Connecting Water Quality and Living Resources in Shallow Waters with a Water Column Hypoxia Monitoring System: A 2025 Update

CBP
CAP-WG Meeting

CBO Hypoxia Team
Bruce Vogt

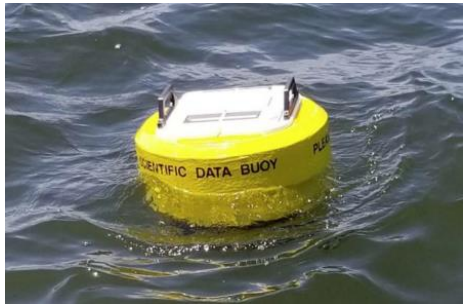
August 11, 2025

Outline

- Background and Goals
- Accomplishments
- Lessons learned
- Future locations, sensor density, partnerships

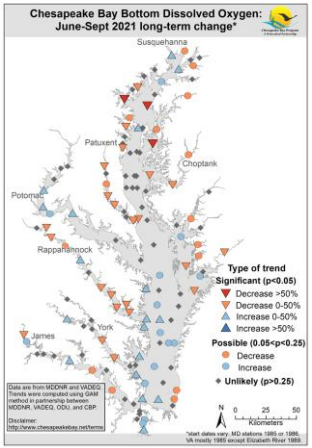
Developing a Real-time Hypoxia Monitoring System

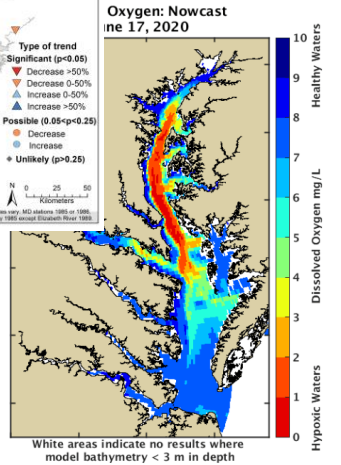
- What: Develop a monitoring network (~10 stations) across mainstem and tributaries
- Why: Improve Assessment of water quality and fish habitat
- Who: EPA, NOAA, Chesapeake Bay Program Hypoxia Collaborative
- Where: Phased deployment in targeted locations
- How: EPA funding, maintained and operated by NOAA; data used by modelers and scientists



Expected Outcomes

- Increase understanding of temporal and spatial variability of dissolved oxygen in deep and shallow water
- Improve validation for the models used in annual hypoxia reporting
- Establish sampling design and monitoring needed to assess TMDL water quality attainment criteria
- Provide data to develop improved habitat suitability models for multiple species

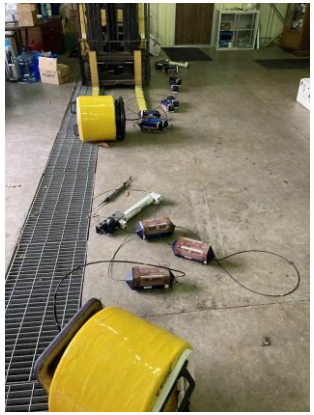


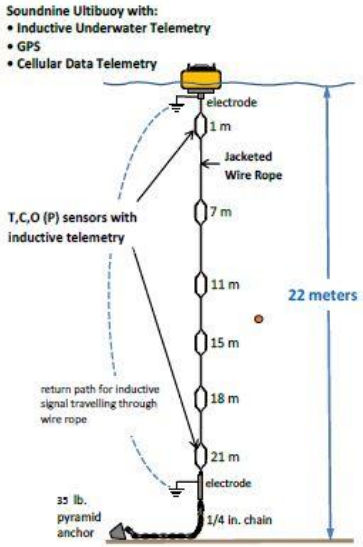


System Hardware

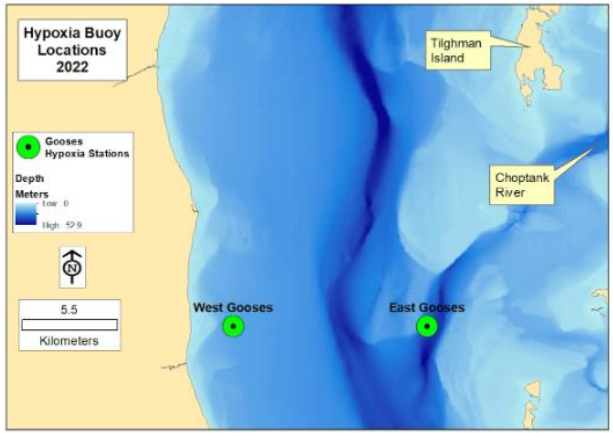
- A station consists of
  - buoy/controller/cellular modem
  - some number of sensors on an inductive wire
  - mooring

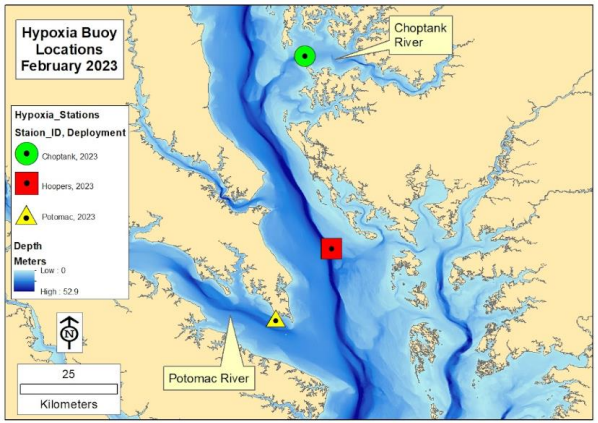
- XIM-CTD-DO Sensor
  - conductivity cell
  - temperature sensor
  - pressure sensor
  - dissolved Oxygen sensor
  - barnacles not included

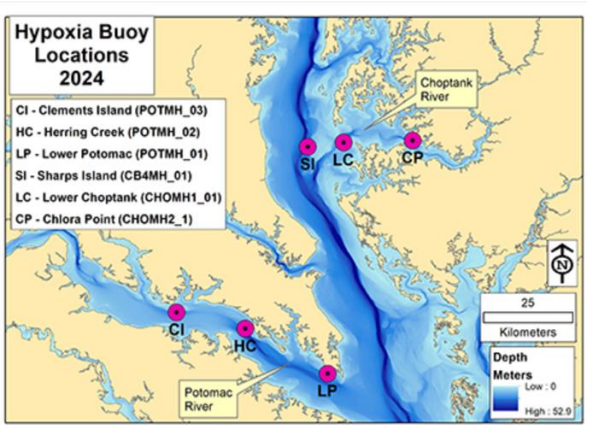




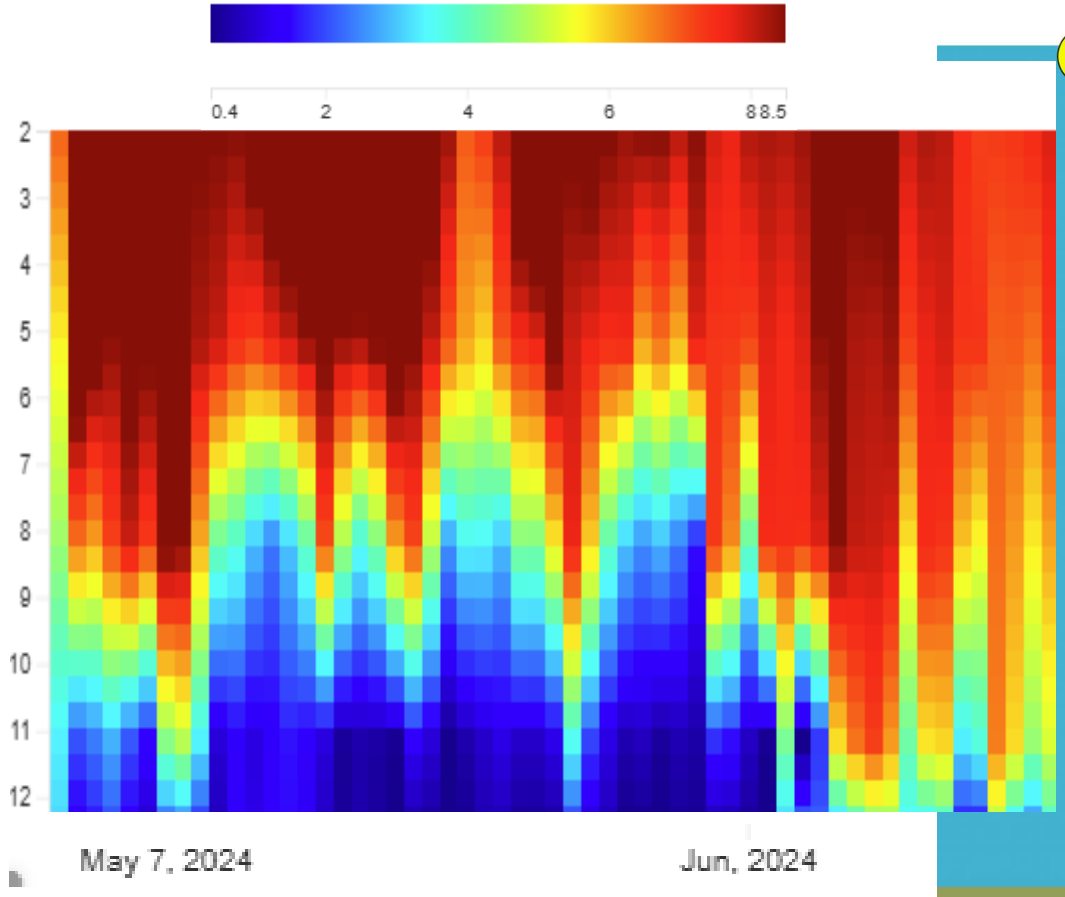
Deployments to date

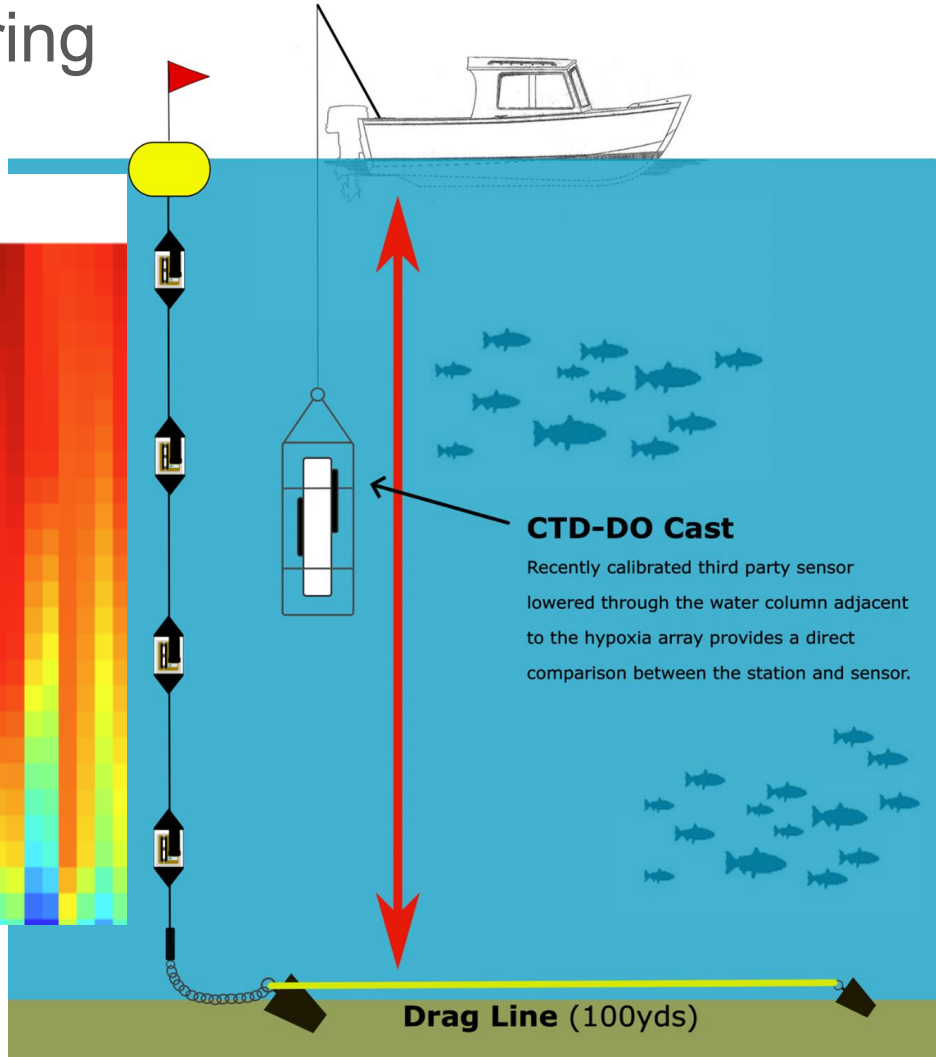




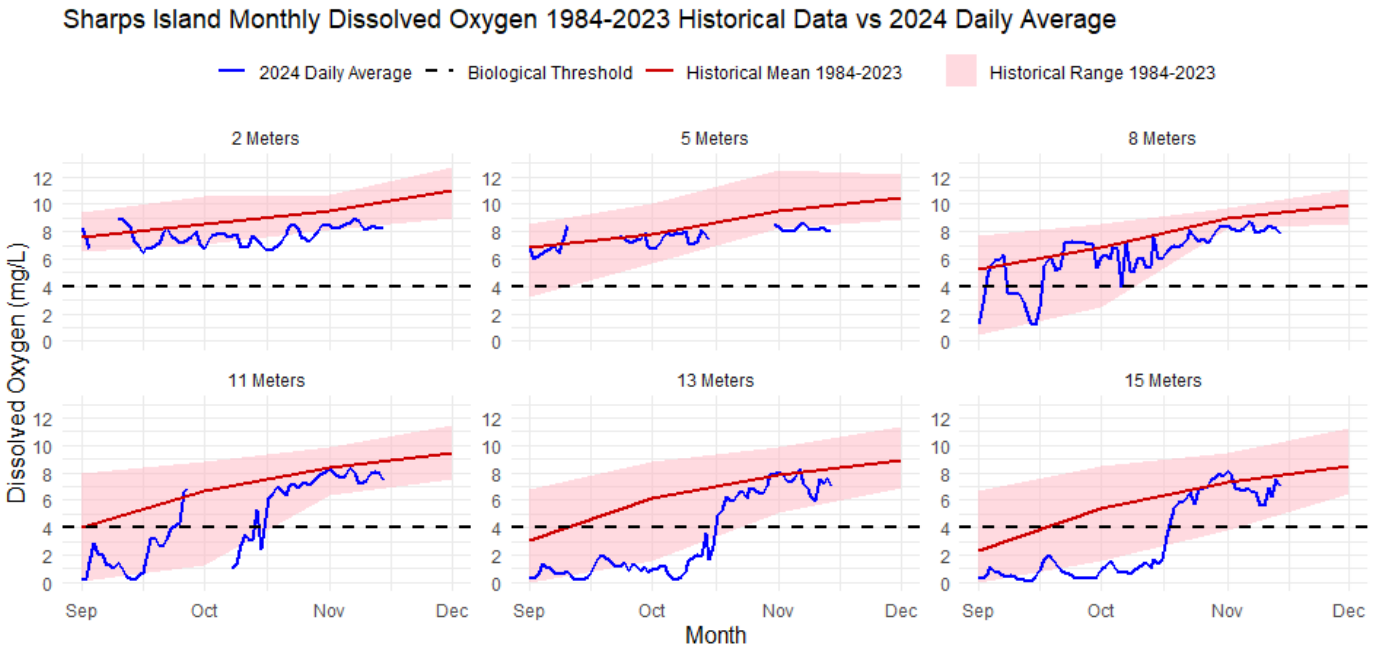


Water Column Hypoxia Monitoring





Data by sensor depth



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Access

CSV flat files of QC'd annual station data (2024 coming soon)

End of Year Data Review Reports

An API key is available for direct server access

Chesapeake Bay
INTERPRETIVE BUOY SYSTEM

HOME | ABOUT ▼ | LOCATIONS ▼ | EXPLORE ▼ | DATA ▼

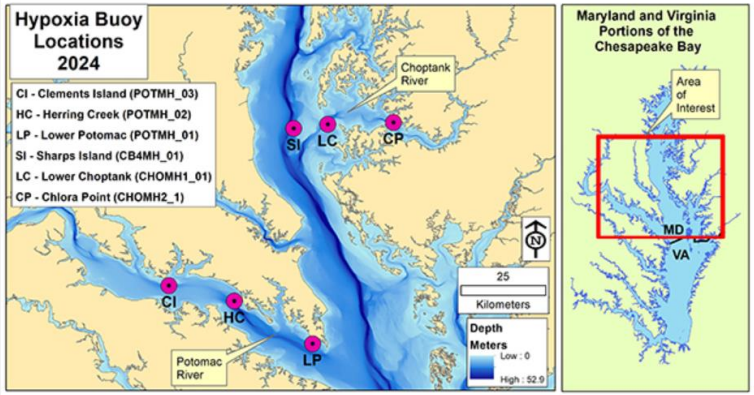
Home > Data > Water-Column Habitat Data

Water-Column Habitat Data

The NOAA Chesapeake Bay Office team deploys and maintains buoys to monitor dissolved oxygen, temperature, and salinity from the surface of the water to the bottom of the Bay by using "hypoxia buoys." Measuring and tracking hypoxia—very low levels of dissolved oxygen in the water—helps scientists more fully understand how levels vary from the surface to the bottom, and how they change throughout the year. This information can help identify where, and how big, the "dead zone" of hypoxic water in the Chesapeake is each year. Data from these buoys can help the Chesapeake Bay Program model how dissolved oxygen levels change over time and space. Fisheries scientists can use the data to learn more about the effects of hypoxia and changes in water conditions on different species, because the water column provides important fish habitat.

2024 Data

In 2024, NCBO deployed buoys in two river systems. Three buoys each were deployed in the Choptank River and in the Potomac River. Data from these locations will be available for you to download in the near future:



Real-Time Buoy Data
AT YOUR FINGERTIPS

GRAPHING
DOWNLOAD
MOBILE APPS

Buoy Status

AN	ANNAPOLIS	ONLINE
GR	GOOSES REEF	ONLINE
PL	POTOMAC	ONLINE
SR	STINGRAY POINT	OFFLINE
YS	YORK SPIT	ONLINE

DATA IN THE Classroom
Use buoy data to learn about the Bay ecosystem

ARE YOU A FAN ?
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https://buoybay.noaa.gov/data/2023-water-column-data

Notes/Lessons Learned on Costs

- Each depth monitored requires inventory of 3 sensors/year to maintain accurate data, sensors cost ~$5K each
- Sensor lifespan is still unknown, but some remain operational after 5 years
- System computers are resilient, with the oldest at 5 years
- We feel the optimal spot is monitoring in less than 10m w/ the exception of a deep sentinel (8m is nearly dead in summer)
- 3 sensor depths per station characterizes the extent of the water column critical to LR
- More sensors (4+) per station improves data resolution, it greatly increases maintenance and equipment costs to the point of being unsustainable with current resources
- Periodic reinvestment in sensors and manufacturer calibration and maintenance is critical

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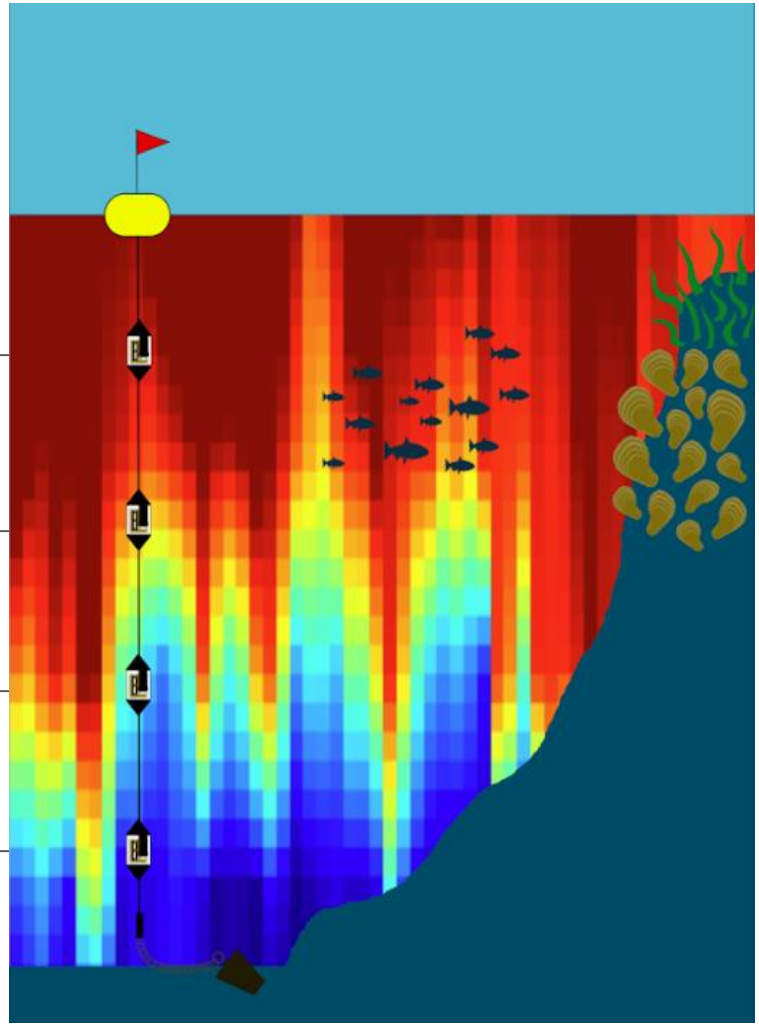
Sensor Logic and Living Resources

~2m approximates the limit of light penetration for SAV recovery

~5m represents the limit of oyster restoration to protect from low DO

~8m represents the depth of intermittent periods of low DO

~11m represents the depth of extended periods of low DO



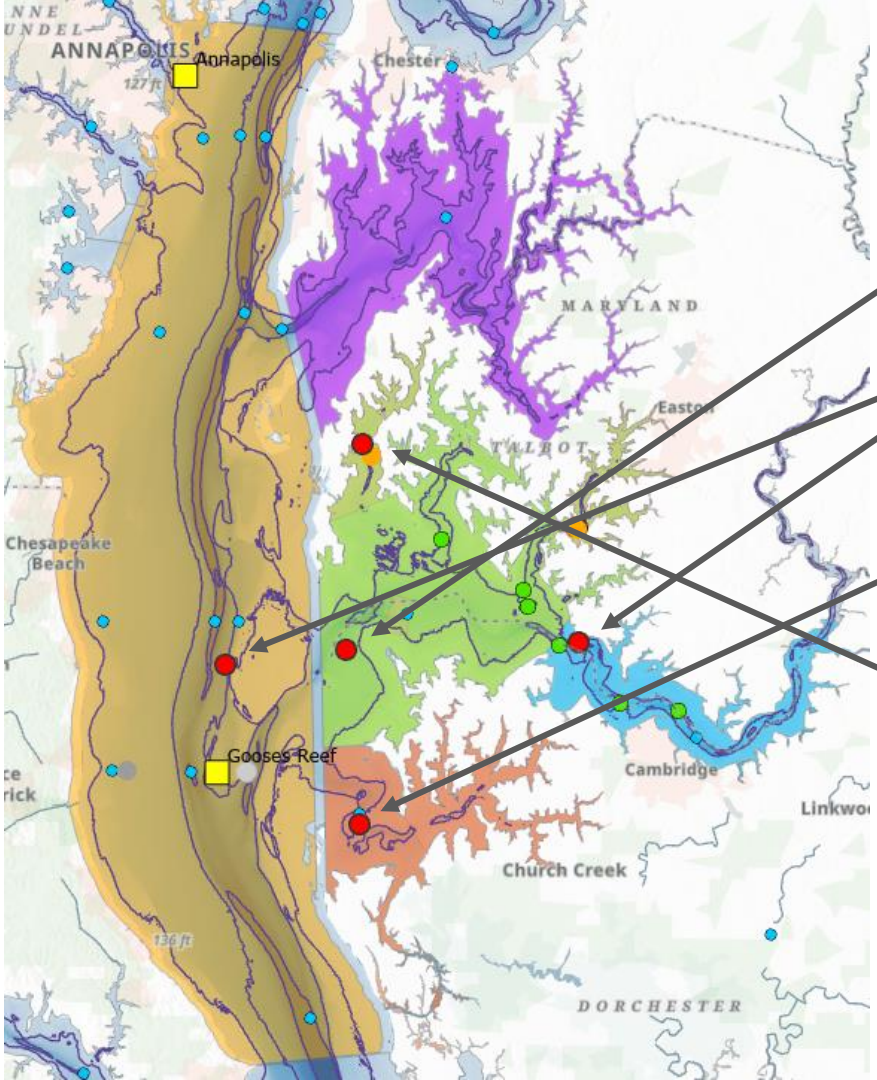
Hypoxia Monitoring 2025

3 Choptank locations from 2024 are out collecting data in 3 segments

We do not have the capacity to return to the Potomac River this year

We are working to partner in VA NERR for 1-2 station deployments

Planning for 6+ buoys in 2026



Summary

- Successful deployments in multiple segments since 2022
- Data QA/QC'd and provided to users
- Streamlining O&M
- Optimizing sensor density (2m, 5m, 8m)
- Partnerships needed for greater spatial distribution
- Balancing attainment with assessing restoration impacts
- Loss of staff and vessel issues impacted 2025 deployment
- 2026 should have 6+ stations deployed

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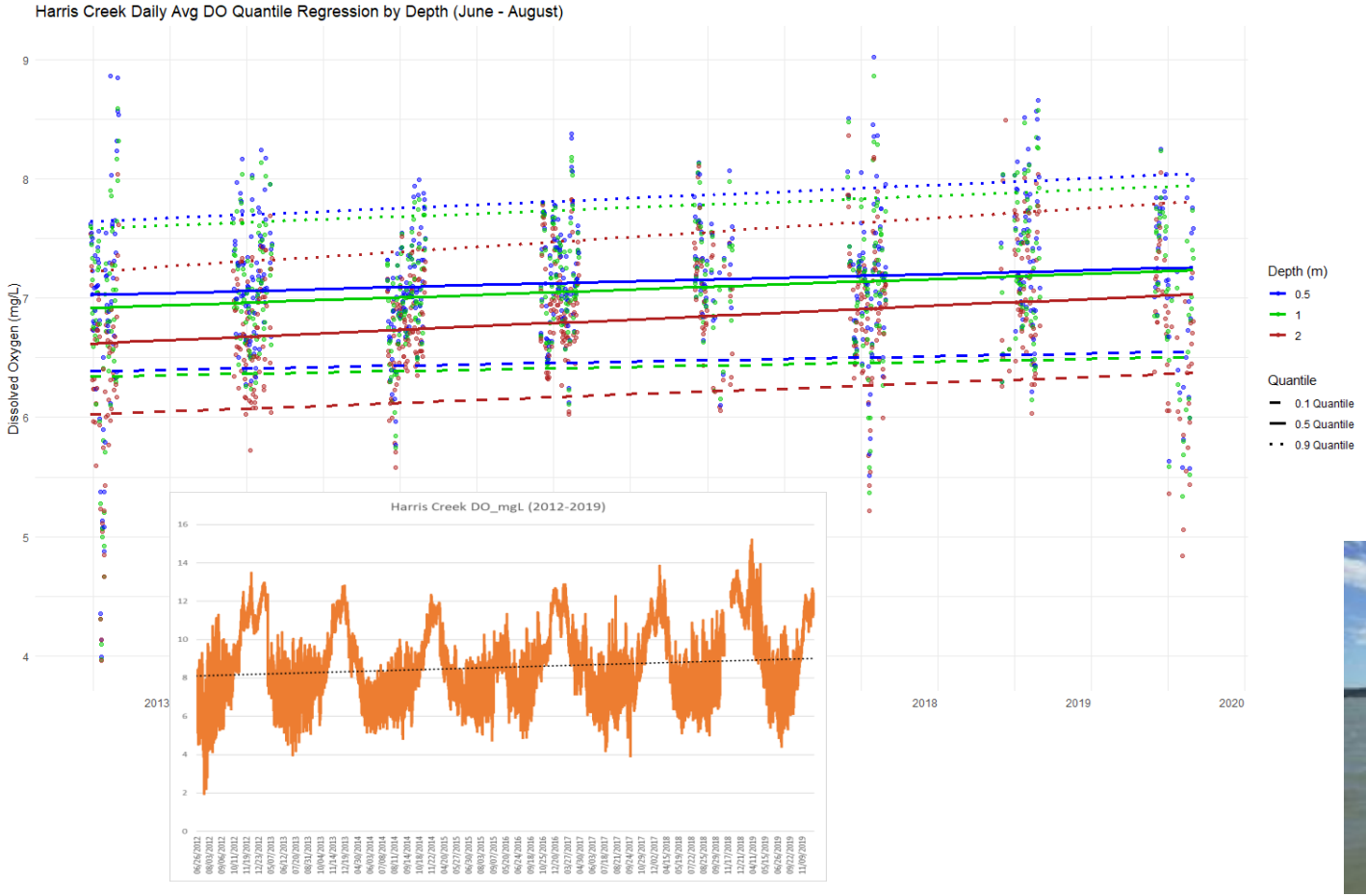
Backup

Connecting to Living Resources

Are oysters contributing to improved DO conditions?



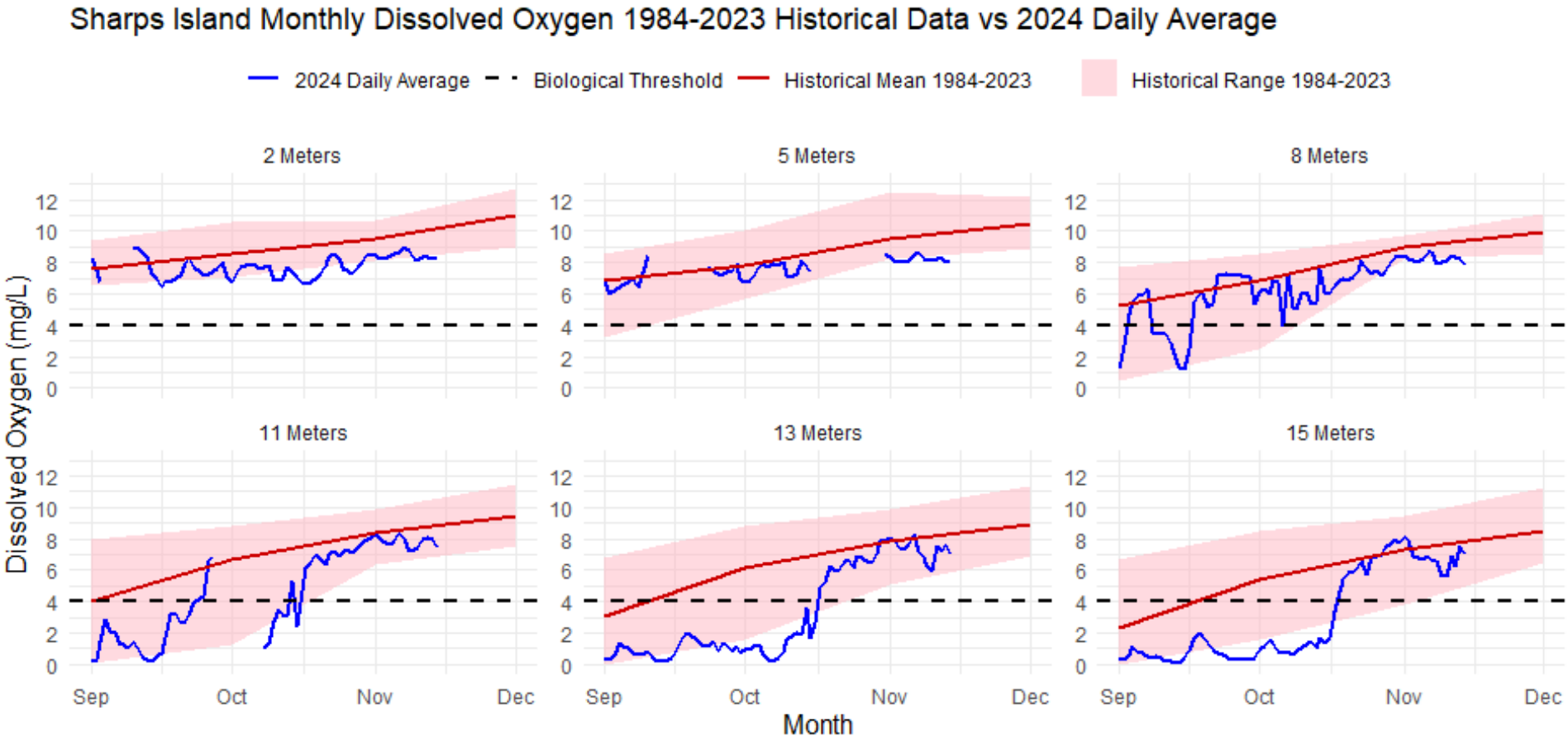
Harris Creek
MDDNR

2012-2019

Diagnostic Monitoring of Shallow Water (0.5-2m) Within Restored Oyster Reefs

Shows Improving DO Conditions during summer months at all depths (most with 2m)

CBO Seasonal Summary Quarterly Reports



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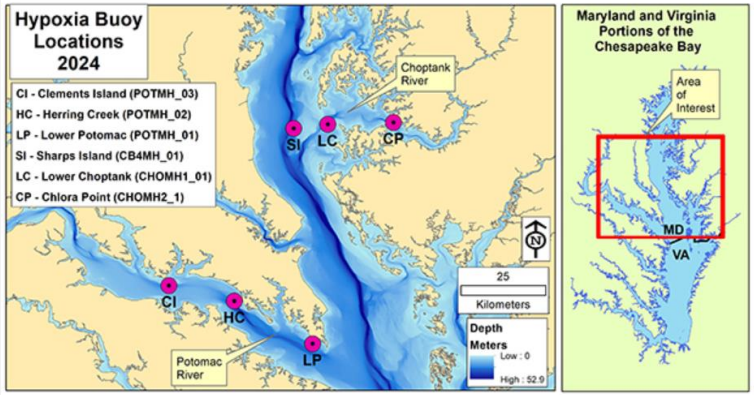

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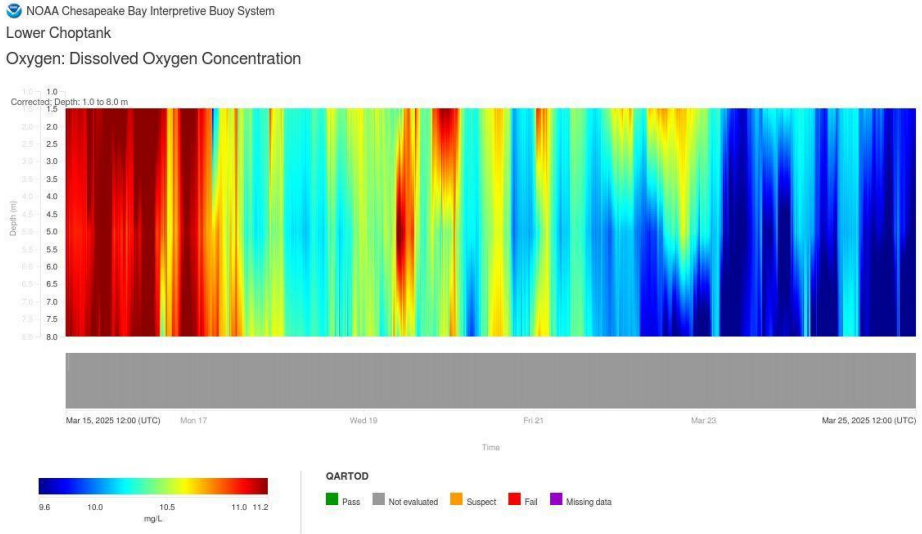
Near Real-time raw data imagery in



https://sensors.ioos.us/?new_session=true#metadata/156/sensor_source