eDNA Research and Applications in Aquaculture

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Cornell Atkinson Center for Sustainability

Knowledge-to-Impact

Cornell University Ecosystem

- People and Programs
- Grants, Contracts and Philanthropy

Co-Created Partnerships

Public & Nonprofit Sectors

Private Sector

Impact

- Practices
- Policies
- Public Opinion
- Products

Cornell University
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.

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**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.
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

Sequencing for metabarcoding
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
Policy action needed to unlock eDNA potential

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Toward a national eDNA strategy for the United States
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:
Environmental DNA: A New Low-Cost Monitoring Tool for Pathogens

Supervised machine learning inference in monitoring the environmental impacts of salmon aquaculture

Beyond taxonomy in the context of

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

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
eDNA & Genomics Core Facility at Cornell University
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?