# Impacts of changing Bay habitat conditions on Summertime Resident Chesapeake Bay Striped Bass Habitat

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MARYLAND DEPARTMENT OF NATURAL RESOURCES

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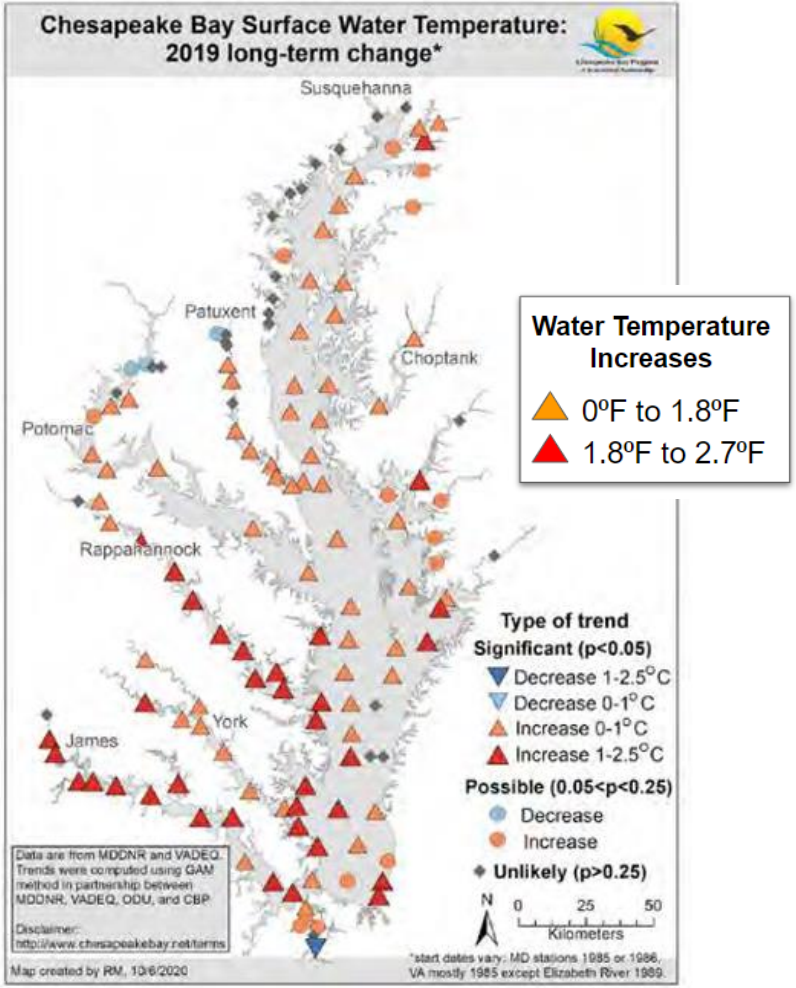



# A Changing Chesapeake Bay

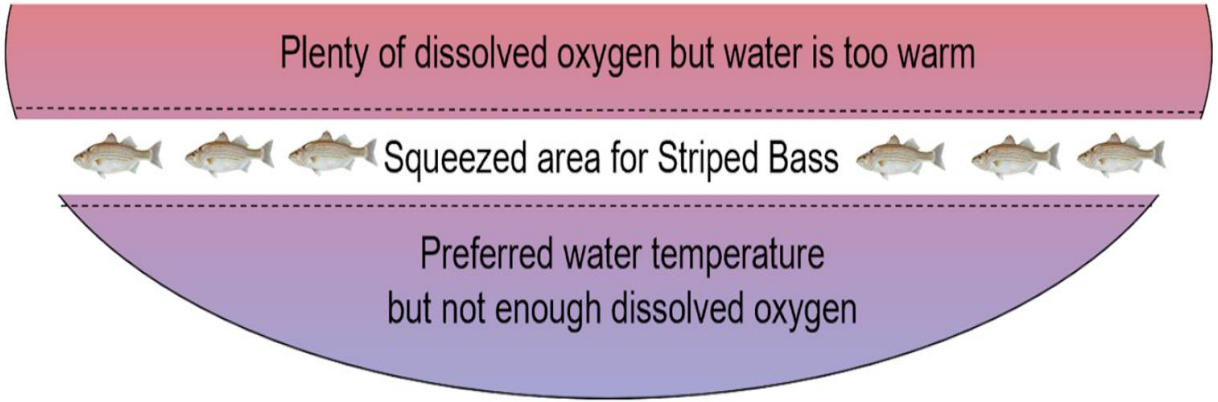
## Climate Change Impacts

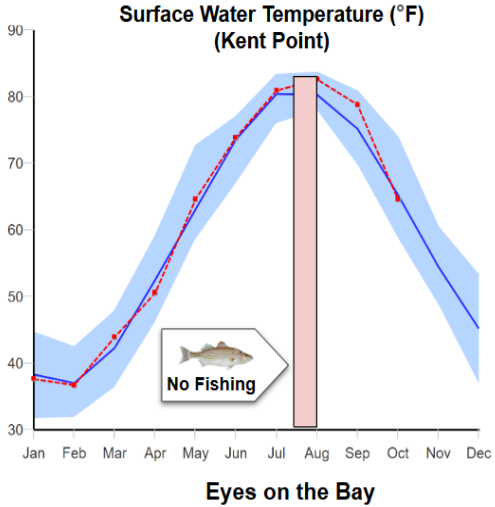
- Bay water temperature increasing over last three decades - Most Bay stations showing between 1° to 2°F increase since 1985. Increases are not consistent throughout water column (R. Murphy, 2020)
- Marine heat waves becoming more frequent in Bay waters *(Mazzini and Pianca, 2021)*

## Nutrient and Sediment Reduction

- Since the 1980's and more aggressive recently, Bay States have been working to reduce excess nutrients and sediment to increase available oxygen for Bay organisms and clearer water for SAV.

# Striped Bass Squeeze



# Determining Summer Habitat Thresholds for Resident Striped Bass

- To assess habitat conditions, we needed to develop dissolved oxygen (DO) and water temperature requirements (WT) for “typical” harvestable resident fish during worst habitat conditions (June - August)
    - Smaller fish are more tolerant of poor water quality and larger fish are less tolerant
- We developed Chesapeake Bay specific requirements for resident striped bass using results from scientific literature: Bioenergetics models, direct observation, tagging, telemetry, and literature reviews.
    - Mostly studies were Bay specific with some SE reservoir studies
- Four habitat categories: Suitable, Tolerable, Marginal, and Unsuitable

# Chesapeake Bay Striped Bass Thresholds for Dissolved Oxygen (DO) & Water Temperature (WT)

**Suitable** - Supports "normal" occupancy and growth potential, no mortality
DO ≥4 mg/l, WT ≤82.4°F (28°C)

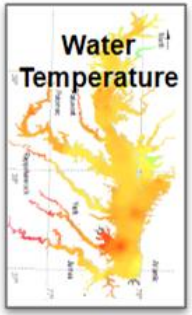
**Tolerable** - Supports occupancy for a modest period of time with limited or negative growth potential, little or no mortality (~1 month)
DO <4 mg/l & ≥3 mg/l, WT >82.4°F(28°C) & ≤84.2°F (29°C)

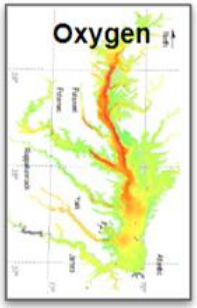
**Marginal** - Supports very brief occupancy with potential for high mortality beyond brief exposure (Just passing through)
DO <3 mg/l & ≥2 mg/l, WT >84.2°F (29°C) & ≤86°F (30°C)

**Unsuitable** - Not suitable conditions experiencing either hypoxia or excess water temperature
DO <2 mg/l, WT >86°F (30°C)

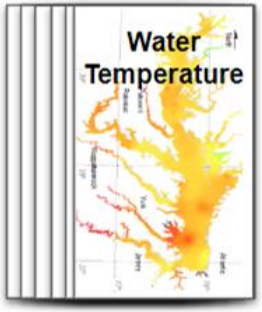
# Process for Assessing Maryland Striped Bass Habitat (DO and WT)

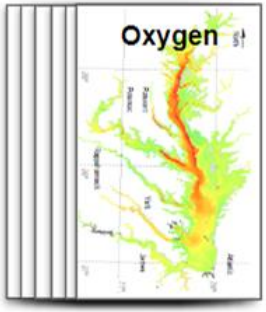
Compile Bay data from each cruise at 165 stations from 1986 to 2020



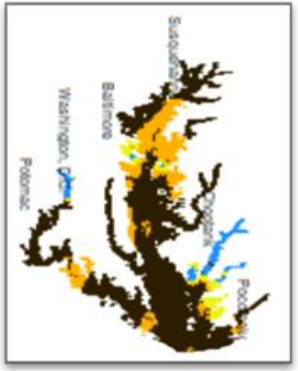

By cruise, interpolate data to create 3D Bay for Oxygen & Water Temperature




Repeat for each of the 509 cruises

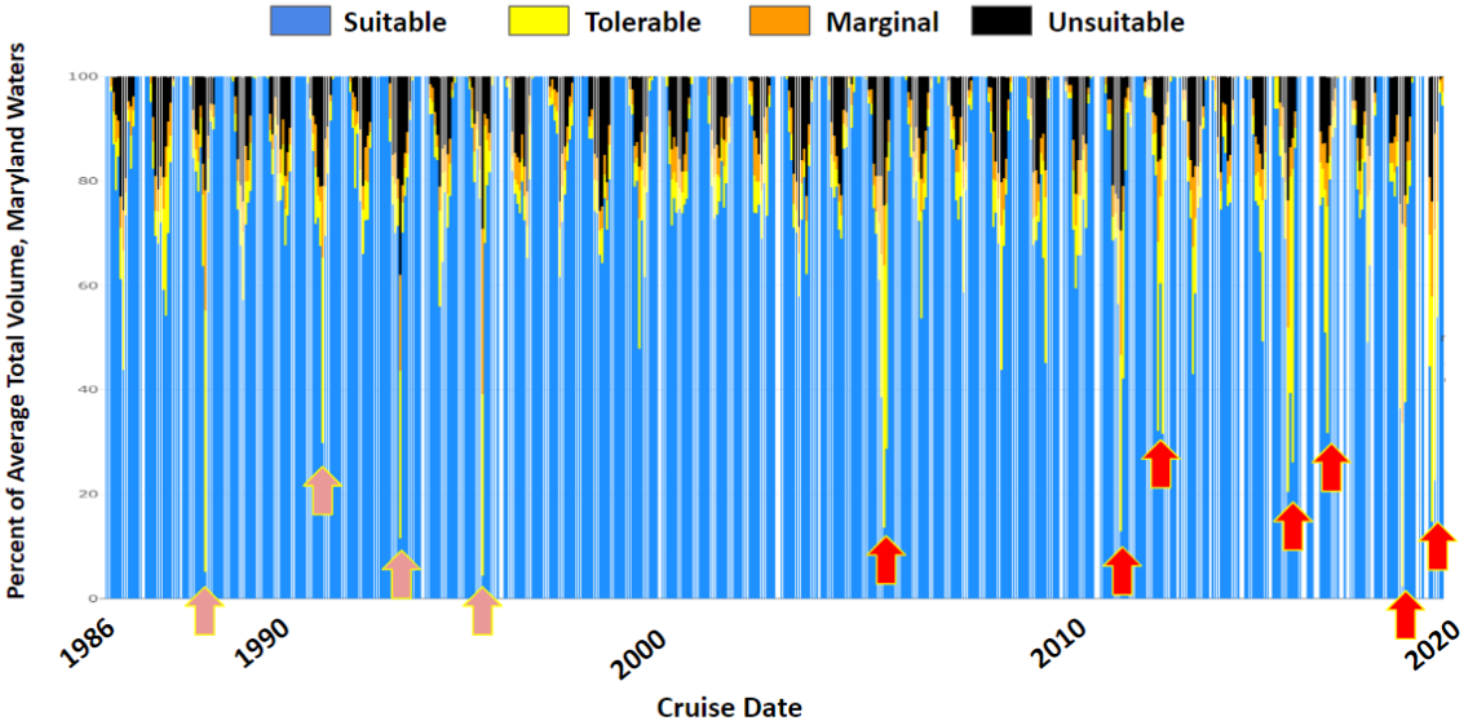

Apply Striped Bass Habitat Thresholds




Cut to Maryland Tidal Waters and then Assess Striped Bass Habitat

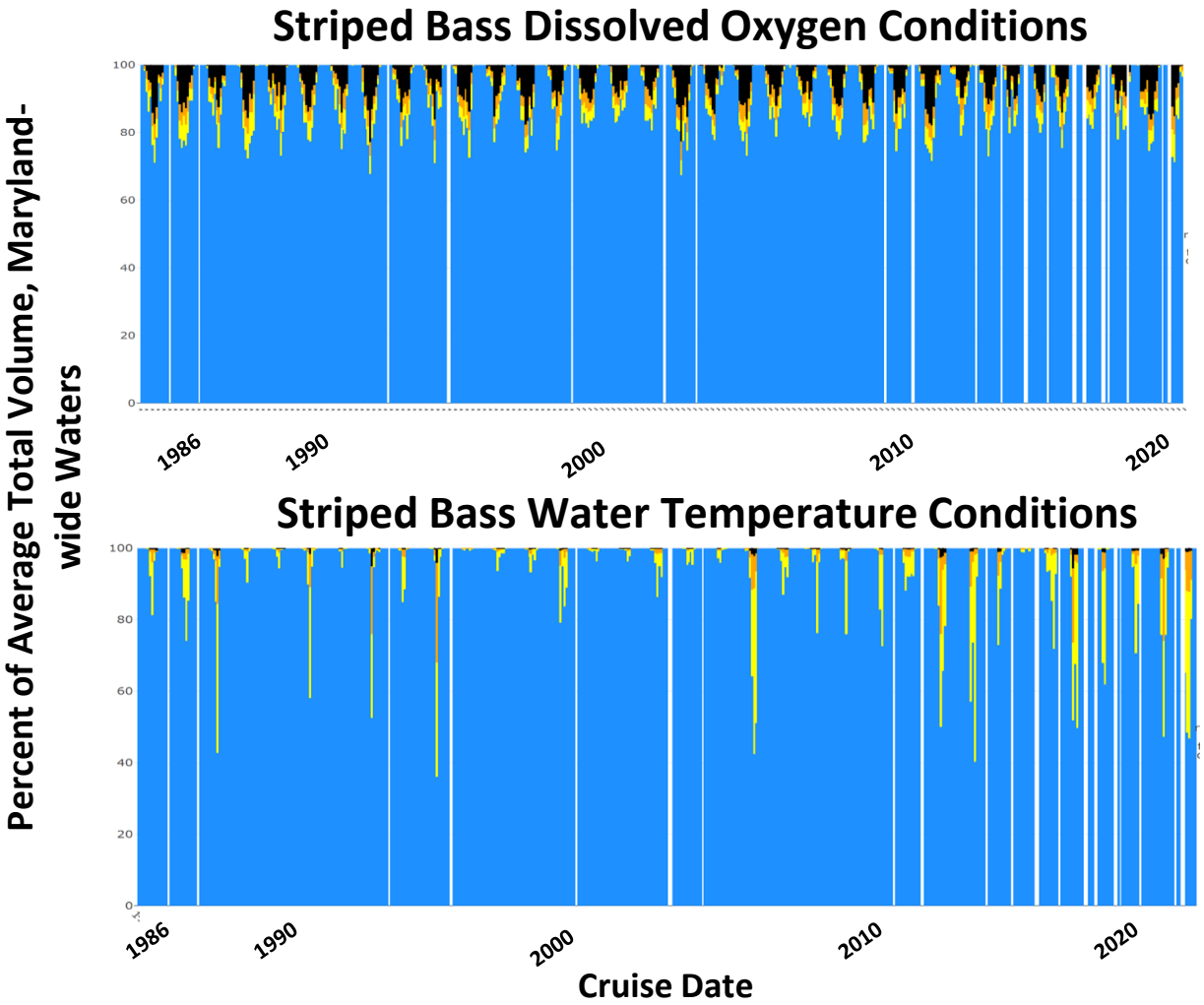
# How have resident Striped Bass habitat conditions changed since 1986?

# Maryland-wide Striped Bass Habitat Conditions




Single months of degraded conditions:1988, 1991, 1993, 1995

Consecutive months of degraded conditions: 2005, 2011, 2012, 2016, 2017, 2019, 2020




**Oxygen Summary**

- Nutrient and Sediment reduction efforts have offset warming Bay waters and increasing populations to keep oxygen conditions stable
  - Warmer water holds less oxygen, more biological activity, stratification
  - Increases in watershed population: 1980-12.7M, 2017-18.4M

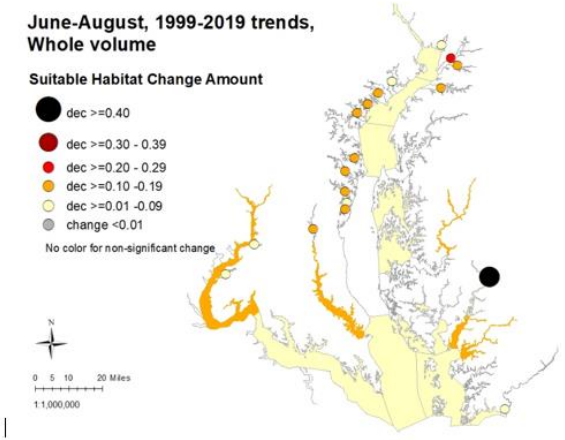
**Water Temperature Summary**

- Declining habitat conditions are primarily due to increasing water temperature

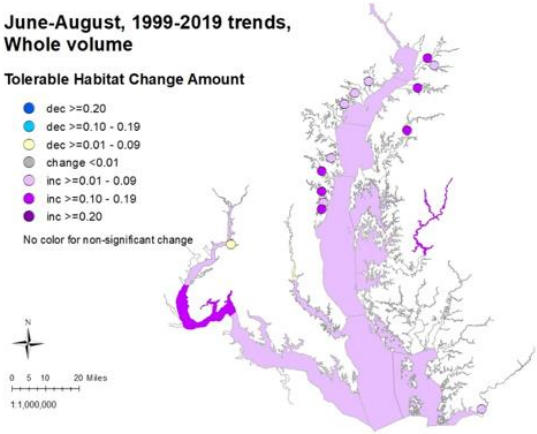
# Habitat Quality Degrading

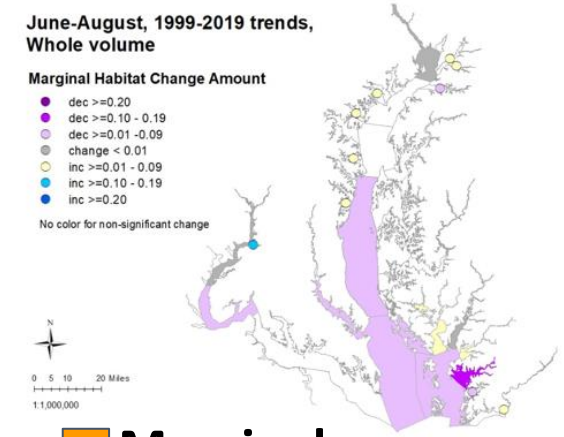
- Shifting from suitable towards Tolerable and Marginal habitat conditions

Suitable

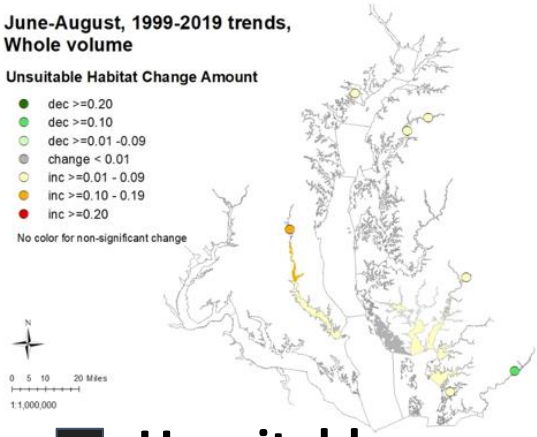



Tolerable




Marginal



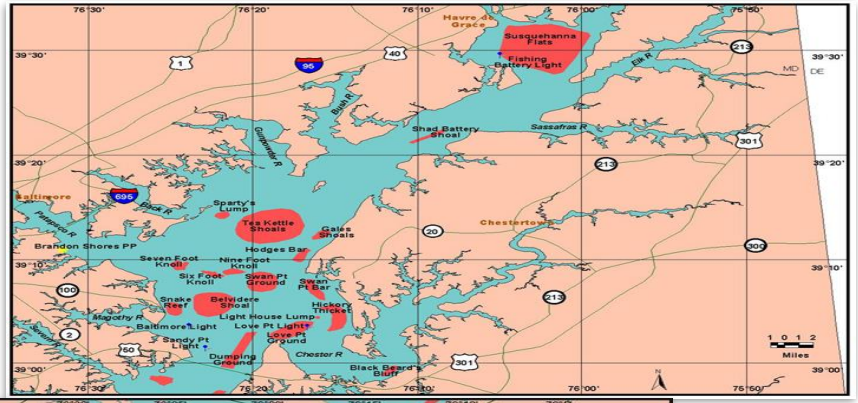

Unsuitable

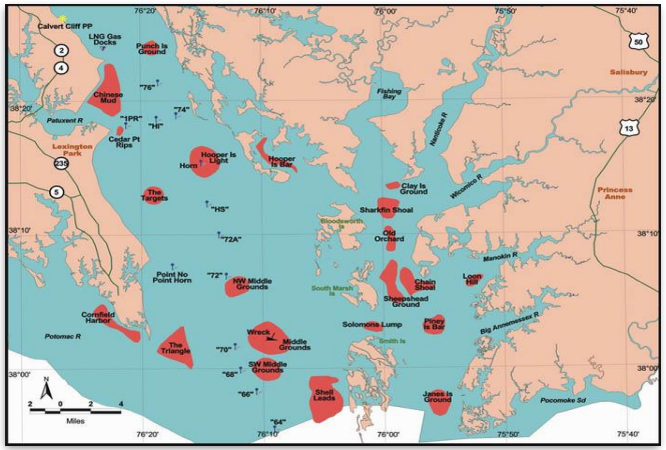
# How have resident Striped Bass habitat conditions at popular fishing locations changed since 1986?

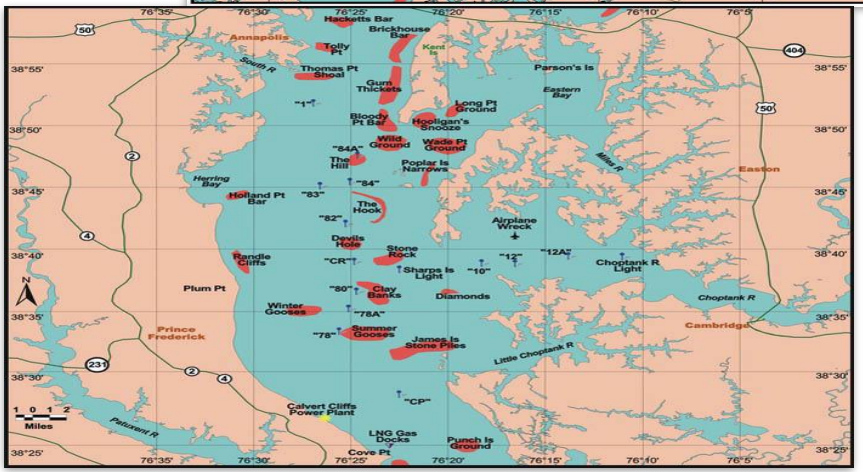
# Popular Maryland Fishing Areas

**These prime fishing areas are where fish congregate**

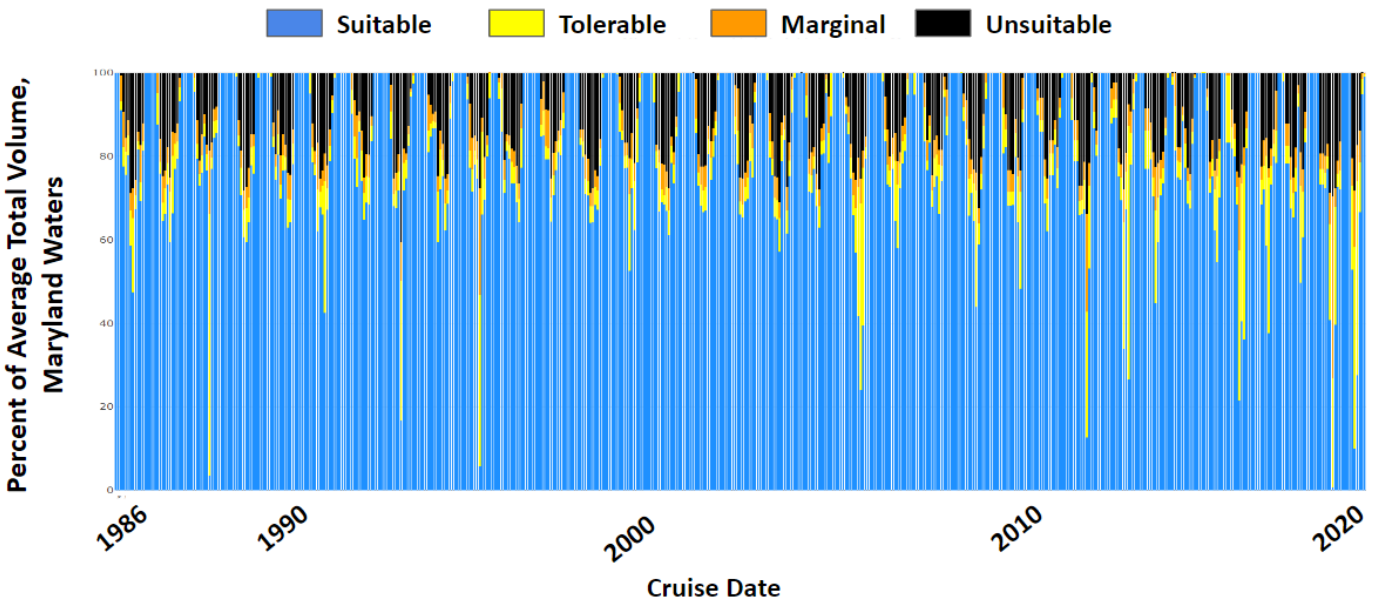
(Genovese, P. 2000)



# Habitat Conditions at Popular Maryland Fishing Areas



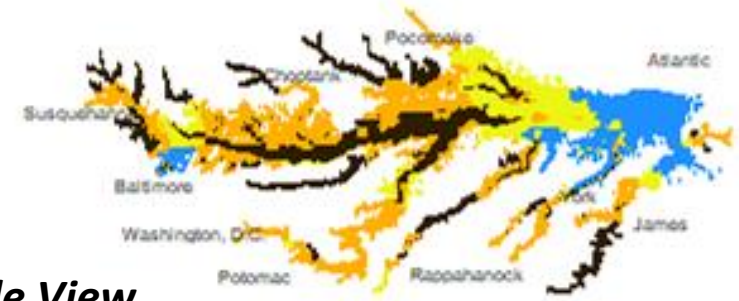

- Same pattern of increasing frequency and duration of degrading conditions

# Episodic Chesapeake Bay Striped Bass Habitat Conditions

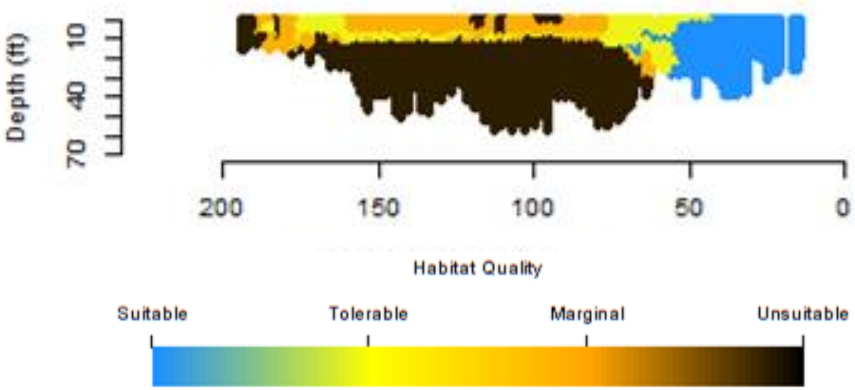
## Example – July 15-31, 2019

**Not only have habitat conditions degraded, these conditions are becoming more frequent, longer lasting and severe**

### *Top View*

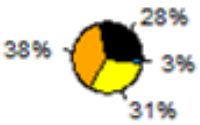



### *Side View*

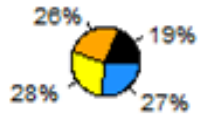



**Suitable -** Supports "normal" long-term occupancy with growth potential
**Tolerable** - Supports occupancy for a modest period of time, ~ 1 month, with limited or negative growth potential
**Marginal** - Supports very brief occupancy with little impact on growth potential
**Unsuitable** - Does not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

### *Habitat Quality (%)*

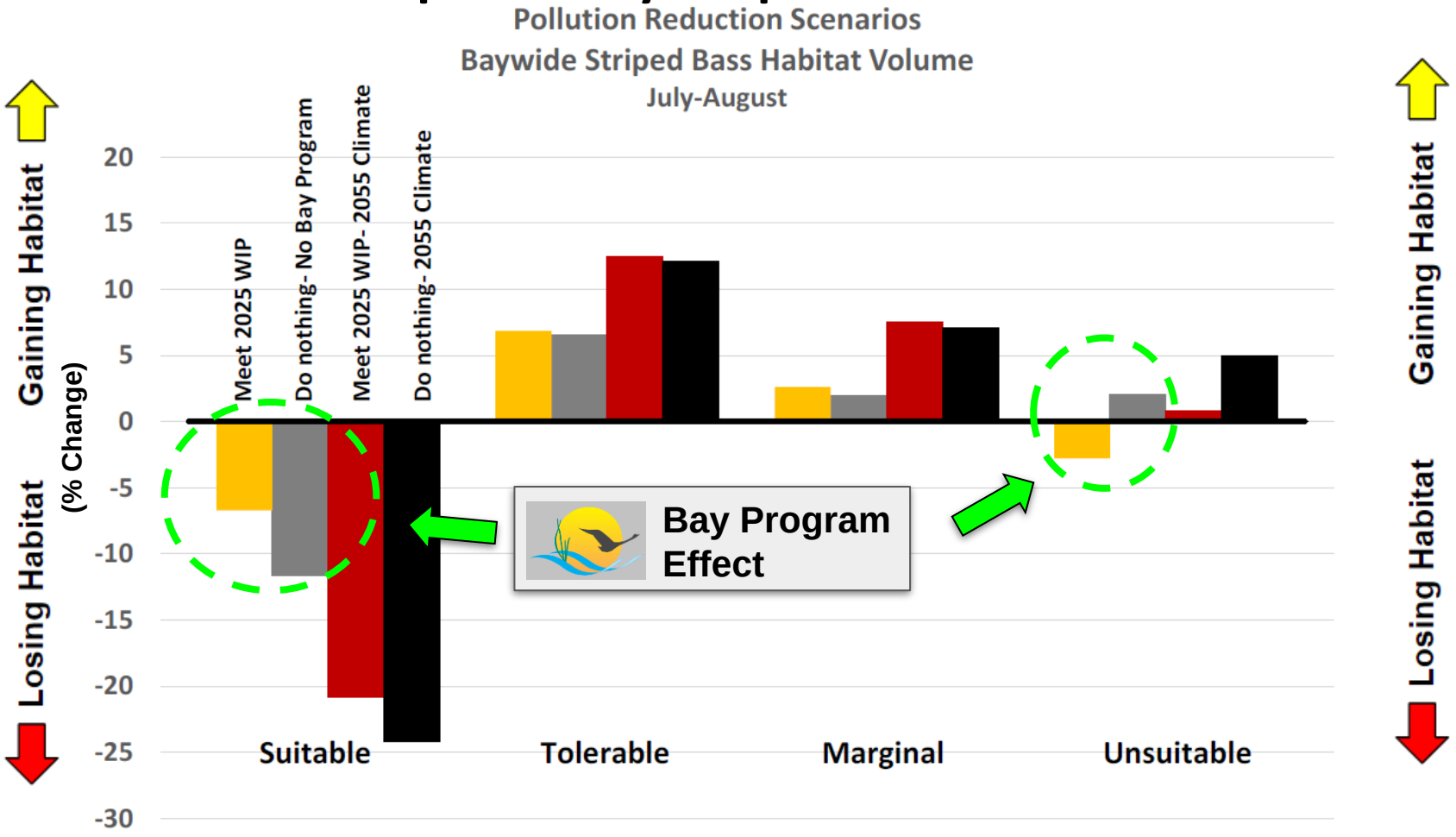


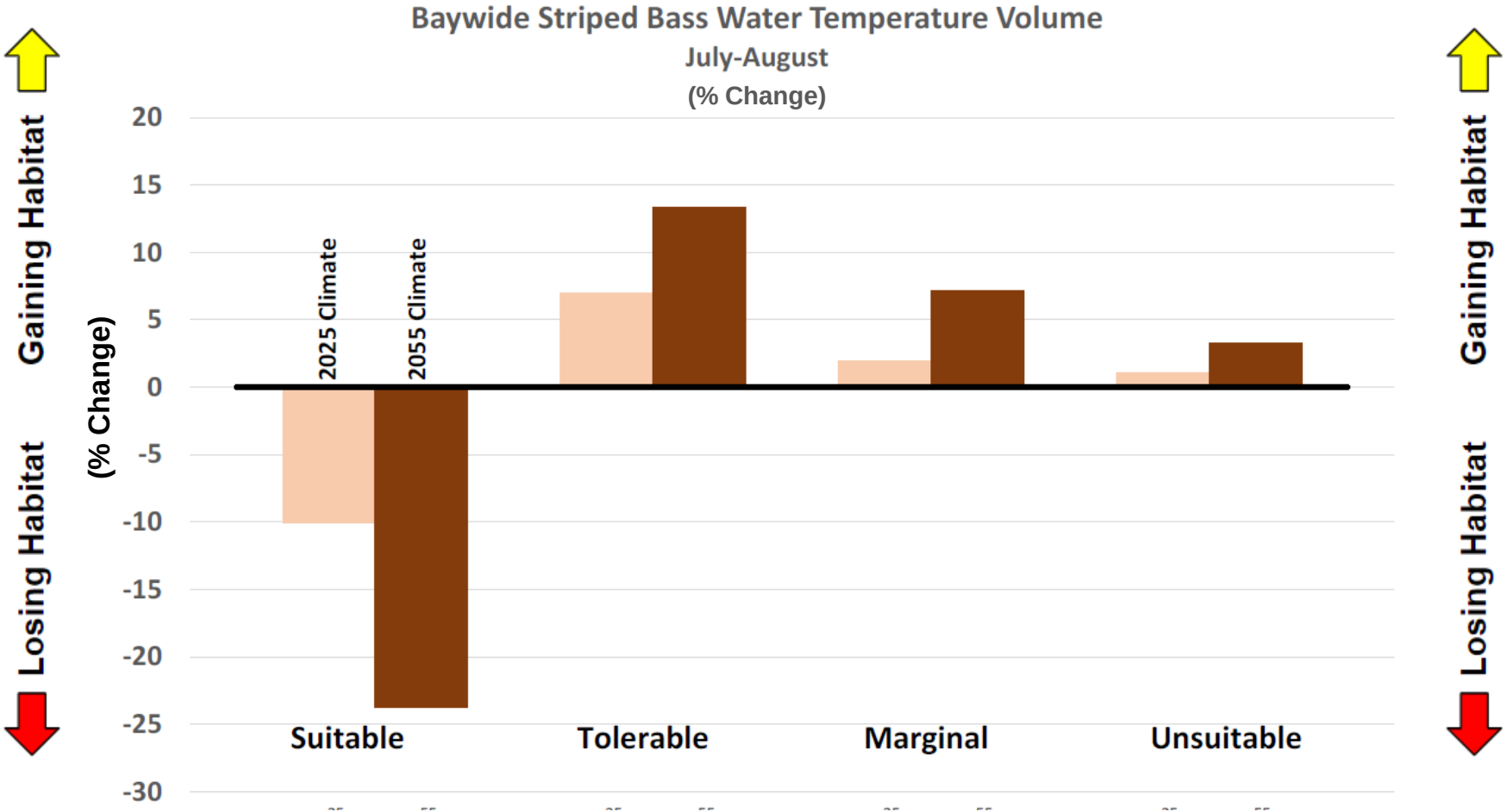

***Maryland***




***Baywide***

# Future Chesapeake Bay Striped Bass Habitat Conditions




Baywide Striped Bass Water Temperature Volume
July-August
(% Change)
Gaining Habitat
Losing Habitat
(% Change)
20
15
10
5
0
-5
-10
-15
-20
-25
-30
2025 Climate
2055 Climate
Suitable
Tolerable
Marginal
Unsuitable
Gaining Habitat
Losing Habitat

# Summary

- Striped bass habitat has degraded since 1986, mostly in the last 10-20 years. Baywide, Suitable habitat has decreased about 10% since 1991-2000 (baseline conditions).
- Increasing water temperature is the major driver
- In the future, the Chesapeake Bay fishery will likely experience more frequent, longer lasting and more degraded habitat conditions. By 2055, suitable habitat will have decreased about 25% since 1991-2000 (baseline conditions).
- Despite increasing water temperature being the primary driver to impacting striped bass habitat, it is still extremely important to continue nutrient and sediment reduction actions.

*Special thanks to* ***Maryland DNR Resource Assessment Service & Fishing and Boating Service*** *Bay monitoring, data management, analysis and administrative folks*