SCCWRP's fact sheet series

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Commission Meeting

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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


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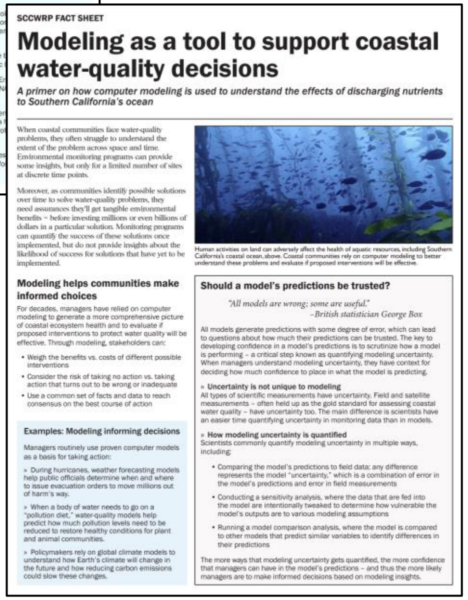
Using DNA technology to protect beachgoers from fecal contamination

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


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

Water-quality modeling


SCCWRP FACT SHEET

How SCCWRP adds value to aquatic ecosystems management

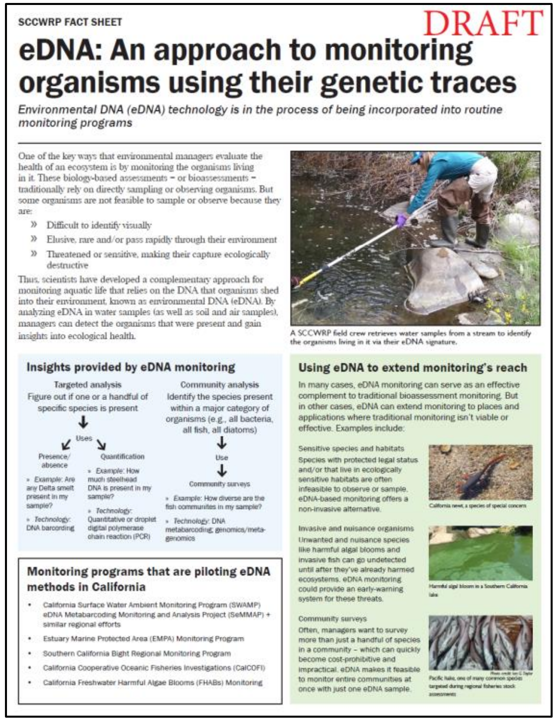
The applied-science research agency builds a rigorous technical foundation for management decision-making

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



SCCWRP 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 insights into ecological health.

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

Insights provided by eDNA monitoring

Targeted analysis
Figure out if one or a handful of specific species is present
Uses
Presence/absence
» *Example:* Are any Delta smelt present in my sample?
» *Technology:* DNA barcording
Quantification
» *Example:* How much steelhead DNA is present in my sample?
» *Technology:* Quantitative or droplet digital polymerase chain reaction (PCR)

Community analysis
Identify the species present within a major category of organisms (e.g., all bacteria, all fish, all diatoms)
Use
Community surveys
» *Example:* How diverse are the fish communites in my sample?
» *Technology:* DNA metabarcoding; genomics/meta-genomics

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 Algae Blooms (FHABs) 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.

California newt, a species of special concern

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.

Harmful algal bloom in a Southern California lake

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.

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

SCCWRP 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.

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

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, Microbiology, and Submerged Aquatic Vegetation.

Southern California seafloor sediment and a California halibut

» **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 SMC stream monitoring program

Prioritizing future fact sheets

- In June, you used ranked-choice voting to prioritize the next 6 fact sheets

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

- In August, CTAG recommended a change to this list

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