



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

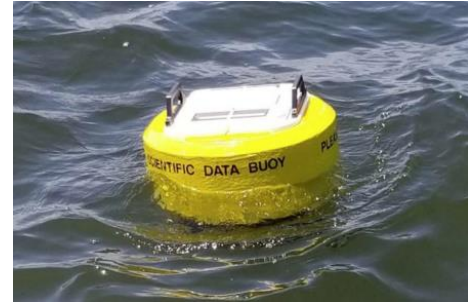
Outline

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



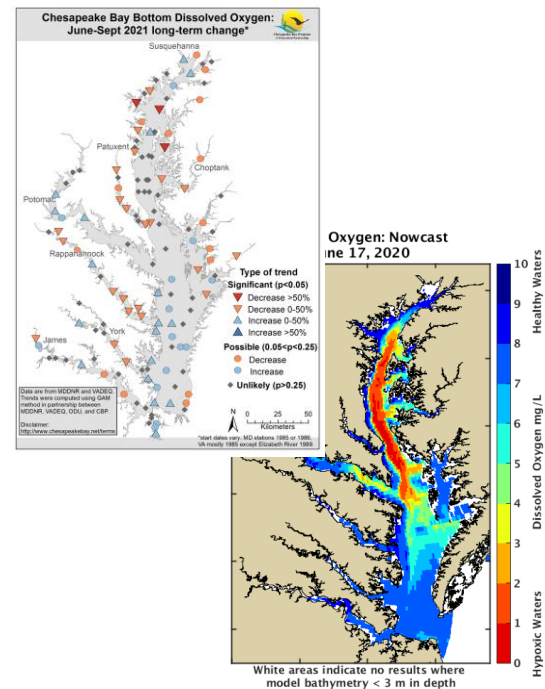
Developing a Real-time Hypoxia Monitoring System

- 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



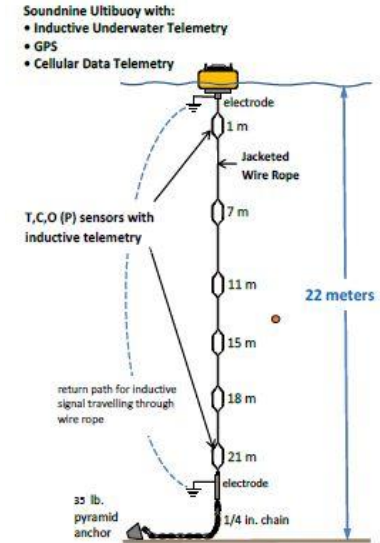
Expected Outcomes

- 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

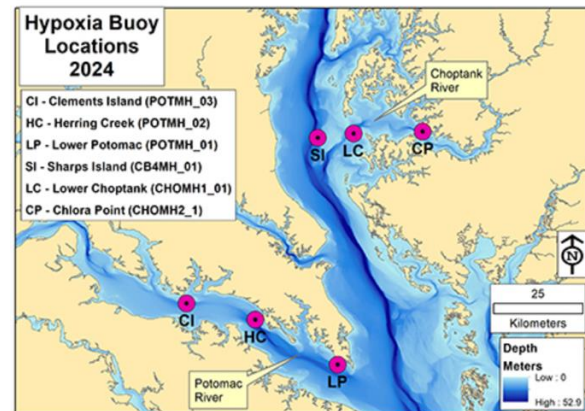
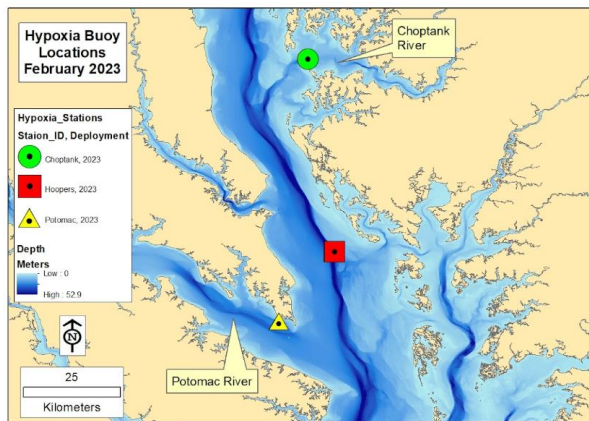
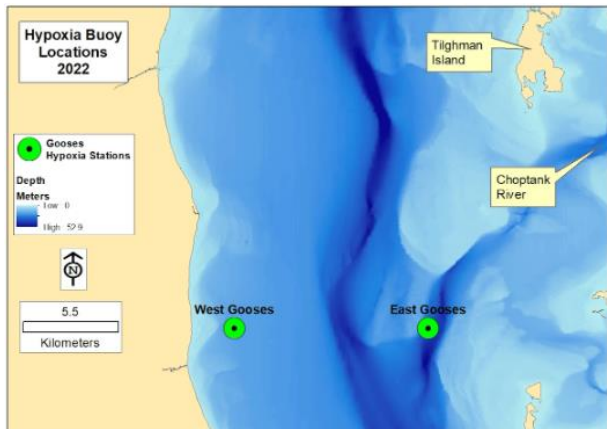


System Hardware

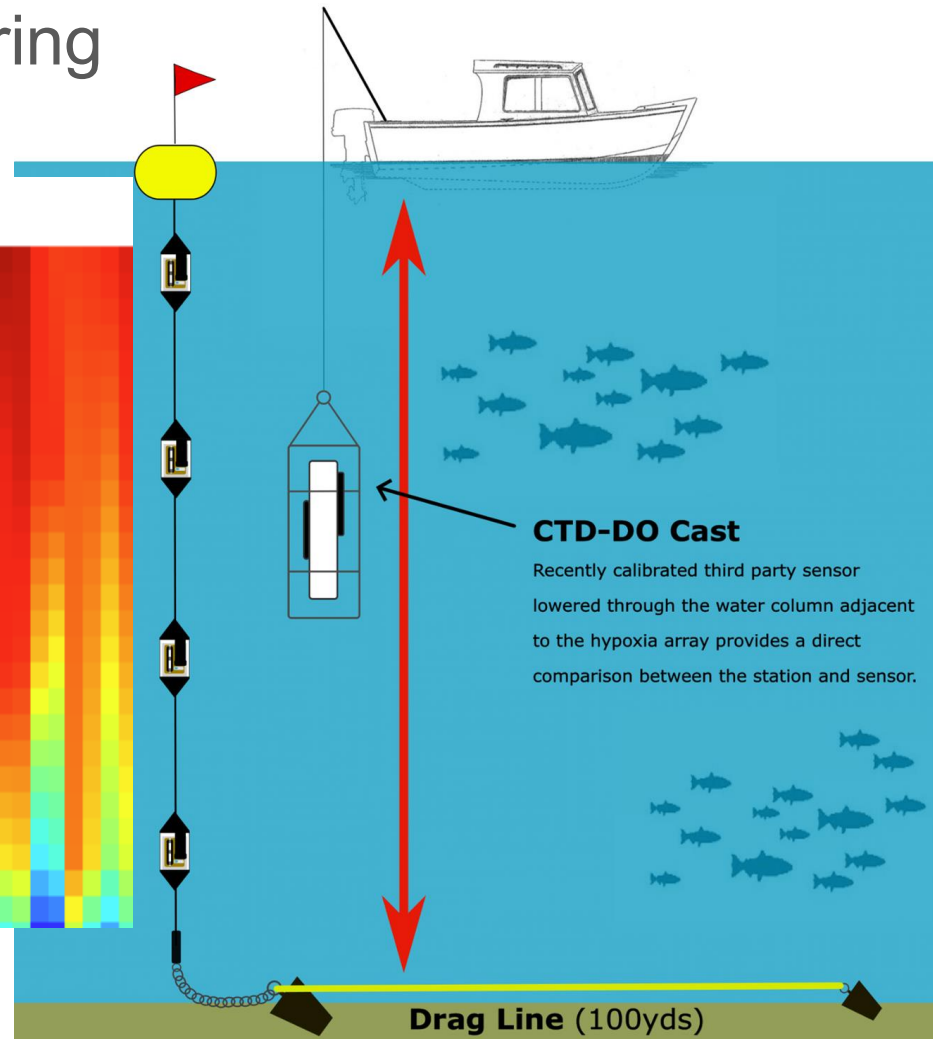
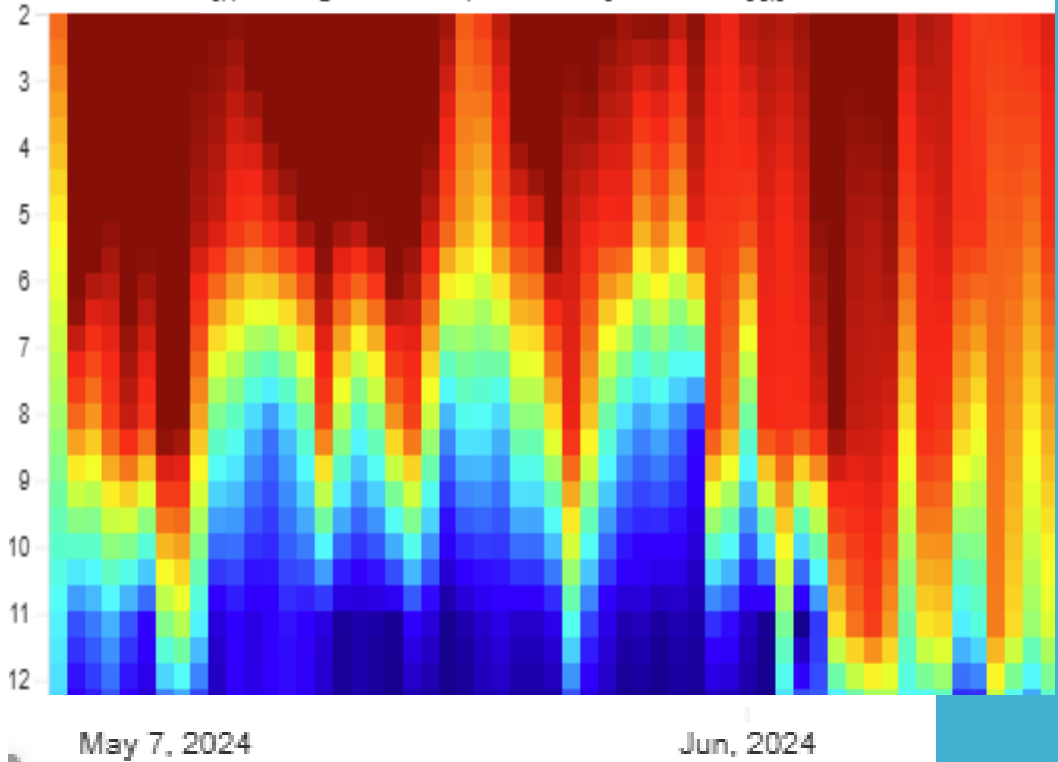
- A station consists of
 - buoy/controller/cellular modem
 - some number of sensors on an inductive wire
 - mooring
- XIM-CTD-DO Sensor
 - conductivity cell
 - temperature sensor
 - pressure sensor
 - dissolved Oxygen sensor
 - **barnacles not included**



Deployments to date

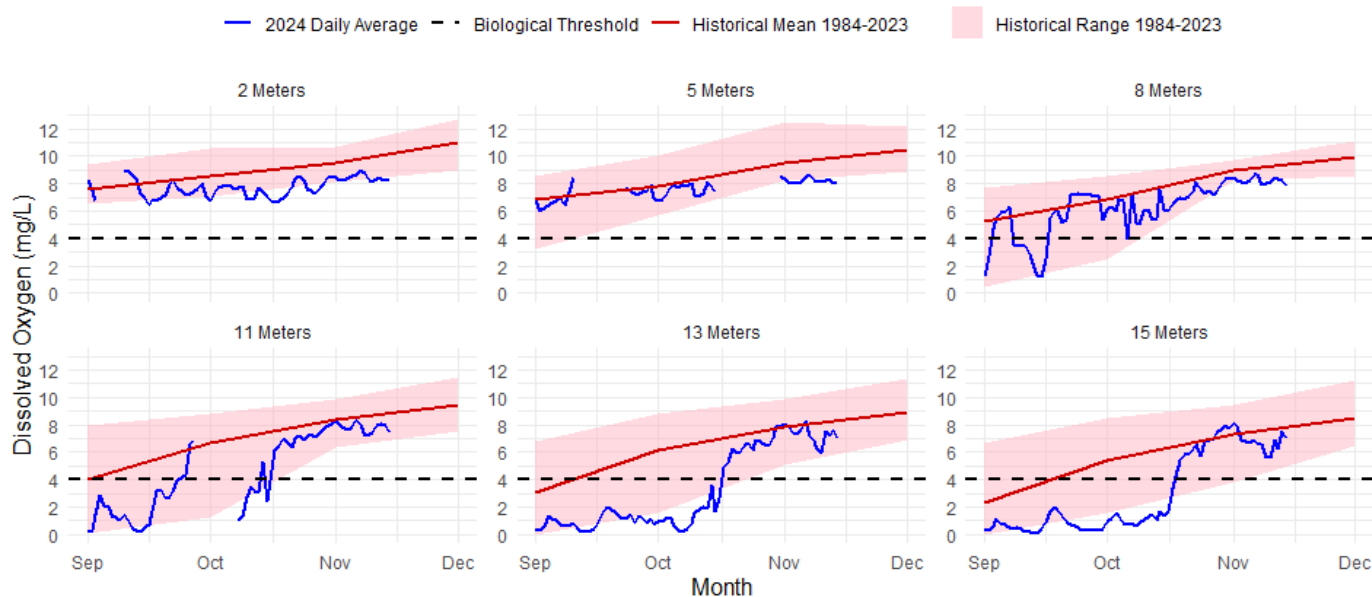


Water Column Hypoxia Monitoring



Data by sensor depth

Sharps Island Monthly Dissolved Oxygen 1984-2023 Historical Data vs 2024 Daily Average



NOAA
FISHERIES

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

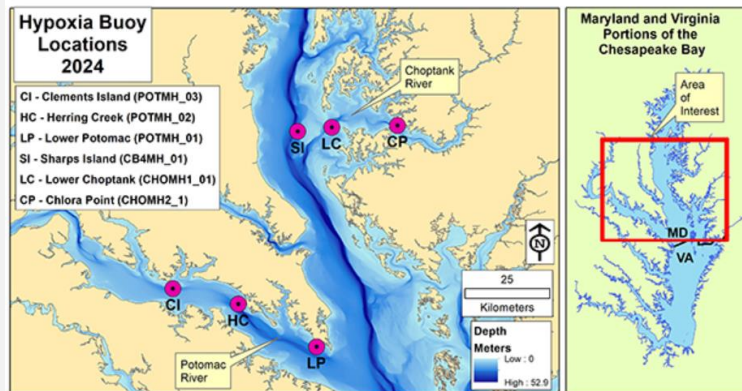
[Home](#) > [Data](#) > Water-Column Habitat Data

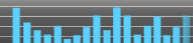
Water-Column Habitat Data




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	GOOSSES 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 ?
See us on Facebook

<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



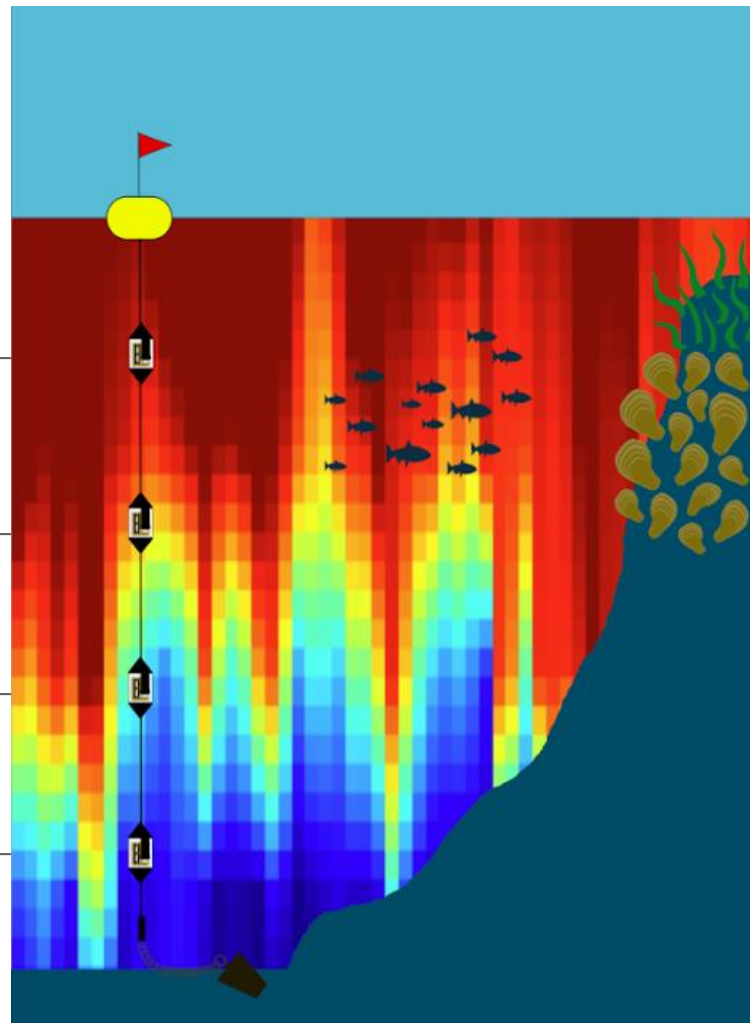
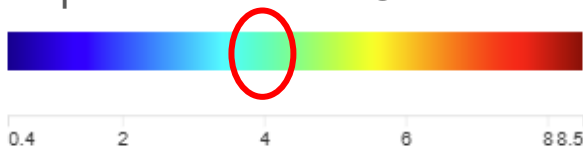
Sensor Logic and Living Resources

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

4 ~5m represents the limit of oyster
5 restoration to protect from low DO
6

7 ~8m represents the depth of
8 intermittent periods of low DO
9

10 ~11m represents the depth of
11 extended periods of low DO
12



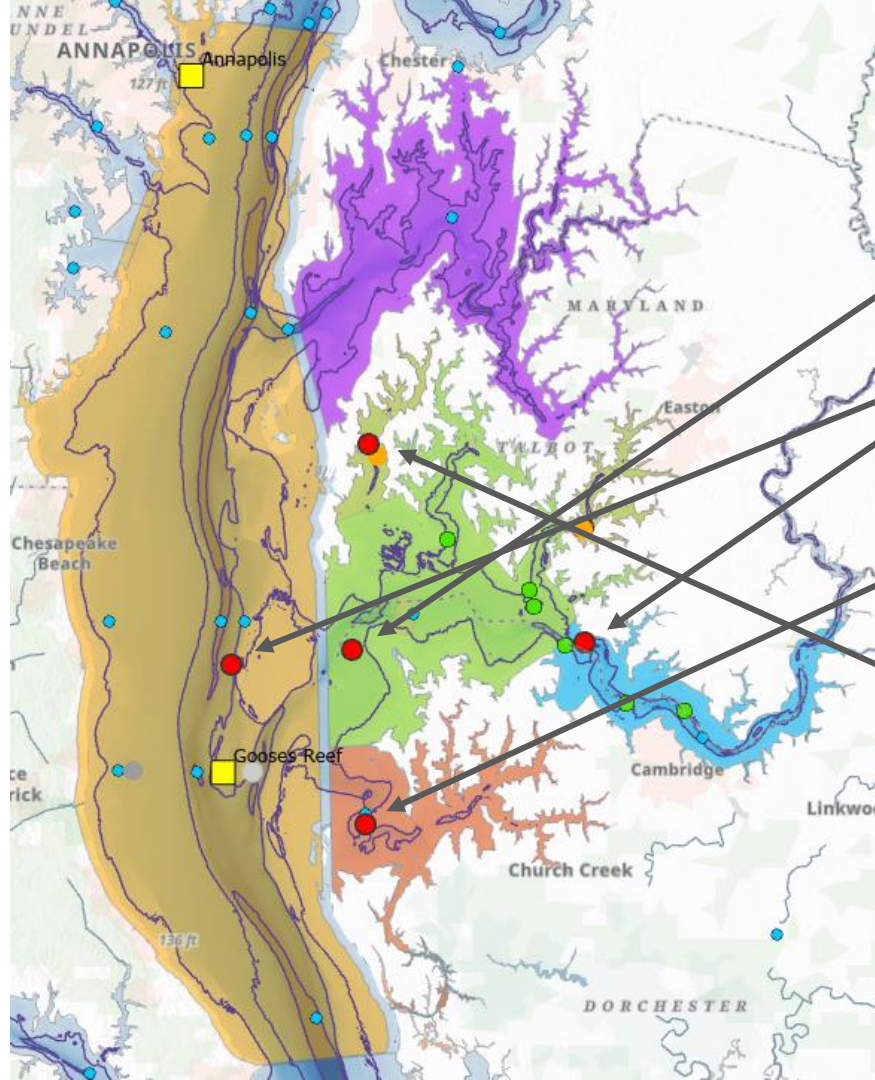
Hypoxia Monitoring 2025

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



Remained out over Winter

Deployed 3/14

Likely next Deployment in 4th Segment

Optional LR Deployment

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



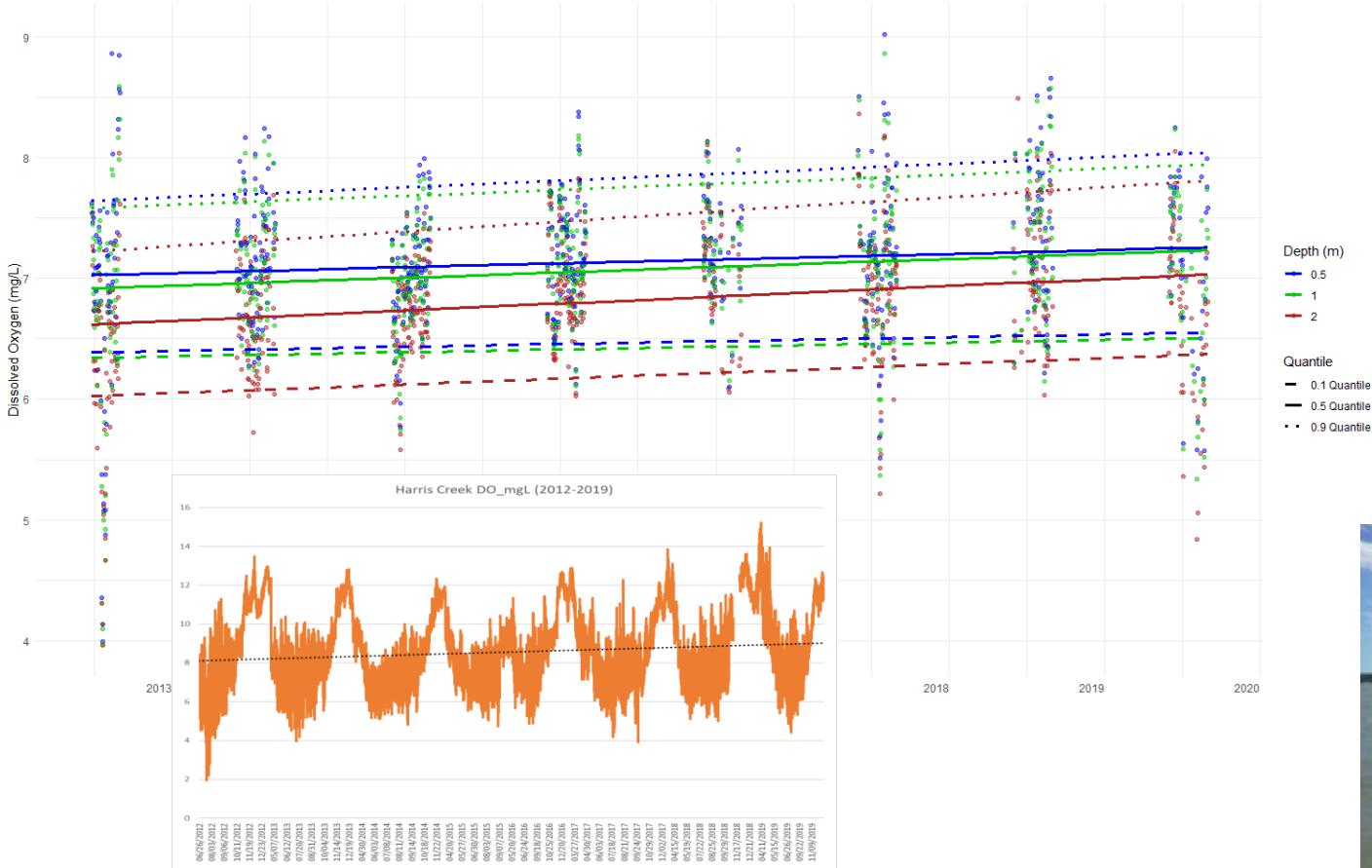
Backup

An underwater photograph showing a large, textured scallop shell on the left, surrounded by various marine organisms like sea anemones and smaller shells. The water is murky and yellowish-green. The text "Connecting to Living Resources" is overlaid in white on the right side.

Connecting to Living Resources

Are oysters contributing to improved DO conditions?

Harris Creek Daily Avg DO Quantile Regression by Depth (June - August)



Harris Creek MDDNR

2012-2019

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

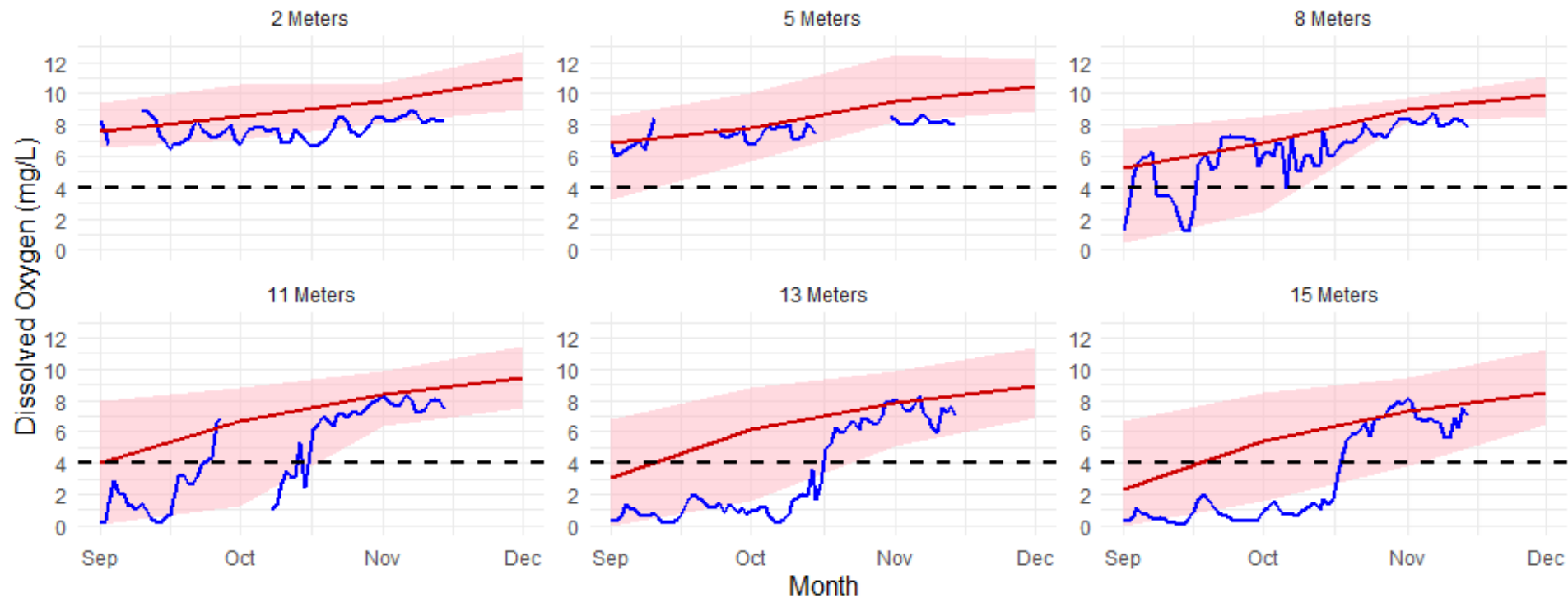
Shows Improving DO
Conditions during
summer months at all
depths (most with 2m)



CBO Seasonal Summary Quarterly Reports

Sharps Island Monthly Dissolved Oxygen 1984-2023 Historical Data vs 2024 Daily Average

— 2024 Daily Average - - - Biological Threshold — Historical Mean 1984-2023 Historical Range 1984-2023



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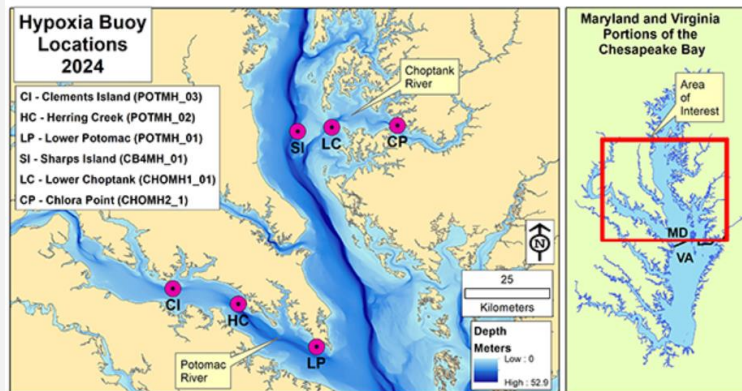
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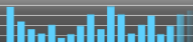
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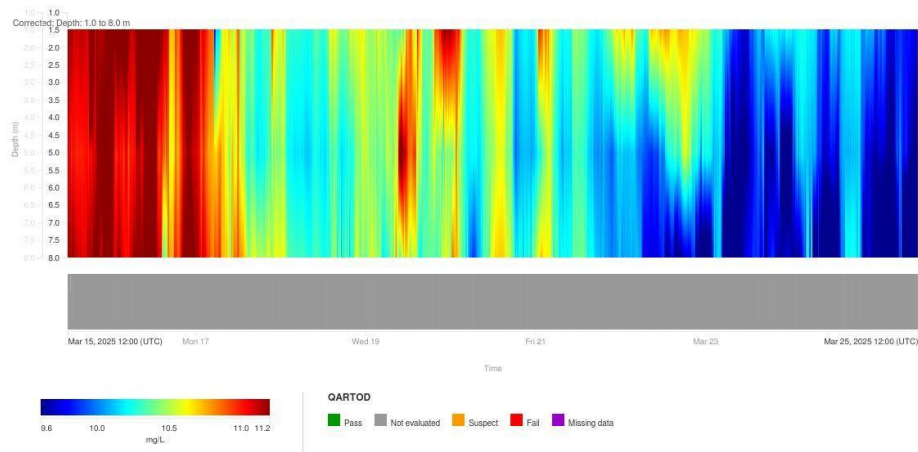
Access

Near Real-time raw data imagery in

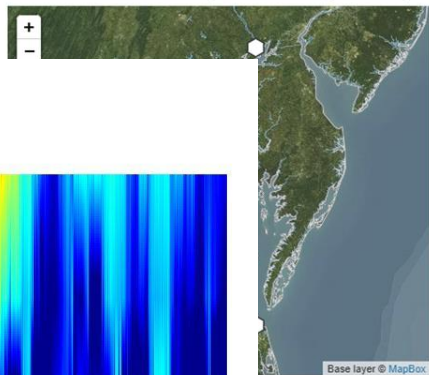
NOAA Chesapeake Bay Interpretive Buoy System

Lower Choptank

Oxygen: Dissolved Oxygen Concentration



NOAA Chesapeake Bay Interpretive Buoy System



Stations

Inventory

Search:

Station	Start	End
44043 - Patapsco, MD	Dec 31, 2014 19:10 (EST)	Dec 10, 2024 09:18 (EST)
44061 - Upper Potomac, MD	Apr 15, 2015 15:00 (EDT)	Aug 14, 2017 14:18 (EDT)
44063 - Annapolis, MD	Dec 31, 2014 19:00 (EST)	Mar 25, 2025 07:54 (EDT)
44072 - York Spit, VA	Jul 21, 2016 16:50 (EDT)	Mar 25, 2025 07:54 (EDT)
Annapolis (Historic CBIBS)	Nov 16, 2015 20:10 (EST)	Dec 5, 2016 07:50 (EST)
Chlora Point	Apr 9, 2024 13:10 (EDT)	Mar 25, 2025 07:50 (EDT)
Clements Island	Jun 11, 2024 12:50 (EDT)	Dec 17, 2024 12:30 (EST)
East Gooses (2021)	Dec 1, 2021 12:10 (EST)	Dec 15, 2021 10:20 (EST)
East Gooses (2022)	May 16, 2022 12:00 (EDT)	Aug 31, 2022 22:50 (EDT)
First Landing (Historic CBIBS)	Mar 15, 2016 12:10 (EDT)	Dec 14, 2016 16:40 (EST)
Gooses Reef (Historic CBIBS)	Mar 15, 2016 12:10 (EDT)	Jan 3, 2017 17:00 (EST)
Herring Creek	Jun 25, 2024 23:00 (EDT)	Dec 4, 2024 04:00 (EST)
Jamestown (Historic CBIBS)	Mar 15, 2016 12:10 (EDT)	Jan 3, 2017 17:00 (EST)
Lower Choptank	Apr 18, 2023 18:30 (EDT)	Mar 25, 2025 07:30 (EDT)
Lower Potomac	May 25, 2023 11:30 (EDT)	Nov 26, 2024 05:50 (EST)

Showing 1 to 25 of 25 entries

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