoring ✓
2. Harmful algal blooms
3. PFAS
4. Microplastics
5. HF183
6. Ocean acidification and hypoxia



# Next steps

- We'll produce our next fact sheet for you next quarter
- Keep up in the loop about how you're using these fact sheets
  - We are producing these documents for your benefit