Developing Water Temperature & Dissolved Oxygen Thresholds for Striped Bass Summer Habitat in Maryland's Portion of the Chesapeake Bay

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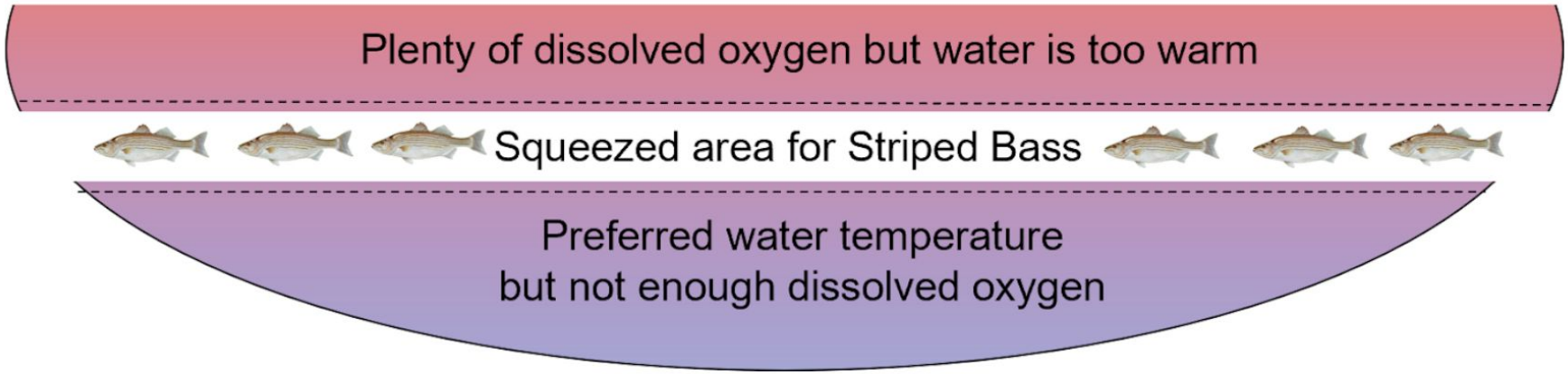
Overview

- Striped bass squeeze and impacts for management
- Existing striped bass thresholds or targets
- Revising thresholds
- Applying revised thresholds to Maryland's Chesapeake Bay waters
- Next steps

Striped Bass Squeeze

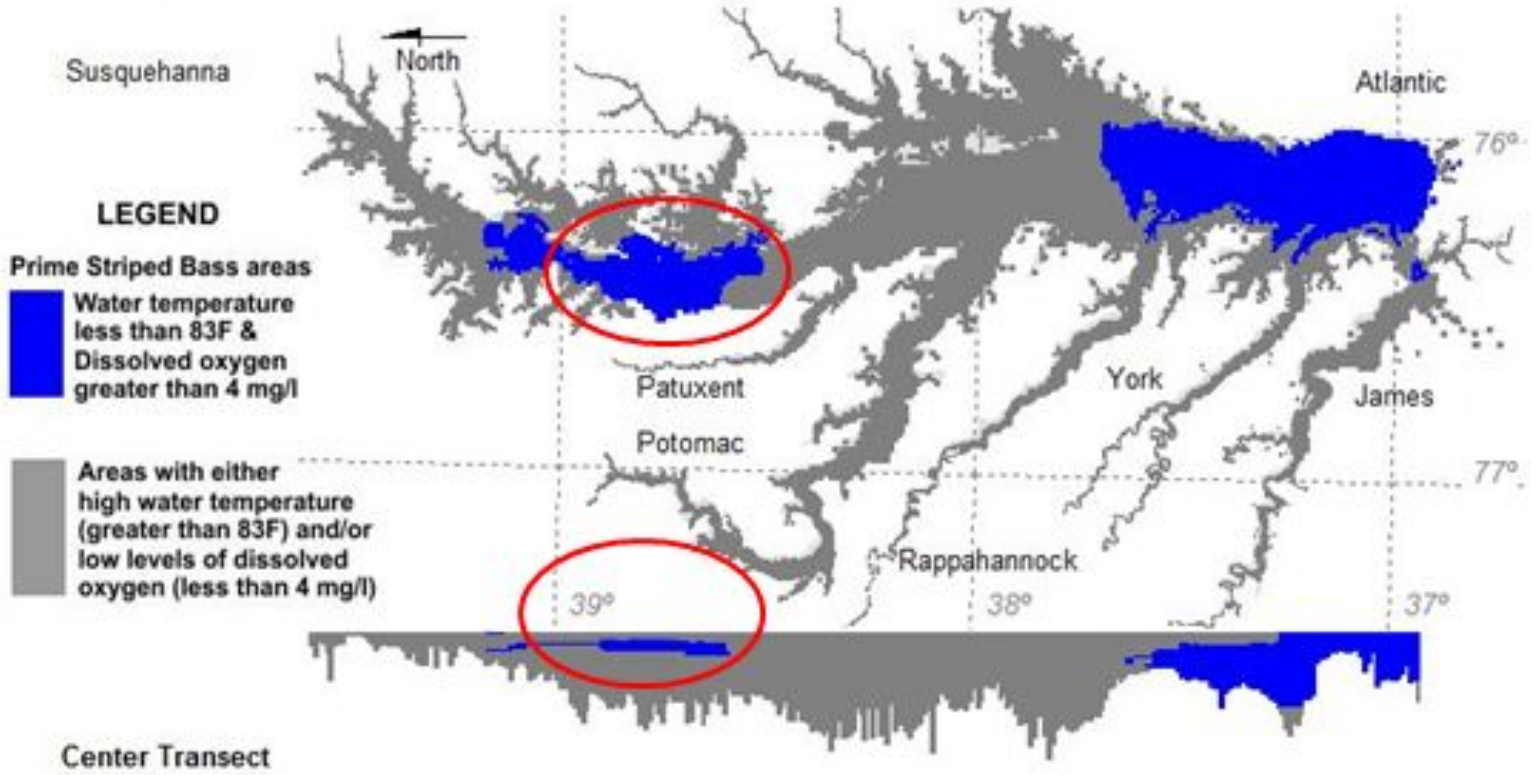
In warmer summer months, elevated surface water temperatures and increasing amounts of oxygen poor bottom waters force striped bass into a very narrow band of cooler water with adequate oxygen.



Common Summertime Location of Rockfish schools

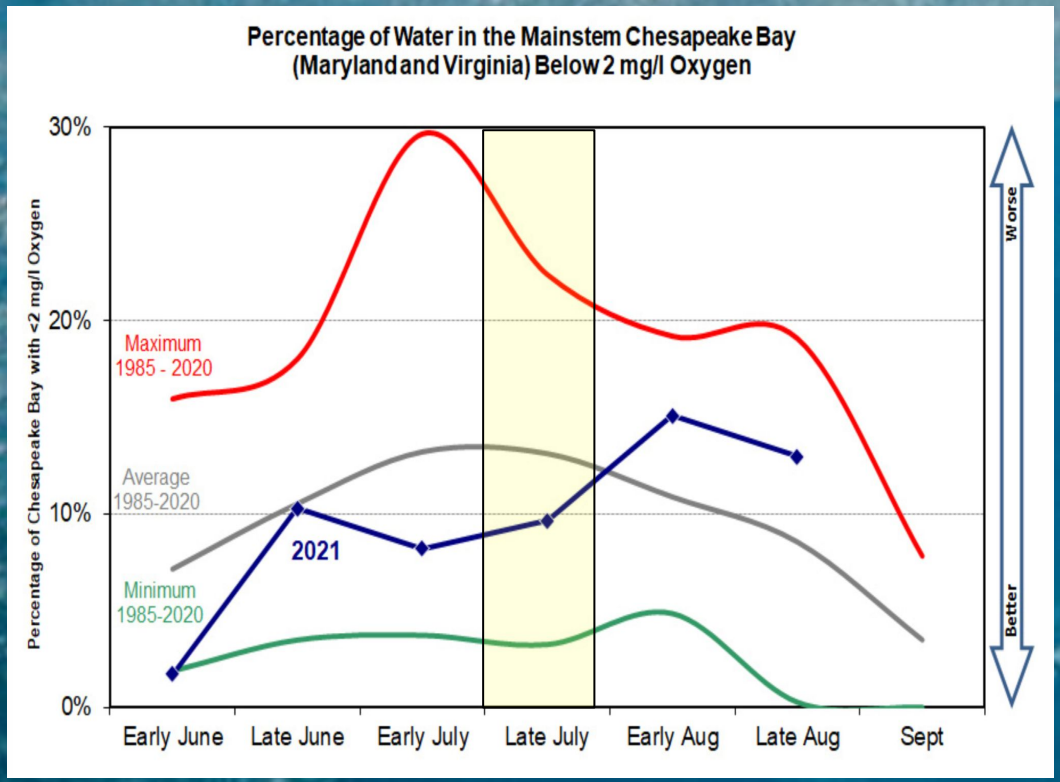
Coolest water with suitable oxygen for Striped Bass

August 8-10,2016

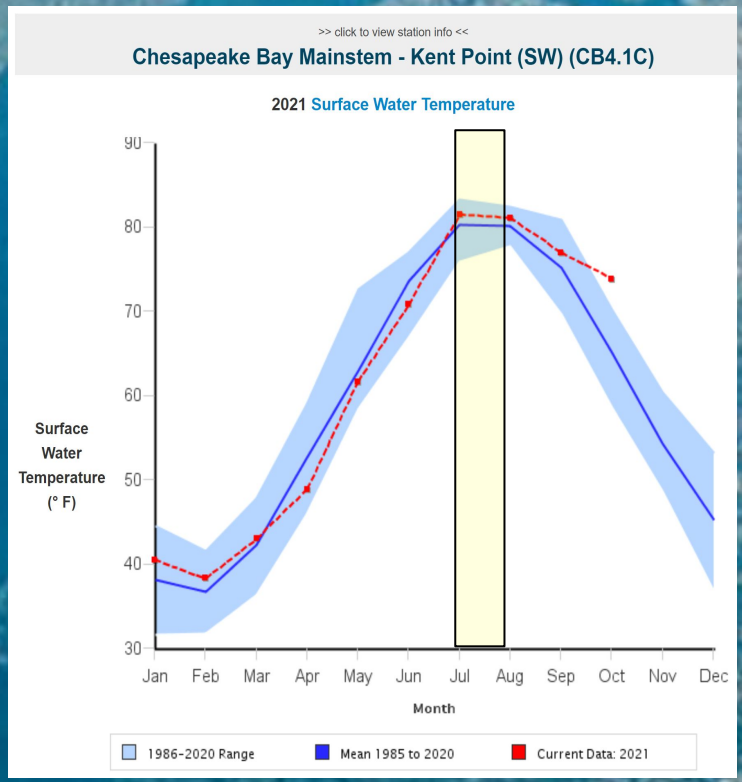


Impacts for Management

Hypoxia (Low Oxygen)



Water Temperature



Some Striped Bass Studies with Thresholds or Targets

- **The DO target of ≥ 5 mg/L or greater that are considered desirable** for many Chesapeake Bay living resources and have been adopted into the Chesapeake Bay states – Maryland, Virginia, and Delaware – and the District of Columbia's water quality standards regulations. In addition, **DO ≤2 mg/l were considered to produce lethal effects**
- **Striped bass mortalities due to limited availability of cool > 25°C, oxygenated water (<2 mg/l)** (Coutant, 1985)
- Modified (Coutant, 2013) 30**°C with no mortality**
- (Hartman and Brandt, 1995) **28°C can have negative impacts**
- (Kraus, Secor and Wingate, 2015) **Striped bass avoided DO ≤ 2 and occupied +28°C water**

Revising Chesapeake Bay Striped Bass Habitat Thresholds for Oxygen & 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
- The following factors (stressors) influencing temperature tolerance were not included: Feeding, Mycobacteriosis, Salinity and Catch & Release.

Striped Bass Habitat Condition Categories

- **Suitable** - Supports "normal" occupancy with growth potential
- **Tolerable** - Supports occupancy for a modest period of time with limited growth potential (~1 month)
- **Marginal** - Supports occupancy for a short period with little or no growth potential (Just passing through)
- **Unsuitable** - Not suitable conditions experiencing either hypoxia or excess water temperature

Assembling the Revised Habitat Thresholds for Oxygen & Water Temperature

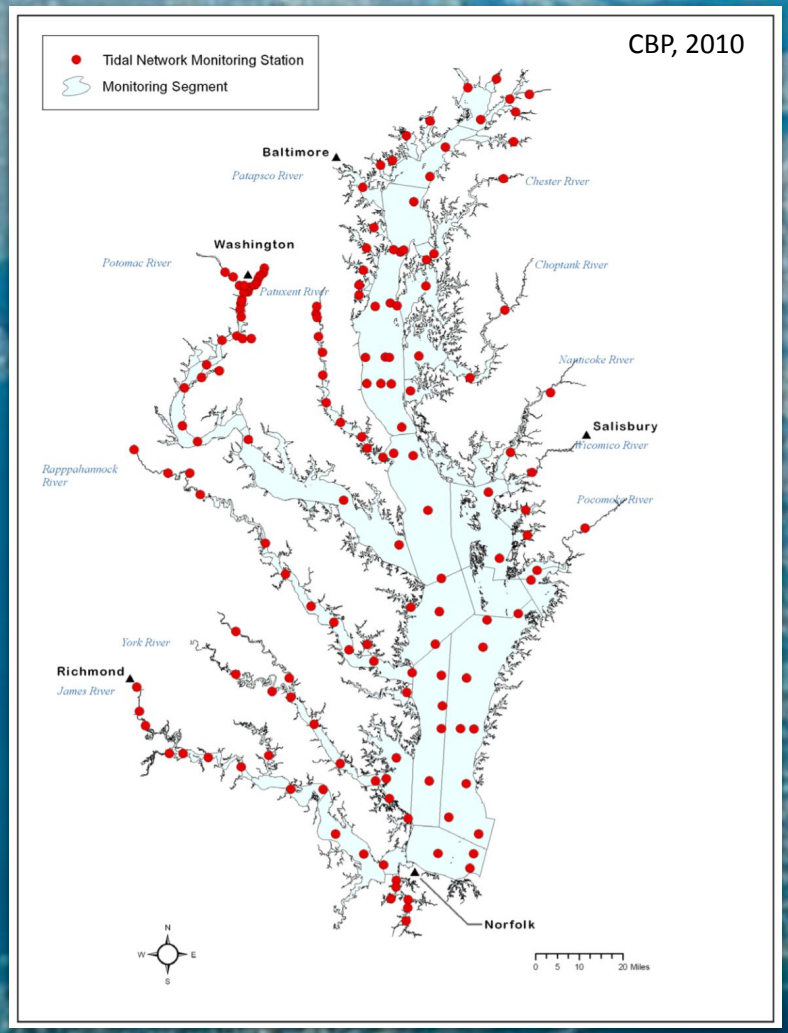
- Reviewed over a dozen relevant papers including bioenergetic models, direct observations, telemetry and others were reviews of other studies
- Some focused on DO, others water temperature and some both DO and water temperature
- Most were Chesapeake Bay based, others were based on reservoir studies
- Many were focused on a variety of different sized striped bass
- Information pulled from these studies focused on Chesapeake Bay resident-sized striped bass

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

- **Suitable** - DO ≥4 mg/l, WT ≤ 82.4°F (28°C)
- **Tolerable** - DO 4 mg/l < ≥3 mg/l, WT 82.4°F(28° C)<≥ 84.2°F (29°C)
- **Marginal** - DO 3 mg/l <≥ 2 mg/l, WT 84.2°F (29° C)<≥ 86°F (30°C)
- **Unsuitable** - DO < 2 mg/l, WT > 86°F (30°C)

Application of Habitat Thresholds

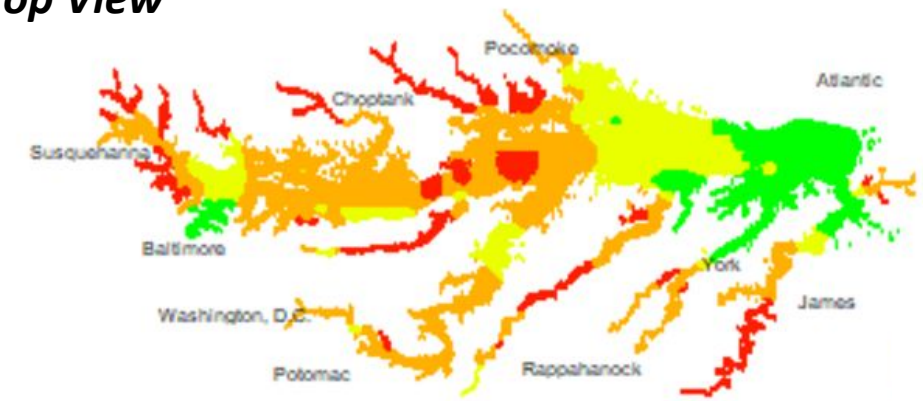
- The revised thresholds were applied to the Chesapeake Bay long-term and shallow water monitoring data collected over 160 cruises occurring between 2010 and 2020.
- Monitoring data was interpolated to create monthly three-dimensional recreations of Chesapeake Bay water temperature and dissolved oxygen conditions.
- A total of 165 of these stations were kept for this analysis.



Chesapeake Bay Striped Bass Habitat Conditions

Summary – July 15-31, 2019

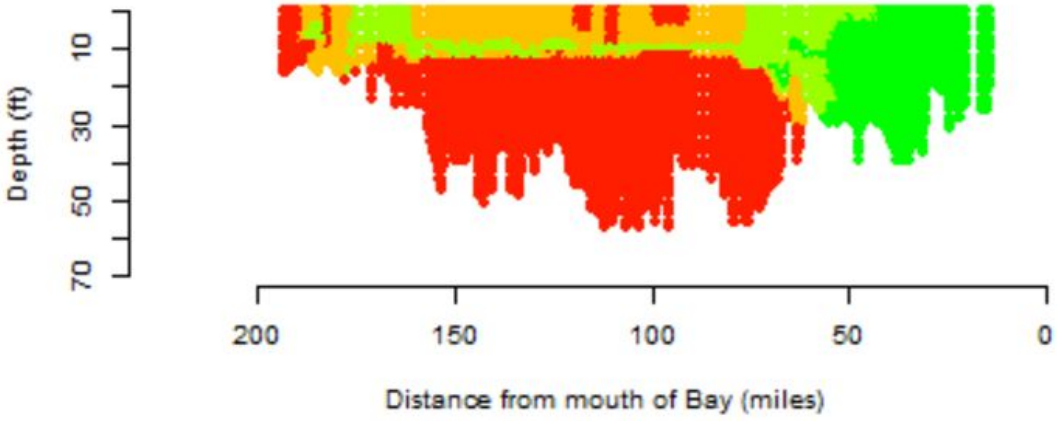
Top View



Habitat Conditions

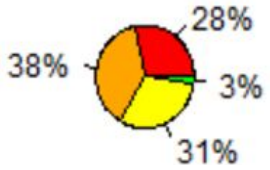
Suitable - Supports "normal" long-term occupancy with growth potential
Tolerable - Supports occupancy for a modest period of time, ~ 1 month, with limited or negative growth potential
Marginal - Supports very brief occupancy with little impact on growth potential
Unsuitable - Does not support occupancy

Side View

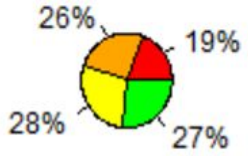


Habitat Quality (%)

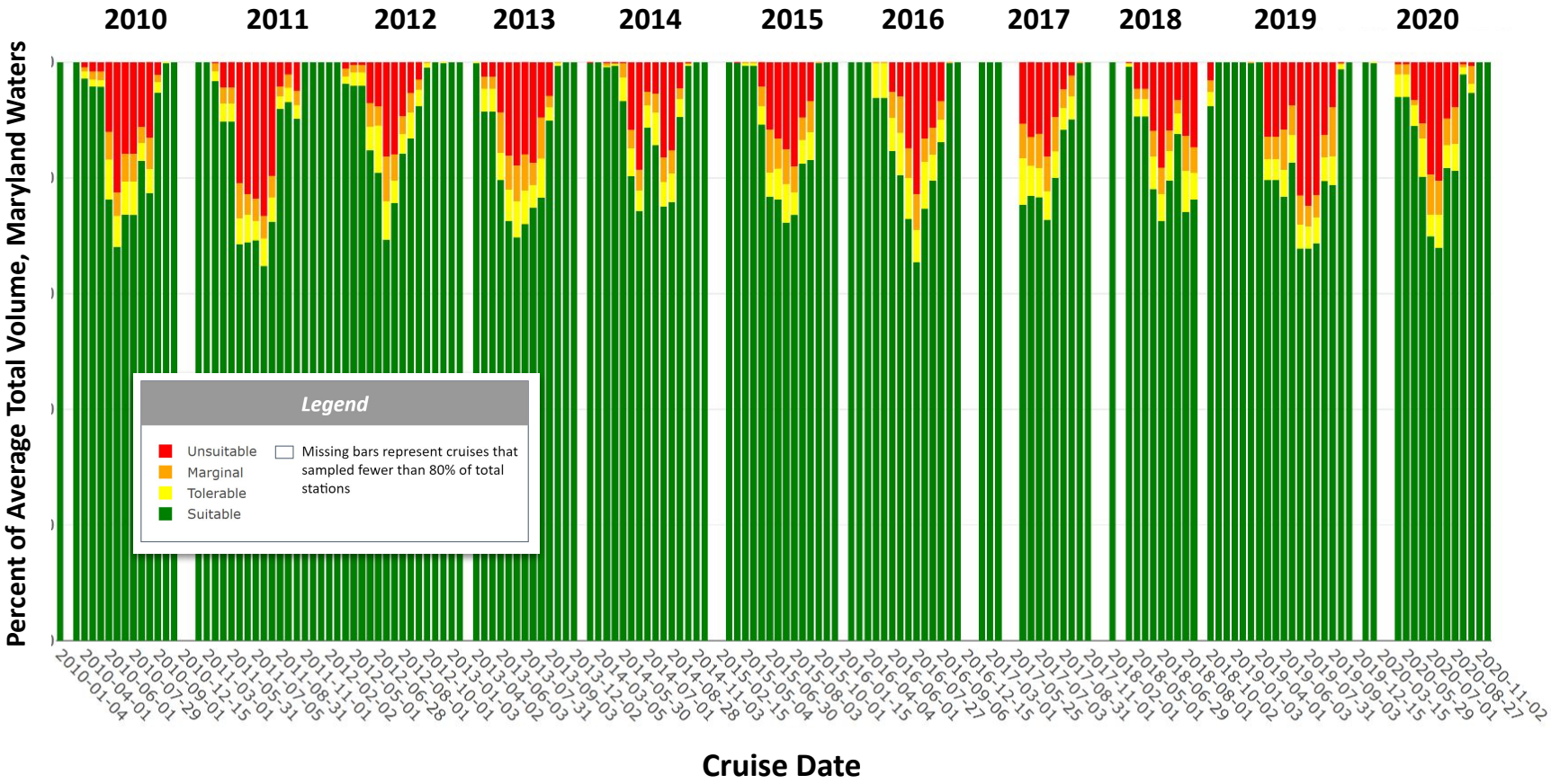
Maryland



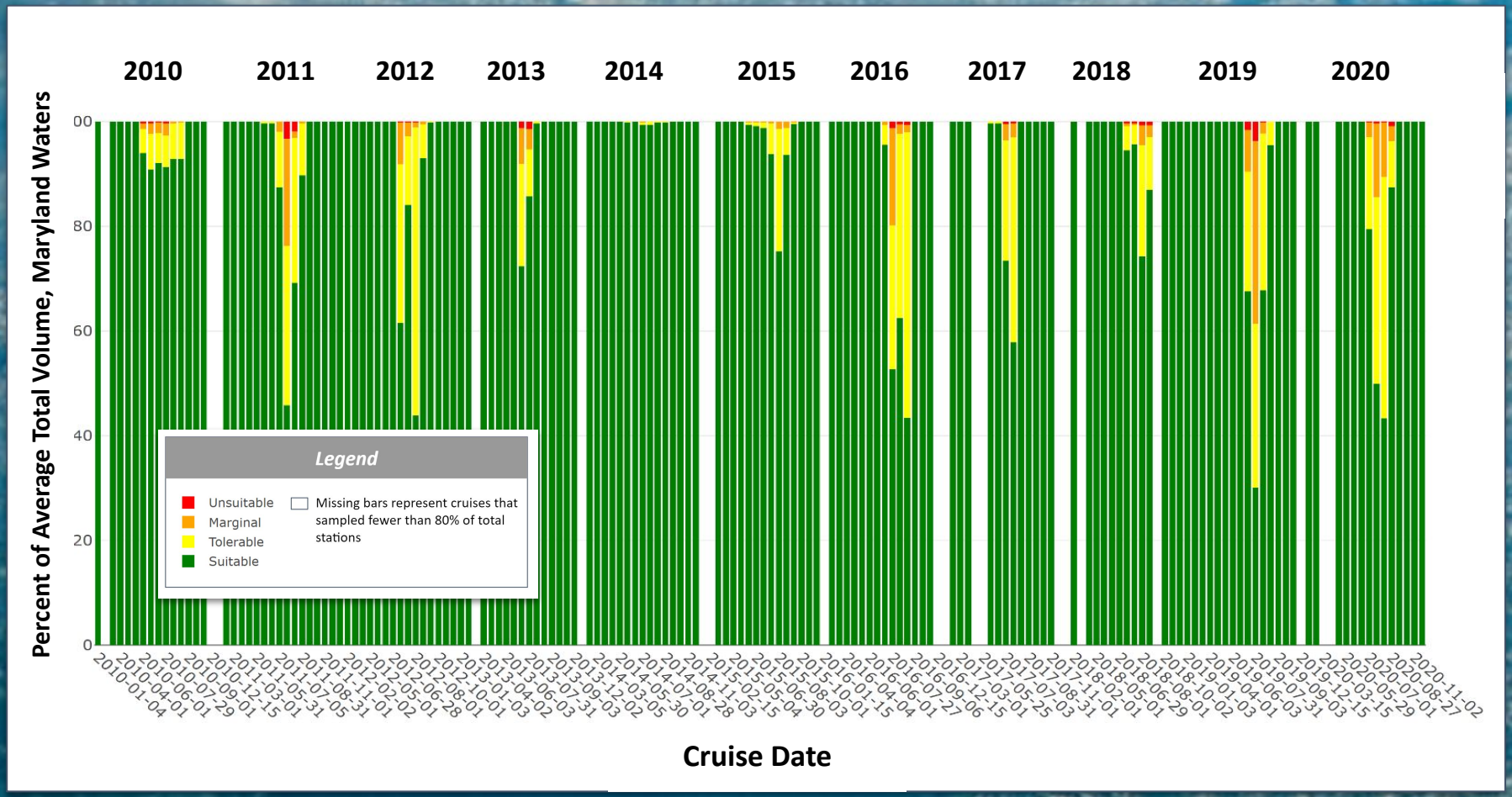
Baywide



Striped Bass Habitat Volume by Cruise
Dissolved Oxygen (2010-2020)



Striped Bass Habitat Volume by Cruise
Water Temperature (2010-2020)



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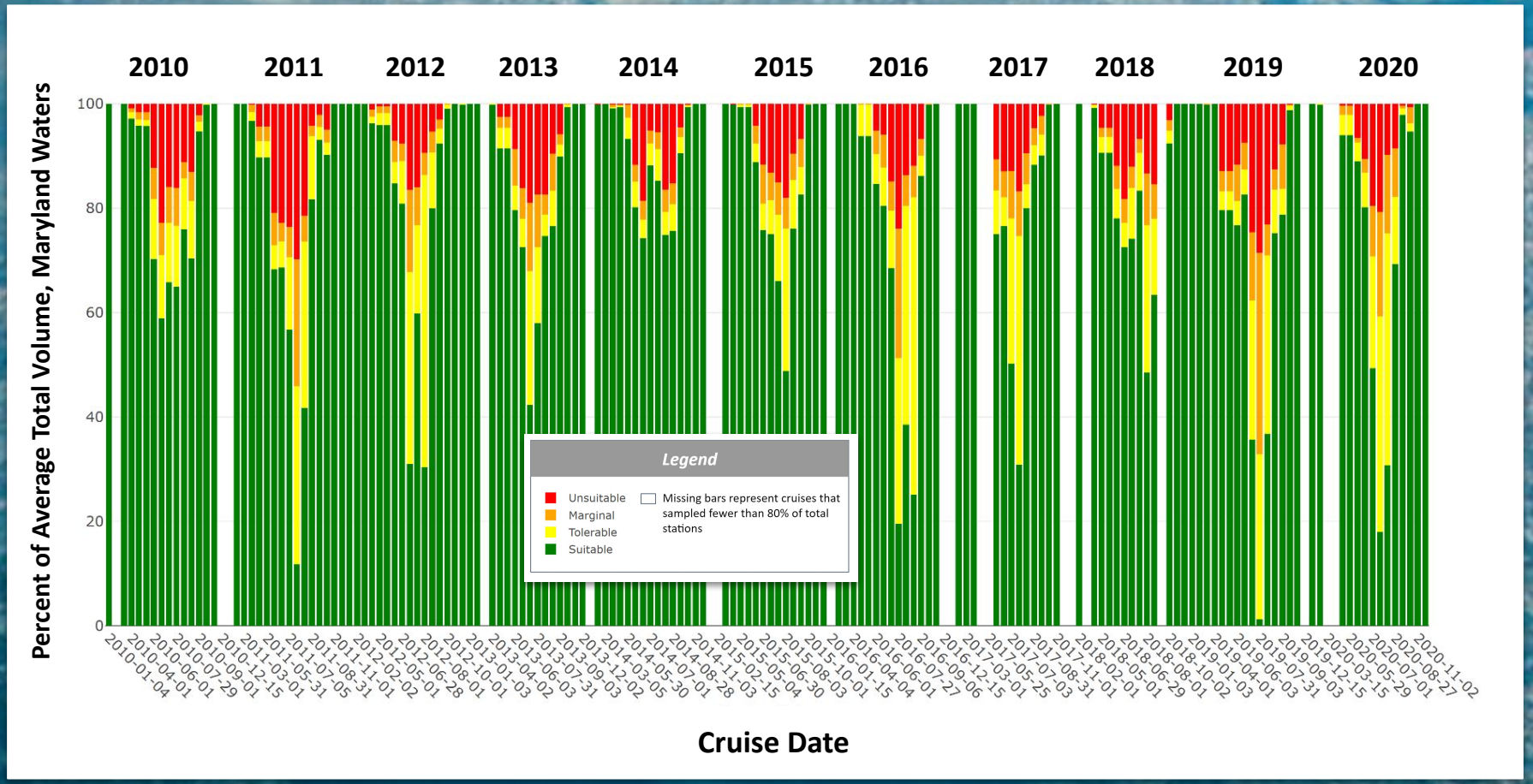

Next Steps

- Incorporate comments from reviews
- Extend dataset back to 1986 then run long-term trends of striped bass habitat for Bay segments
- Work with Chesapeake Bay Program (CBP) modelers to assess Bay conditions for striped bass in relation to various Bay restoration/climate scenarios to determine percent improvement since 1985 or current conditions, etc.
  - *Objective will be to answer **"How much more suitable habitat will a restored Bay provide?"***
- 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***

Proposed Chesapeake Bay Striped Bass Habitat Thresholds for Oxygen & Water Temperature

Temperature (˚C)	Synthesis	Hartman and Brandt, 1995	Kraus et al. 2015	Constanti et al. 2008	Coutant 2013	Groner et al. 2018	Itakura et al. 2021
Study Type		Bioenergetics (Model)	Observations & energetics	Observation, Lab (DO), bioenergetics	Review of 20 years, multiple studies, 24 locations	Mycobacteriosis & warming water temperatures	Telemetry tracking
Suitable	28	28	Mean 28.4-29.2	28	28	27	27-28
Tolerable	29	29 (inflection)	for both		29		29
Marginal	30	30	31		30		31
Unsuitable	>30	>30	>31		>30		>31
Dissolved Oxygen (mg/L)							
Suitable	4	N/A	Mean 5.6-6.6	4-4.5	4		5+
Tolerable	3	N/A	for both	3	3		<5
Marginal	2	N/A		1	2		
Unsuitable	<2	N/A	<2	< 1	<2	<3	<2