Environmental DNA (eDNA) Implementation in California

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eDNA: research to implementation

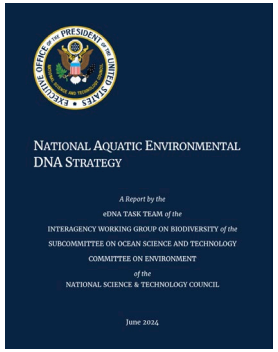
2022

SCCWRP hosts 2nd National Workshop on Marine eDNA

2023

International Organization for Standards (ISO) drafts first eDNA standard methods

2024



White House OSTP published eDNA National Strategy

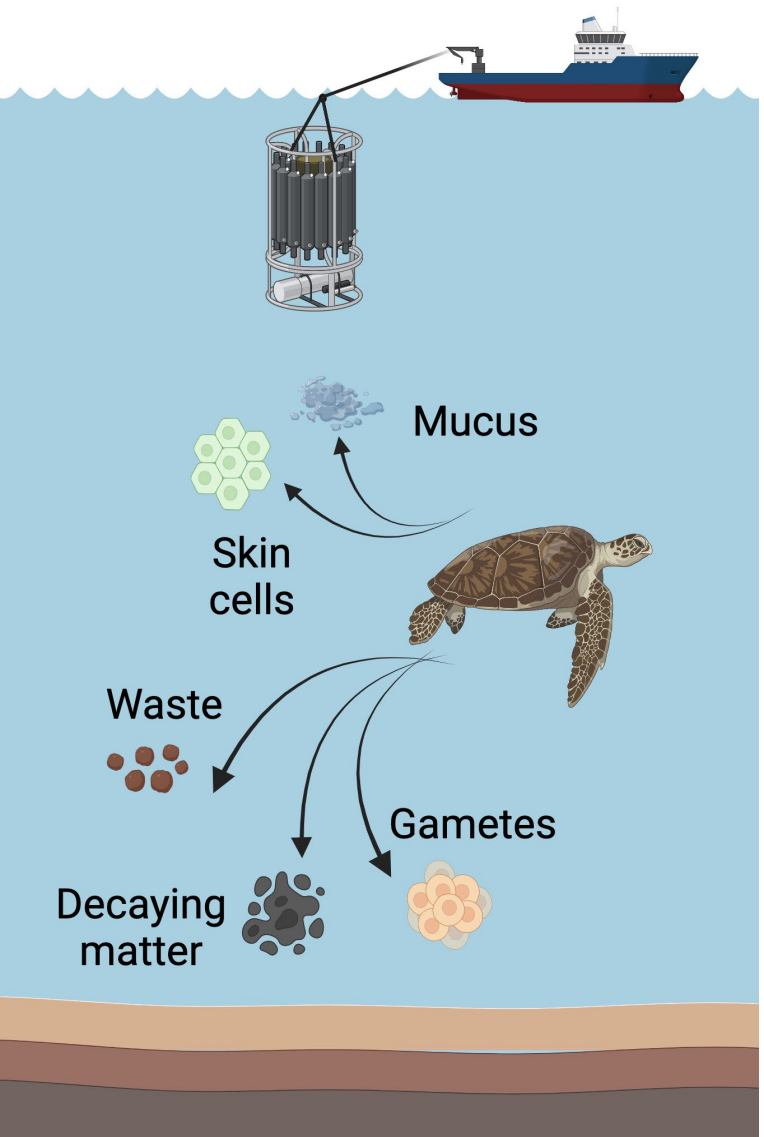
2025

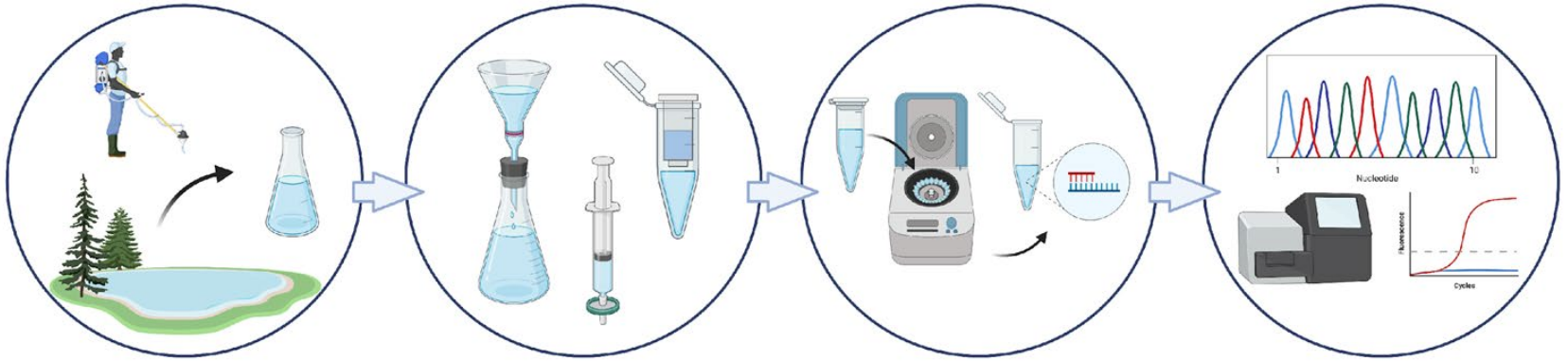
NOPP meeting on eDNA implementation

2026?

*What eDNA methods are ready **now**?*
*What methods are still **in development**?*

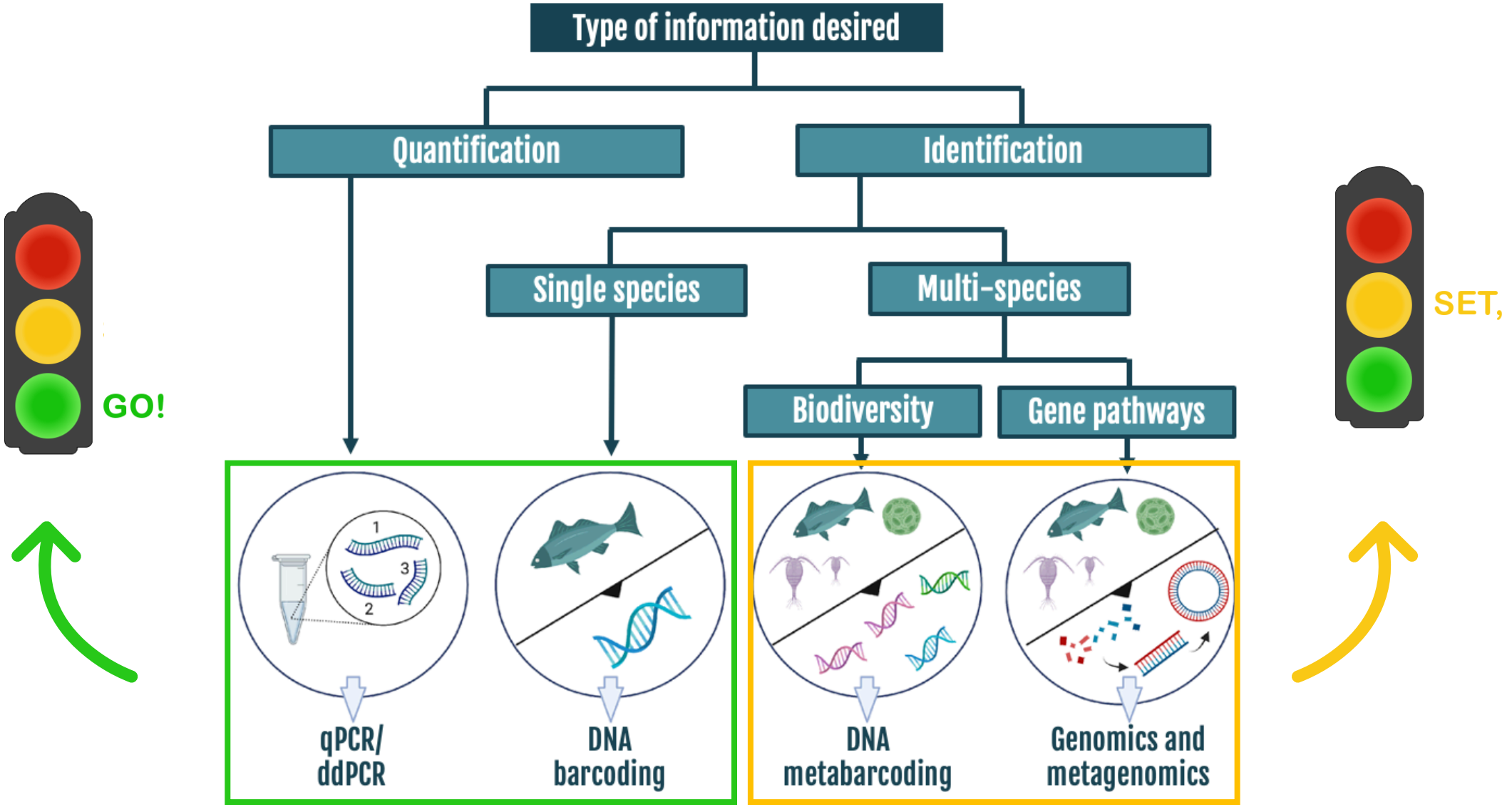
What is environmental DNA (eDNA)?





Typical eDNA workflows involve the collection of an environmental sample, filtration or precipitation to concentration the sample, DNA extraction, and analysis for either *quantification* or *identification*.

The eDNA toolkit

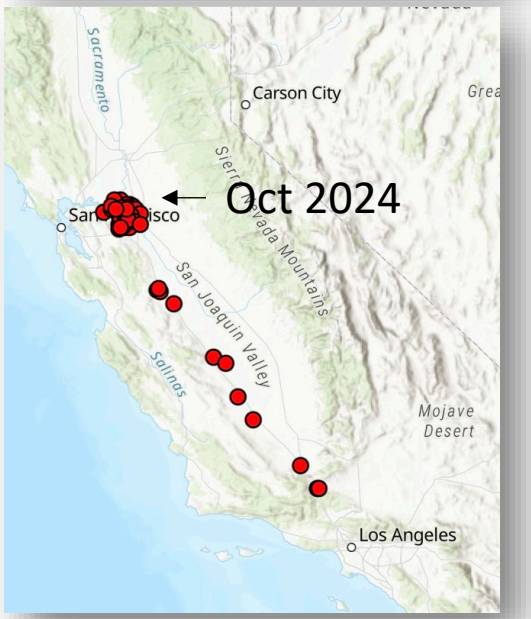


eDNA in action: Delta Smelt

- Delta Smelt (*Hypomesus transpacificus*) are **small, rare, short-lived, and endangered**
- eDNA is **non-destructive, sensitive,** and enables monitoring in otherwise difficult to sample habitats
- CA DWR is using eDNA for **permit compliance surveillance** of Delta Smelt at pumping facility
- DWR uses qPCR and a rapid, field-based assay to **inform management decisions**

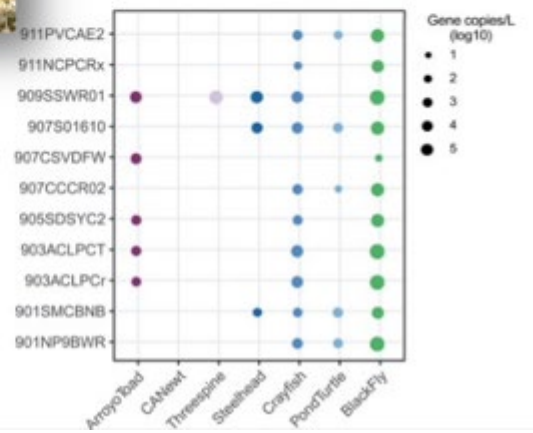
eDNA in action: Golden Mussel

- **Invasive Golden Mussel *(Limnoperna fortunei*)**
- eDNA is **sensitive** and able to distinguish **closely related species**
- **Statewide eDNA monitoring network** now in place with intercalibration in development
- SCCWRP is working with San Bernadino Valley MWD to test for Golden mussel in the Citrus Reservoir



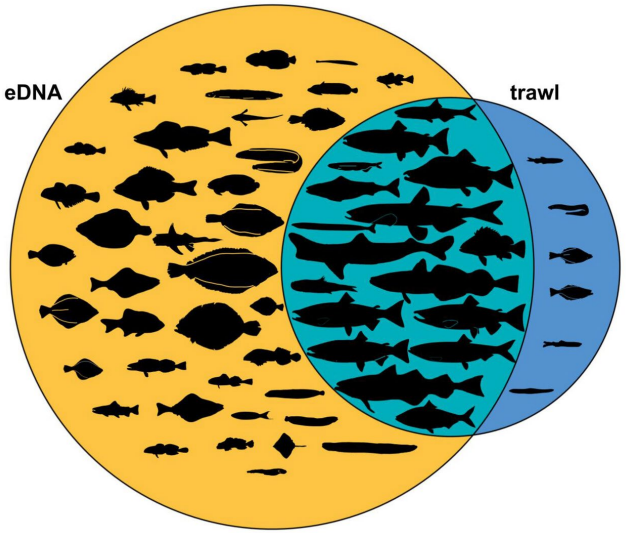
eDNA in action: routine monitoring

- RB9 has been piloting ddPCR assays for **invasive and endangered species** monitoring
  - Water eDNA samples are collected alongside traditional bioassessment sampling
- eDNA is **non-destructive, sensitive**, helps expand suite of monitored taxa
- Positive detections are **flagged for follow-up** with additional visual and eDNA sampling



In development: community-based applications

Fish biodiversity

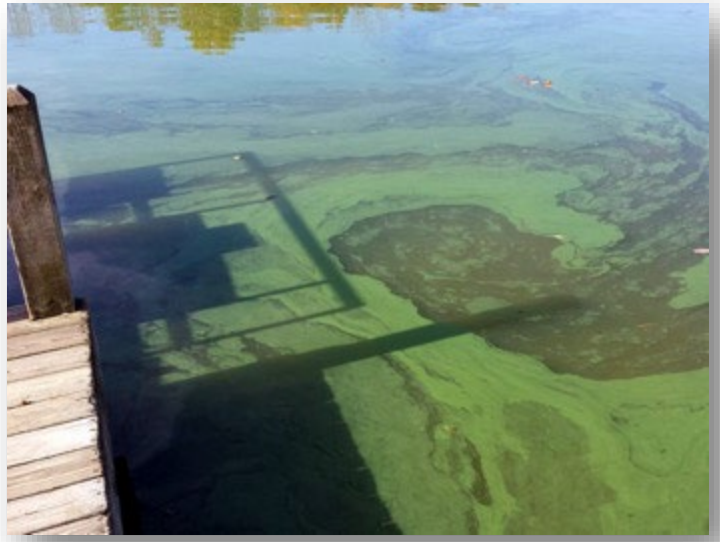


- Non-destructive sampling
- Ability to resolve difficult to ID taxa
- Scale across space/time

Algal Bioassessment

- Alleviates taxonomic capacity limitations
- Cost <<< traditional approaches

Harmful algal blooms



- Sensitive, early detection of harmful taxa
- Community level, species level, and gene level approaches

In development: community-based applications

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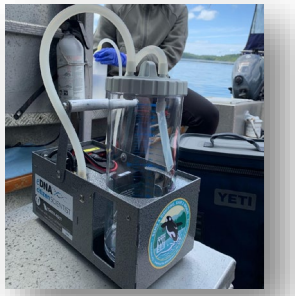
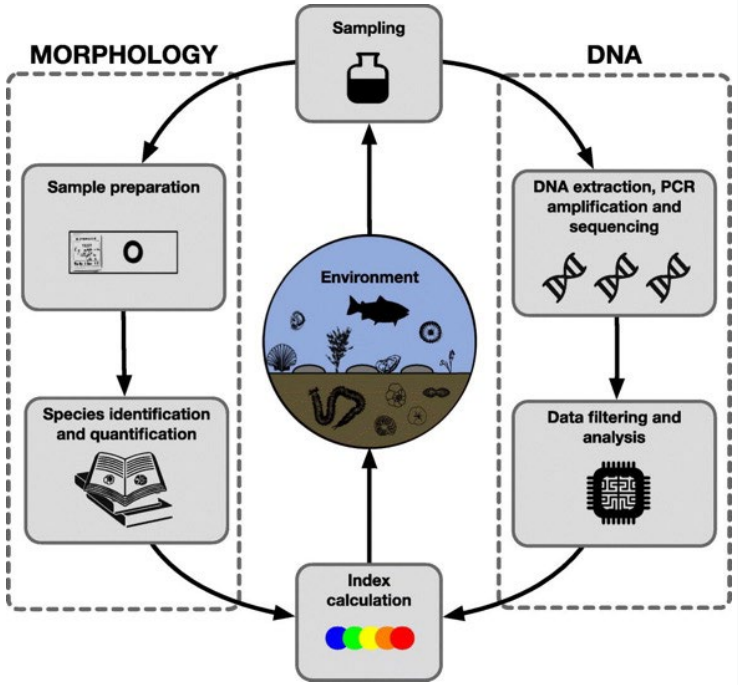


EMPA
Monitoring Program

- Non-destructive sampling
- Ability to resolve difficult to ID taxa
- Scale across space/time

Algal Bioassessment



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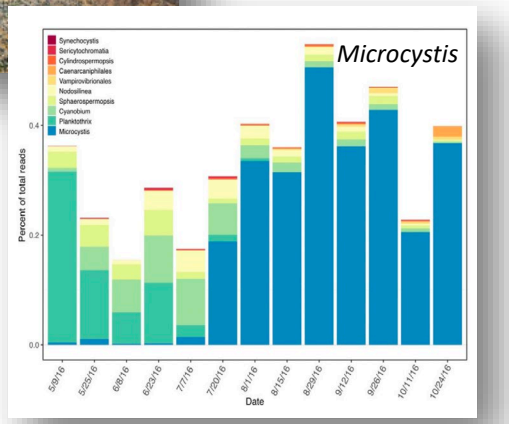
Harmful algal blooms



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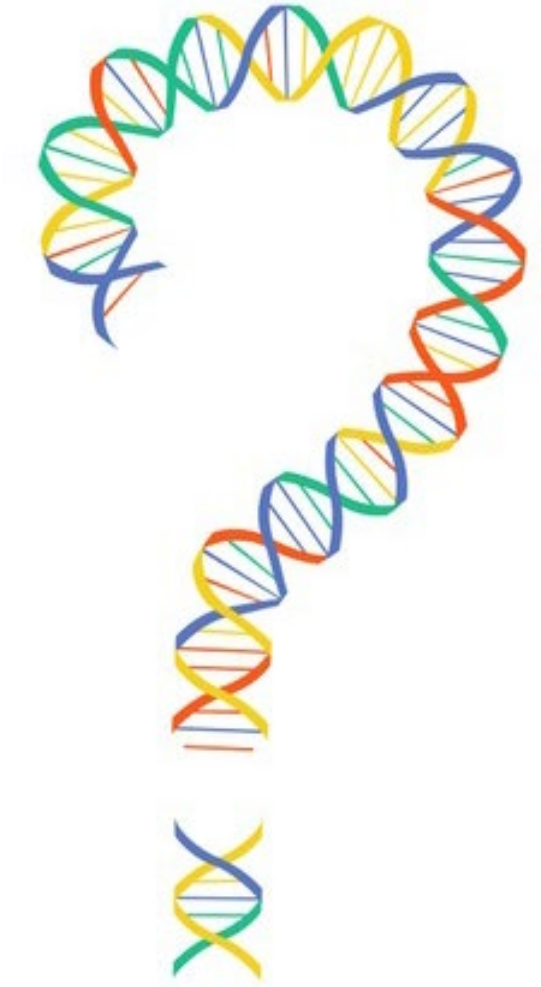
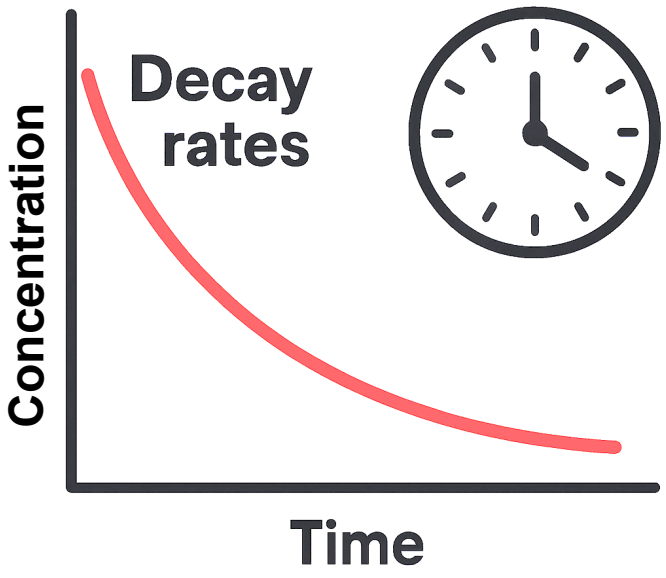
Priority eDNA research questions



- How recently was this organism here?
- How far did the eDNA signal travel?
- Will you miss certain species because of gaps in DNA reference libraries?
- How do you know the organism is alive or dead?
- How do you know if the toxin genes are turned on or off?

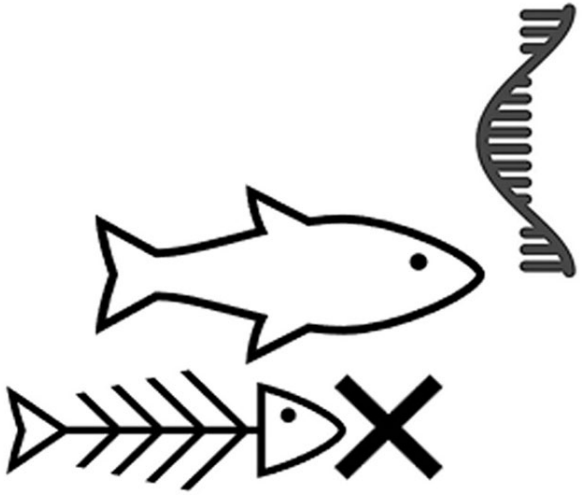
Research to advance eDNA method adoption

eDNA fate + decay



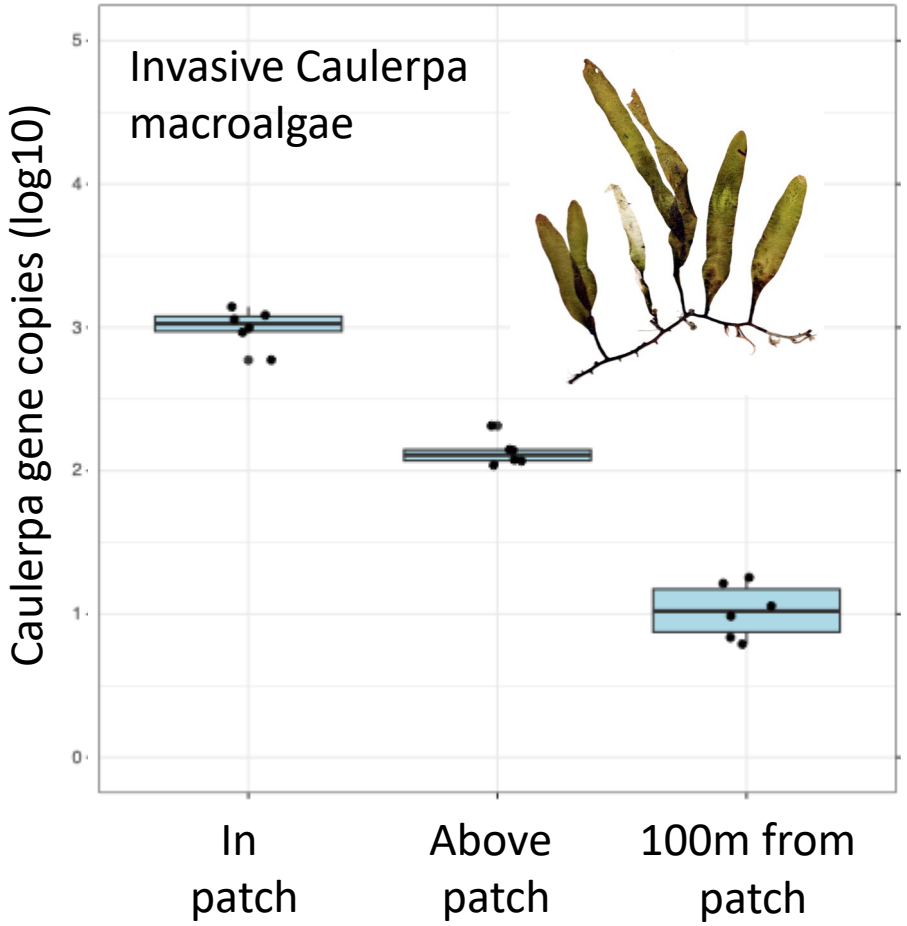
DNA Barcode Library

Live vs. dead (eRNA)



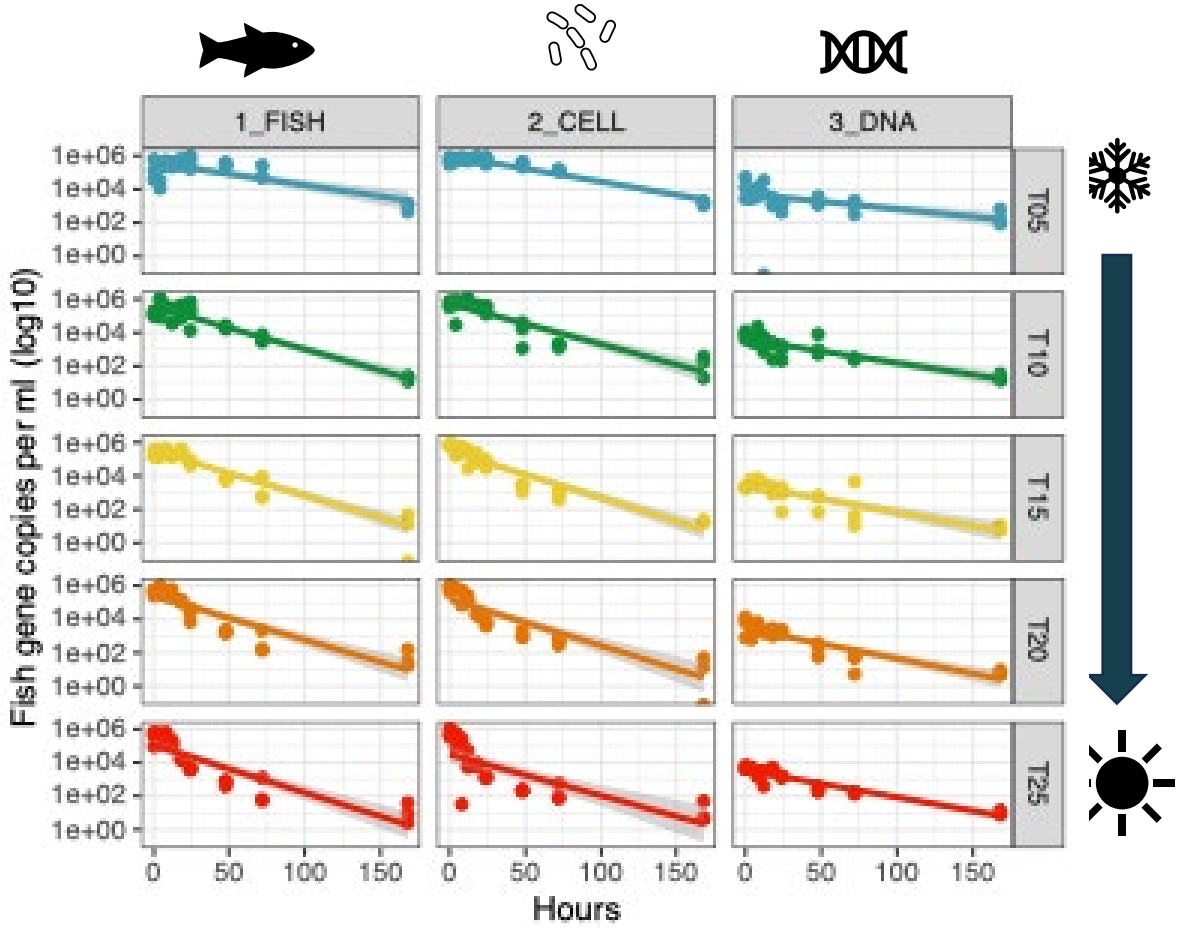
eDNA fate and decay

eDNA across space



Predictive models

eDNA across time



Expanding DNA Reference Libraries

CALIFORNIA OCEAN PROTECTION COUNCIL

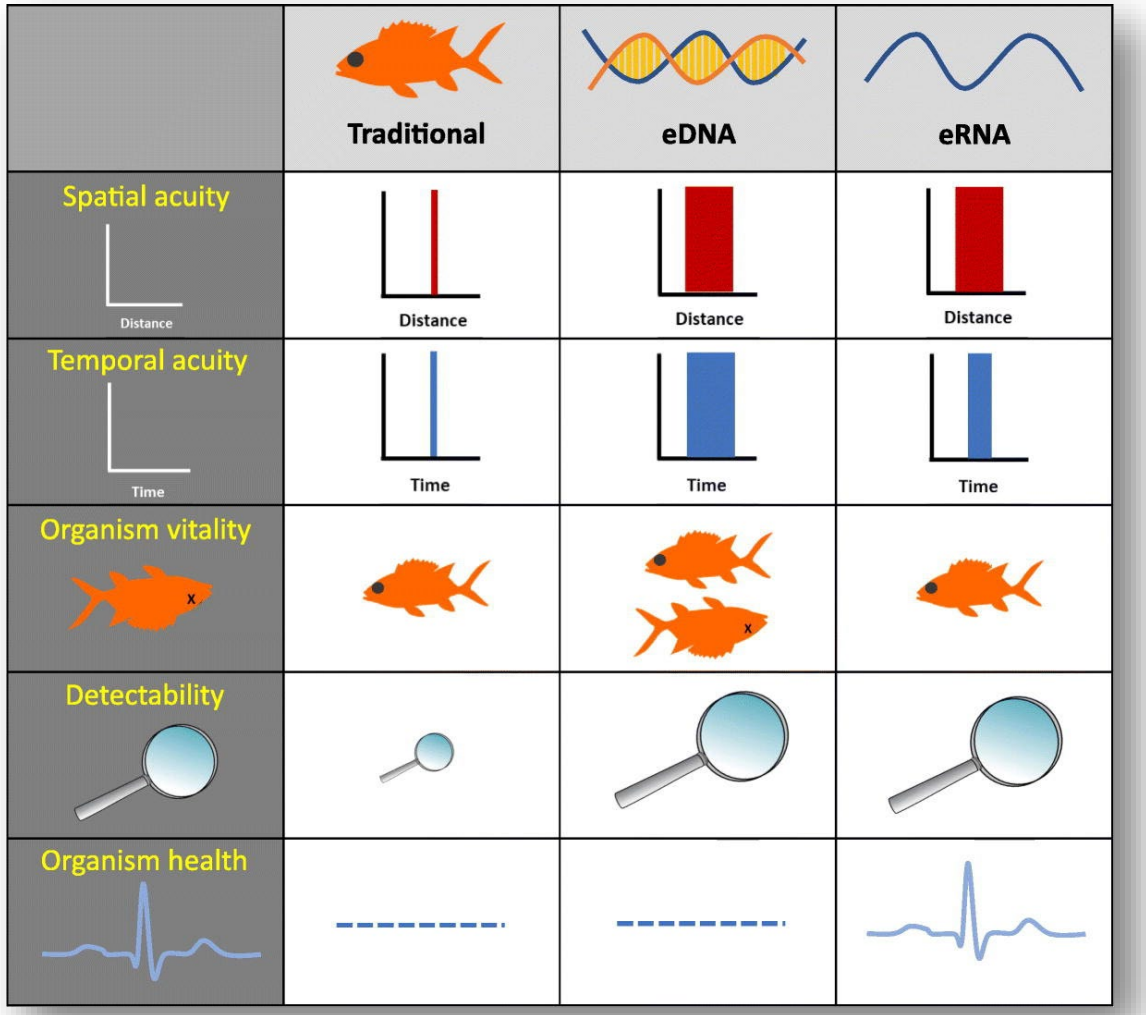
California Institute for Biodiversity

COASTAL QUEST
Building Resilient Communities

- California has allocated $9M for **Intertidal Biodiversity DNA Barcode Library**
- Will help to advance our understanding of biodiversity hotspots and species range shifts
- SCCWRP is helping to lead the development of the **standardized field and lab protocols**

Live vs. dead (eRNA)

- eRNA **degrades faster** than eDNA and is only produced by living organisms
- Targeting eRNA will allow us to distinguish **live vs. dead signals** and also constrain timeframe of detections
- eRNA approaches have great potential for both our pathogen (e.g. Vibrio) as well as our harmful algal bloom monitoring



eDNA method standardization

California Molecular Methods Workgroup

MMWG

THE YUROK TRIBE · GENIDAQS · The City of SAN DIEGO · CALeDNA · SWAMP Surface Water Ambient Monitoring Program · MBARI · SCCWRP · CALIFORNIA WATER QUALITY MONITORING COUNCIL · Smithsonian · CALIFORNIA DEPARTMENT OF FISH & WILDLIFE · NOAA · Water Boards

https://mywaterquality.ca.gov/molecular-methods/

Marine Technology Society eDNA Technology Committee

https://www.mtsociety.org/edna

International eDNA Standardization Task Force

iESTF

ISO Water eDNA collection

ISO Water eDNA extraction

https://iestf.global/

eDNA: research to implementation

- Environmental DNA research has **advanced rapidly** in the past 10 years
- **Targeted species applications** are leading the way for eDNA method adoption for routine implementation
- **Community-based approaches** are developing rapidly thanks to partner pilot studies and tool refinement
- **eDNA method standardization** is a key priority across all applications to ensure eDNA observations are robust, repeatability, and rock solid to support management decisions

Thank you!
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