eDNA Research and Applications in Aquaculture

David M. Lodge

Francis J. DiSalvo Director | Cornell Atkinson Center for Sustainability

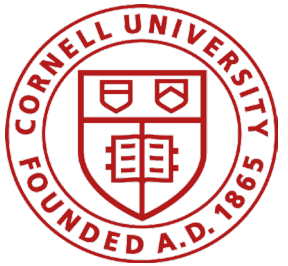
Professor | Dept. Ecology & Evolutionary Biology, Cornell University

2024 New York Seafood Summit

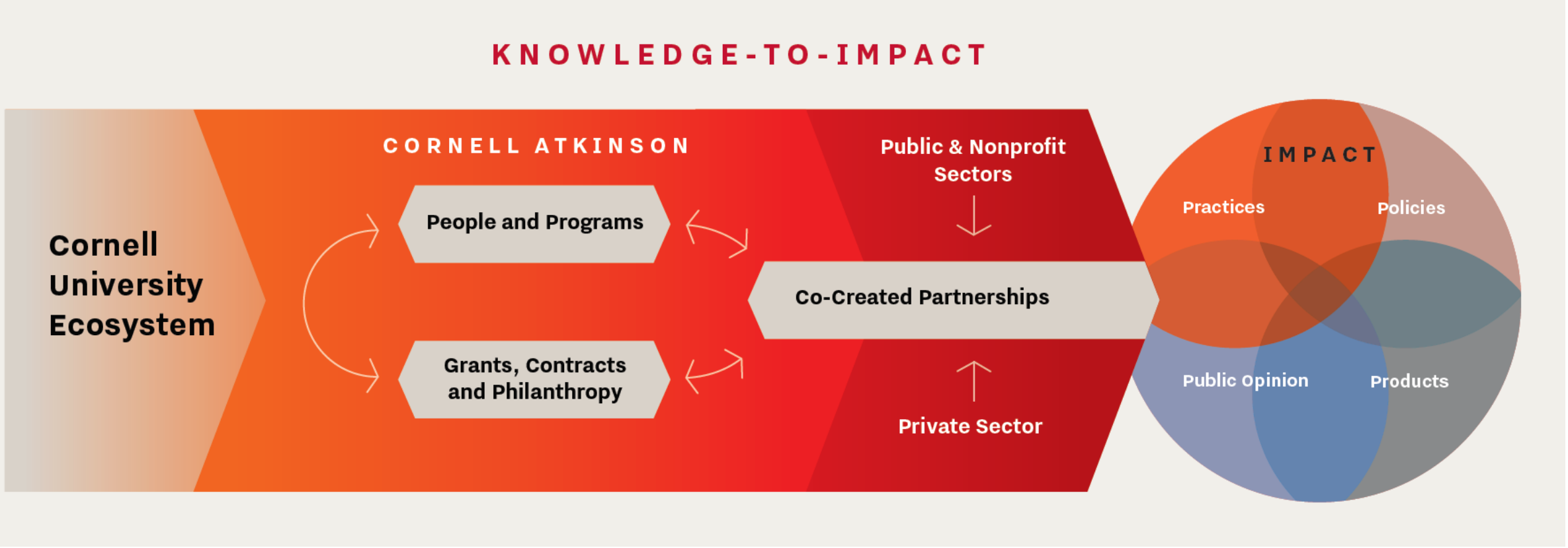
Cornell Agritech

5 March 2024

Cornell Atkinson Center for Sustainability



Cornell Atkinson Center for Sustainability



Our Vision and Mission

Vision: A thriving, resilient, and inclusive U.S. aquaculture industry that supports jobs, expands access to nutritious domestic seafood, and reinforces healthy coastal and ocean ecosystems in a changing environment.

Mission: To provide science, services, and policies that create conditions for opportunity and growth of sustainable U.S. aquaculture.

Goal #1

Manage Sustainably and Efficiently

Improve regulatory processes for sustainable coastal and marine aquaculture through collaboration with partners.

Goal #2

Lead Science for Sustainability

Use world-class science expertise to meet management and industry needs for a thriving seafood production sector and share this knowledge broadly.

Goal #3

Educate and Exchange Information

Build awareness and support for coastal and marine aquaculture through two-way communication with diverse stakeholders and partners.

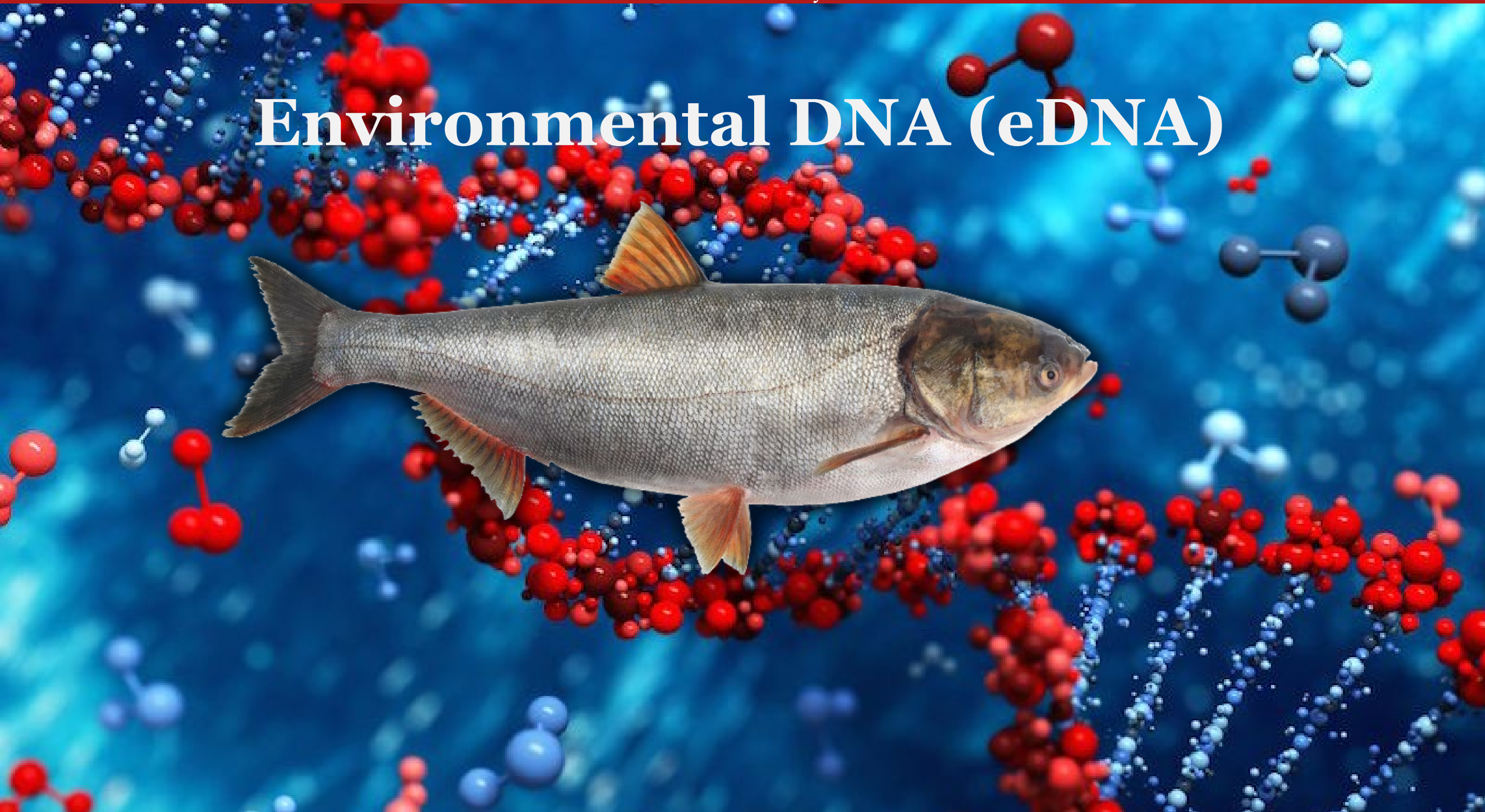
Goal #4

Support Economic Viability and Growth

Facilitate a robust aquaculture industry that thrives as a key component of a resilient seafood sector.

Cornell Atkinson

Environmental DNA (eDNA)



Environmental DNA Overview

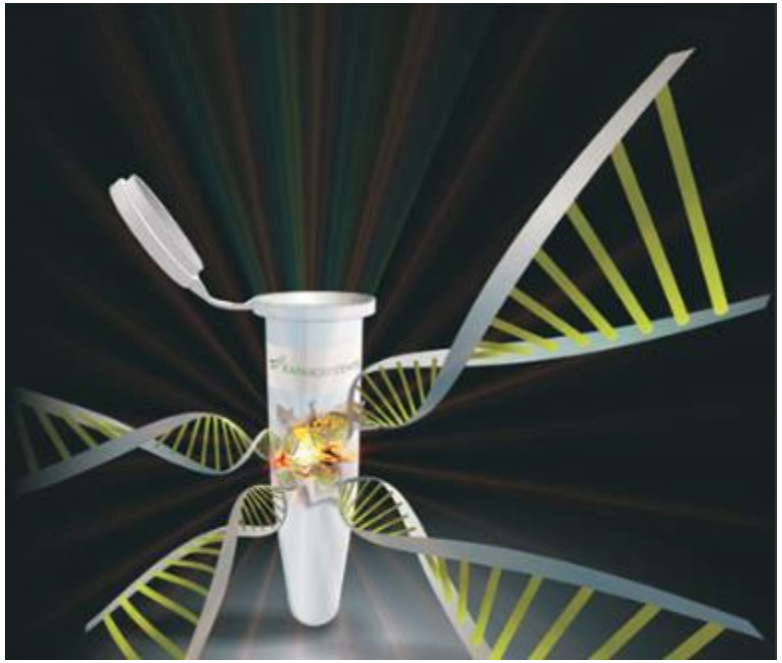
1 Collect water sample

Environmental DNA Overview

1. Collect water sample
2. Filter water sample

Environmental DNA Overview

1. Collect water sample
2. Filter water sample
3. Extract all DNA



Environmental DNA Overview

1. Collect water sample
2. Filter water sample
3. Extract all DNA
4. Amplify target DNA

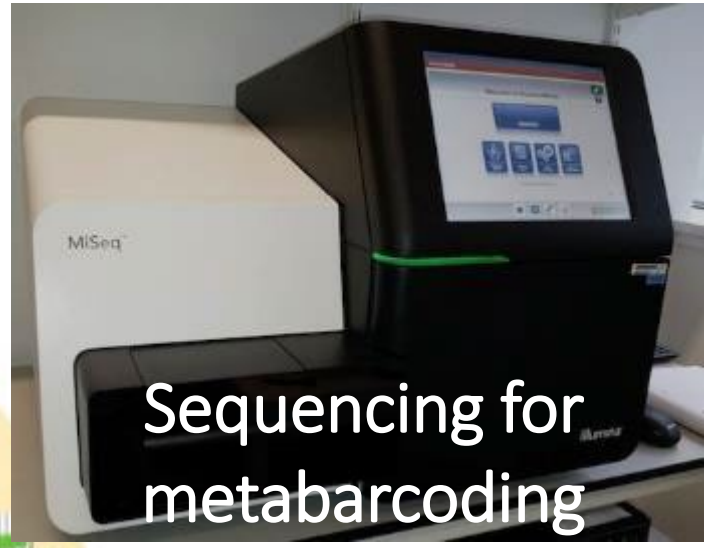
Design primers for target DNA;
Polymerase Chain Reaction (PCR)

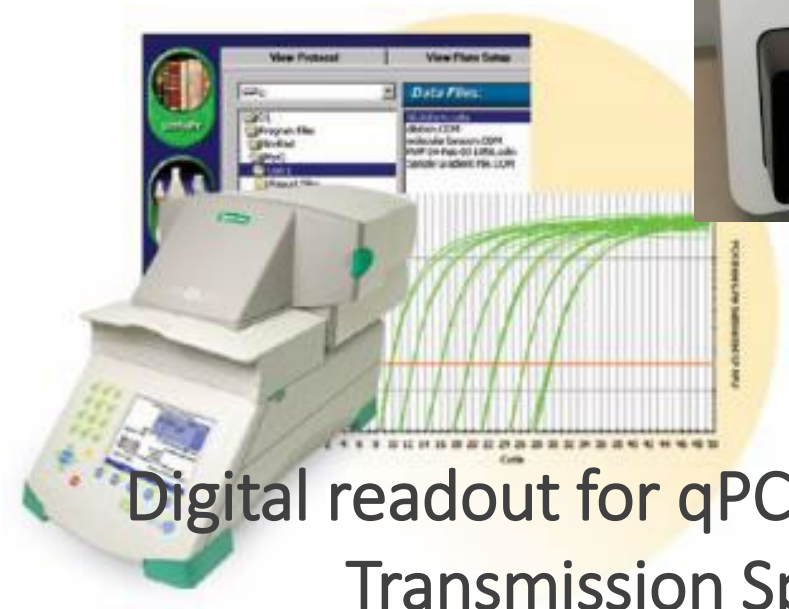
Quantitative PCR

Digital droplet PCR

Environmental DNA Overview

1. Collect water sample
2. Filter water sample
3. Extract all DNA
4. Amplify target DNA
5. Visualize DNA presence





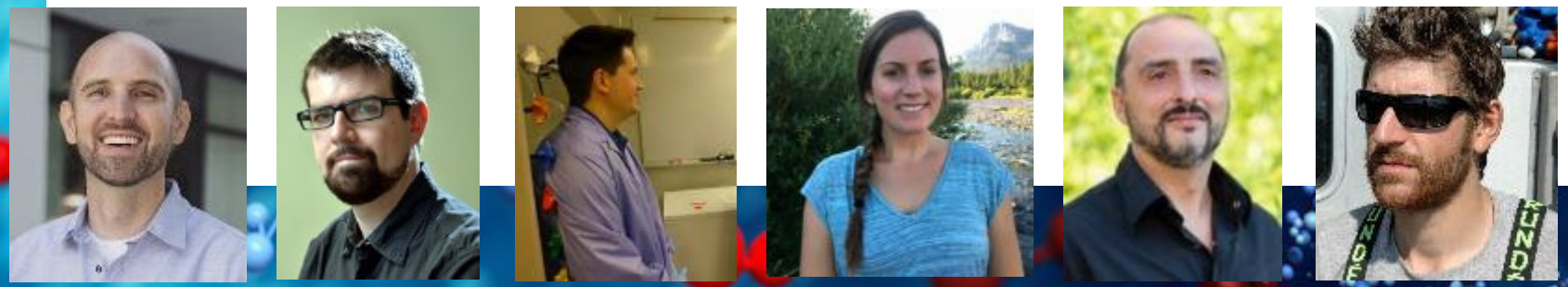
Digital readout for qPCR and ddPCR, Laser Transmission Spectroscopy

Growth in R&D of eDNA over last 15 yr

Management-ready eDNA

1. **Single species detection** using species specific primers and qPCR or dPCR.
2. **Multiplex approach**, e.g., 52 invasive species per sample
3. **"All" species detection** using primers with much broader taxonomic coverage, sequencing, and bioinformatics analysis, i.e., metabarcoding.
4. **Abundance**

For many applications, eDNA is faster, cheaper, more accurate



448 COMMENTARY

Policy action needed to unlock eDNA potential

David M Lodge
Department of Ecology and Evolutionary Biology and Cornell Atkinson Center for Sustainability, Cornell University, Ithaca, NY (dml356@cornell.edu)

Front Ecol Environ 2022; 20(8): 448–449, doi:10.1002/fee.2563

Received: 18 February 2023 | Revised: 25 April 2023 | Accepted: 26 April 2023

DOI: 10.1002/edn3.432

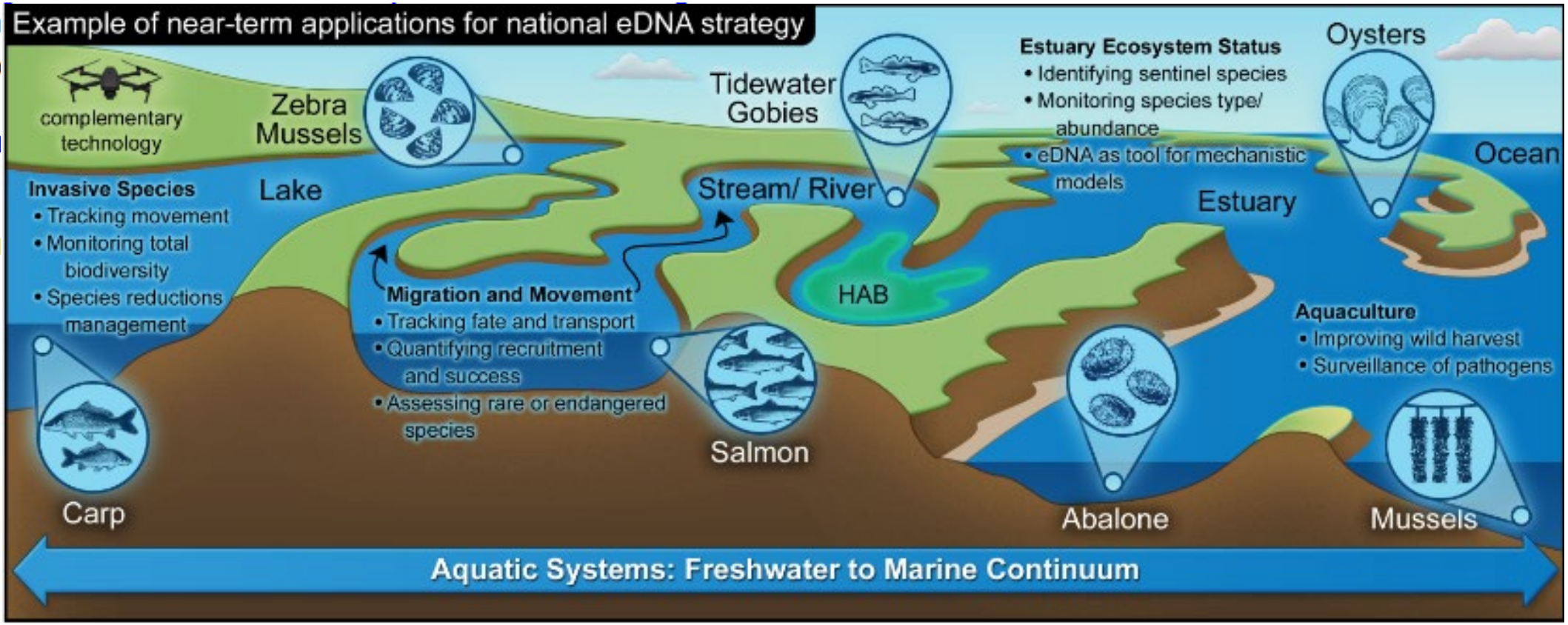
Environmental DNA

WILEY

PERSPECTIVE

Toward a national eDNA strategy for the United States

Ryan P. Kelly[1] | David M. Lodge[2] | Kai N. Lee[3] | Susanna Theroux[4] |
Adam J. Sepulveda
Elizabeth Andruszk
Kelly D. Goodwin[9]
Cathryn L. Abbott[1]
Peter M. Thielen[15]
Margaret E. Hunte
Mark Y. Stoeckle[21]
Karen E. James[24]
John F. Griffith[4] |



Cornell Atkinson


THE WHITE HOUSE
WASHINGTON
EXECUTIVE OFFICE OF THE PRESIDENT OF THE UNITED STATES
Office of Science and Technology Policy

National Workshop on Marine eDNA

The biennial National Workshop on Marine Environmental DNA (eDNA) serves as a mechanism to bring together researchers, practitioners, and policymakers to discuss eDNA technologies, newly released national strategies, and implementation priorities. In June of 2024, we will convene to discuss four major subthemes:

Register

6/3/2024 8:00 AM
6/4/2024 8:00 AM

frontiers in Microbiology

ORIGINAL RESEARCH
published: 07 December 2018
doi: 10.3389/fmicb.2018.03009

Environmental DNA: A New Low-Cost Monitoring Tool for Pathoge

Received: 24 October 2019 | Revised: 17 March 2020 | Accepted: 31 March 2020
DOI: 10.1111/mec.15434

Lucy Peters[1,2†], *Sof*
Anna Kintner[2], *Øyv*

SPECIAL ISSUE

MOLECULAR ECOLOGY WILEY

Supervised machine learning i inference in monitoring the en aquaculture

frontiers | Frontiers in Genetics

TYPE Original Research
PUBLISHED 26 August 2022
DOI 10.3389/fgene.2022.957251

Received: 21 September 2020 | Revised: 31 March 2021 | Accepted: 4 May 2021
DOI: 10.1111/1755-0998.13426

Larissa Frühe[1] |
Guillaume Lenten
Thorsten Stoeck[1]

RESOURCE ARTICLE

Beyond taxonom in the context of f

Olivier Laroche[1,2] | Xa

Check for updates

OPEN ACCESS

EDITED BY
Georgina Valentine Wood,
University of Western Australia, Australia

REVIEWED BY
Simo Njabulo Maduna,
Norwegian Institute of Bioeconomy Research (NIBIO), Norway
Liz Alter,
California State University, United States

*CORRESPONDENCE
Kim Præbel,
kim.praebel@uit.no

SPECIALTY SECTION
This article was submitted to Evolutionary and Population Genetics

Fine-scale differences in eukaryotic communities inside and outside salmon aquaculture cages revealed by eDNA metabarcoding

Marta Turon
Owen S. Wa

[1]Norwegian College
[2]Norwegian Institute

Annex 16

THE USE OF ENVIRONMENTAL DNA METHODS FOR DETECTION OF OIE LISTED AQUATIC ANIMAL DISEASES

A discussion paper developed by the OIE Aquatic Animal Health Standards Commission (Aquatic Animals Commission) for Member comments.

Version: 28 September 2021

Environmental DNA (eDNA) & Genomics Core Facility

HOME SERVICES PEOPLE CONTACT PROJECTS AND PARTNERSHIPS

eDNA & Genomics Core Facility at Cornell University

Cornell Atkinson

What applications of eDNA could improve aquaculture siting, management, health, safety?

1. For what purposes do you now sample water or organisms? Could eDNA substitute for more laborious or time-consuming traditional methods?
2. Could site selection and/or impact monitoring be better with eDNA?
3. What pathogens, parasites, predators, invasive species do you wish you could have better surveillance or monitoring of?
4. Could meeting regulatory requirements be accelerated with eDNA?