

Forage Indicator Efforts Connecting Water Temperature to Living Resources

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The Forage Outcome

“Continually improve our understanding of the role of forage in the Bay, and develop a strategy for assessing the forage base.”

Purpose of Forage Indicators

What do we really want to know?

- Is there enough prey available for predators in the Bay?
- How does prey availability change over time?

How can we track prey availability over time?

- Develop a suite of indicators that provide information about forage abundance

The Keys to Indicator Development

- Identify key forage species
- Quantify environmental relationships
- Determine prey consumption habits

Important Forage Species for the Chesapeake Bay

Representative Predators

Five predator species were selected by the Steering Committee of the 2014 Forage Workshop to serve as representative indicator species for the range of predators and lifestyle types in the Chesapeake Bay. The selected species included:



Striped Bass
anadromous, piscivore



Summer Flounder
mesohaline-polyhaline, piscivore



Atlantic Croaker
oligohaline-polyhaline, omnivore



Clearnose Skate
polyhaline, omnivore



White Perch
oligohaline, omnivore

To identify important forage in the Chesapeake Bay ecosystem, an analysis of a long term, fishery-independent survey ([ChesMMA](#)) was conducted to quantify the gut contents of five representative predator species.

Forage species were considered important if the forage taxon or group composed at least 5% by wet weight of a predator's diet in at least one of the five ChesMMA seasonal sampling cruises taken during any year of the study (on right).

Forage species are critical to sustaining production of economically and ecologically valuable fish species in the Chesapeake Bay.

Key Forage*



Bay Anchovy



Polychaetes



Mysids



Amphipods and isopods



Weakfish (juveniles)



Spot (juveniles)



Mantis shrimp



Razor clams



Sand shrimp



Atlantic croaker (juveniles)



Macoma clams

* Based on wet weight of prey in stomach analysis of 5 representative predators in the Chesapeake Bay (ChesMMA)

Additional Important Forage

Managed
forage
species



Atlantic menhaden



Blue crab

Historically
important



Shad & river herrings

Forage of
Upriver
Predators



Small bivalves



Atlantic Silverside



Mummichog

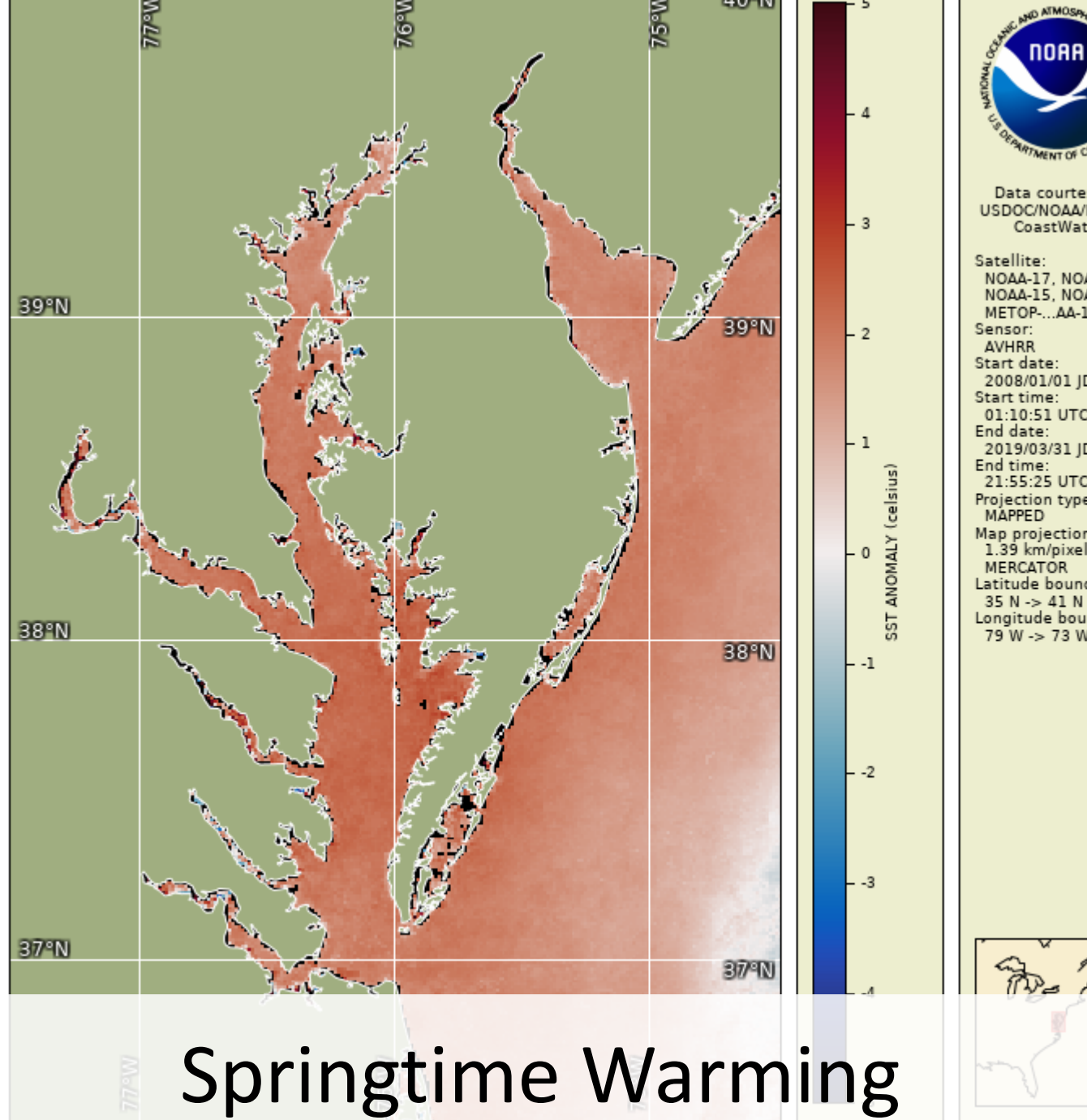
Additional species were added to the list of important forage by the participants of the Forage Workshop to include forage of under-represented freshwater predators, historically important forage, and managed forage (additional important forage above).

For more details on this analysis, please view the Scientific and Technical Advisory Committee's [2014 Forage Workshop Report](#).

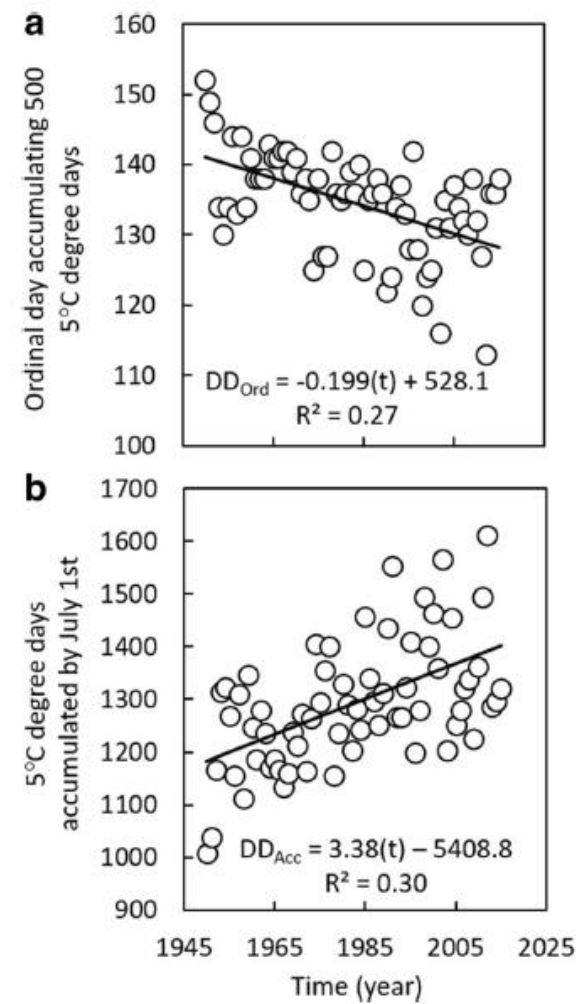
Above data is based on the 2014 Scientific and Technical Advisory Committee Forage Workshop

Forage Indicator Development Plan

Tier 1: Abundance		Species of Interest
Benthic Invertebrates		Polychaetes
Demersal Finfishes		Atlantic croaker
Pelagic Finfishes		Bay anchovy Atlantic menhaden
Tier 2: Habitat and Environmental Factors		Species of Interest
Springtime Warming		Bay anchovy Polychaetes
Habitat Suitability Index		Bay anchovy
Hardened Shorelines		Juvenile blue crabs
Tier 3: Predator Consumption		Species of Interest
Diet Profiles		Striped bass



Springtime Warming

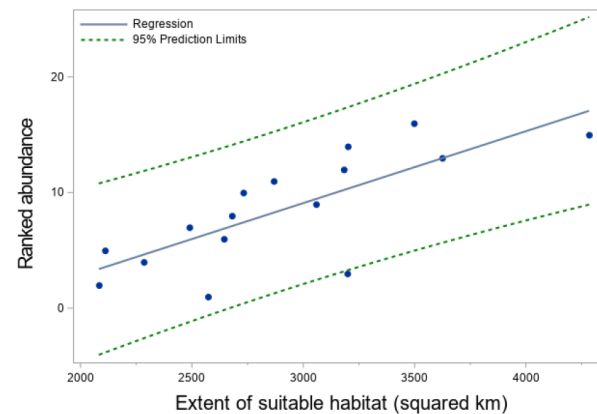
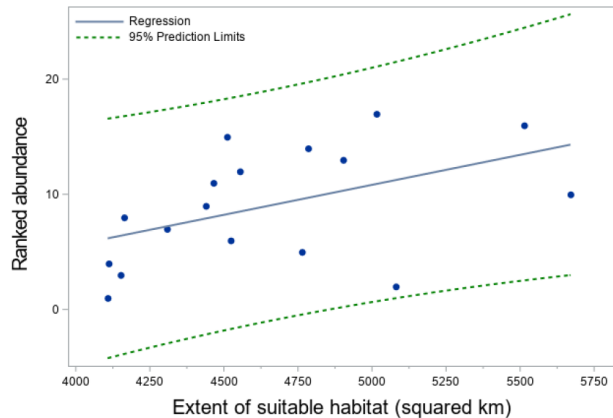


Woodland et al. 2021

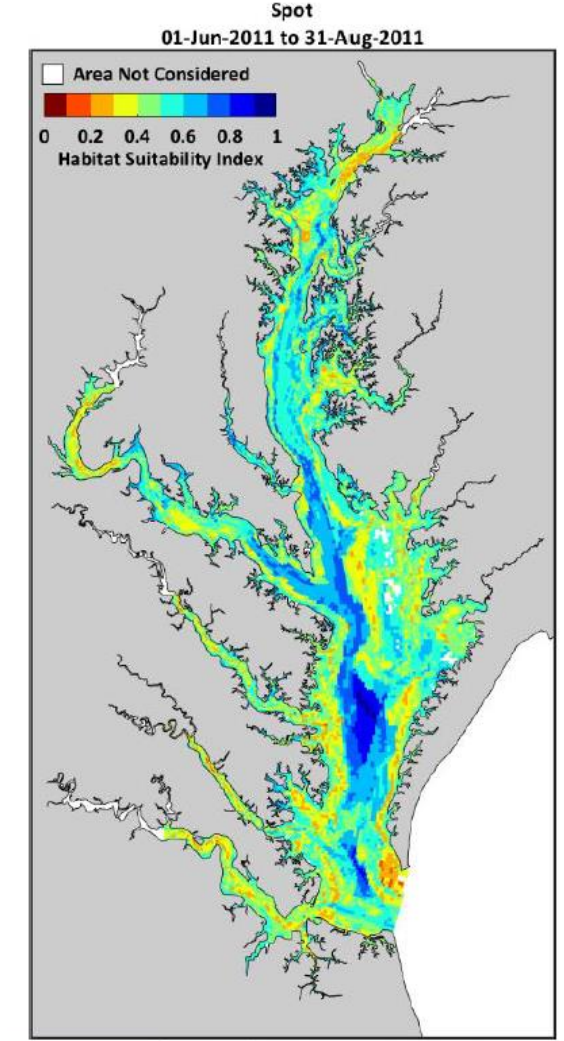
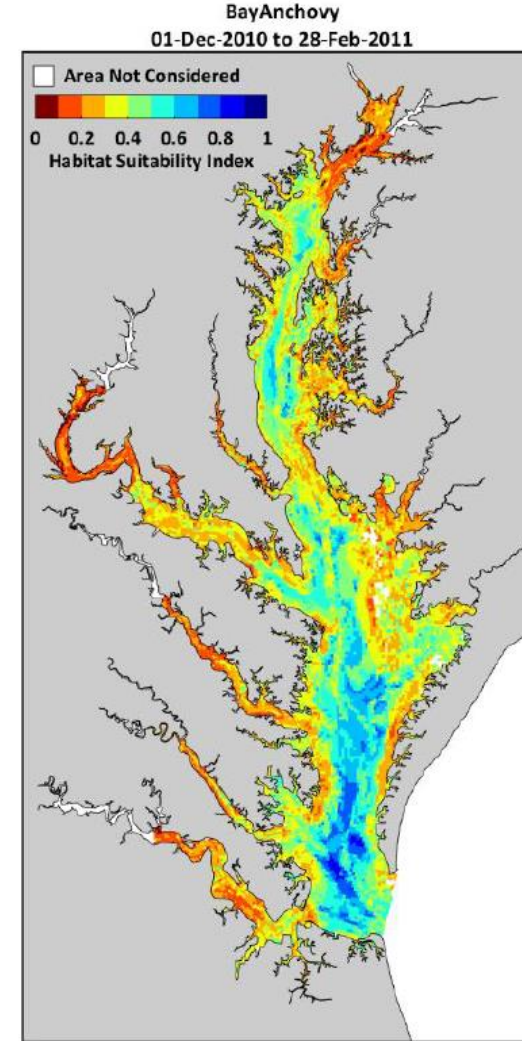


Habitat Suitability Index

- Assessed the extent of suitable habitat for 4 key forage species
 - Fisheries survey data
 - Modeled environmental conditions (water temperature, salinity, DO)



Fabrizio et al. 2021



Indicator Applications

- To develop a useful indicator:
 - Identify key species/habitats of management interest
 - Identify and quantify environmental relationships (e.g. trends, thresholds)
- Address fisheries and CBP priorities and interests
 - Ecosystem-based fisheries management (EBFM)
 - Climate change impacts
 - Informing habitat management/conservation