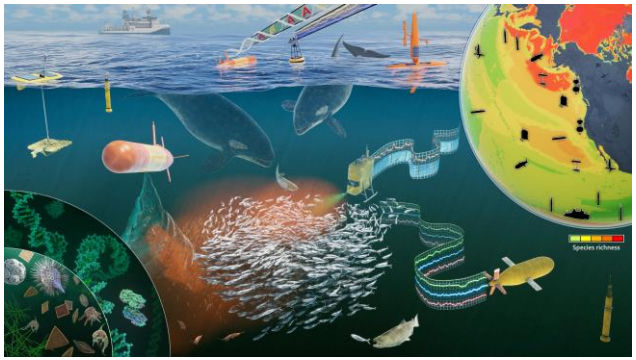
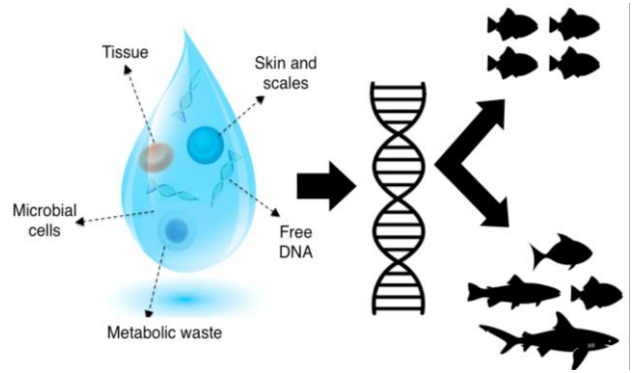

FIDO: A Low-Cost, Scalable Autonomous Robot for Environmental DNA Sampling and Preservation
Enoch Nicholson, Scott Jensen, Adam Sepulveda, Kevan Yamahara, James Birch
OCEANS Brest
June 18th, 2025
MBARI
Monterey Bay Aquarium Research Institute

MBARI (Monterey Bay Aquarium Research Institute)



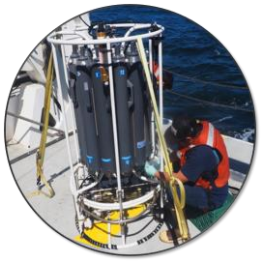
MBARI Monterey Bay Aquarium Research Institute

Environmental DNA (eDNA) and marine biodiversity assessments



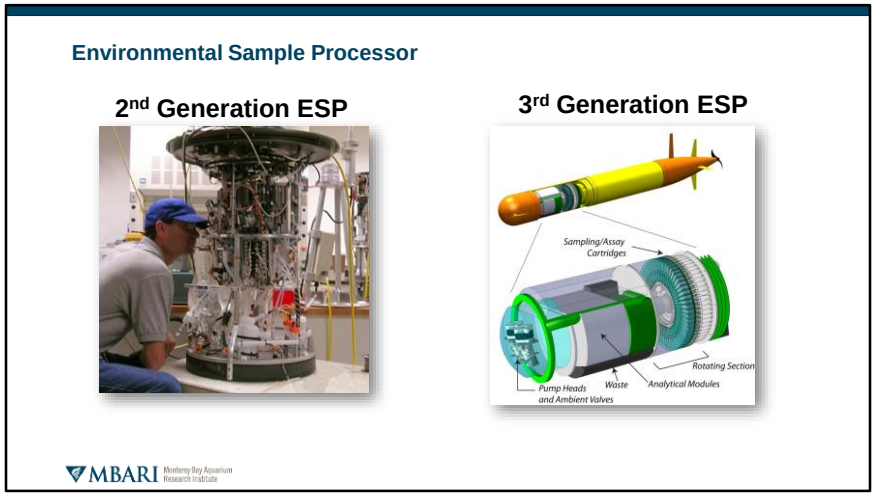
MBARI Monterey Bay Aquarium Research Institute

eDNA requires sample collection



In the quest for answers, this is boring…

MBARI Monterey Bay Aquarium Research Institute

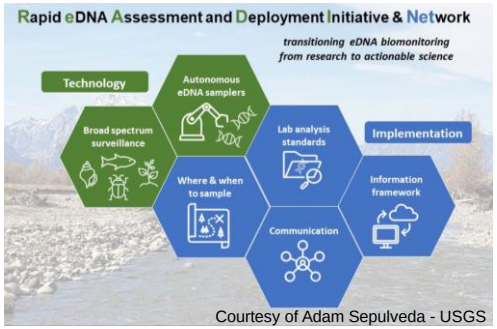


For almost 3 decades our team has been developing the ESP or environmental sample processor. Starting with the 2G ESP on the left and 3G ESP on the right. I am happy to discuss these instruments with folks, but I really want to hone in on their design requirements

Both of these instruments were designed with the idea providing in situ analytical capabilities. Where we are no longer returning samples back to the lab but instead sending back data. Moreover, functional these instruments were designed for submerged deployments in the ocean either on stationary moorings, in the case of the 2G ESP or mobile deployments on 3G ESP using AUV.

These are very specific requirements that enable us to ask and solve different scientific research questions.

READI-Net



Courtesy of Adam Sepulveda - USGS

MBARI Monterey Bay Aquarium Research Institute

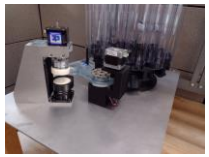
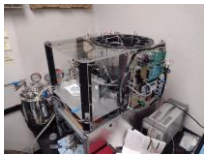
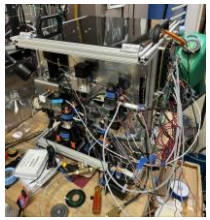
FIDO: Filtering Instrument for DNA Observation

Hardware:

- Affordable enough for wide adoption
- Acquire at least 100 samples
- Deployable by 2 people (max)
- Simple setup and maintenance
- System must decontaminate itself
- Comms options (WIFI, Bluetooth, Cellular, Satellite)
- Maximize sample volume

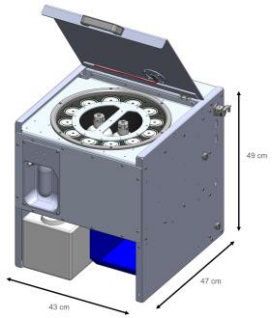
Software:

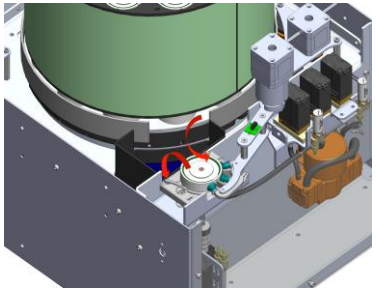
- Device should have two-way communication
- Control via simple web-based GUI
- Sample data logging (volume, date-time, flowrate)
- Manual and Schedule-Based Sampling
- Instrument State (Current State)


MBARI Monterey Bay Aquarium Research Institute

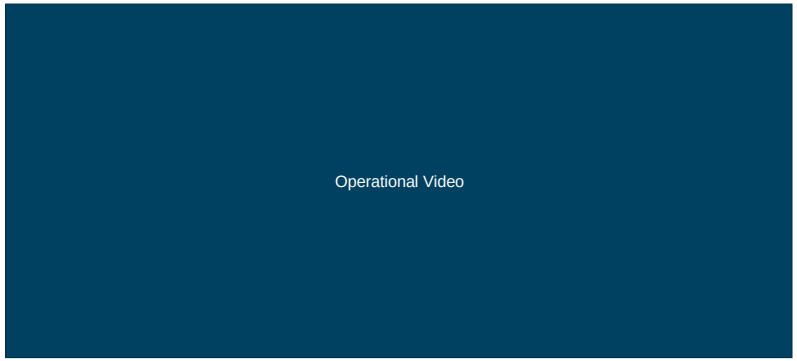
FIDO: Instrument Overview





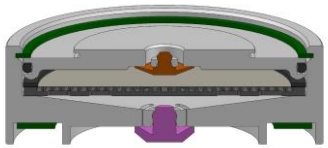
MBARI Monterey Bay Aquarium Research Institute

FIDO: Instrument Overview



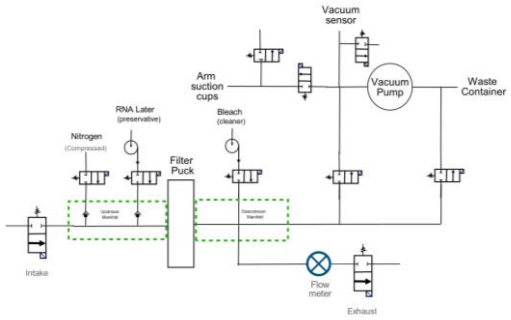
MBARI Monterey Bay Aquarium Research Institute

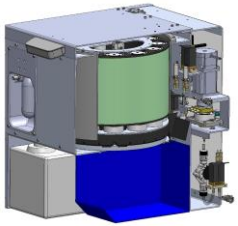
FIDO: Pucks



MBARI Monterey Bay Aquarium Research Institute

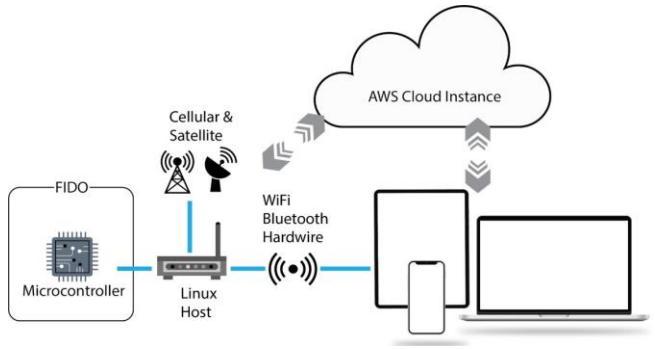
FIDO: Fluid System & Reagents





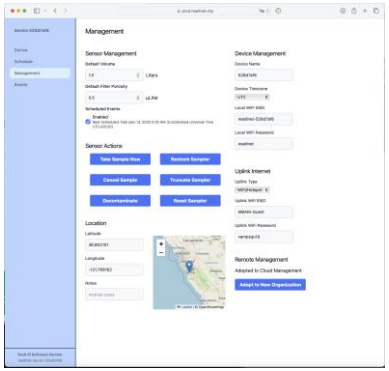
MBARI Monterey Bay Aquarium Research Institute

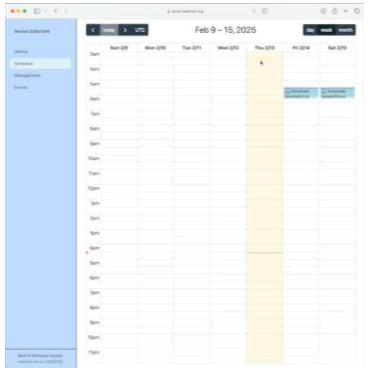
FIDO: System Architecture



MBARI Monterey Bay Aquarium Research Institute

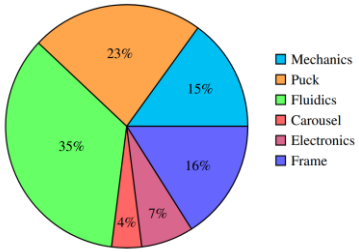
FIDO: GUI Control





MBARI Monterey Bay Aquarium Research Institute

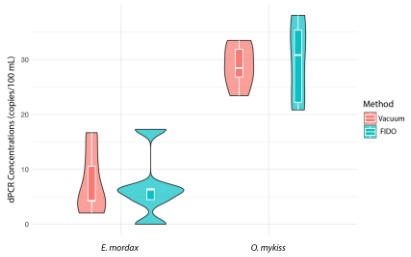
FIDO: System Costs & Manufacturing



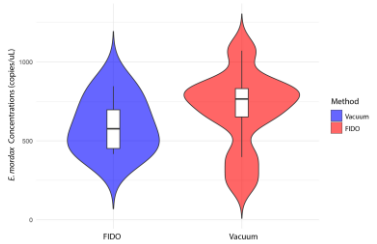
MBARI Monterey Bay Aquarium Research Institute

Testing & Validation: Laboratory Work

dPCR Anchovy and Rainbow Trout



qPCR Anchovy



MBARI Monterey Bay Aquarium Research Institute

Testing & Validation: Field Tests

Integration on-board RSV Nuyina

MBARI Monterey Bay Aquarium Research Institute

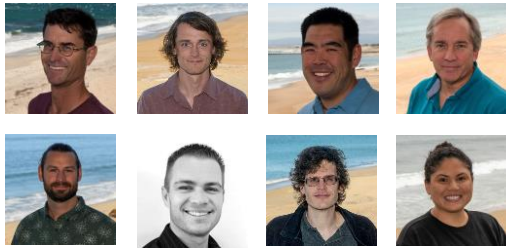
Next Steps

- Validation is continuing
- 10 production units are currently being built
- Open to collaborate on field deployments
- Looking to license to commercial vendor

MBARI Monterey Bay Aquarium Research Institute

Validation is continuing
qPCR and metabarcoding
READI-Net Implementation in 2025
10 production units are currently being built
Open to collaborate on field deployments
Looking to license to commercial vendor

Acknowledgments



MBARI
Monterey Bay Aquarium
Research Institute

the David & Lucile Packard FOUNDATION

USGS
science for a changing world

MBARI Monterey Bay Aquarium Research Institute