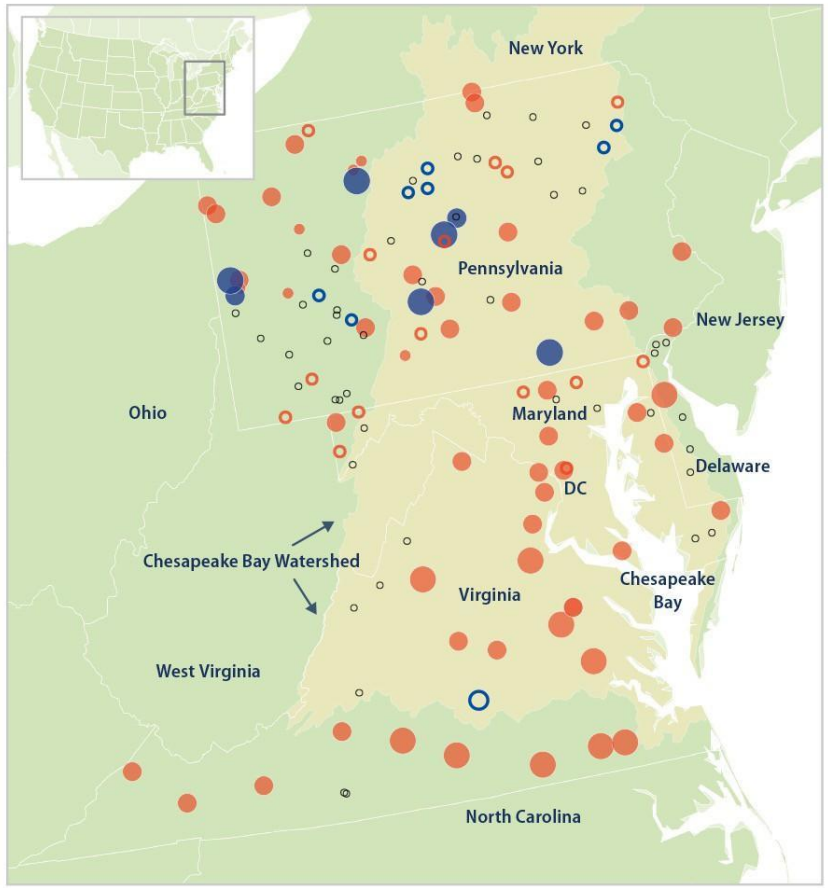
CLIMATE CHANGE SCIENCE TO INFORM MANAGEMENT NEEDS IDENTIFIED BY STAKEHOLDERS TO TACKLE RISING WATER TEMPERATURES IN THE CHESAPEAKE BAY

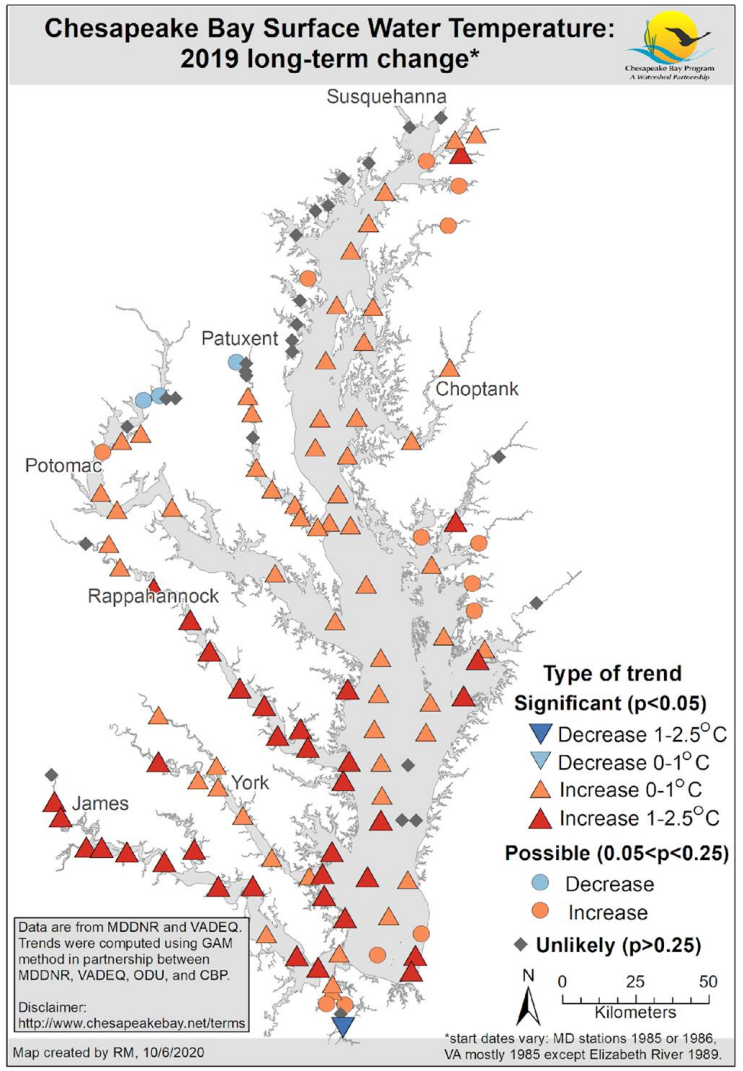
Climate Resiliency Workgroup August Meeting
August 17th, 2023

Jamileh Soueidan, Chesapeake Research Consortium/NOAA Affiliate

CLIMATE CHANGE CHALLENGE: RISING WATER TEMPERATURES



(Rice and Jastram, 2015)



Presentation Outline

Main Objective of Workshop Effort: Understand impacts of rising water temperatures on living resources in the Chesapeake Bay and identify management/policy recommendations to address these changes, as well associated science and research needs to support these recommendations.

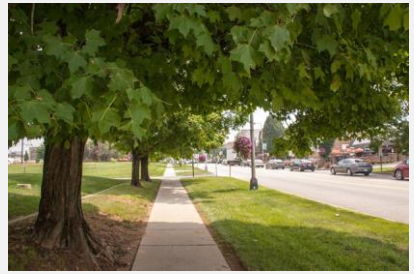
This Presentation:

- **Brief overview of drivers of rising water temperatures and ecological implications**
- Review tidal management/policy recommendations in workshop report
    - Themes: Ecosystem-Based Management, Future Climate Conditions, Extreme Stressors, Nearshore Habitats
- Review key science and research needs to support recommendations

BMPs

Conservation

Land use practices



Watershed

Moderation
Minimize Heating

Tidal & Watershed

Adaptation
Minimize Impacts & Adjust

Submerged Aquatic Vegetation (SAV)

Oysters

Blue Crabs

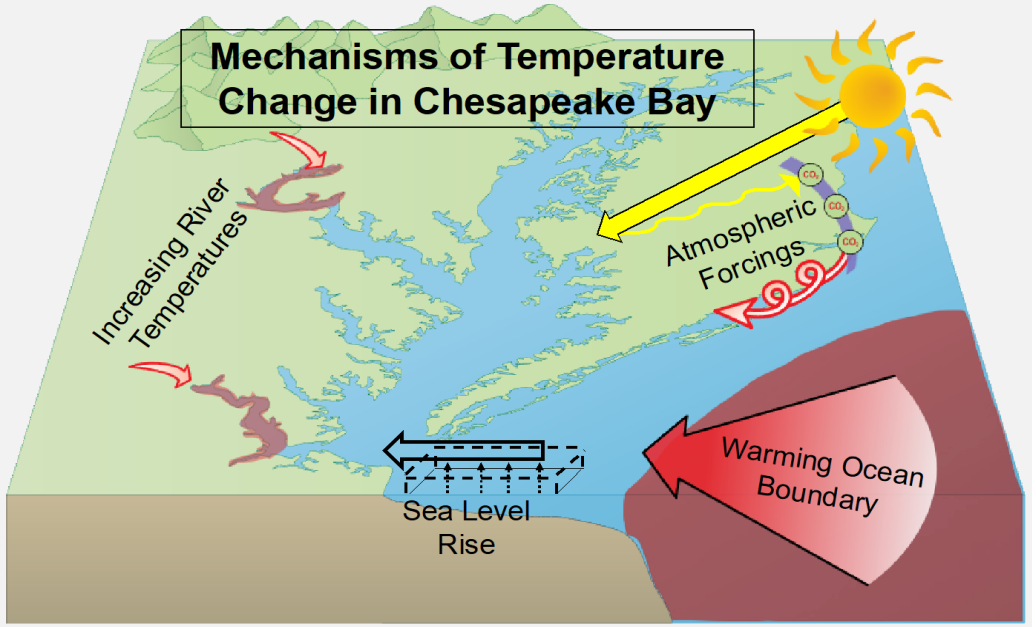
Forage

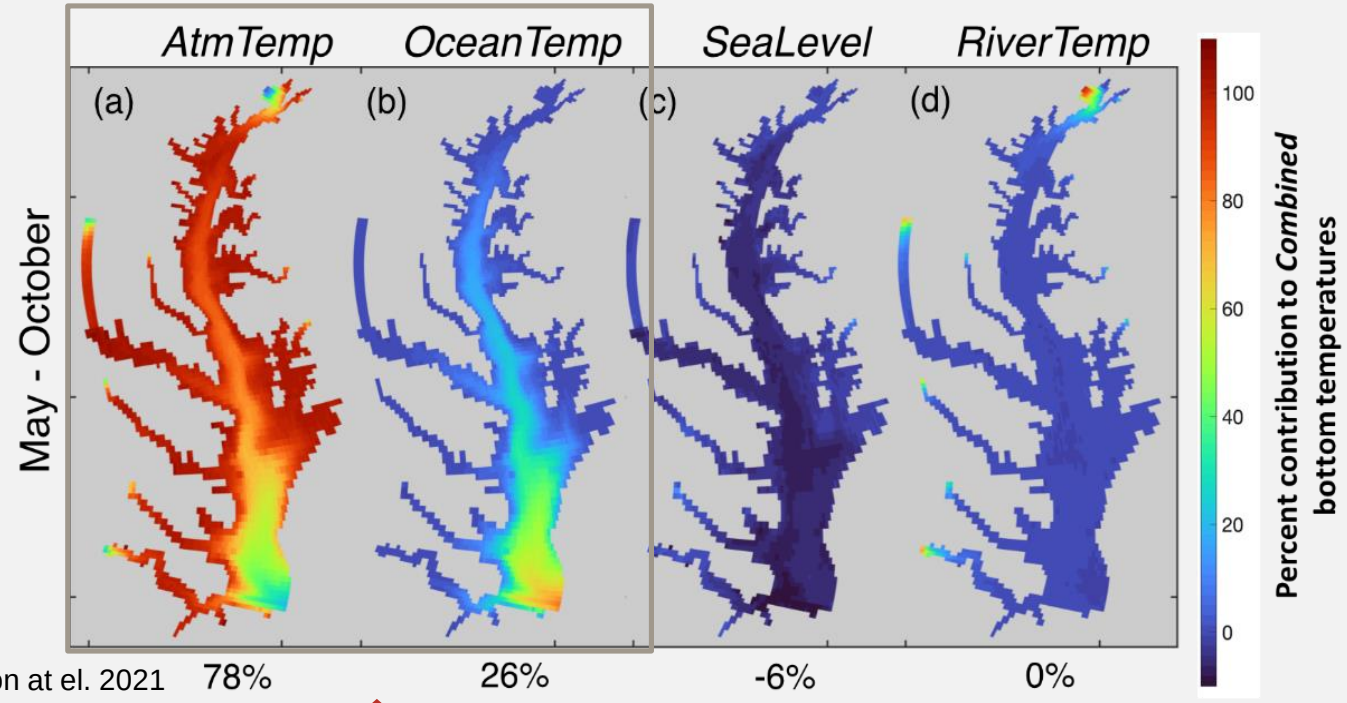
(Menhaden, Bay anchovy, benthic invertebrates)

Striped Bass

Brook Trout

DRIVERS OF RISING WATER TEMPERATURES IN THE CHESAPEAKE BAY



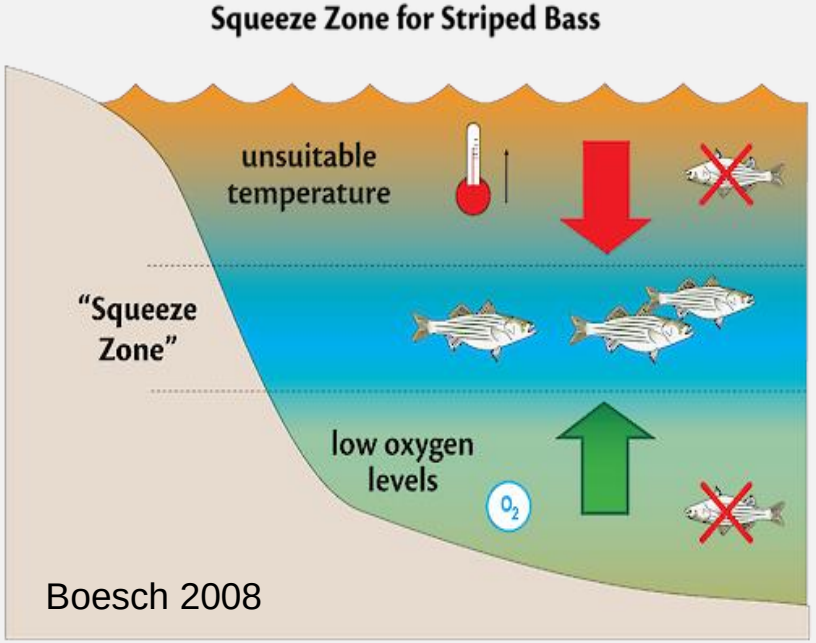


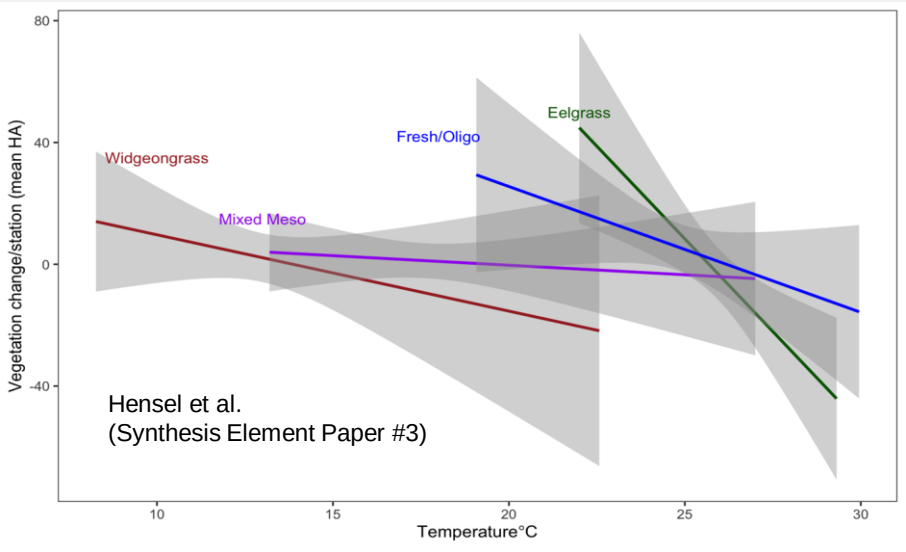
Source: Hinson at el. 2021

A. Air temperatures ⇧
B. Ocean temperatures ⇧
C. Sea level rise ⇩
D. River temperatures ⇧

Rising Tidal Water Temperatures:
Ecological Impacts to Living Resources and Habitats

- Changes in habitat suitability for vulnerable species (e.g., striped bass, eelgrass) from extreme stressors
- Shifts in species range and habitats





- Species level impacts from rising water temperature may be positive or negative depending on species, life stage, and location in the estuary
- Eelgrass is negatively impacted by rising water temperature, while other species (e.g., widgeongrass, freshwater species) may be more heat tolerant

Bottom Line:

Chesapeake Bay of the Future will not be the Chesapeake Bay of the Past

- Bay water temperatures are increasing and will continue to increase – affects all water quality, living resources, and habitat outcomes in the Chesapeake Bay Watershed Agreement.
- The Chesapeake Bay Watershed Agreement focuses on climate resilience and adaptation.
- Report focuses on building resilience and adaptation with strategic restoration and management strategies to minimize negative impacts and promote positive outcomes under changing climate conditions.

Photo: Dave Harp, *Bay Journal*


Photo: Peter McGowan, USFWS

Presentation Outline

Main Objective of Workshop Effort: Understand impacts of rising water temperatures on living resources in the Chesapeake Bay and identify management/policy recommendations to address these changes, as well associated science and research needs to support these recommendations.

This Presentation:

- Brief overview of drivers of rising water temperatures and ecological implications
- **Review tidal management/policy recommendations in workshop report**
  - **Themes: Ecosystem-Based Management, Future Climate Conditions, Nearshore Habitats, Extreme Stressors**
- Review key science and research needs to support recommendations

RECOMMENDATIONS: ECOSYSTEM-BASED MANAGEMENT

- Establish fishing guidance based on temperature and dissolved oxygen and habitat condition thresholds to reduce catch and release mortality during periods of poor environmental condition.
- Hold workshop with fishery stakeholders to explore long-term strategies to advance ecosystem approaches that incorporate climate change considerations; include discussions on potential new fisheries and adaptation needs.

Photo: Eric Packard

RECOMMENDATIONS: FUTURE CLIMATE CONDITIONS

- Develop and implement strategy to improve communications on future climate conditions which includes information on expected scenarios for impacts to existing species and on emerging species from the south.
- Support social science research and develop targeted communication for specific audiences (policymakers, managers, residents, local partners).

Photo: Dave Harp, *Bay Journal*

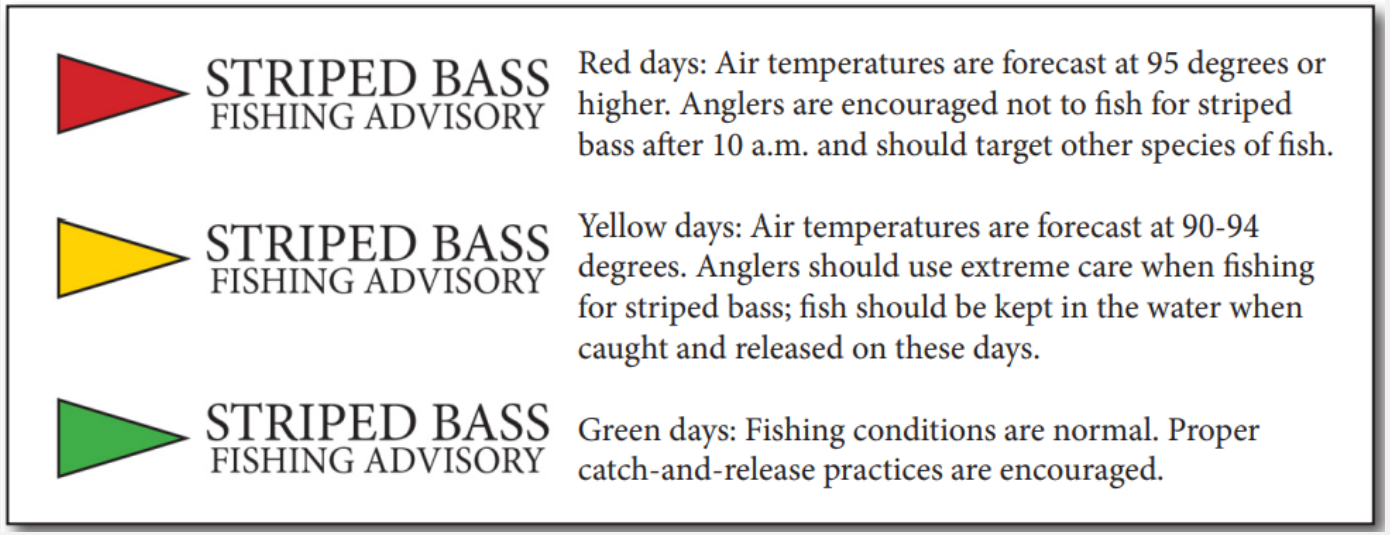
RECOMMENDATIONS: NEARSHORE HABITAT

- Develop common criteria and metrics to help target, site, and design natural infrastructure projects where multiple benefits can be optimized.
- Support research to investigate co-location of restoration strategies to improve resilience (e.g., oyster reef and seagrass restoration).


Photo: Will Parsons, CBP

RECOMMENDATIONS: EXTREME STRESSORS

- Convene an interdisciplinary team of scientists, resource managers, meteorologists, and communicators to design and create a publicly available marine heat wave alert system.
- Connect alert system with habitat preferences of key species and guidance on fishing behavior; consider incorporating other key parameters (e.g., dissolved oxygen, salinity).



Example from Maryland Department of Natural Resources

Presentation Outline

Main Objective of Workshop Effort: Understand impacts of rising water temperatures on living resources in the Chesapeake Bay and identify management/policy recommendations to address these changes, as well associated science and research needs to support these recommendations.

This Presentation:

- Brief overview of drivers of rising water temperatures and ecological implications
- Review tidal management/policy recommendations in workshop report
    - Themes: Ecosystem-Based Management, Future Climate Conditions, Extreme Stressors, Nearshore Habitats
- **Review key science and research needs to support recommendations**

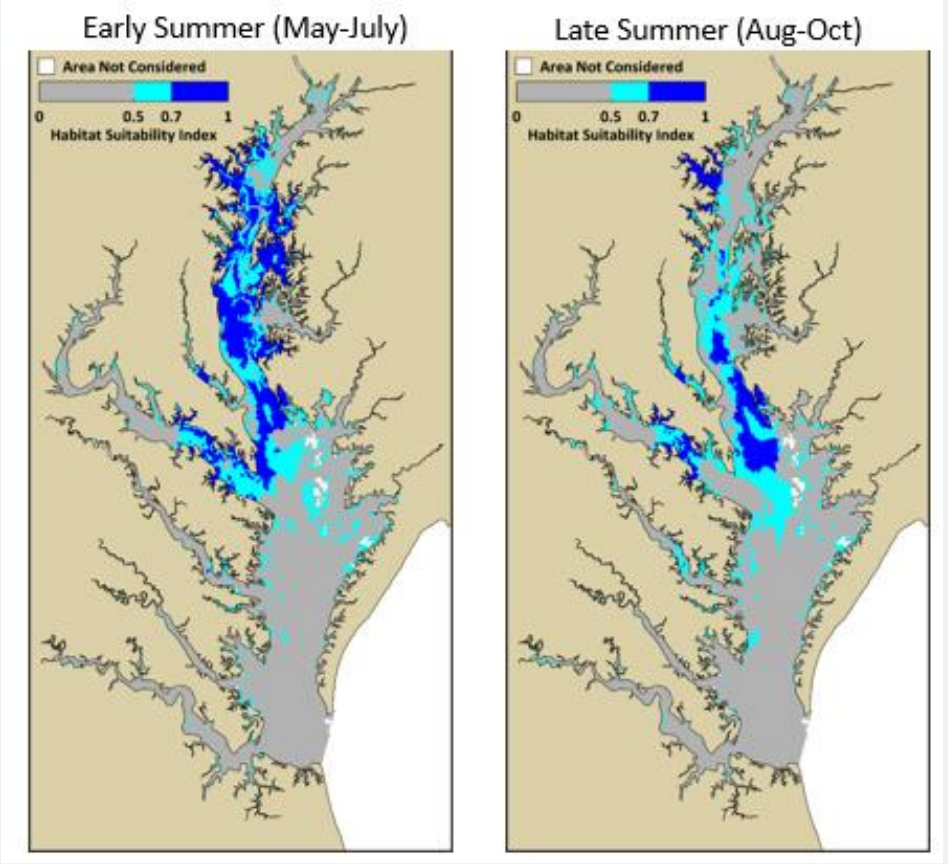
IDENTIFIED SCIENCE NEEDS: ECOSYSTEM-BASED MANAGEMENT—MONITORING

Photo: Doug Wilson

- Improve environmental monitoring of surface and bottom temperature, dissolved oxygen, and fish habitat condition.
- Consider establishing monitoring stations where there are significant fisheries habitat and spawning grounds.
- Evaluate needs for zooplankton monitoring at fish spawning and nursery areas to assess food web shifts.
- Explore the need for *in situ* monitoring of lower trophic organisms to better assess physiological response to changing conditions.

IDENTIFIED SCIENCE NEEDS:
ECOSYSTEM-BASED MANAGEMENT—ANALYSES AND MODELING

- Synthesize existing science to establish habitat condition thresholds based on temperature and dissolved oxygen for key fisheries species (e.g., striped bass, summer flounder).
- Develop habitat suitability models and indicators for key fisheries resources.
- Research how loss of late-winter/spring eelgrass habitat will affect blue crab populations.
- Build into ecosystem models, improved information on drivers of natural mortality, recruitment success, and climate change impacts for key fishery species.
- Support assessments for emerging fisheries as climate change creates favorable conditions for these fisheries to be economically viable.

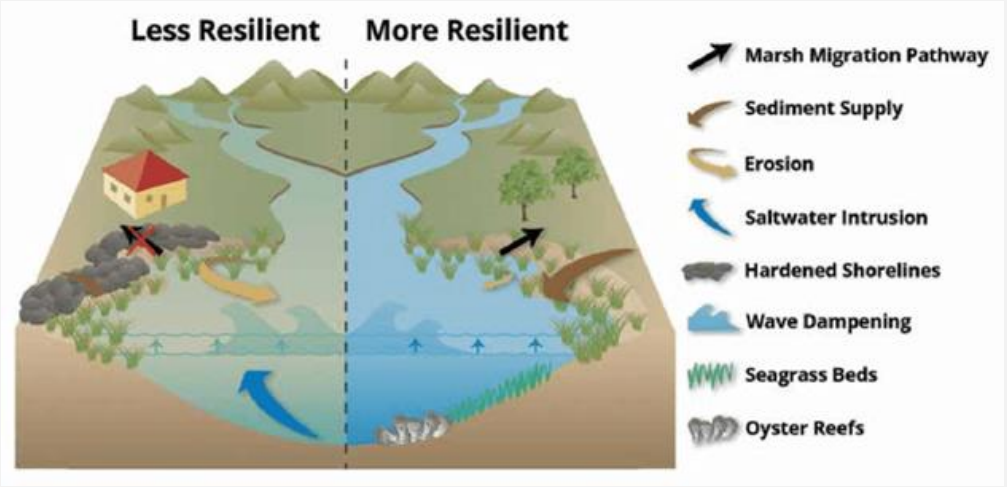


Example from Striped Bass Habitat Suitability Study (Dixon et al. 2022)

IDENTIFIED SCIENCE NEEDS: NEARSHORE HABITAT—STRATEGIC RESTORATION

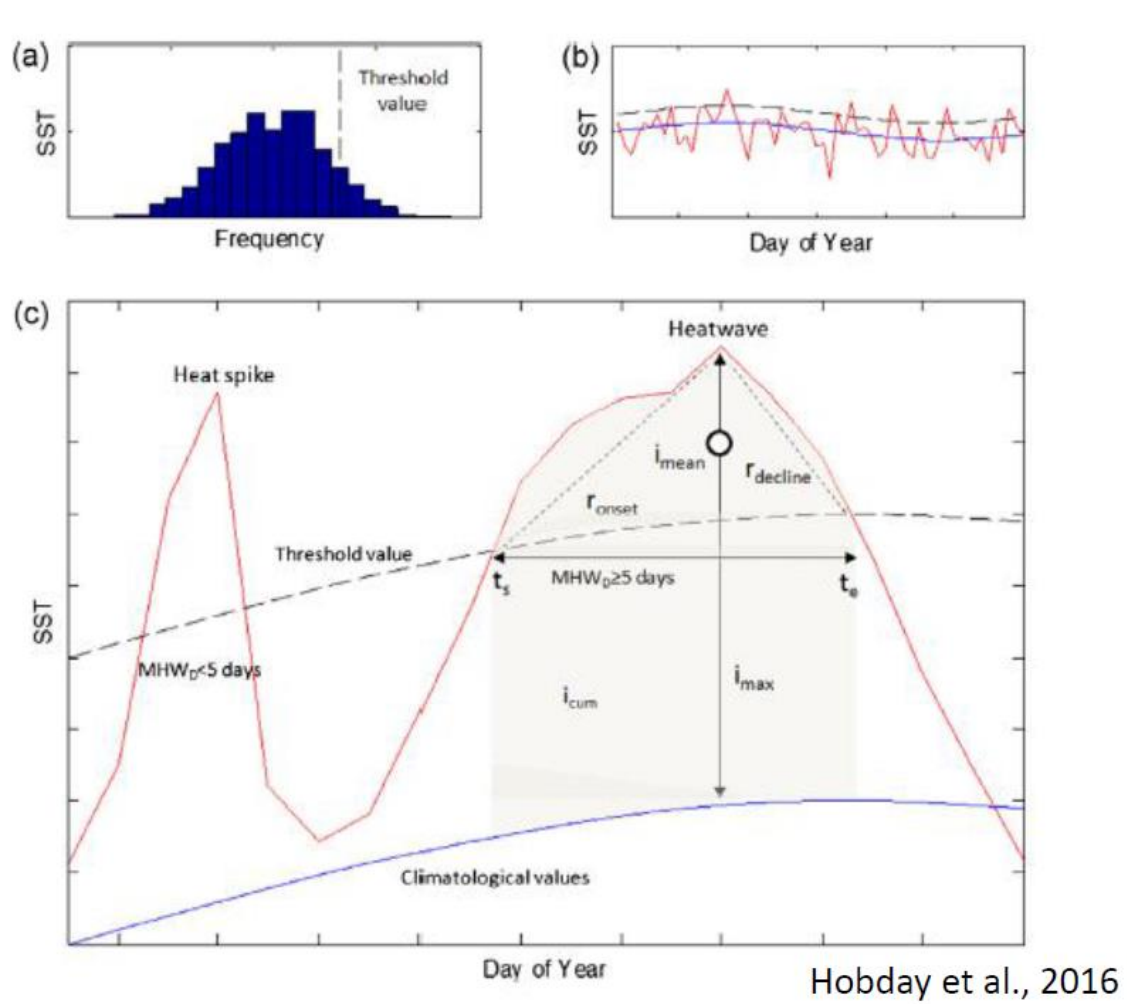
- Support research to determine the ecological impacts or benefits from natural infrastructure implementation under future climate change scenarios (e.g., sea level rise, temperature change).
- Develop criteria for targeting nearshore restoration where multiple benefits and ecosystem services can be optimized.
- Increase understanding of watershed practices that can reduce local warming effects.


Photo: Peter McGowan, USFWS



Kister 2016 (Reprinted with permission from the Integration & Application Network, 2013)

IDENTIFIED SCIENCE NEEDS:
EXTREME CLIMATE CHANGE STRESSORS—MARINE HEAT WAVES



Hobday et al., 2016

- Relate current definitions of marine heat waves with living resource thresholds to determine an appropriate definition for Chesapeake Bay.
- Explore real time monitoring of marine heat waves and forecast products.
- Consider a marine heat wave indicator that connects with living resource management and guidance to the public.

KEY TAKEAWAYS

- There are steps we can take now to better prepare for changing conditions:
  - Reduce climate change stress on key fisheries resources by minimizing other stressors (e.g., nutrient pollution, fishing pressure, hardened shorelines), especially during periods or areas of high vulnerability (e.g., marine heat waves).
  - Facilitate discussions with managers and industry on shifts in key fishery resources, for both existing and emerging fisheries.
  - Promote strategic use of natural infrastructure and living shorelines to maximize multiple benefits, including enhancing fish habitat and resilience.
  - Explore options for siting different restoration efforts, such as oyster and seagrasses, near each other to bolster climate resiliency.

ACKNOWLEDGEMENTS: TIDAL COAUTHORS

- Julie Reichert-Nguyen, Bruce Vogt, and Mandy Bromilow, NOAA Chesapeake Bay Office
- Alex Gunnerson, August Goldfischer, and Justin Shapiro, Chesapeake Research Consortium
- Brooke Landry, Maryland Department of Natural Resources
- Breck Sullivan, United States Geological Survey (USGS)
- Rich Batiuk, Coastwise Partners

A special thanks to the many stakeholders who participated in the workshop!

Rising Water Temperature Workgroup Report Link:
https://www.chesapeake.org/stac/document-library/rising-watershed-and-bay-water-temperatures-ecological-implications-and-management-responses/

THANK YOU

EMAIL: JAMILEH.SOUEIDAN@NOAA.GOV

REFERENCES

- Boesch, D.F. (editor). 2008. Global Warming and the Free State: Comprehensive Assessment of Climate Change Impacts in Maryland. Report of the Scientific and Technical Working Group of the Maryland Commission on Climate Change. University of Maryland Center for Environmental Science, Cambridge, Maryland. This report is a component of the Plan of Action of the Maryland Commission on Climate Change, submitted to the Governor and General Assembly pursuant to Executive Order 01.10.2007.07.
- Dixon, R. L., Fabrizio, M. C., Tuckey, T. D., & Bever, A. J. (2022) Extent of Suitable Habitats for Juvenile Striped Bass: Dynamics and Implications for Recruitment in Chesapeake Bay. Virginia Institute of Marine Science, William & Mary. doi: 10.25773/v87b-6b43.
- Fabrizio, M. C., Tuckey, T. D., Smith, S. C., Ross, P. G., Snyder, R. A., Wang, H. V., & Bever, A. J. (2022) Characterization of Nursery Habitats used by Black Sea Bass and Summer Flounder in Chesapeake Bay and the Coastal Lagoons. Virginia Institute of Marine Science, William & Mary. doi: 10.25773/PJCC-RG41.
- Hinson, K. E., Friedrichs, M. A., St-Laurent, P., Da, F., & Najjar, R. G. 2021. Extent and causes of Chesapeake Bay warming. JAWRA Journal of the American Water Resources Association.
- Hobday, A. J., Alexander, L. V., Perkins, S. E., Smale, D. A., Straub, S. C., Oliver, E. C., et al. 2016. A hierarchical approach to defining marine heatwaves. Progress in Oceanography. 141, 227–238. doi: 10.1016/j.pocean.2015.12.014.
- Mazzini, P. L., & Pianca, C. 2022. Marine Heatwaves in the Chesapeake Bay. Frontiers in Marine Science, 8(750265).
- Rice, K.C., and Jastram, J.D., 2015. Rising air and stream-water temperatures in Chesapeake Bay region, USA: Climatic Change, v. 128, p. 127-138 https://doi.org/10.1007/s10584-014-1295-9.