

Developing and Applying Water Temperature & Dissolved Oxygen Thresholds to Visualize the Effect on Chesapeake Bay Striped Bass Summer Habitat

PROGRESS UPDATE - PROVISIONAL DATA



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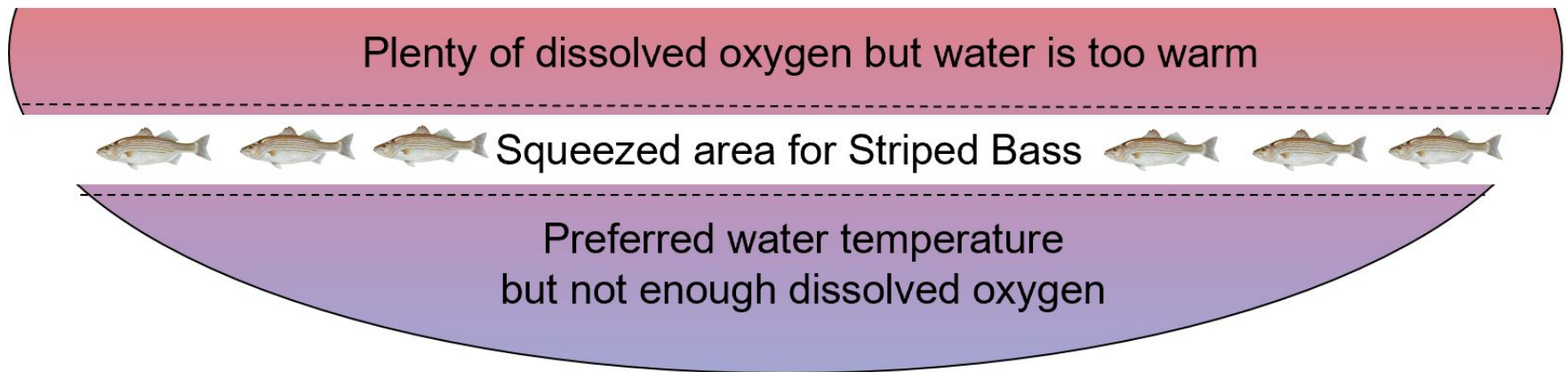
4/6/22

Overview

- Striped bass squeeze and impacts for management
- Revising the existing striped bass thresholds
- Applying revised thresholds to the Chesapeake Bay waters
- Evaluating impacts of various Bay restoration scenarios on summer striped bass habitat
- Next Steps

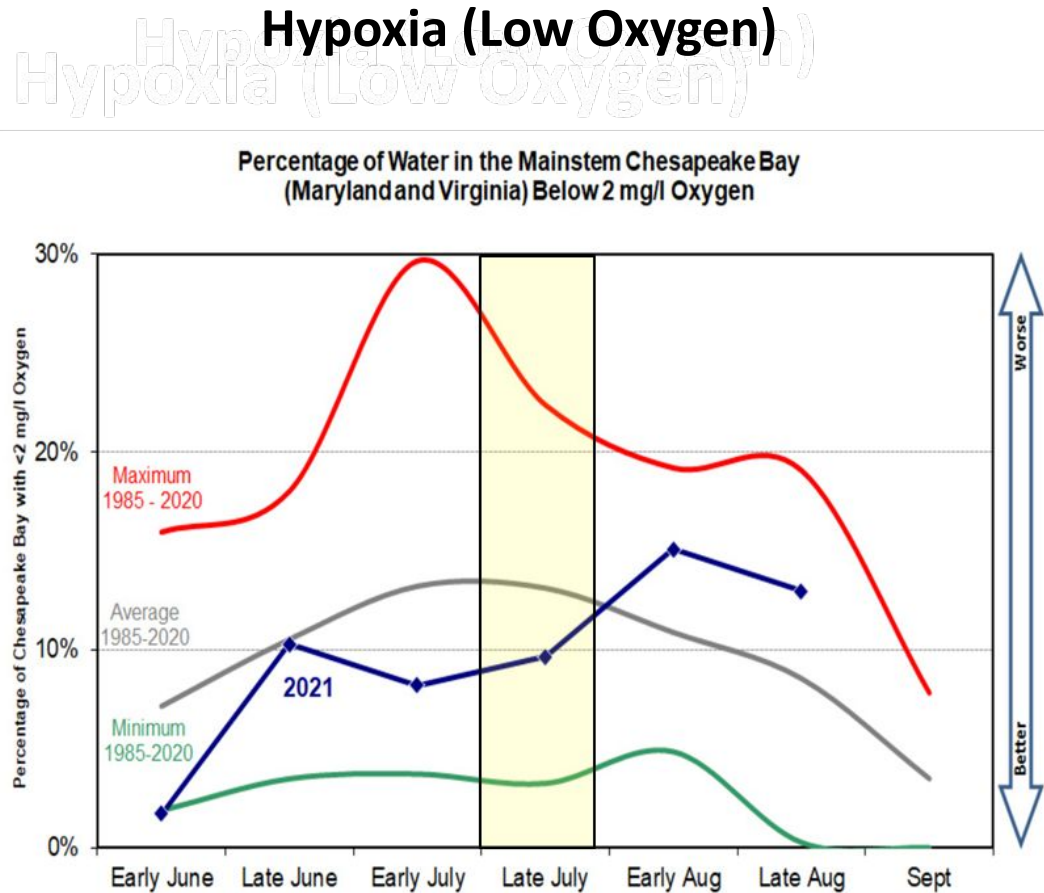
Striped Bass “Squeeze”

In warmer summer months, elevated surface water temperatures and increasing amounts of oxygen poor bottom waters force striped bass into a very narrow band of cooler water with adequate oxygen.

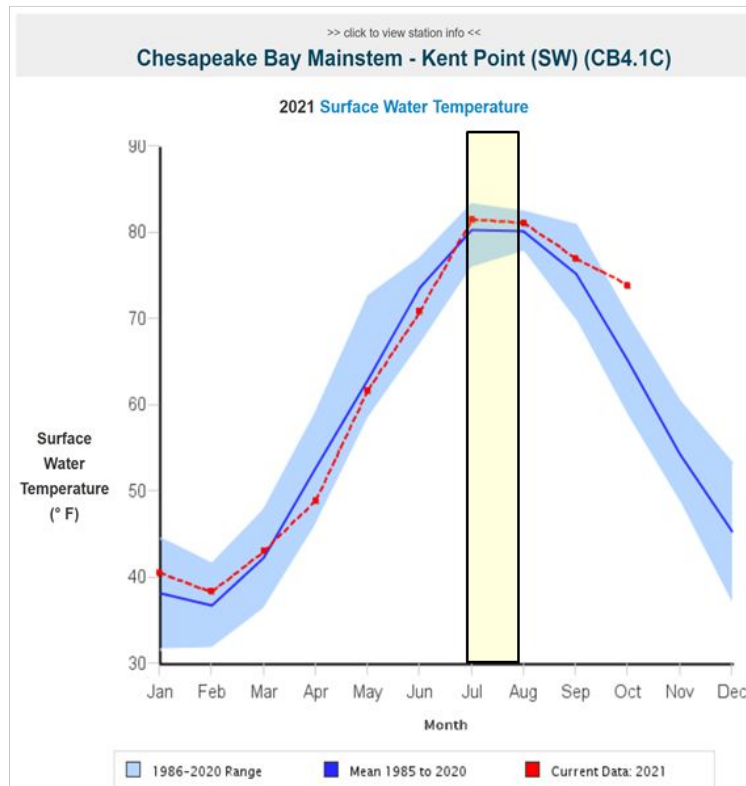


Impacts for Management

Hypoxia (Low Oxygen)






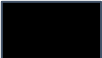
Water Temperature



Revising Chesapeake Bay Striped Bass Habitat Thresholds for Oxygen and Temperature

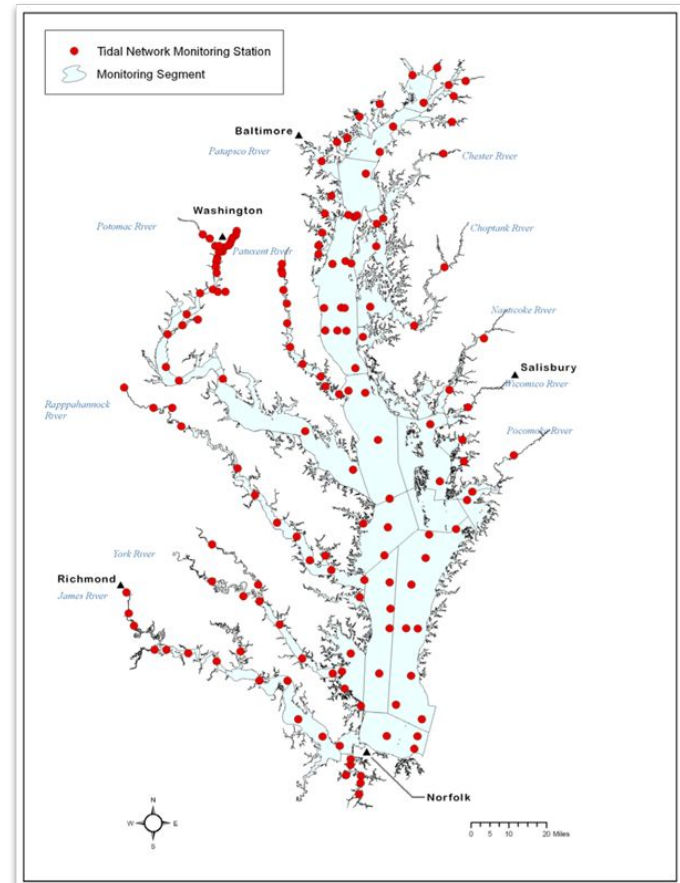
- Habitat criteria were developed from a literature review of Chesapeake Bay Striped Bass studies that evaluated water temperature and/or dissolved oxygen (DO), and the update of the *Temperature Oxygen Squeeze* hypothesis developed in southeastern United States reservoirs.
- The criteria development was confined to the size of striped bass likely to be Chesapeake Bay residents that do not participate in the Atlantic coast migration (mostly 3 to 6 year-old males along with some young, immature females) and constitute a year-round population providing Maryland's major saltwater recreational fishery and an important commercial fishery.
- These fish are much smaller than the larger striped bass considered in the original water temperature/dissolved oxygen squeeze.
- The following factors (stressors) influencing temperature tolerance were not included: Feeding, Mycobacteriosis, Salinity, and Catch & Release.

Revised Striped Bass Categories and Thresholds for Dissolved Oxygen (DO) & Water Temperature (WT)

-  **Suitable** - Supports "normal" occupancy with growth potential (DO ≥ 4 mg/l, WT $\leq 82.4^{\circ}\text{F}$ (28°C))
-  **Tolerable** - Supports occupancy for a modest period of time with limited growth potential (~1 month) (DO $4 \text{ mg/l} < \geq 3 \text{ mg/l}$, WT 82.4°F (28°C) $< \geq 84.2^{\circ}\text{F}$ (29°C))
-  **Marginal** - Supports occupancy for a short period with little or no growth potential (Just passing through) - DO $3 \text{ mg/l} < \geq 2 \text{ mg/l}$, WT 84.2°F (29°C) $< \geq 86^{\circ}\text{F}$ (30°C)
-  **Unsuitable** - Not suitable conditions experiencing either hypoxia or excess water temperature- DO $< 2 \text{ mg/l}$, WT $> 86^{\circ}\text{F}$ (30°C)

Application of Habitat Thresholds

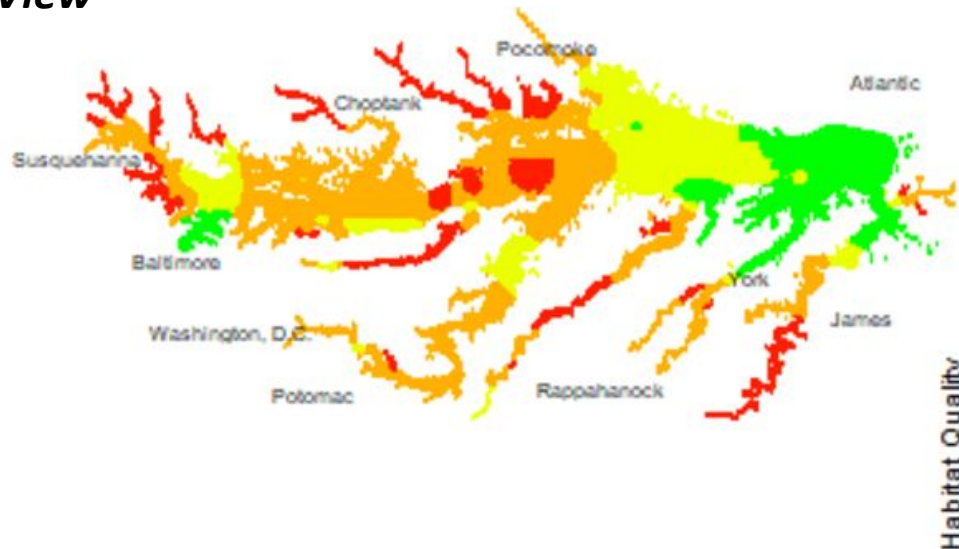
- The revised thresholds were applied to the Chesapeake Bay long-term and shallow water monitoring data collected over all cruises occurring between 1986 and the present.
- Monitoring data was interpolated to create monthly 3-D recreations of Chesapeake Bay water temperature and dissolved oxygen conditions.
- A total of 165 of these stations were kept for this analysis. Stations that were sampled during at least three quarters of these cruises were included in the analysis.



Chesapeake Bay Striped Bass Habitat Conditions

Summary – July 15-31, 2019

Top View



Habitat Conditions



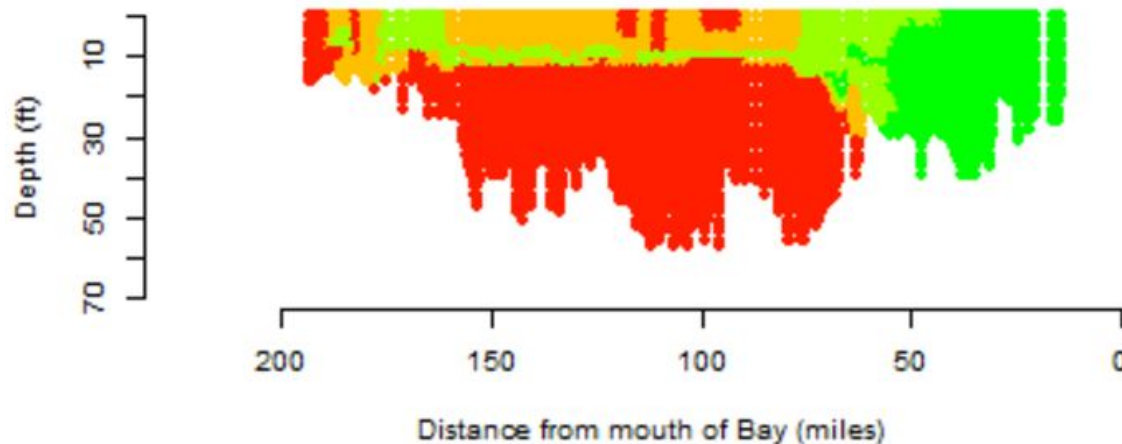
Suitable - Supports "normal" long-term occupancy with growth potential

Tolerable - Supports occupancy for a modest period of time, ~ 1 month, with limited or negative growth potential

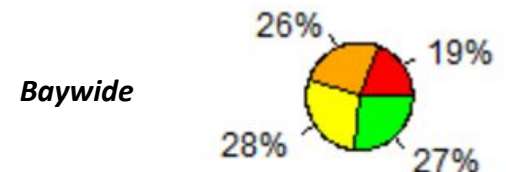
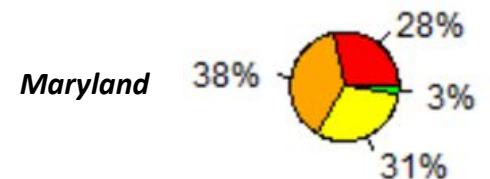
Marginal - Supports very brief occupancy with little impact on growth potential

Unsuitable - Does not support occupancy

Side View



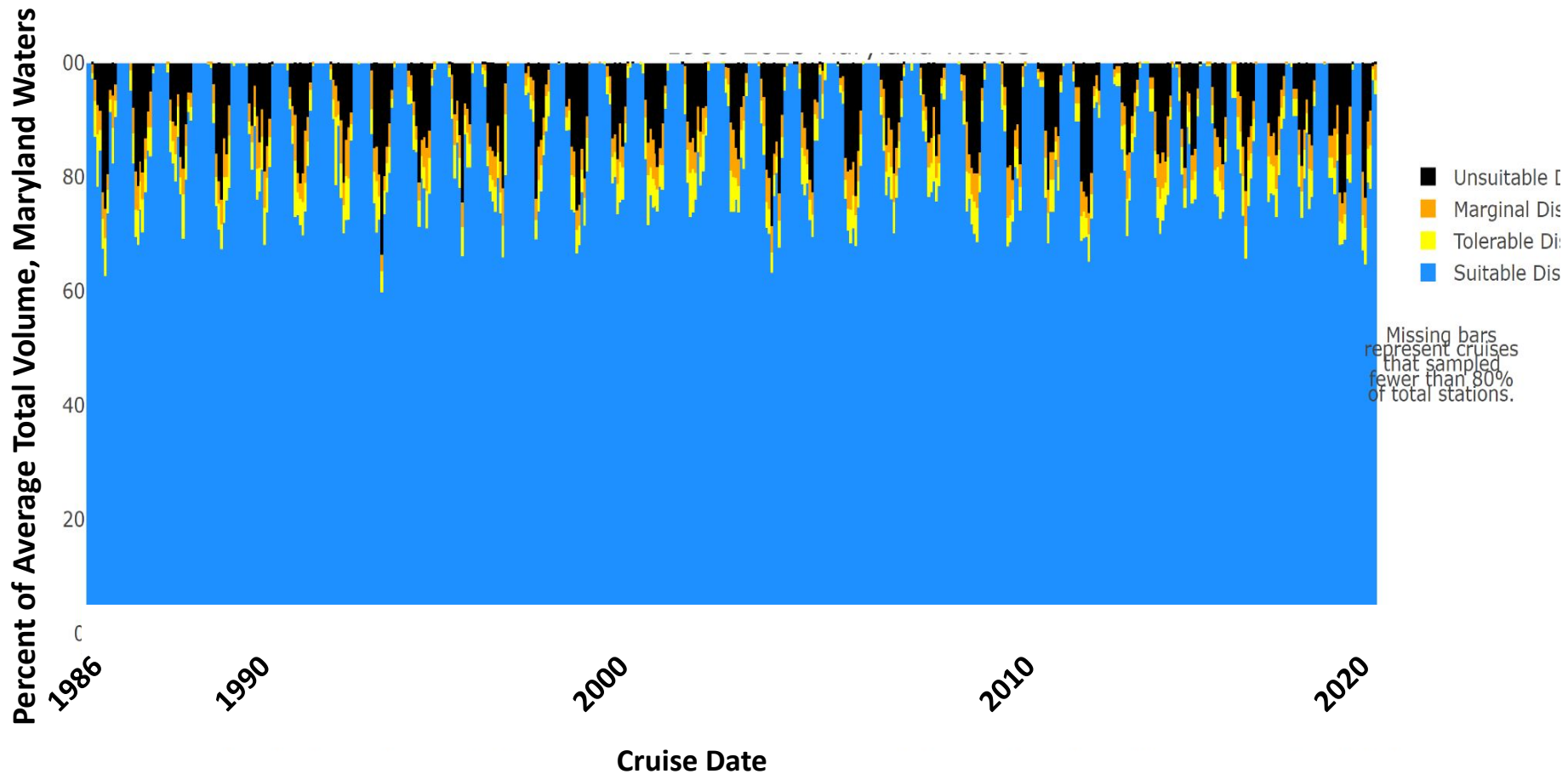
Habitat Quality (%)



Key Question for 1986-2020

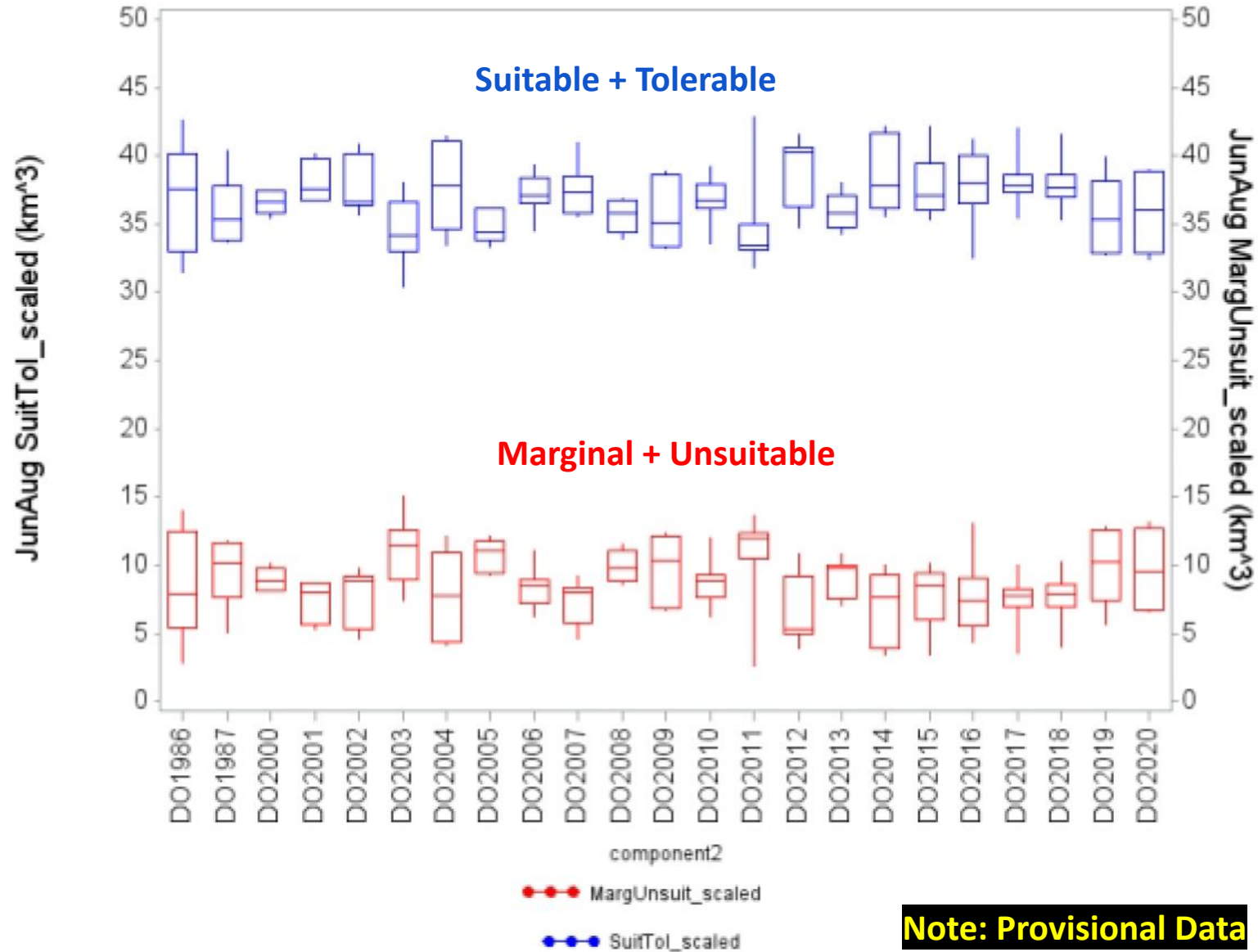
- How has striped bass habitat (DO and Water temperature related) changed since 1986?

Striped Bass Habitat Volume by Cruise Dissolved Oxygen (1986-2020)



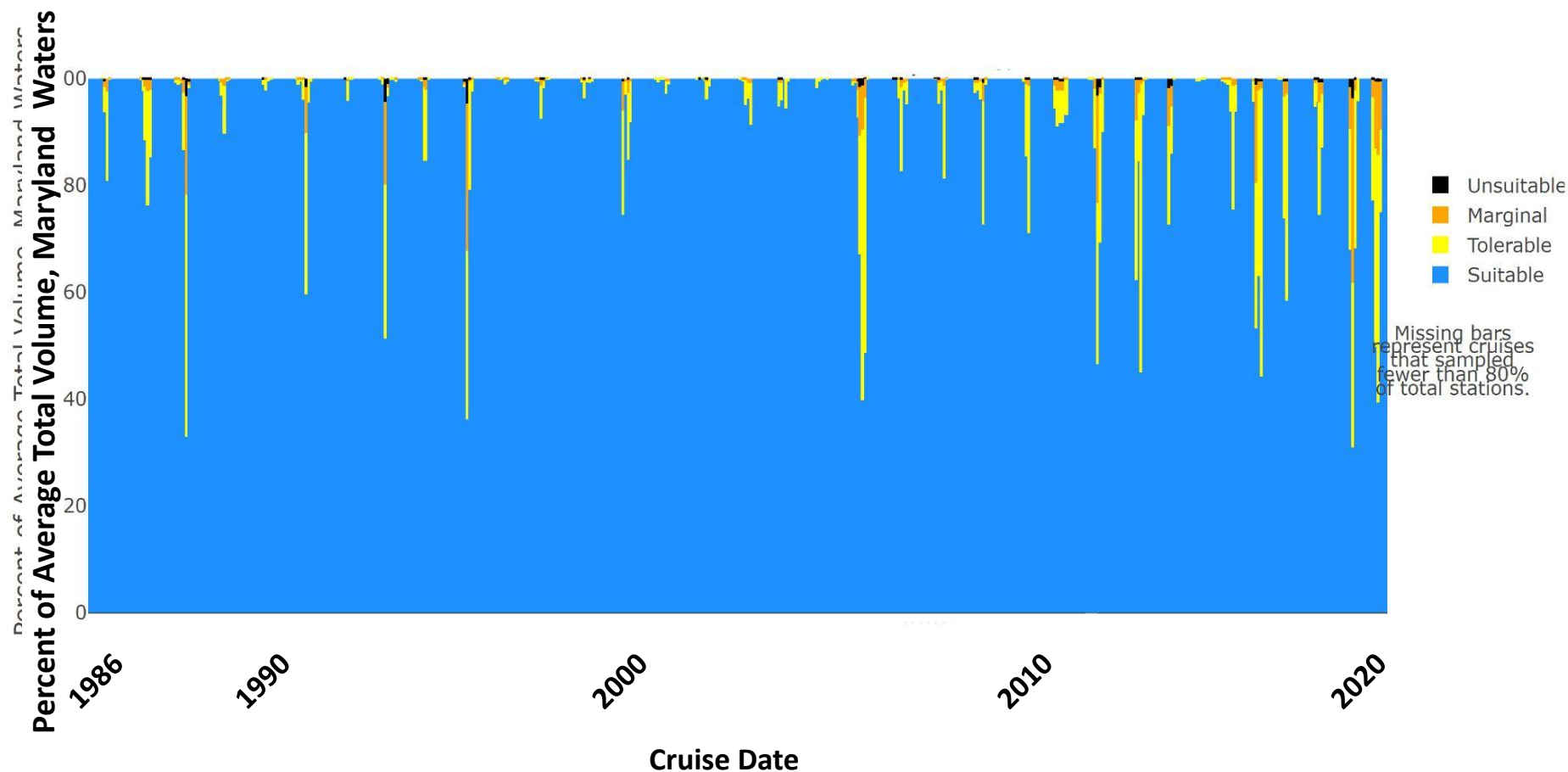
Note: Provisional Data

Maryland - Dissolved Oxygen



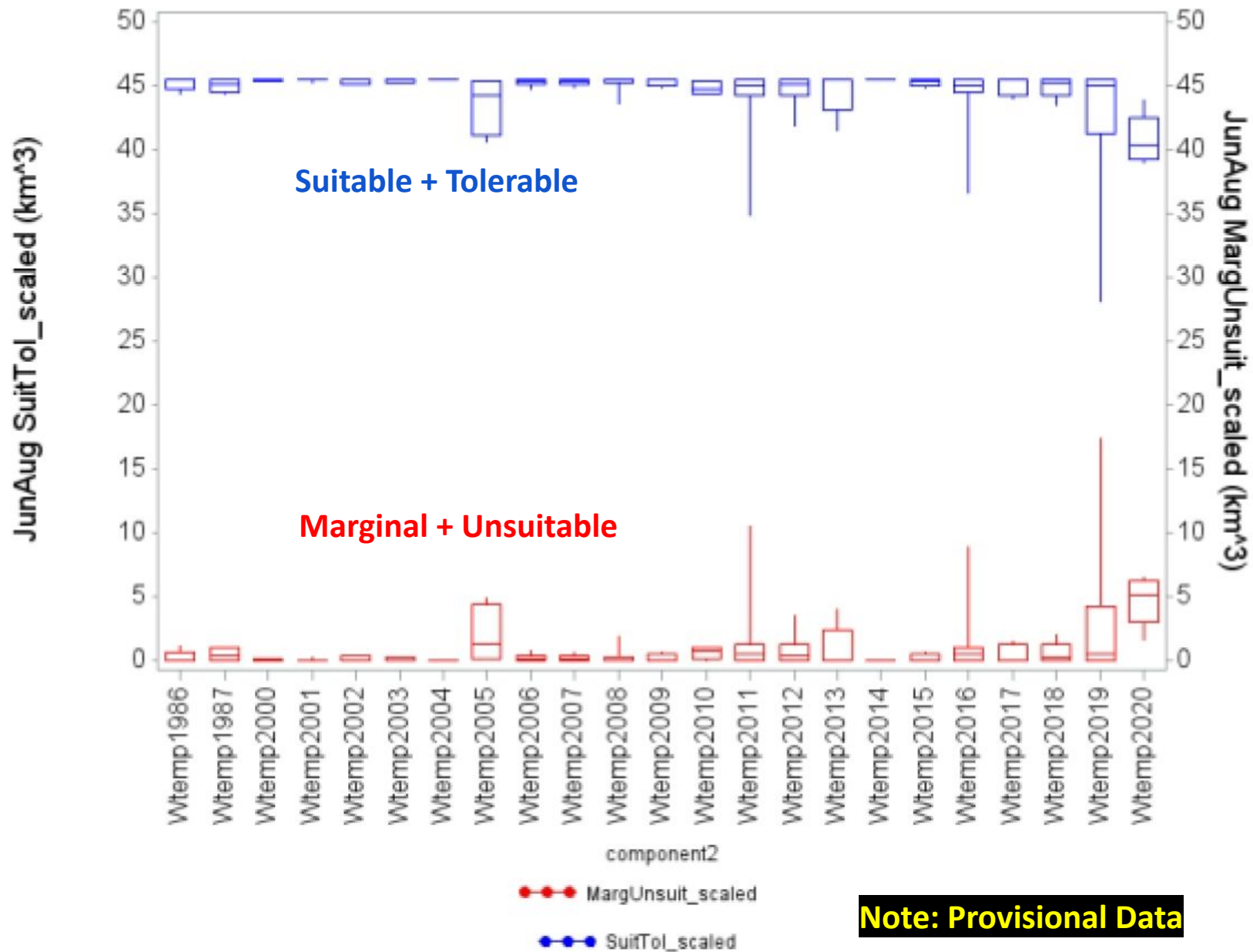
Note: Provisional Data

Striped Bass Habitat Volume by Cruise Water Temperature (1986-2020)



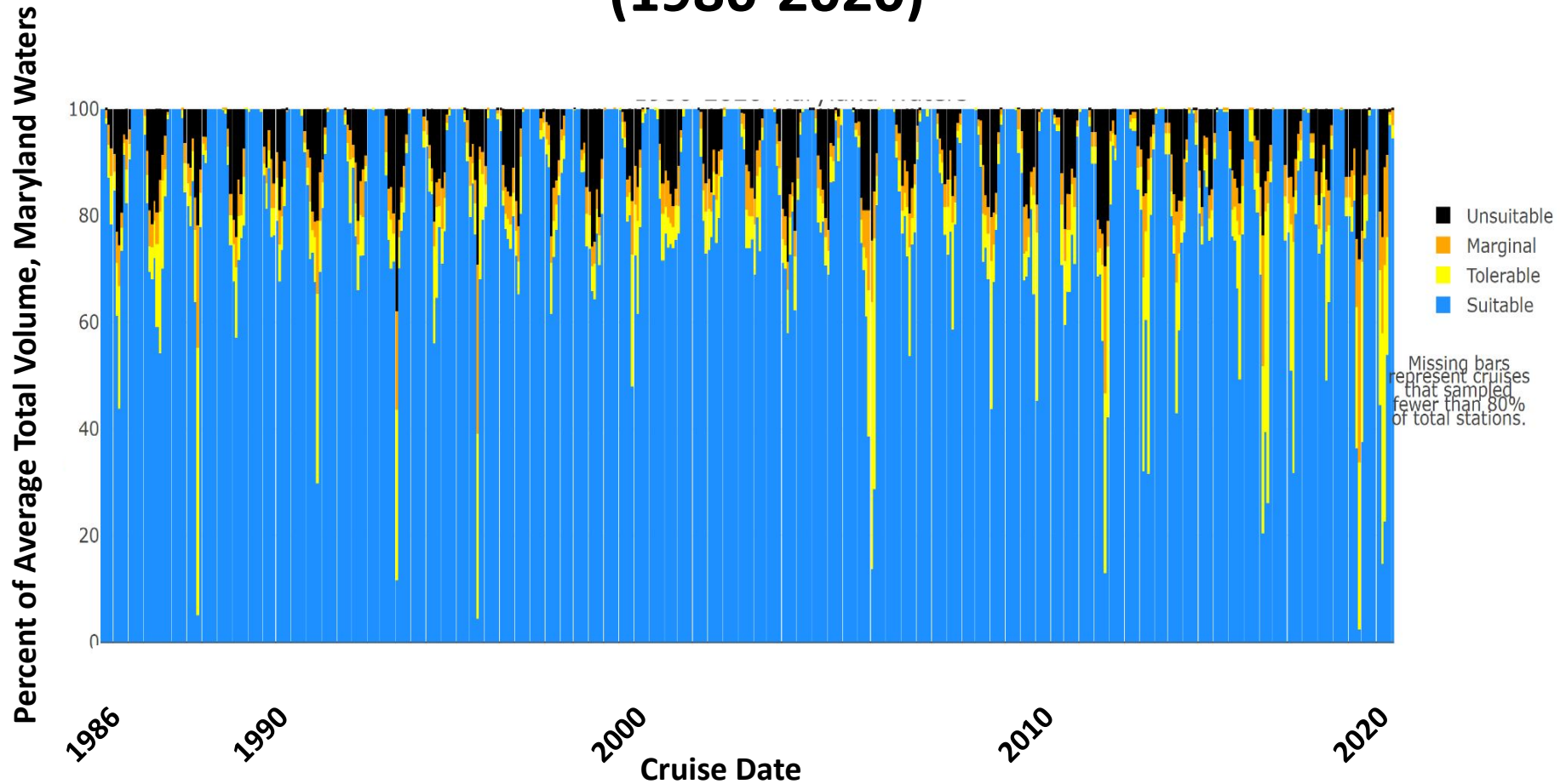
Note: Provisional Data

Maryland -Water Temperature



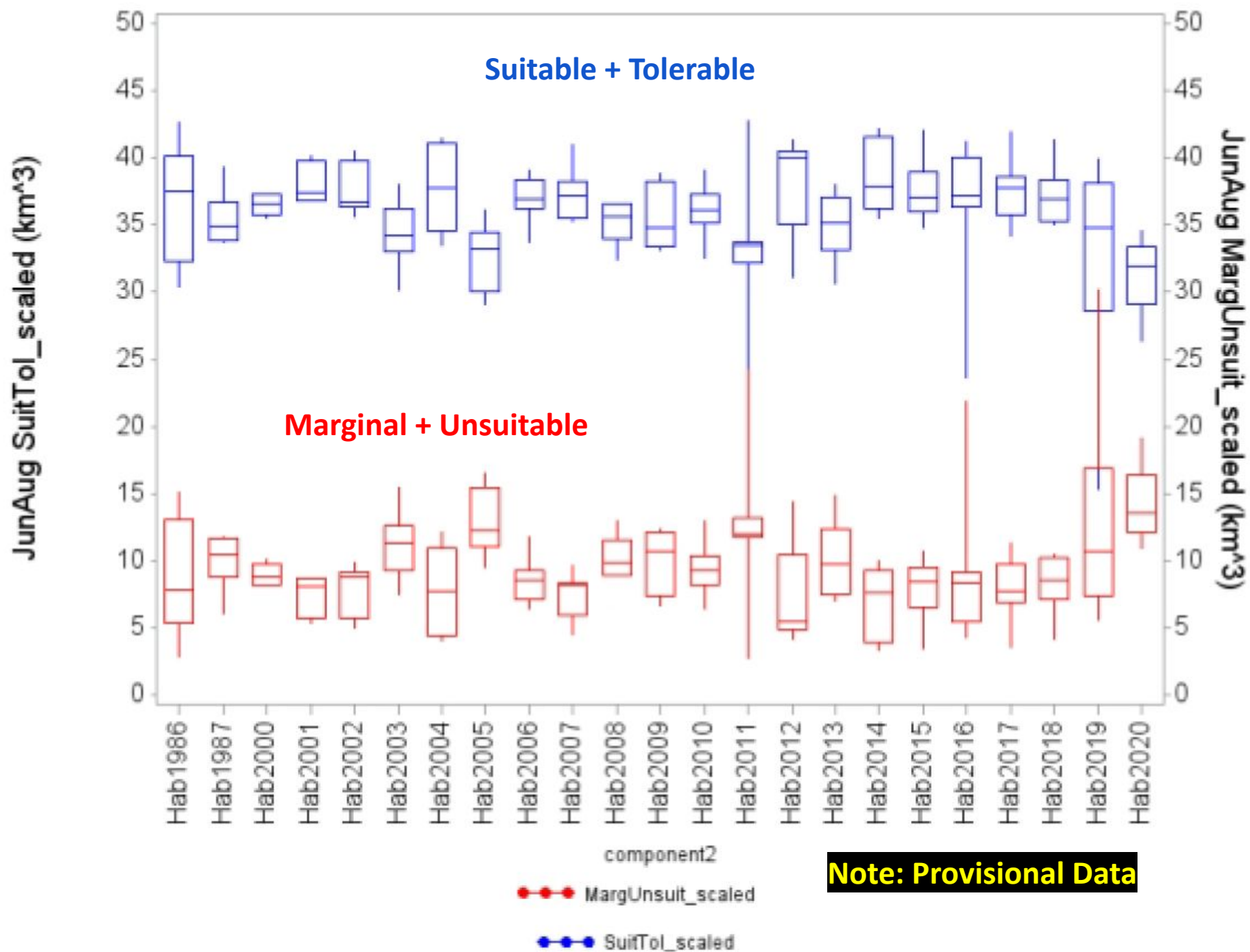
Note: Provisional Data

Striped Bass Habitat Volume by Cruise (1986-2020)



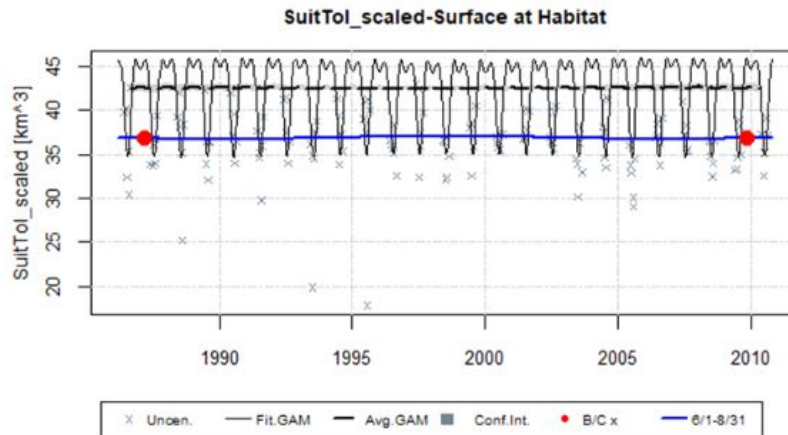
Note: Provisional Data

Maryland Habitat

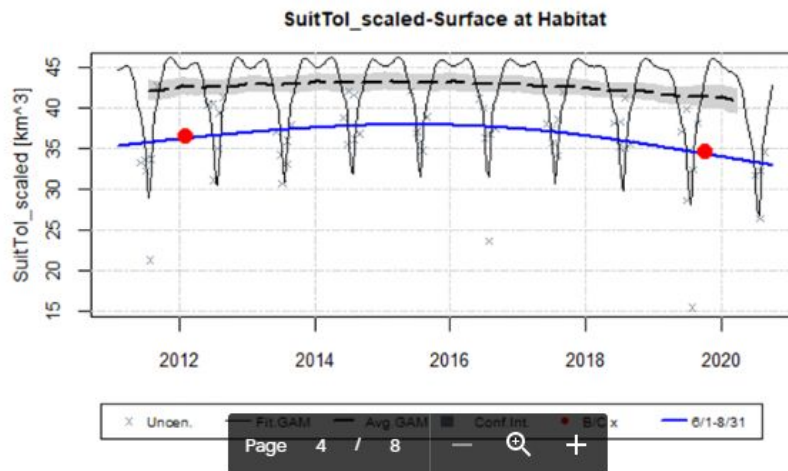


Initial Trend Analysis Results - Maryland

FIRST SECTION 1986-2010



LAST 10 YEARS 2011-2020



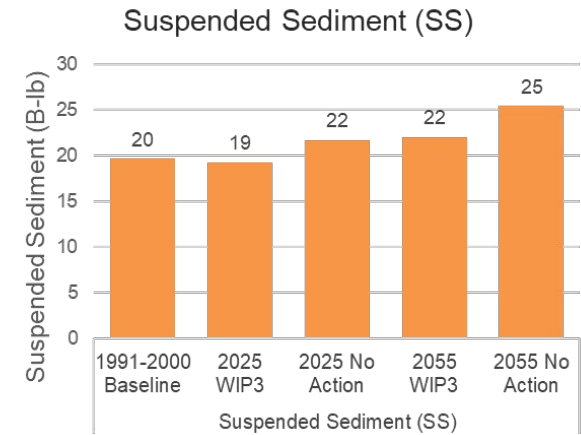
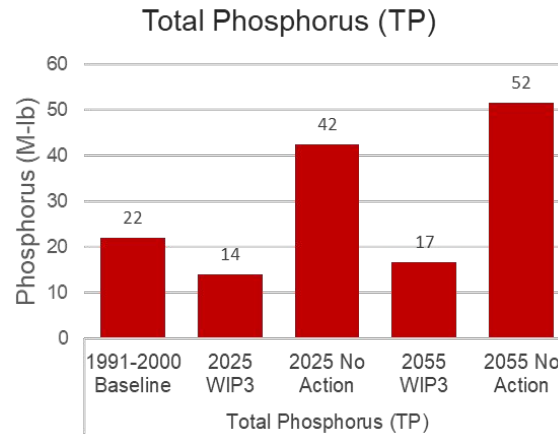
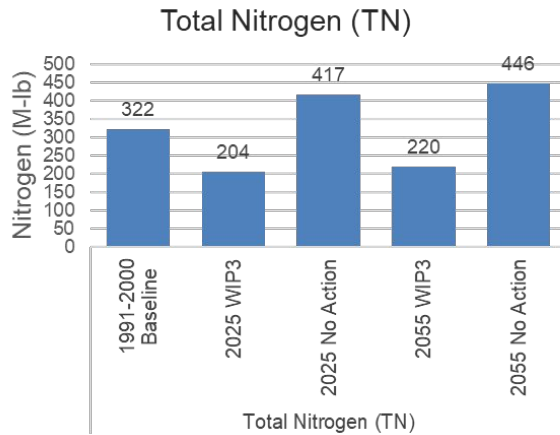
- No significant changes were found for the pre-2011 time periods for Habitat or Wtemp for any season.
- Habitat and Wtemp both had significant worsening changes for 2011-2020 in the June through August.
- No DO trends during any period
- Absolute volume changes are small (less than 2 km³) in all time periods for the JunAug period.
- Also examining Habitat, DO, Water Temperature, segment trends

Note: Provisional Data

Key Questions for Scenarios

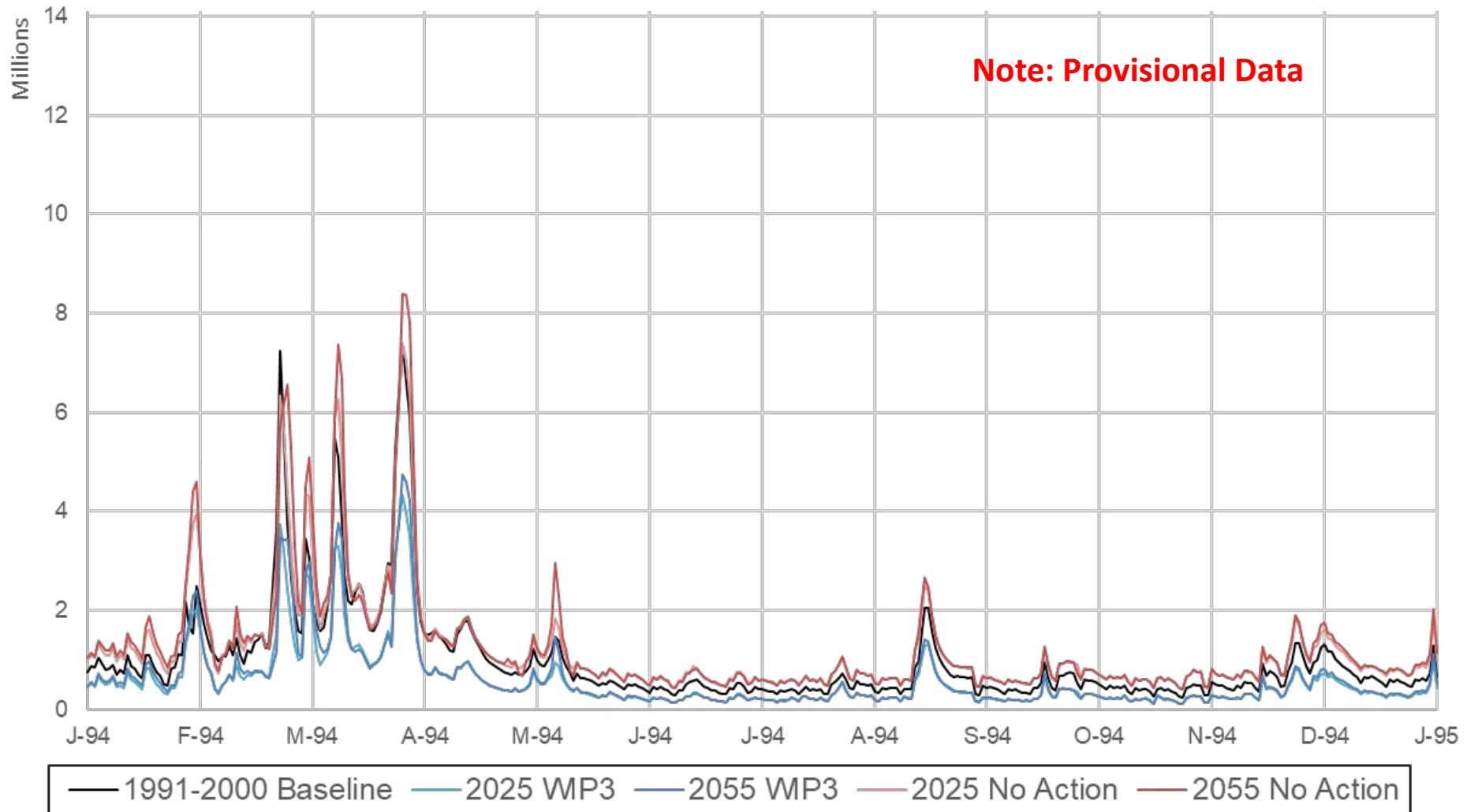
- What is the impact to striped bass habitat from to meeting WIP goals?
- What would be the impact to striped bass habitat if we all did nothing (No Bay Program Scenario)?

Whole Bay Scenarios Evaluated



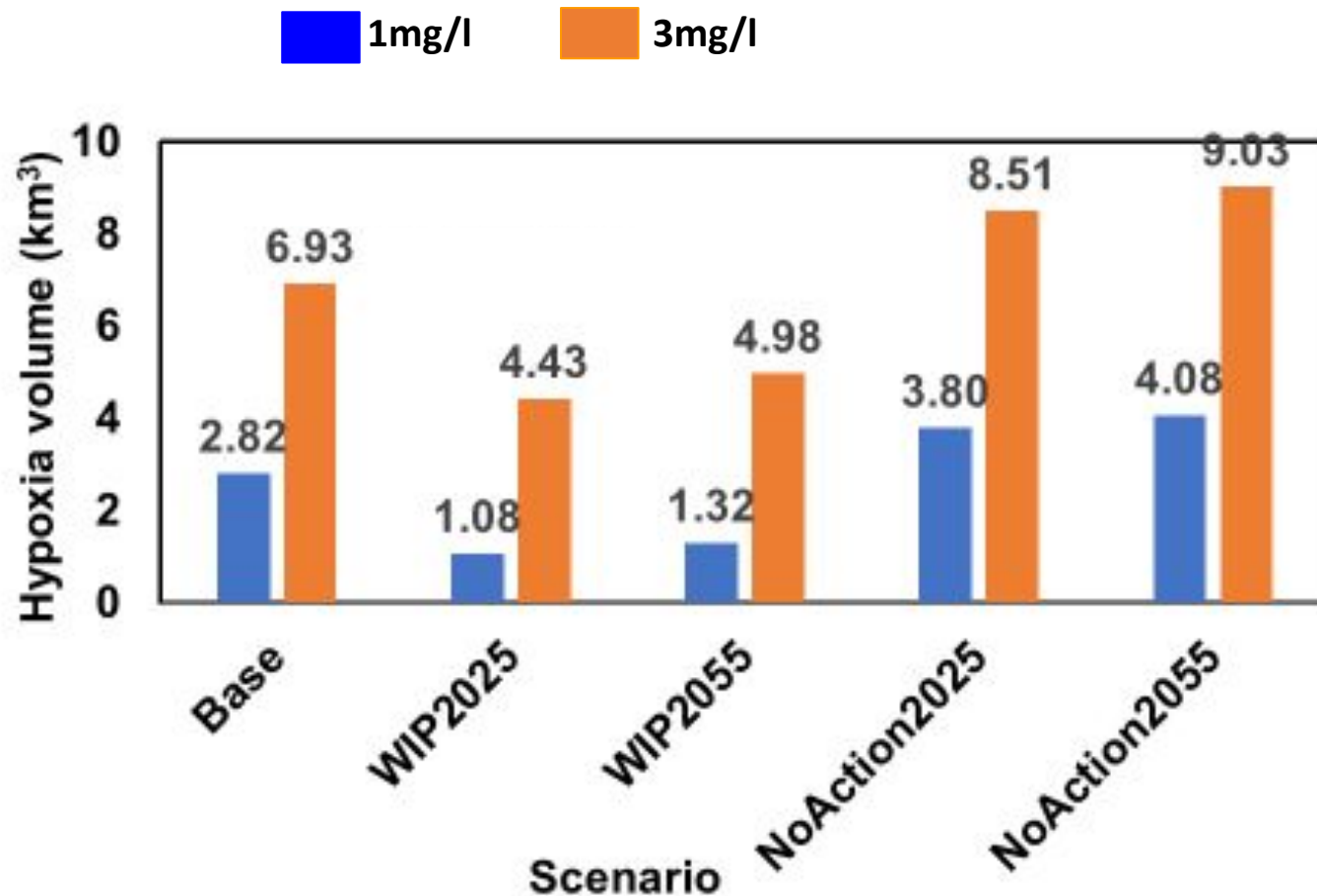
- Base (1991-2000)
- WIP3 L25 E25
- Climate Change 2025
- WIP3 L25 E25 C25
- No Action L25 E25 C25
- No Action L25 E25 C55

Nitrogen Delivery to the Bay



Continuous loads from the WSM DM (Watershed Dynamic Model)

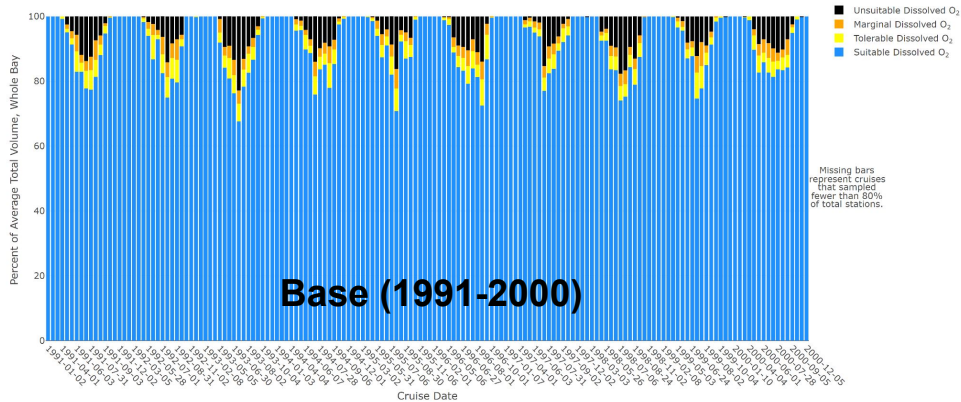
Summer hypoxia volume averaged over 10 years in the whole Bay
(Jun.-Sep. with critical values of 1 and 3 mg/l, respectively)



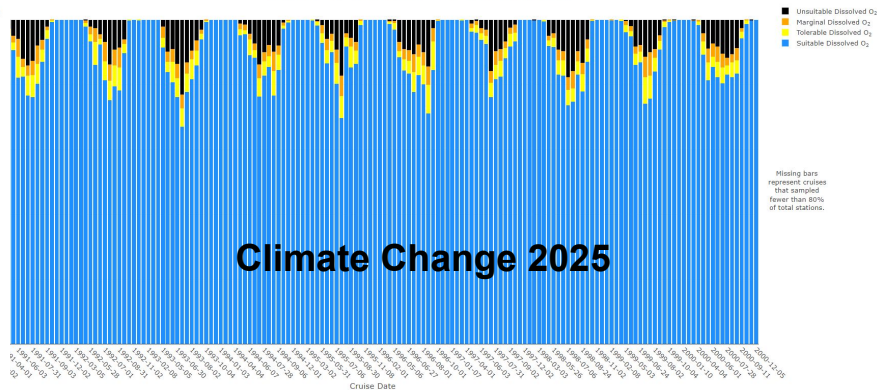
Note: Provisional Data

Dissolved Oxygen - Whole Bay

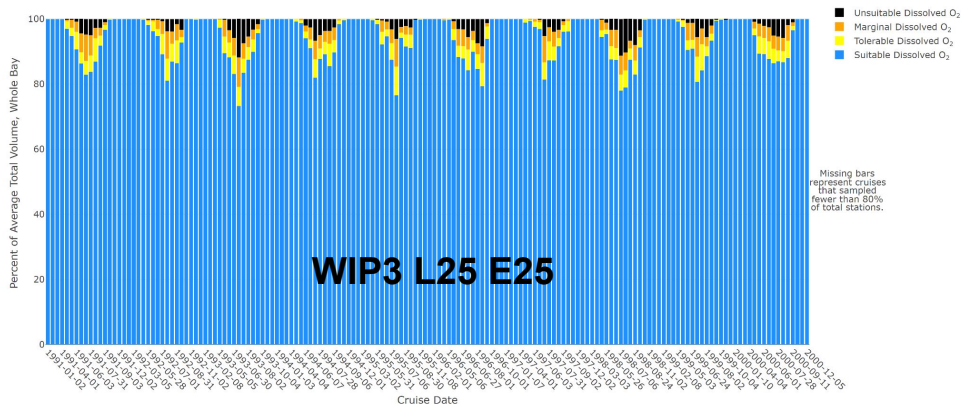
Striped Bass DO Volume by Cruise Model Base 1991-2000 Whole Bay



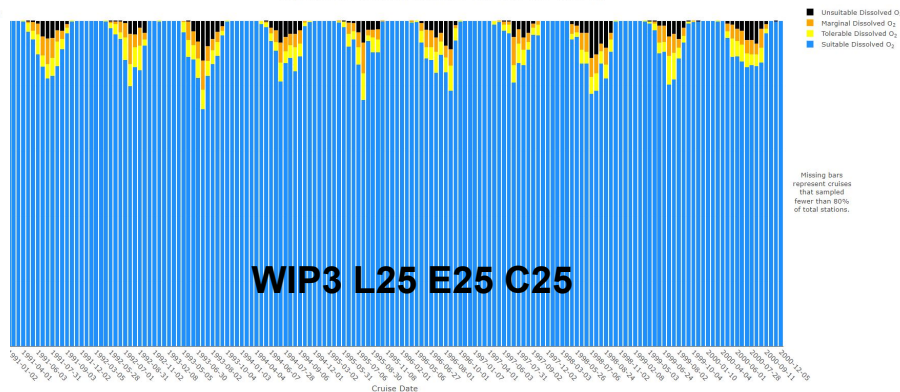
Striped Bass DO Volume by Cruise CC25 1991-2000 Whole Bay



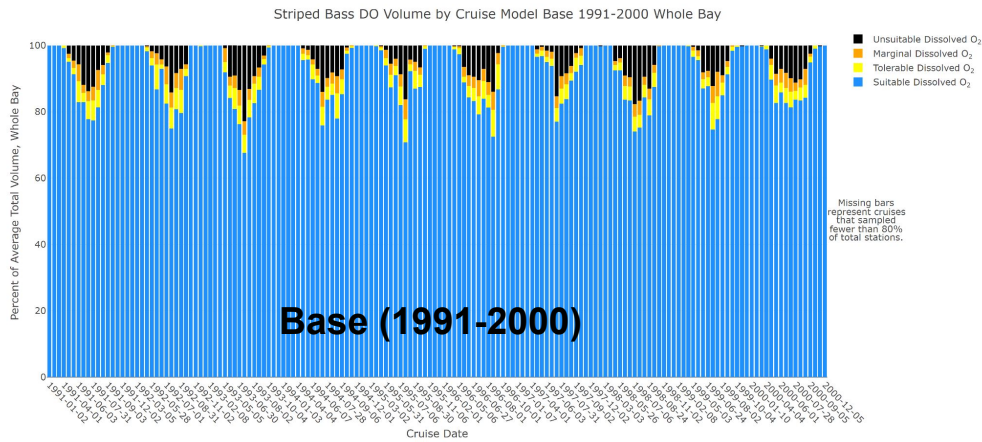
Striped Bass DO Volume by Cruise WIP 1991-2000 Whole Bay



Striped Bass DO Volume by Cruise WIP CC25 1991-2000 Whole Bay



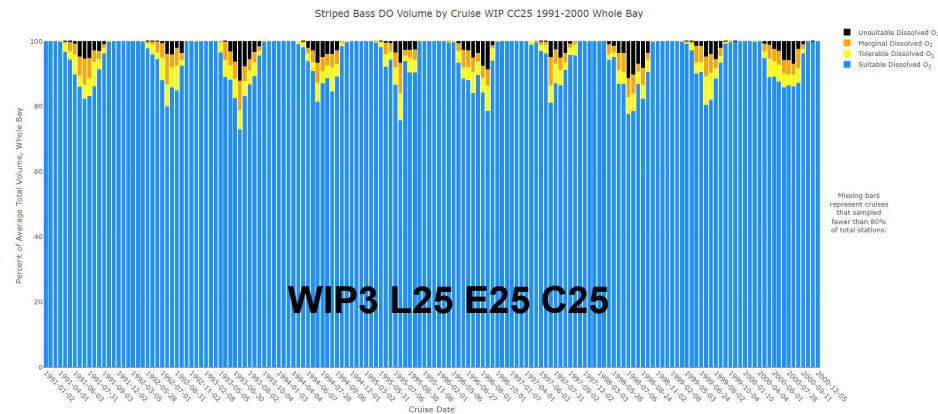
Note: Provisional Data



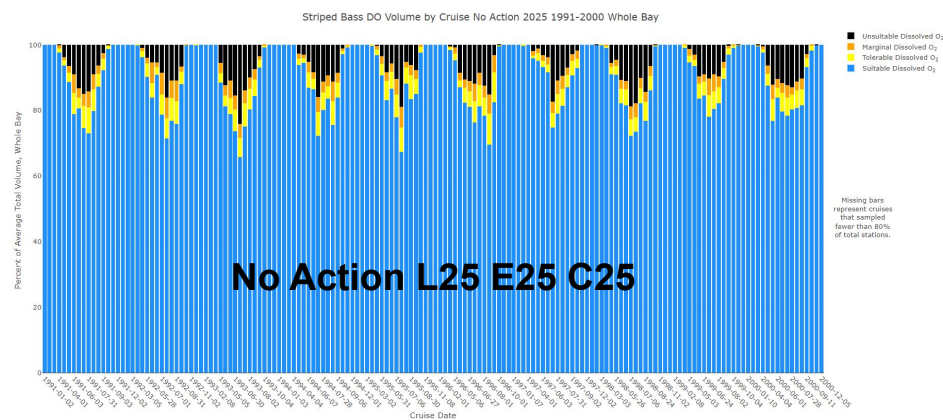
Dissolved Oxygen - Whole Bay



Where we were



Where we want to be in 2025

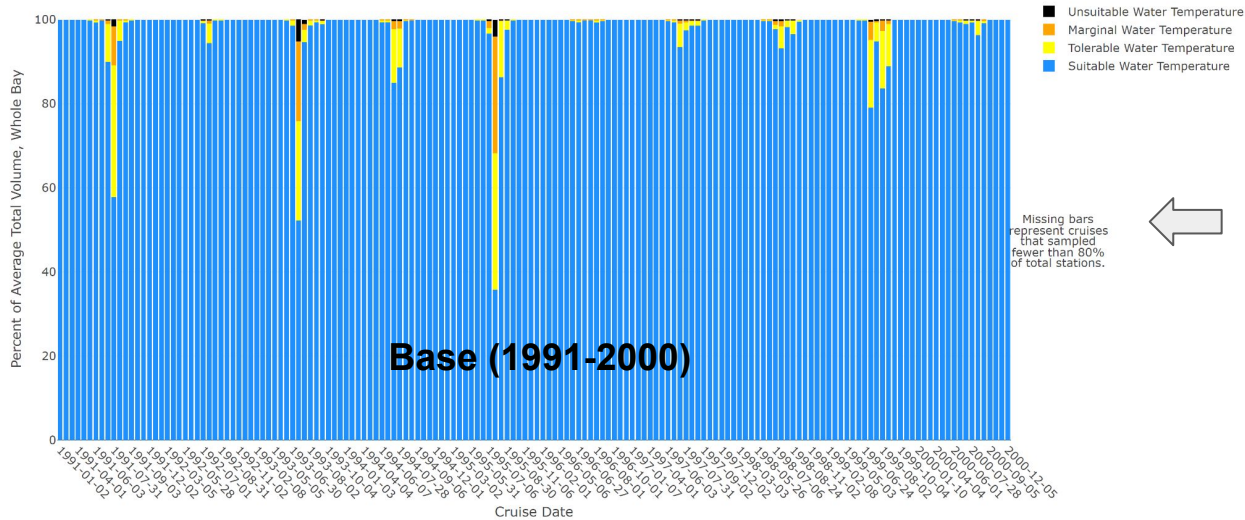


Where we would be in 2025
with no Bay Program

Note: Provisional Data

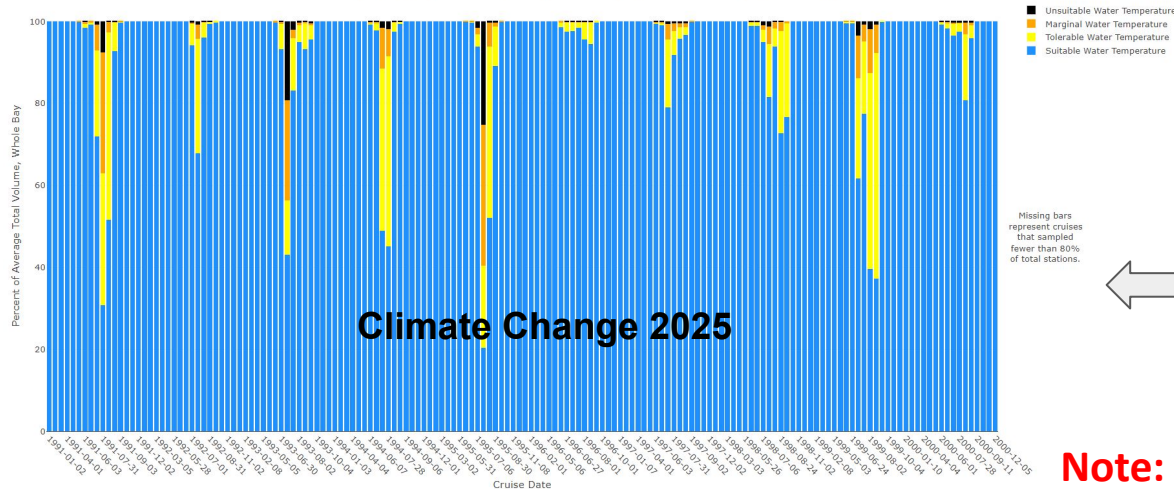
Water Temperature - Maryland

Striped Bass Water Temperature Volume by Cruise Model Base 1991-2000 Whole Bay



Where we were

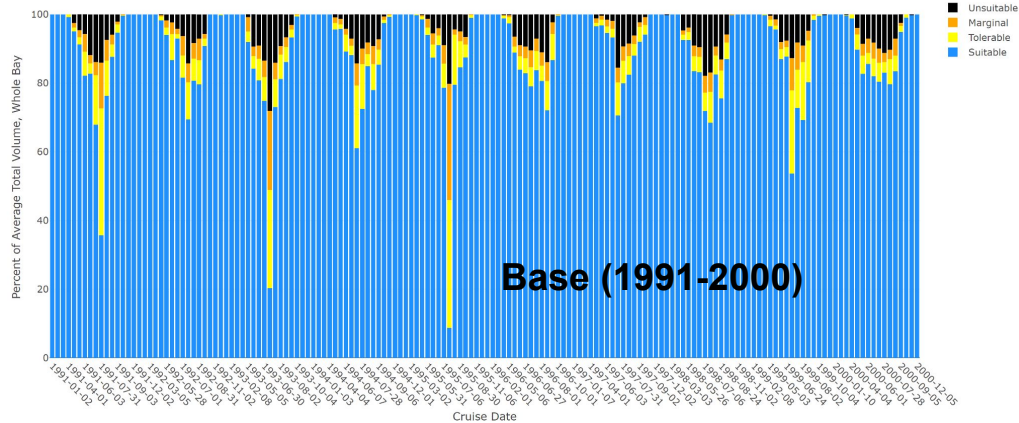
Striped Bass Water Temperature Volume by Cruise CC25 1991-2000 Whole Bay



Where we about are

Note: Provisional Data

Striped Bass Habitat Volume by Cruise Model Base 1991-2000 Whole Bay

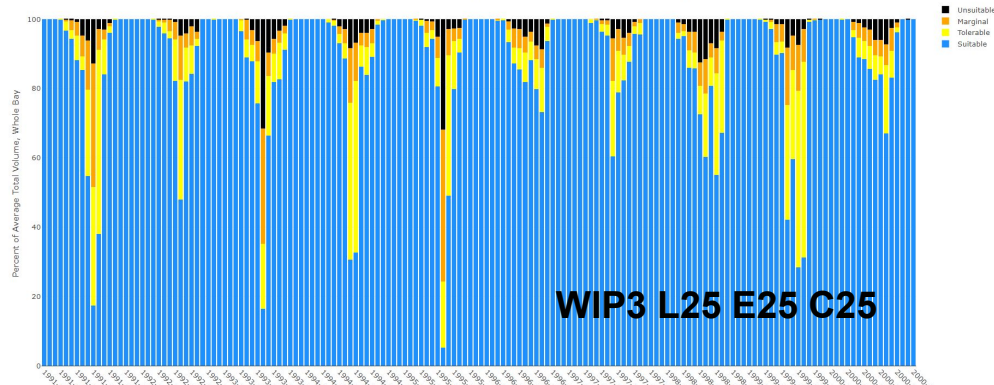


Habitat - Whole Bay



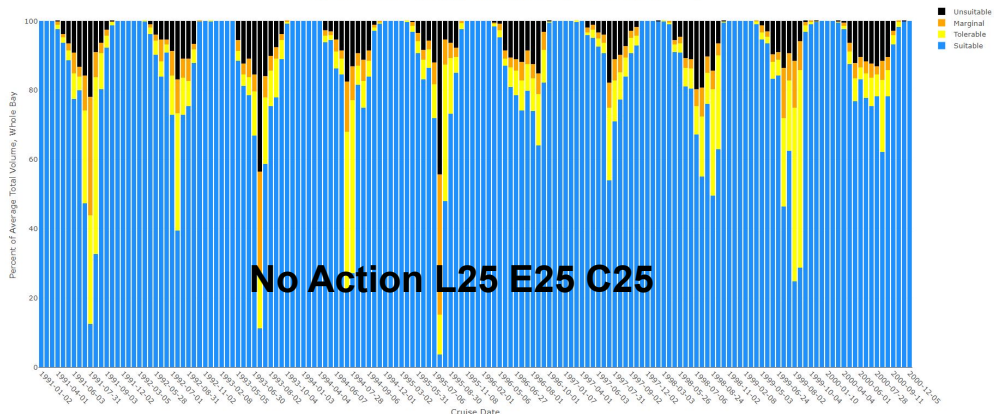
Where we were

Striped Bass Habitat Volume by Cruise WIP CC25 1991-2000 Whole Bay



Where we want to be in 2025

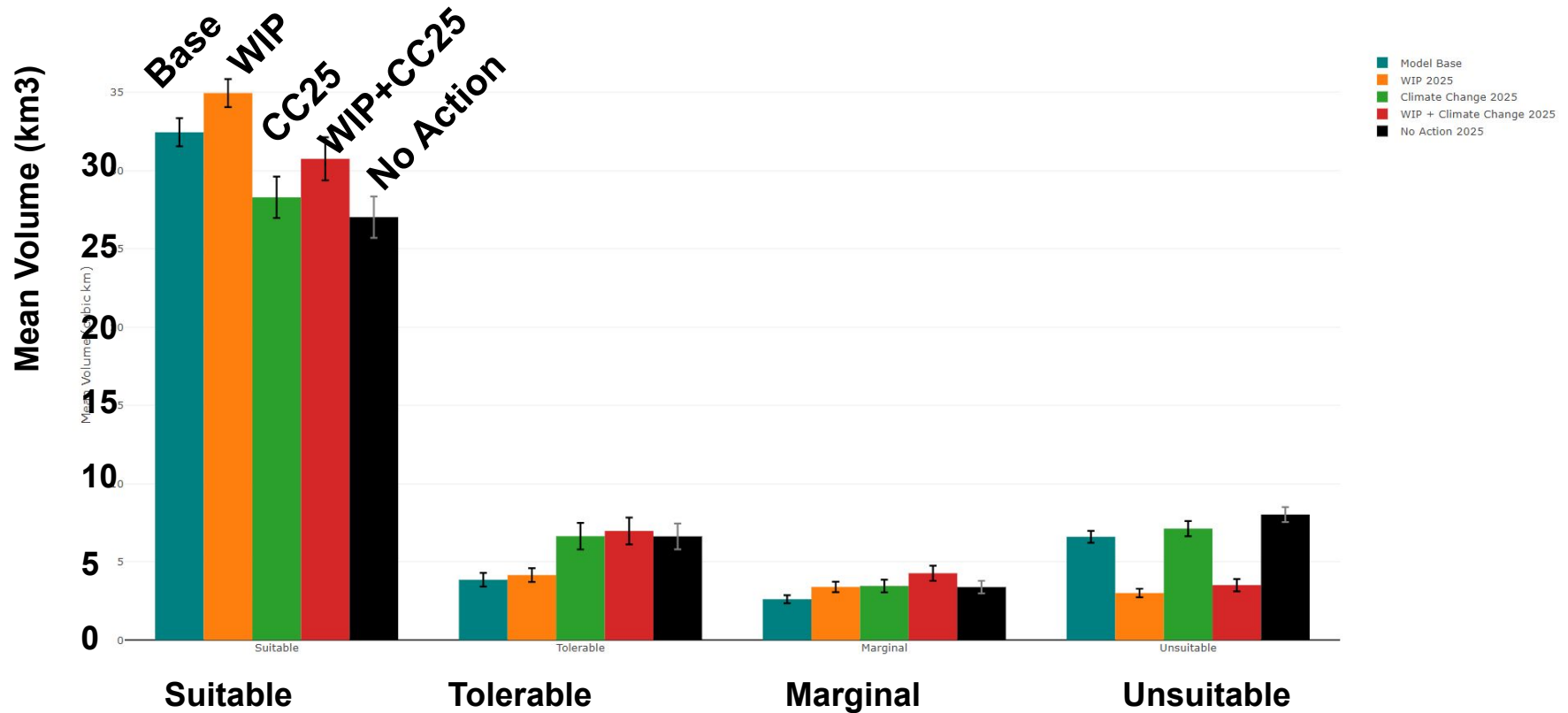
Striped Bass Habitat Volume by Cruise No Action 2025 1991-2000 Whole Bay



**Where we would be in 2025
with no Bay Program**

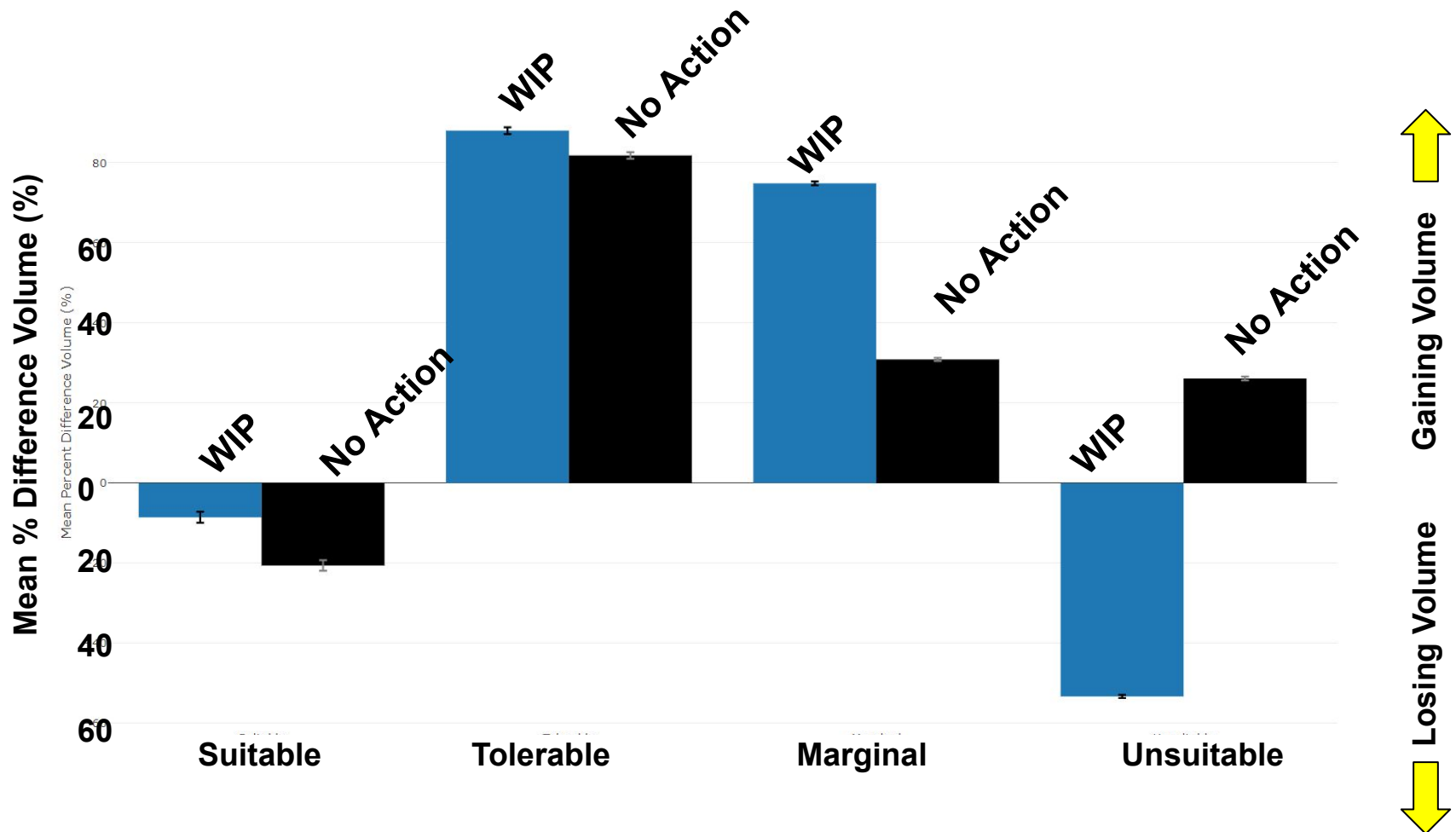
Note: Provisional Data

Mean June-August Bass Habitat Volume (Maryland waters)



Note: Provisional Data

Mean Difference from Base conditions for Striped Bass Habitat Volume (MD waters)



Note: Provisional Data

Draft Summary

- Revised DO and Water temperature related habitat threshold for resident Chesapeake Bay striped bass
- Habitat and Water temperature both had significant worsening changes (frequency and duration) for 2011-2020 during June through August
- Gains in oxygenated habitat from WIP actions are offset by increasing water temperatures
- We are working to be able to answer the following about striped bass habitat:
 - Current volume
 - WIP 2025 volume
 - No Bay Program volume
 - Climate change impacts at 2025 and 2055

Next Steps

- Continue long-term trend analysis for Bay segments
- Continue work with Chesapeake Bay Program (CBP) modelers to continue to assess Bay conditions for striped bass in relation to various Bay restoration/climate scenarios.
- Assess impacts of changing habitat conditions to key fishing locations

Questions?



*Special thanks to **Maryland DNR** and **Virginia DEQ** Bay monitoring, data management and analysis folks. In addition, special thanks to **Maryland DNR Fisheries staff***