What is the highest attainable dissolved oxygen condition in the Delaware Estuary, and what will it mean for aquatic life uses?

Thomas Amidon, BCES
Manager, Water Resources Modeling

and

Jake Bransky
Aquatic Biologist

Delaware River Basin Commission

Partnership for the Delaware Estuary
Science and Environmental Summit

January 30, 2023

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Question #2:

What will enhancing dissolved oxygen mean for aquatic life uses in the Delaware Estuary?

Question #1:

What is the highest attainable dissolved oxygen condition in the Delaware Estuary?

Sarah & Fanghui addressed this question:

What pollutant reductions will achieve the best dissolved oxygen outcome in the Delaware Estuary?

What is the highest attainable dissolved oxygen condition in the Delaware Estuary?

- Recall: pollutant reductions that can achieve the best dissolved oxygen outcome
  - 7 Class A' at ammonia = 1.5 mg/L
  - 2 Class A at ammonia = 5 mg/L
- Additional factors considered:
  - CSO reductions (based on LTCPs)
  - Effluent DO
  - Seasonally variable nitrification
  - 10% Reserve Capacity

CSO Reductions to reflect LTCP	
CSO System	**Post-LTCP (% reduction)**
PWD	55%
CCMUA	59%
Delcora	51%
Wilmington	0%

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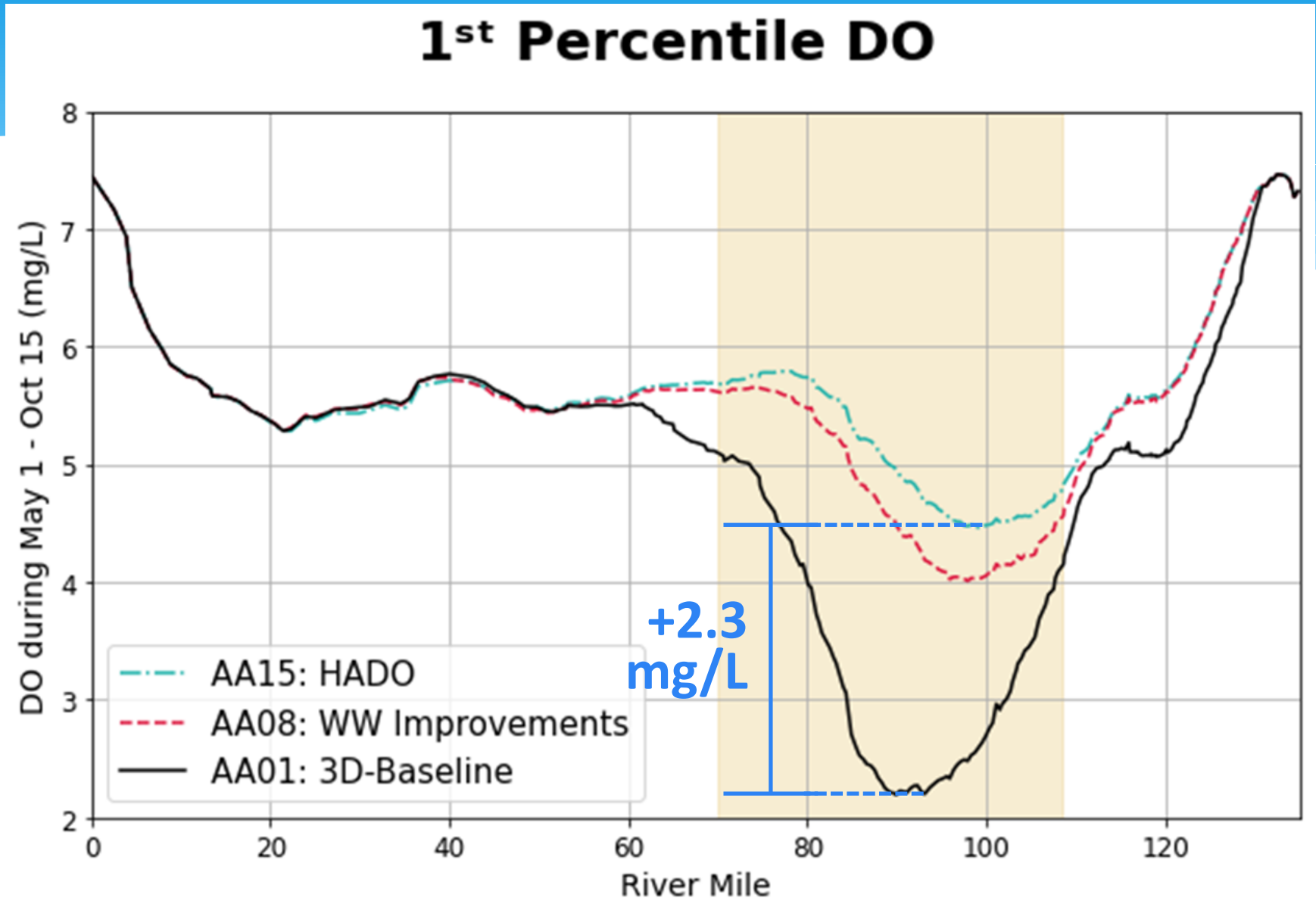
What is the highest attainable dissolved oxygen condition in the Delaware Estuary?



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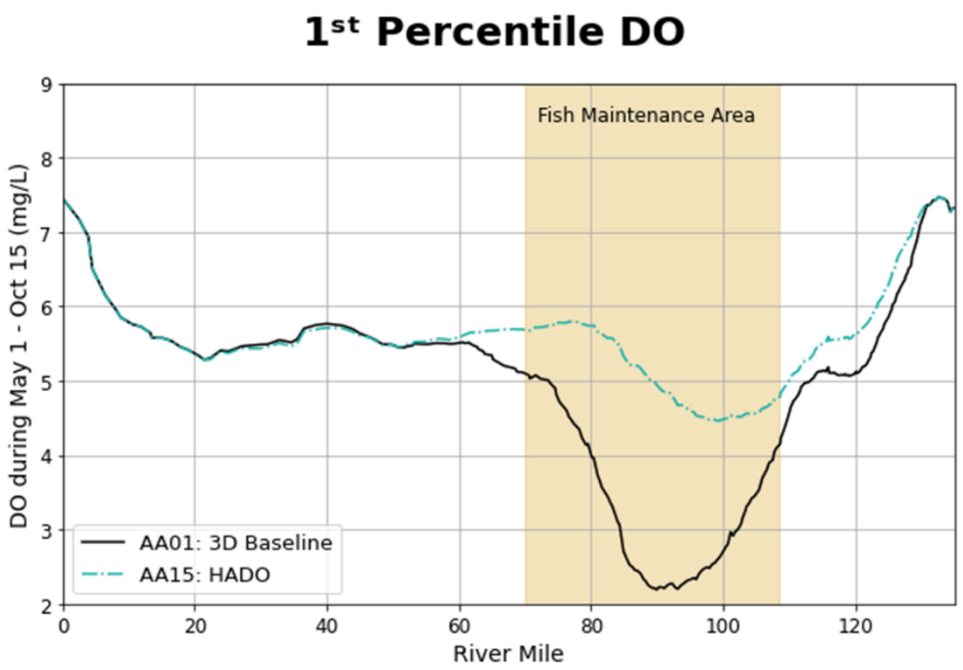

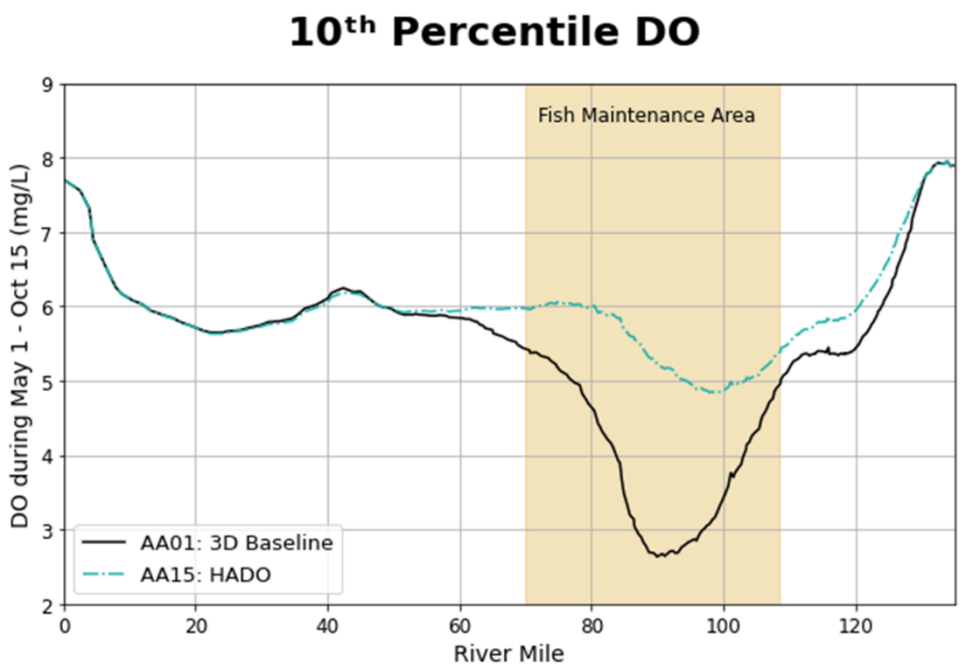

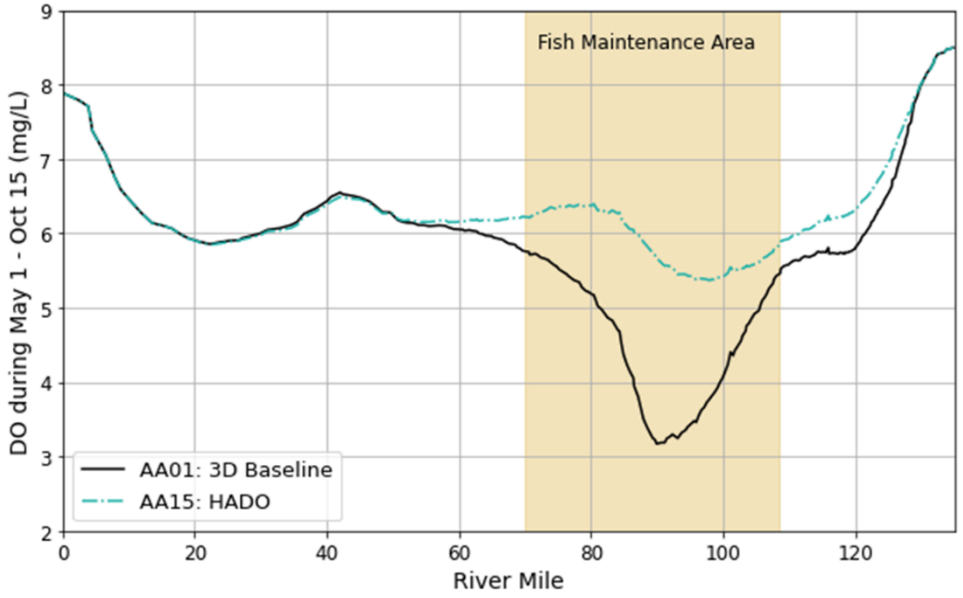

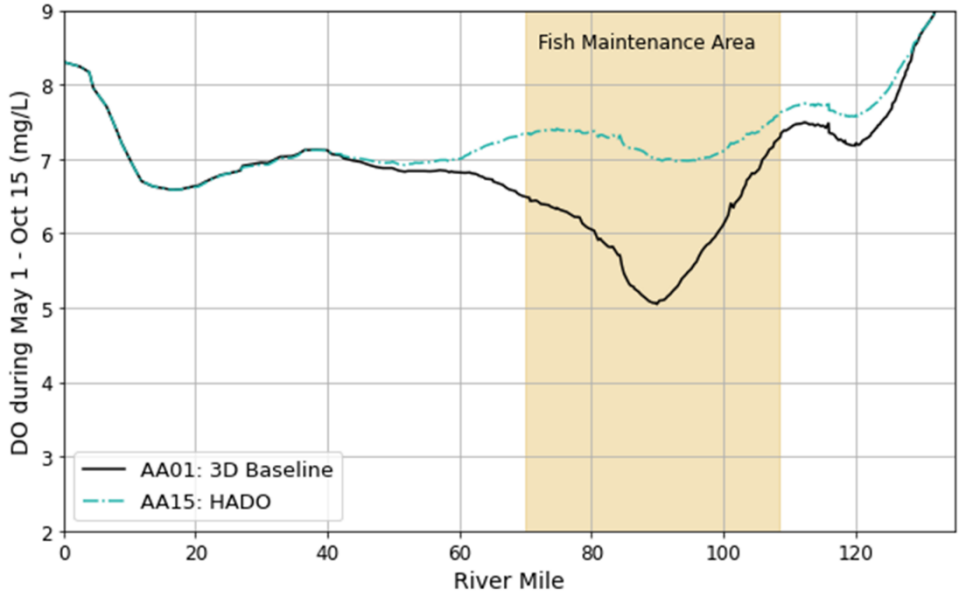

What is the highest attainable dissolved oxygen condition in the Delaware Estuary?

Percentile	Min value in FMA	
	AA01	AA15
1	2.2 mg/L	4.5 mg/L
10	2.6 mg/L	4.8 mg/L
25	3.2 mg/L	5.4 mg/L
50	5.0 mg/L	7.0 mg/L

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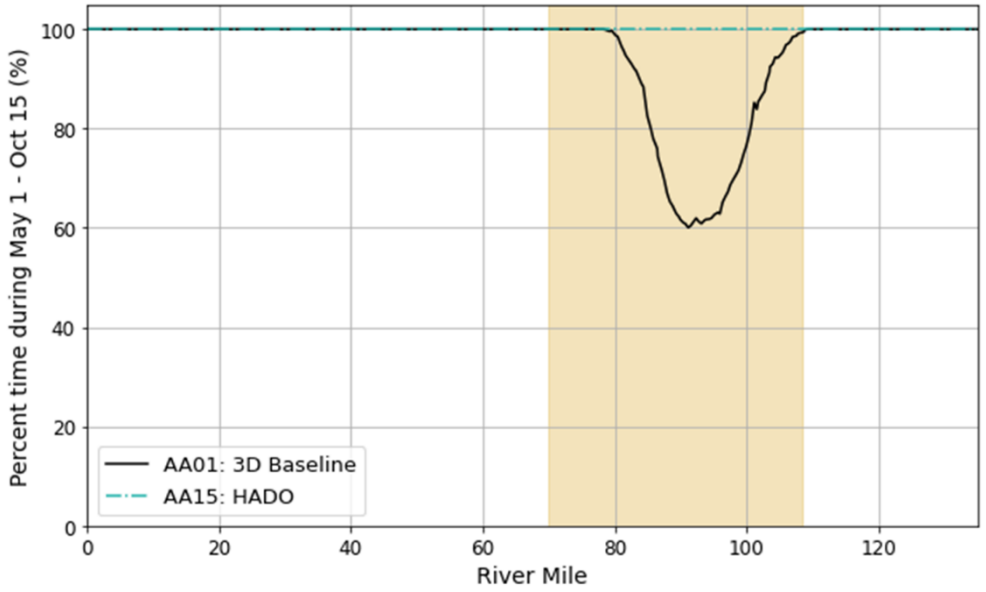
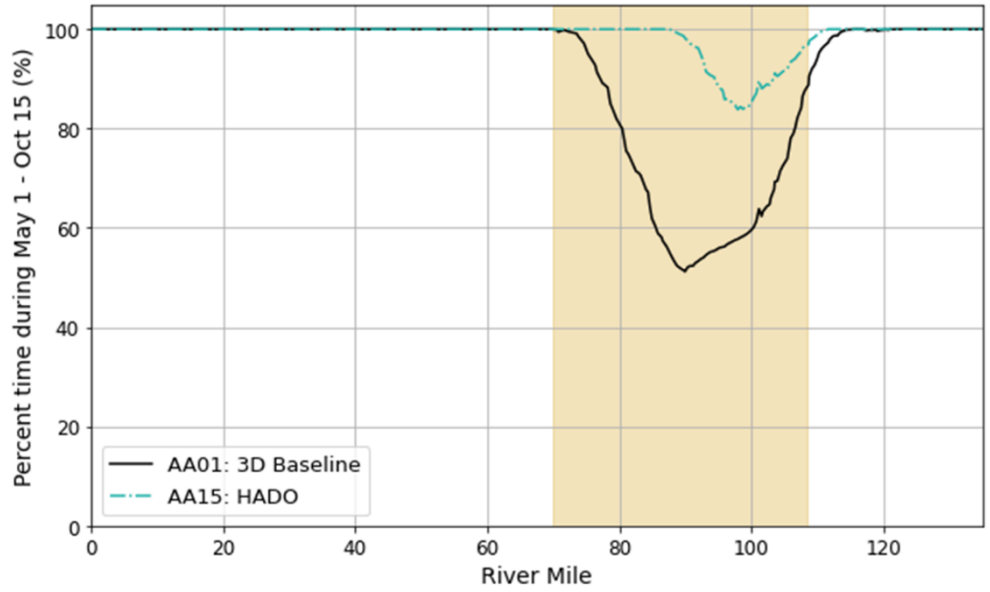
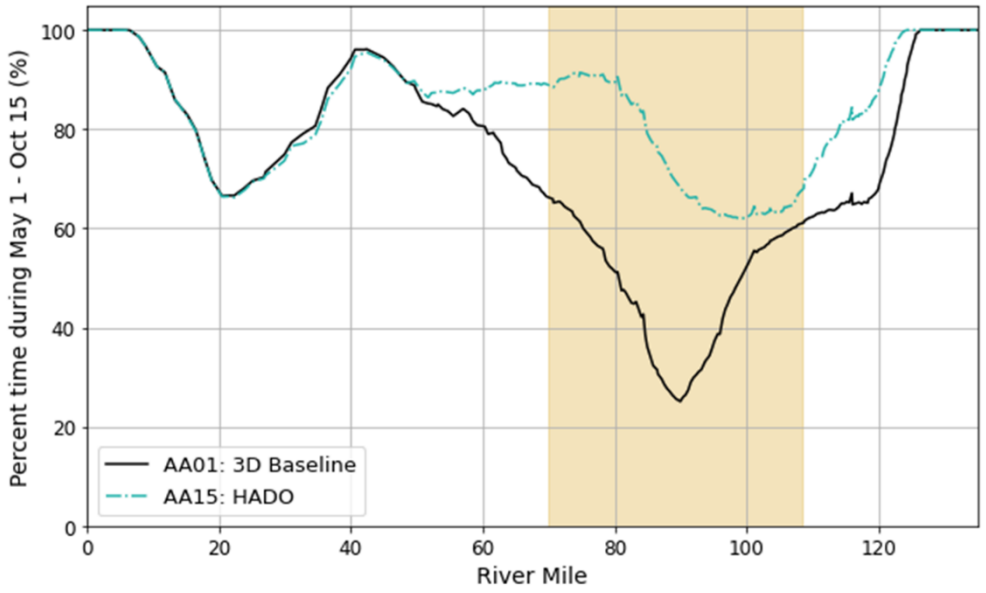
Percent Time above 4 mg/L DO



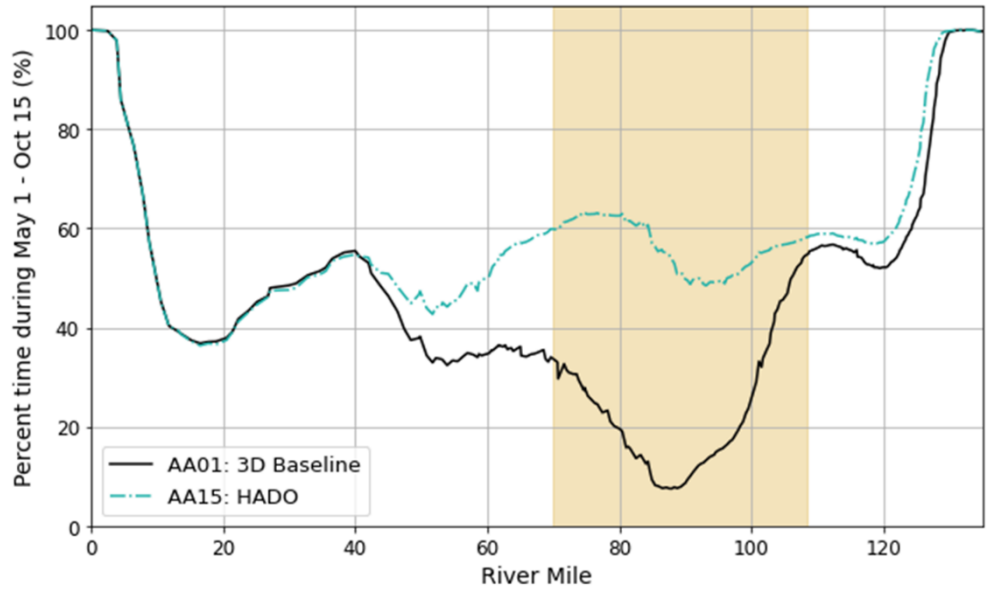
Percent Time above 5 mg/L DO



Percent Time above 6 mg/L DO



Percent Time above 7 mg/L DO



What is the highest attainable dissolved oxygen condition in the Delaware Estuary?

% Time Above	Min value in FMA	
	AA01	AA15
4.0	60%	100%
5.0	51%	84%
6.0	25%	62%
7.0	7.5%	49%

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Why is this important?
How does it relate to aquatic life?

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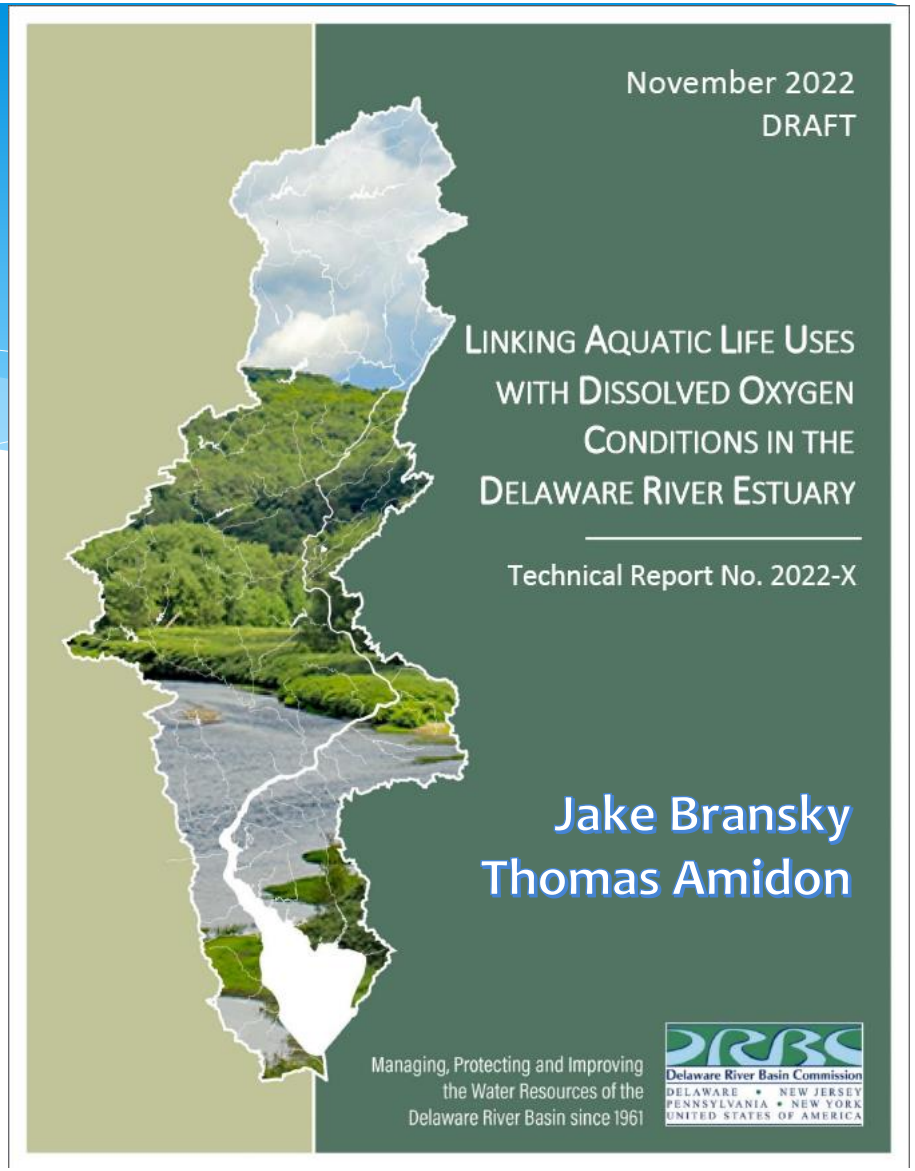
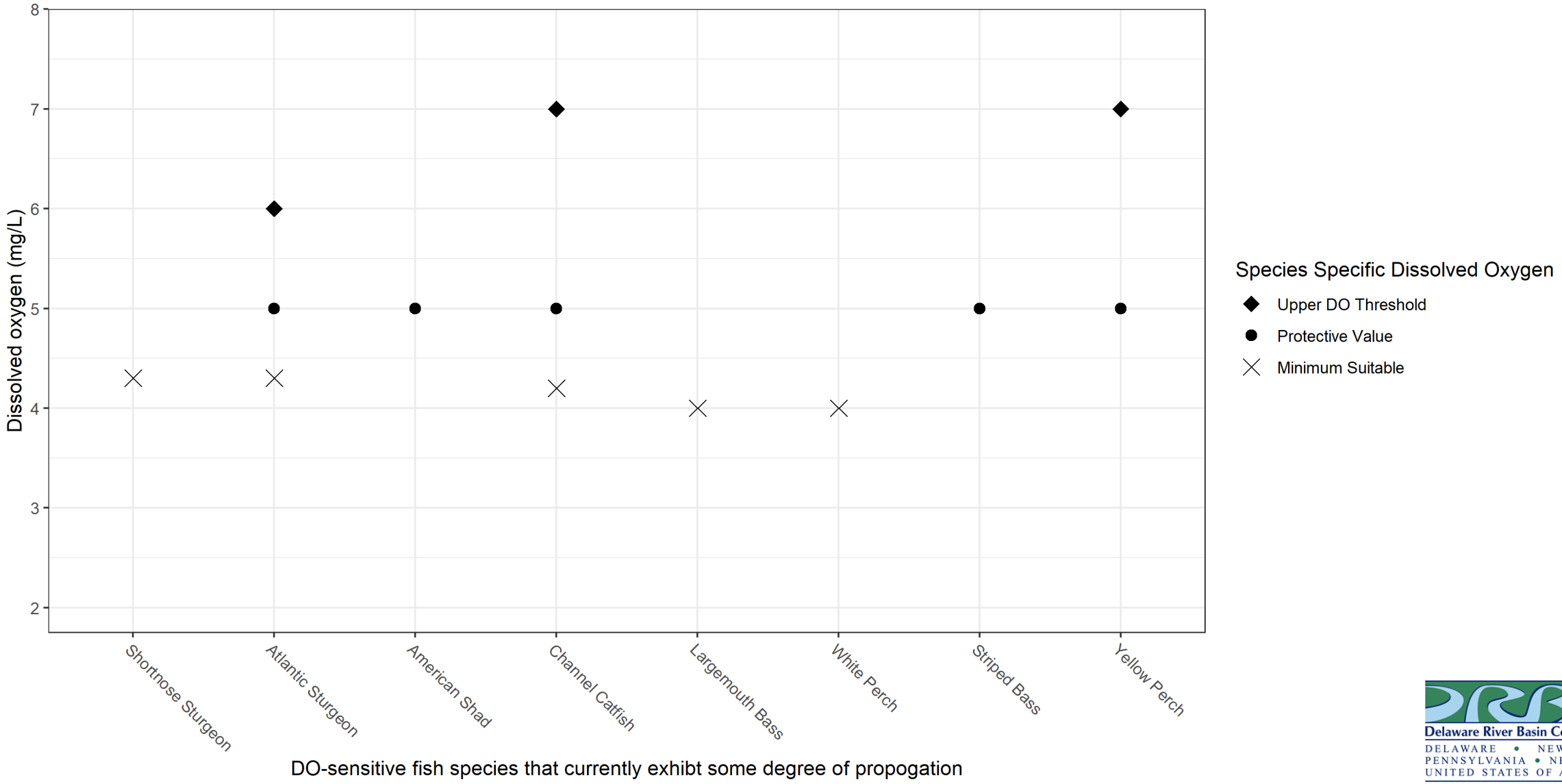
Linking aquatic life uses with dissolved oxygen conditions

- Aquatic life uses are strongly dependent upon DO levels in the water column
- Identified eight DO-sensitive species in the estuary
- Characterized occurrence and distribution of the life stages of DO-sensitive fish species
- Identified relevant research on the oxygen requirements of each at different life stages
- Determine the ranges of DO values that support propagation of DO-sensitive species



Eight DO-Sensitive Fish Species Identified in Tidal River Estuary (Zones 2–5)



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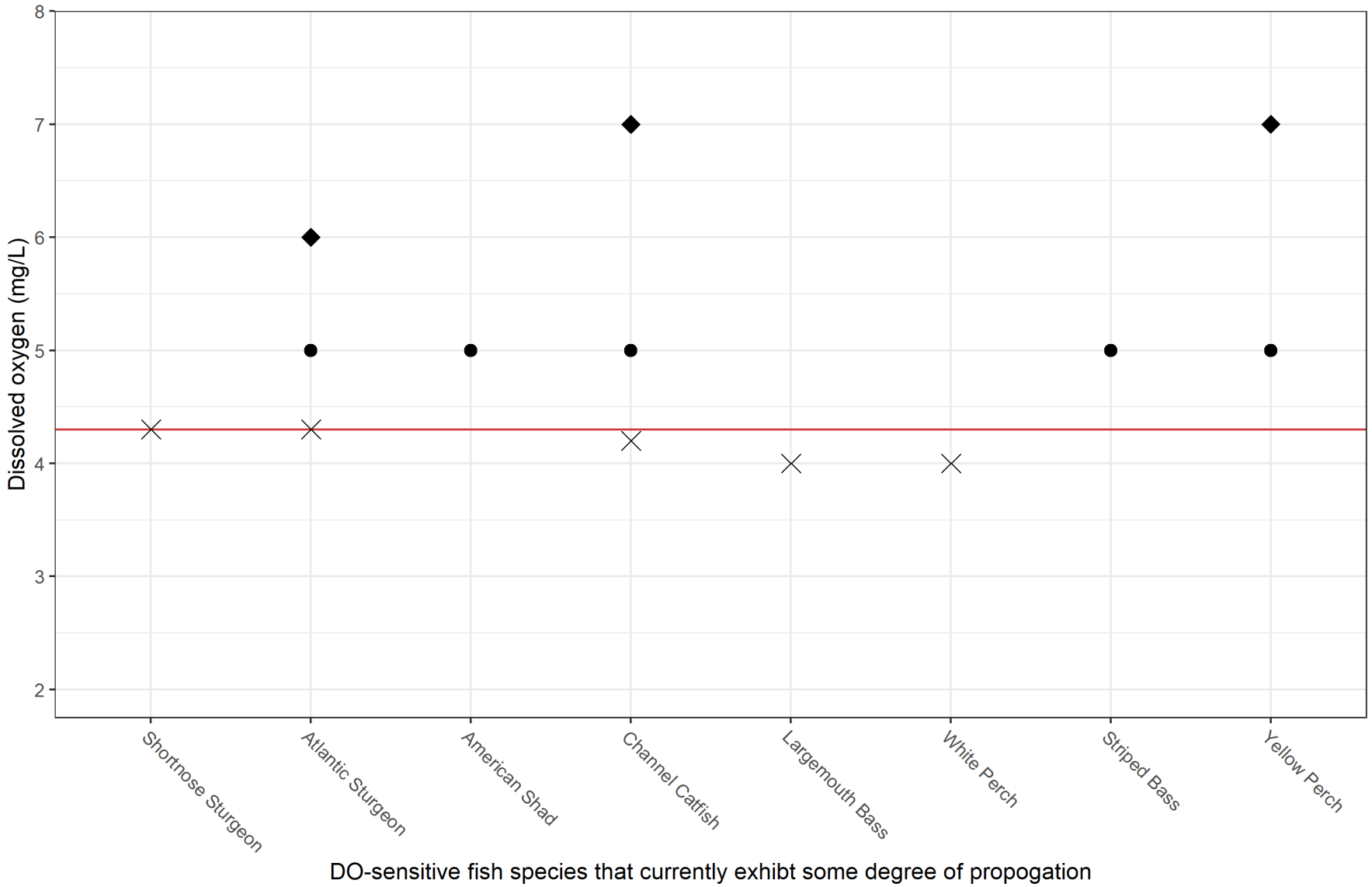

Species Specific Dissolved Oxygen

- Upper DO Threshold
- Protective Value
- Minimum Suitable

Dissolved Oxygen for All Species

- Minimum Suitability Boundary

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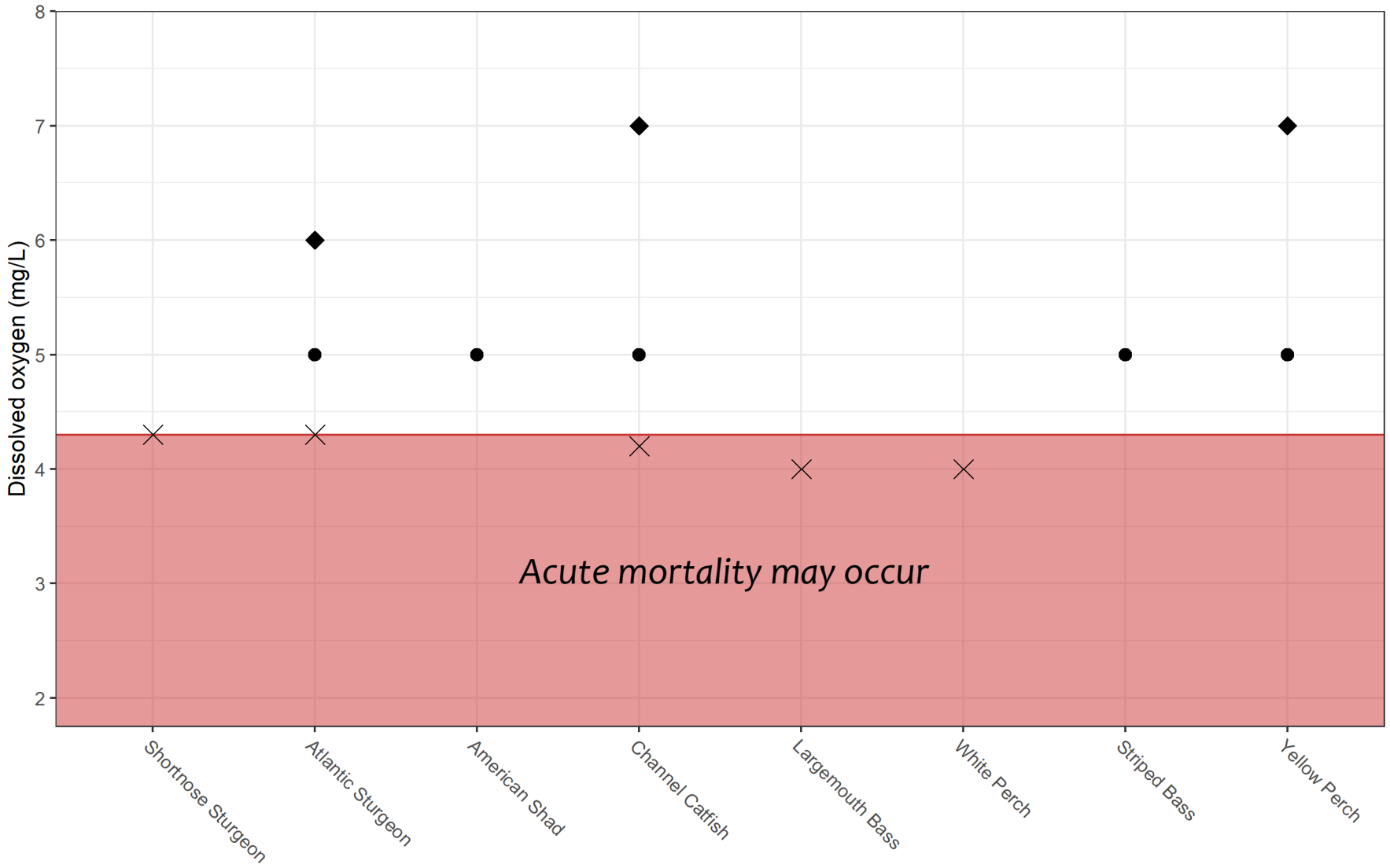

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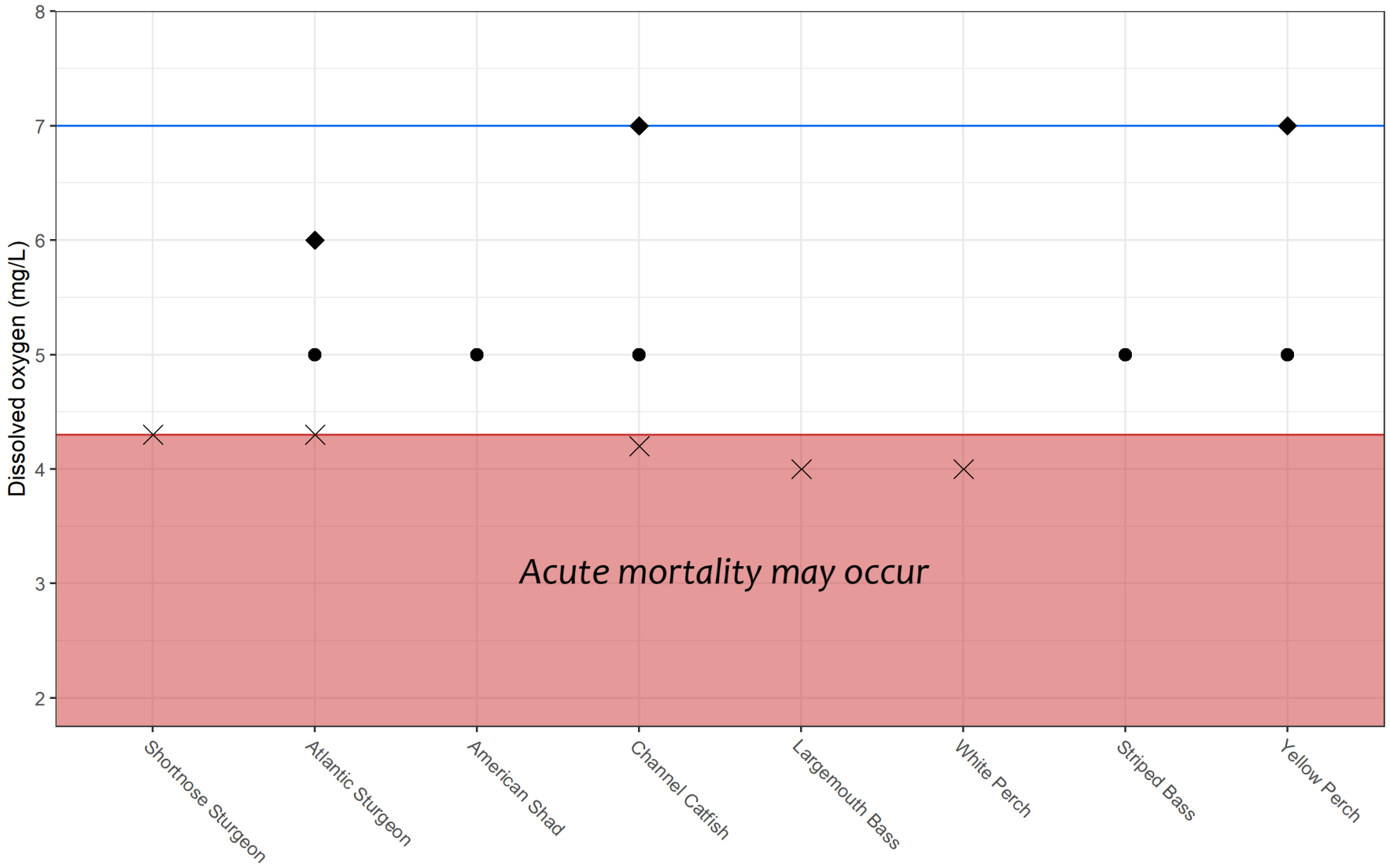

Species Specific Dissolved Oxygen

- Upper DO Threshold
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Dissolved Oxygen for All Species

- Minimum Suitability Boundary
- Upper DO Threshold Boundary

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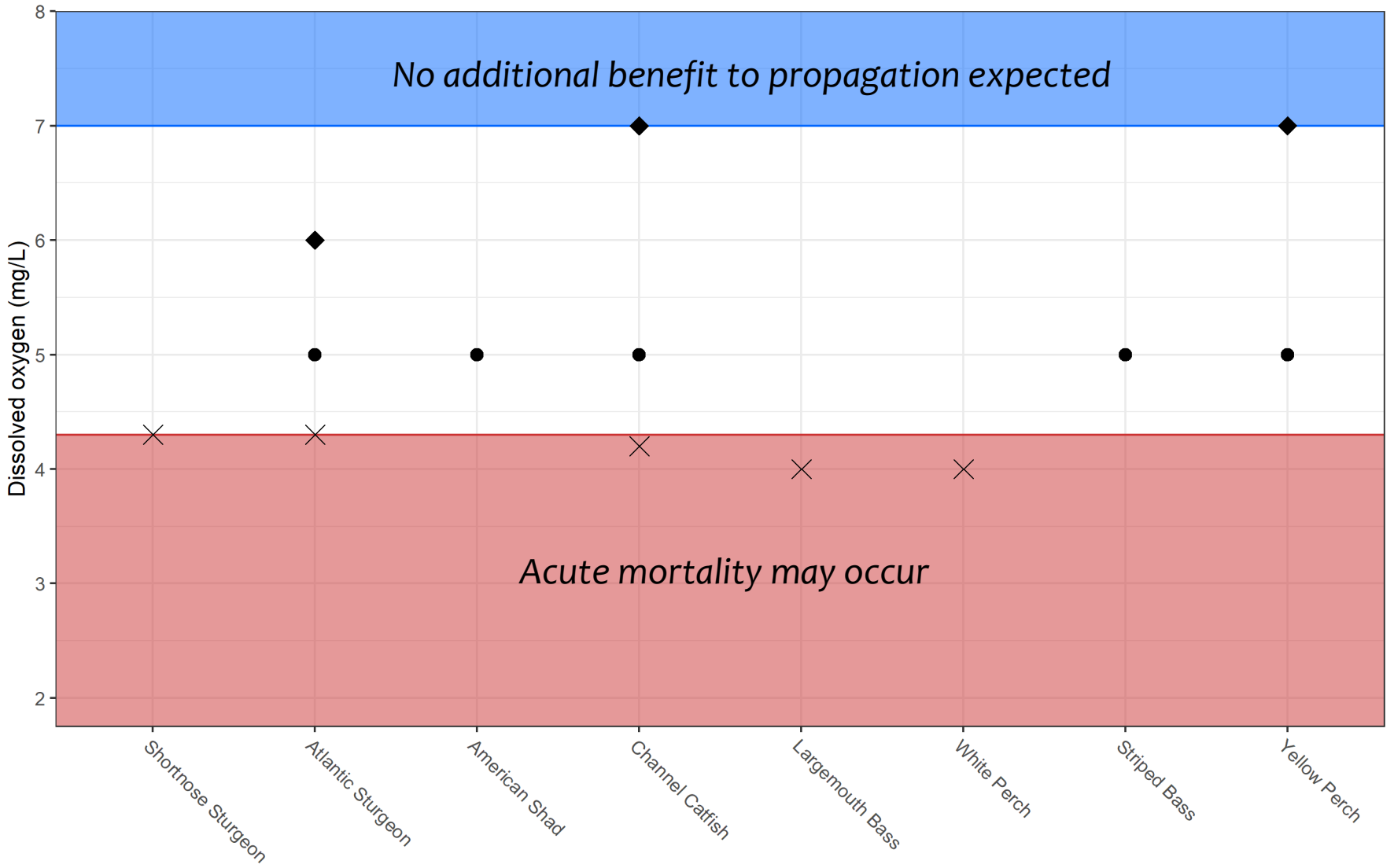

Species Specific Dissolved Oxygen

- Upper DO Threshold
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Dissolved Oxygen for All Species

- Minimum Suitability Boundary
- Upper DO Threshold Boundary

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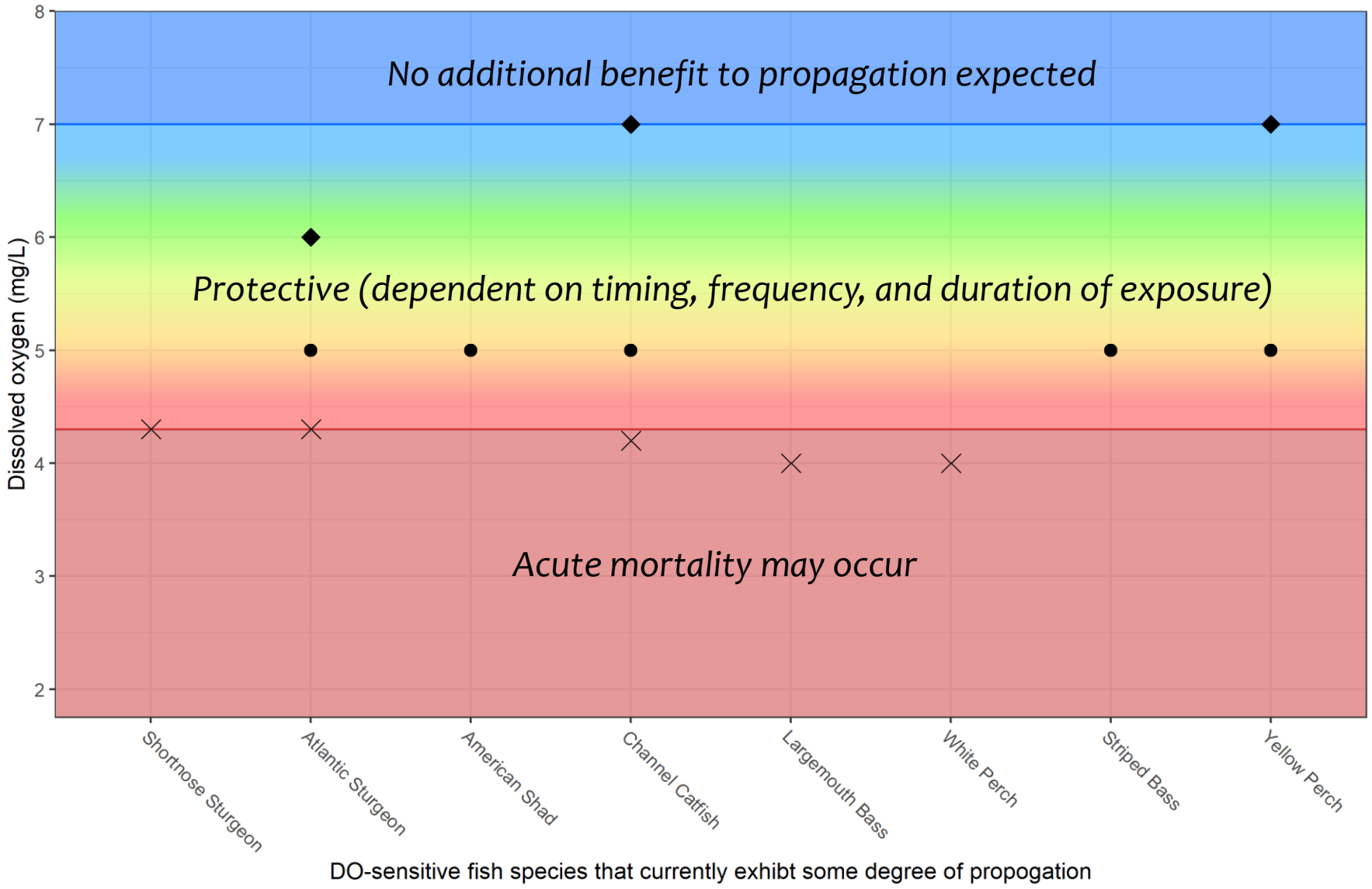

Species Specific Dissolved Oxygen

- Upper DO Threshold
- Protective Value
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Dissolved Oxygen for All Species

- Minimum Suitability Boundary
- Upper DO Threshold Boundary

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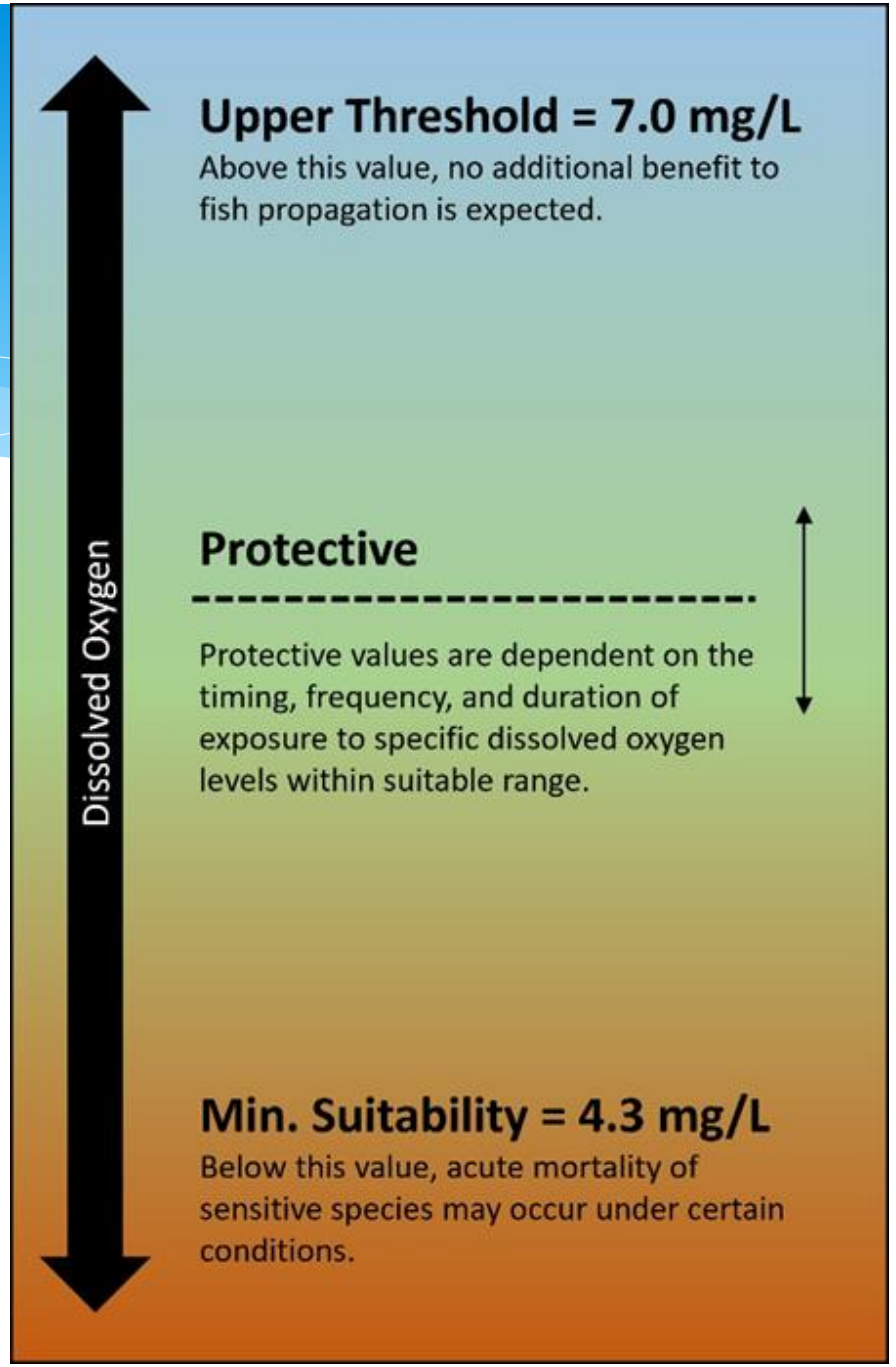
Suitability Gradient

- Minimum suitability threshold of 4.3 mg/L
  - EPA, 2003/2017
  - NOAA, 2017
  - Minimum DO to protect both endangered sturgeon species at stressful temperatures
    - ≥26°C for Atlantic Sturgeon
    - ≥29°C for Shortnose Sturgeon
- Minimum suitability threshold of 5.0 mg/L for spawning
  - American Shad (Stier and Crance, 1985)
  - Striped Bass (Turner and Farley, 1971)
- Upper DO threshold of 7.0 mg/L
  - Yellow Perch (Thorpe, 1977)
  - Channel Catfish (McMahon and Terrell, 1982)



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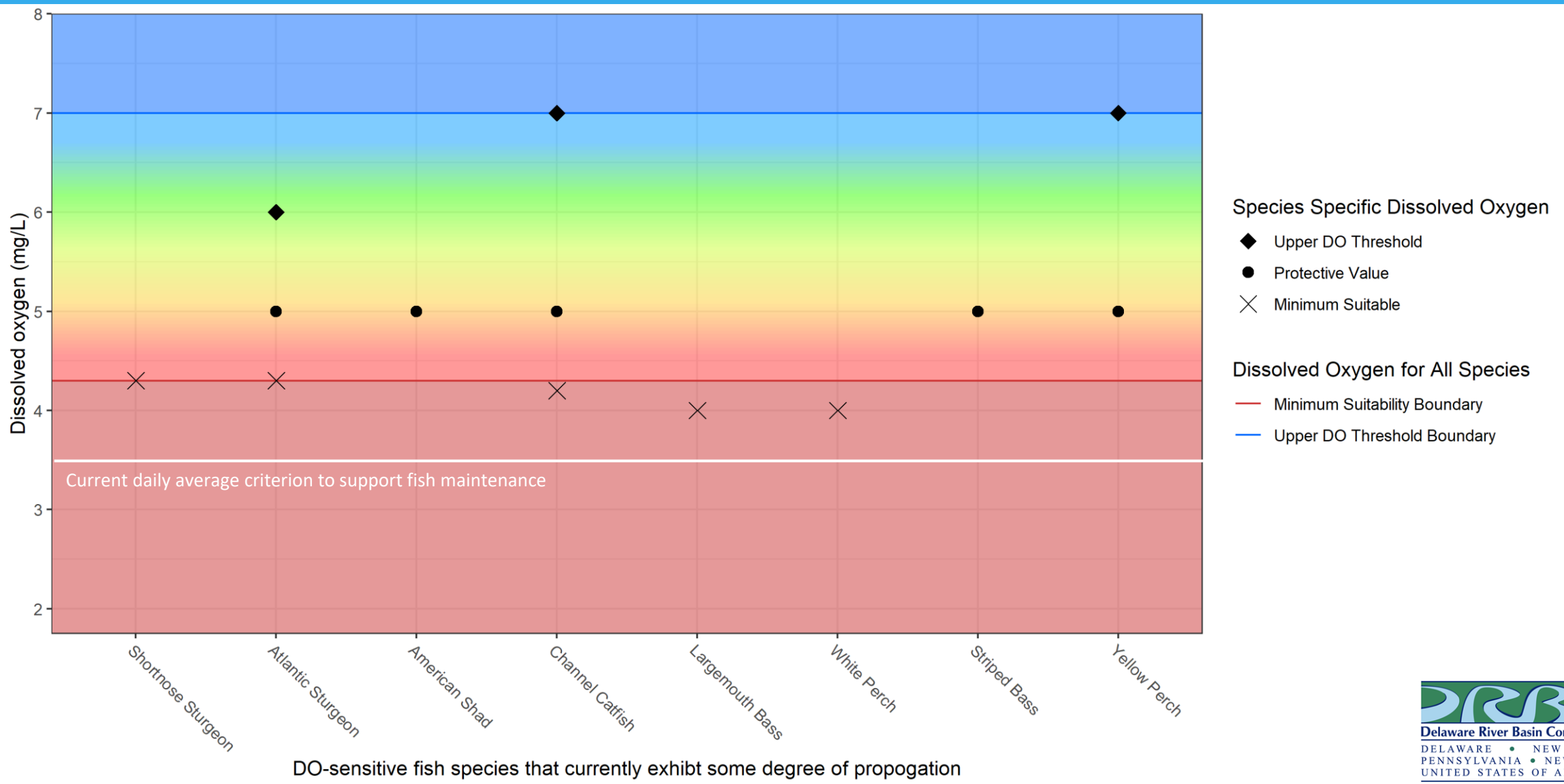
What will enhancing dissolved oxygen mean for aquatic life uses in the Delaware Estuary?



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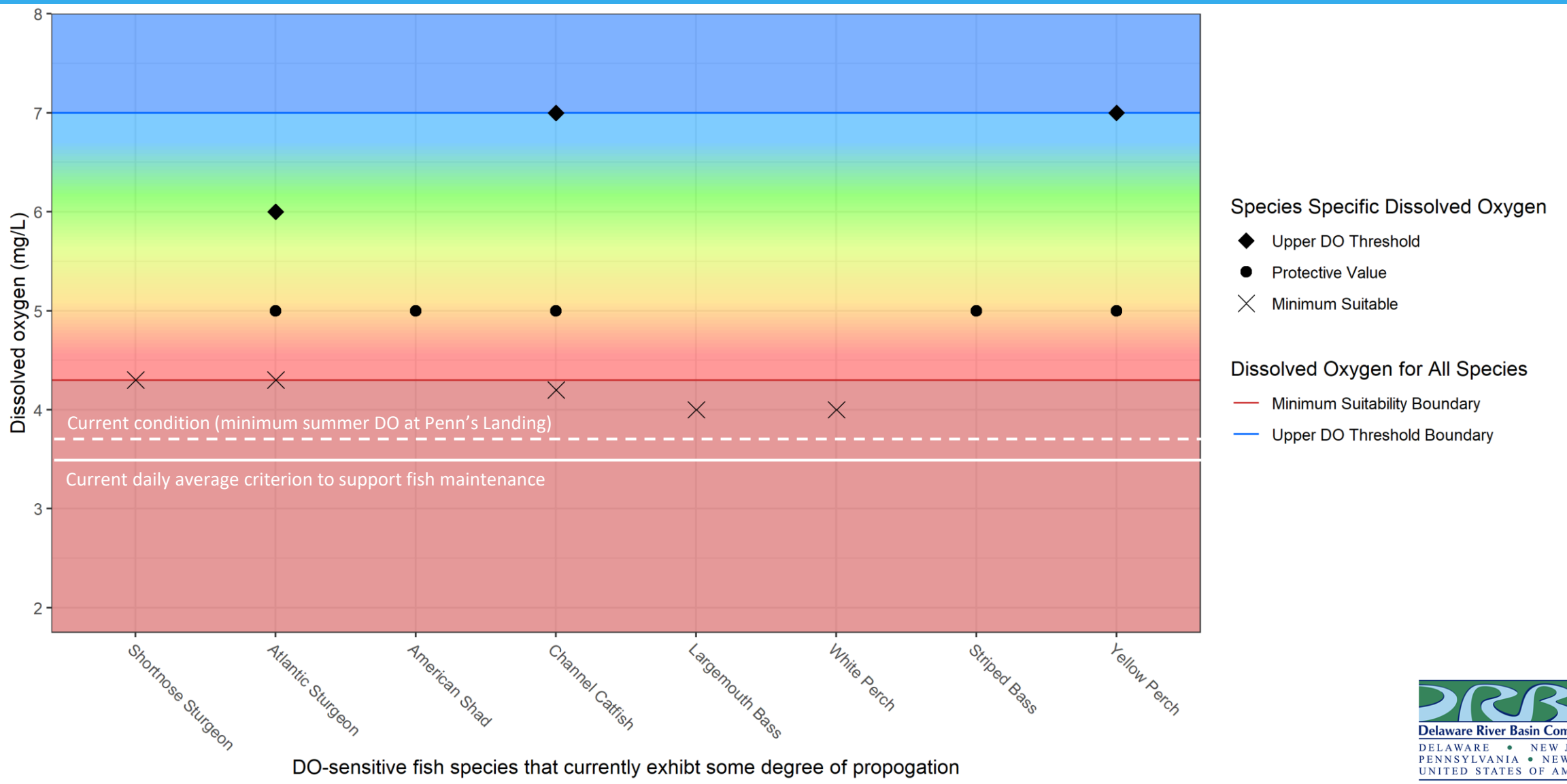

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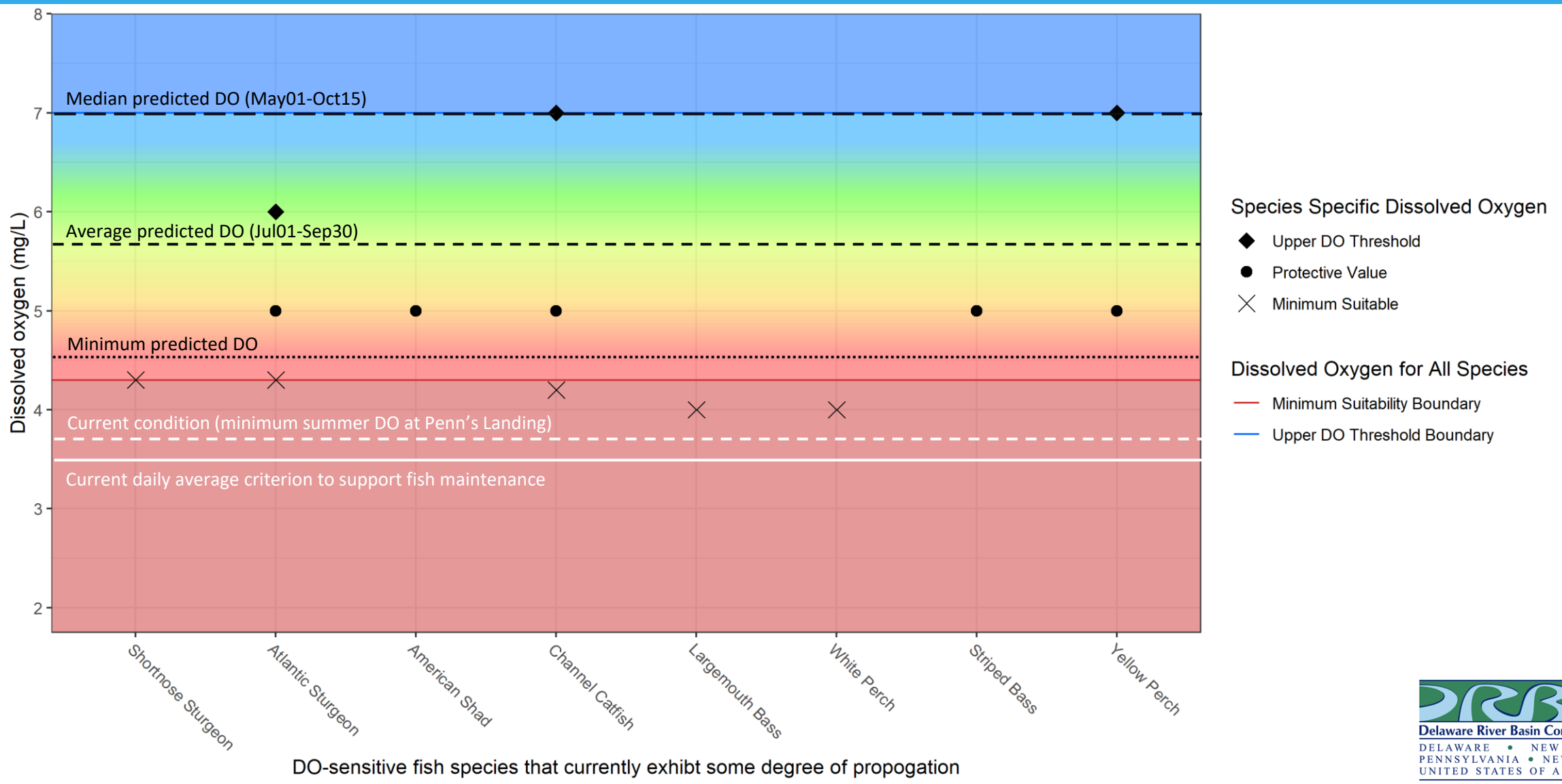

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DRBC concluded, and USEPA affirmed, that:

1) propagation is attainable throughout the estuary must therefore be reflected in designated uses; and
2) DO criteria must be enhanced to protect an upgraded designated use

Designated uses in freshwater tidal river estuary (Zones 2–5)

Portion of Freshwater Estuary	Current Use for resident fish and other aquatic life	Upgraded Aquatic Life Use (draft)
Zone 2 (RM 108–133)	Maintenance and Propagation	Maintenance, migration, and propagation of resident fish, diadromous fish, shellfish, and other aquatic life inhabiting the freshwater Delaware River Estuary
Zones 3, 4, and upper 5 (RM 70–108)	Maintenance	
Rest of Zone 5 (RM 48–70)	Maintenance and Propagation	

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Ongoing Work:
Revise Water Quality Standards and Establish Wasteload Allocations

Aquatic Life Use Co-Regulator Workgroup:

- DRBC working together with USEPA in collaboration with estuary States
- Develop Estuary-specific WQS
  - Upgrade Aquatic Life Use to include propagation
  - Develop DO criteria to support propagation of DO-sensitive fish in FMA
- Deliverable by 11/30/2023
  - Basis and background document(s)
  - Rule proposals to be developed concurrently by DRBC and EPA)

Next Steps:

- Administrative process
  - Notices of proposed rulemaking – by Jan 2024
    - Federal and States
  - Public process – est. by May 2024
    - Public meetings / hearings (at least each State)
    - Written comments
  - CRD and Adoption – no later than March 2025
- Implementation
  - Establish wasteload allocations to meet criteria
  - Through State NPDES permits or DRBC dockets

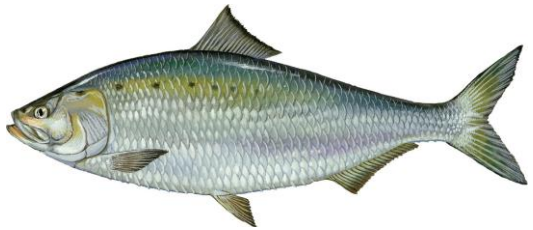
Enhance water quality to fully support maintenance, migration, and propagation of resident and diadromous fish inhabiting the freshwater Delaware River Estuary

Striped Bass, NOAA Fisheries

White Perch, Maine DIFW

Largemouth Bass, Maine DIFW

Yellow Perch, NC Wildlife



American Shad, NC Wildlife

Channel Catfish, NC Wildlife

Atlantic Sturgeon, NOAA Fisheries

Shortnose Sturgeon, NOAA Fisheries

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Improving Dissolved Oxygen and Aquatic Life Uses in the Delaware River Estuary

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Topic	Presenter
Why are we here?	Steve Tambini
How did DRBC address low dissolved oxygen in the Delaware Estuary - then and now?	Namsoo Suk
Where do ammonia and other nutrients in the Delaware Estuary originate, and how do we know?	John Yagecic
What is this estuary-wide eutrophication model and why do we need it?	Li Zheng
What matters and what doesn't with regard to low dissolved oxygen events in the Delaware Estuary?	Fanghui Chen
What combination of wastewater improvements will achieve the best dissolved oxygen outcome in the Delaware Estuary?	Sarah Beganskas
What is the highest attainable dissolved oxygen condition in the Delaware Estuary, and what will it mean for aquatic life uses?	Thomas Amidon
Q&A Panel: Enhancing support for aquatic life uses in the Delaware Estuary	**All**