An Overview of the Forage Status and Trends Report for the Chesapeake Bay

Status and Trends Workgroup Meeting

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Information

- Document created by the Forage Action Team in November 2023
- Provides updates on the status of different forage species found within the Chesapeake Bay
- Used to assess whether key predator populations have enough food
- All information on this PowerPoint (unless otherwise noted) is from that document

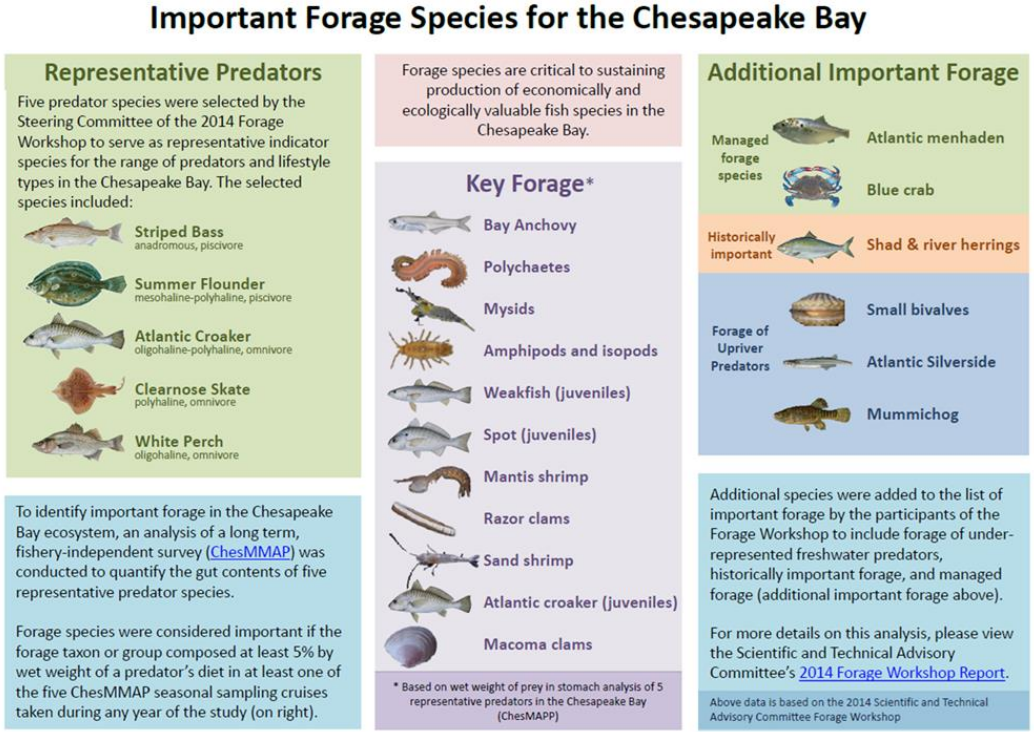
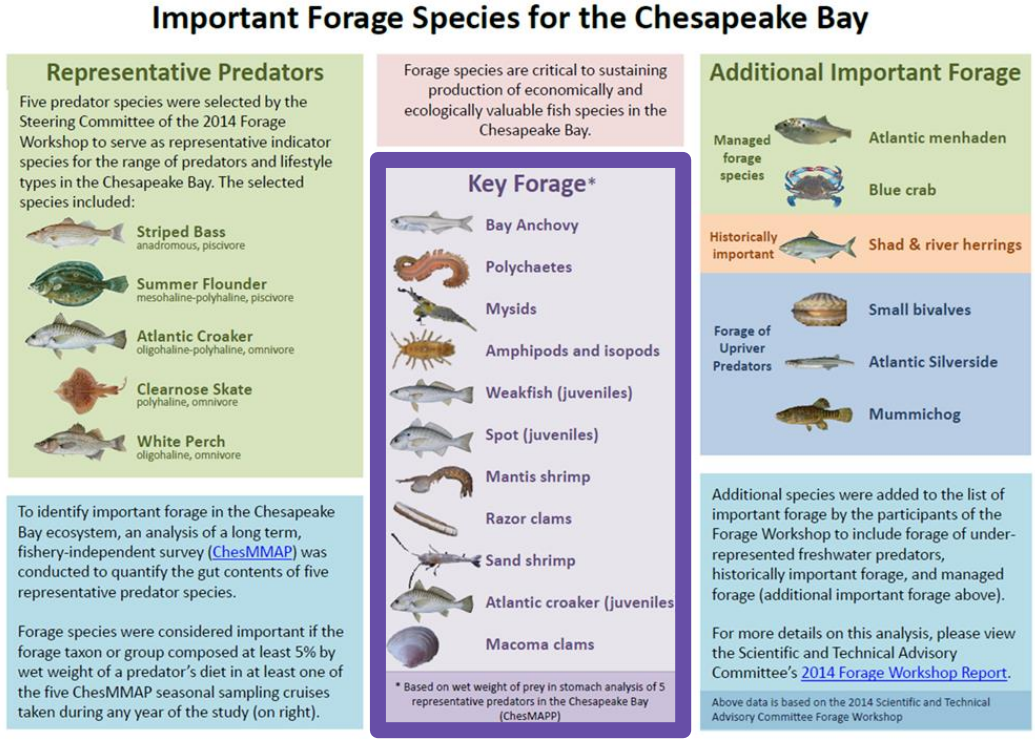


Figure Source: Forage Status and Trends Report for the Chesapeake Bay

Information

- Main focus on Key Forage species



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Indicators

Tier 1: Abundance or biomass time series for each taxa

Tier 2: Relationship between forage abundance and environmental/habitat factors (used to track and predict forage availability)

Tier 3: Changes of predator consumption of forage over time

Tier 1: Forage Abundance - Finfishes

Methods

- Relative abundance of YOY forage fishes calculated using data from various fisheries independent surveys
  - Juvenile Striped Bass Seine Survey (VIMS)
  - Juvenile Finfish Trawl Survey (VIMS)
  - Juvenile Striped Bass Survey (MDNR)
  - Blue Crab Summer Trawl Survey (MDNR)
  - Chesapeake Bay Fishery-Independent Multi Species Survey (UMCES)
- Delta-lognormal generalized linear models used to create abundance indices for each species

Tier 1: Forage Abundance - Finfishes

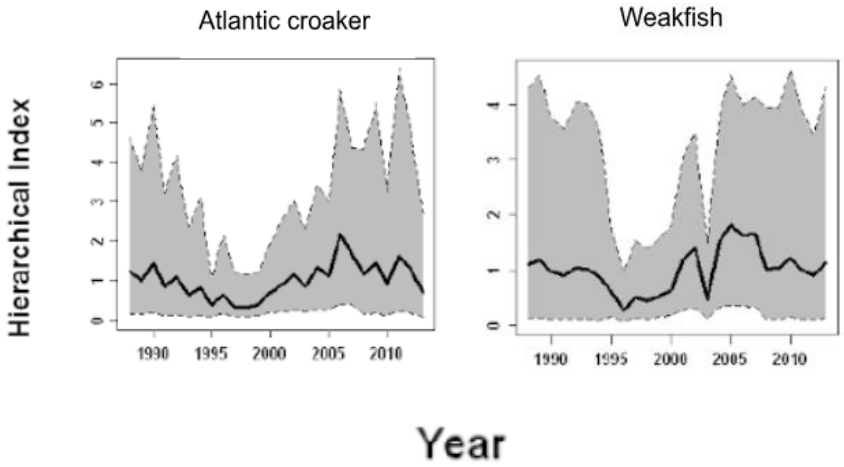
Results

- All forage species showed interannual abundance variability
- A few patterns detected, but varied by species
- Broken down by species

Tier 1: Forage Abundance Patterns - Atlantic croaker and weakfish

Results

- Positive correlation over time series



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Tier 1: Forage Abundance Patterns - Atlantic menhaden and spot

Results

- Positive correlation over time series
- Spot peak abundance 2005-2006

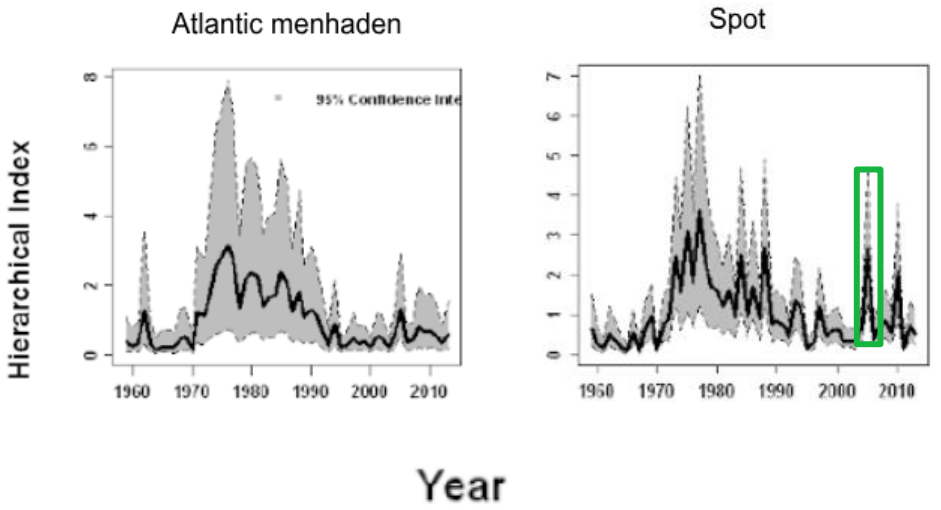
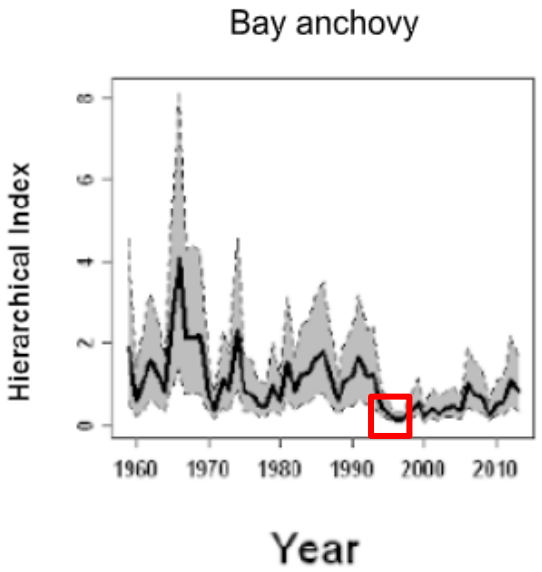


Figure Source: Forage Status and Trends Report for the Chesapeake Bay

Tier 1: Forage Abundance Patterns - Bay anchovy

Results/discussion

- Decline in mid-1990's
- Relatively low and stable after decline
- Research suggests possible environmental and climate factors are linked to reduction



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Tier 1: Forage Abundance - Benthic Invertebrates

Methods

- Data collected from Chesapeake Bay Benthic Monitoring Program
  - Grouped by taxa of interest
- Creation of relative biomass time series including data from 1995-2019
- Total relative biomass over time also estimated
- Delta-generalized linear model (delta-GLM) approach in R
- Year, date, stratum included as explanatory variables
- Linear regression used to examine long-term trends in biomass indices

Tier 1: Forage Abundance - Polychaete Biomass

Results

- Highly variable
- Slight increase of time series
- Indices high in 1995/2011
- Low periods from 1997-1998 and 2004-2008

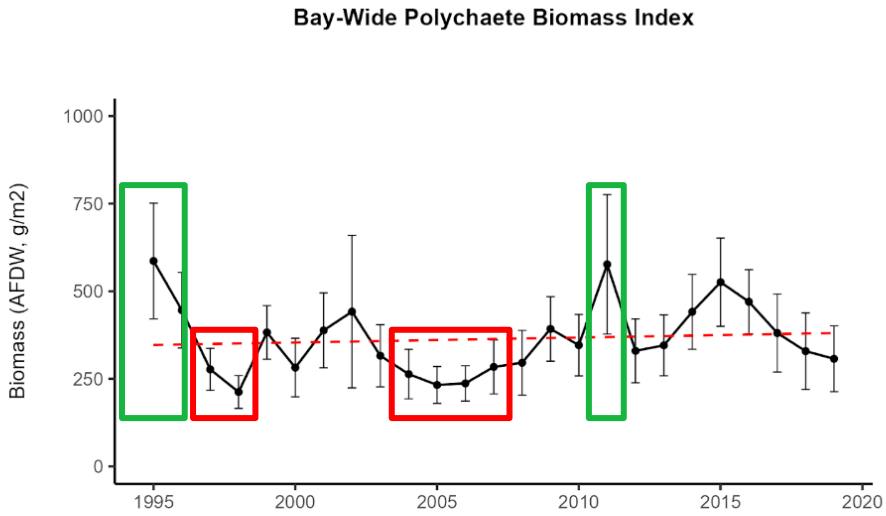

Figure 3. Relative polychaete biomass in the Chesapeake Bay from 1995 to 2019. Error bars represent the 95% confidence intervals of the annual estimates and the dashed red line represents the linear regression model prediction.

Figure Source: Forage Status and Trends Report for the Chesapeake Bay

Tier 1: Forage Abundance - Amphipod Biomass

Results

- Fluctuated around average
- High biomass years: 2003, 2011, 2014, and 2015

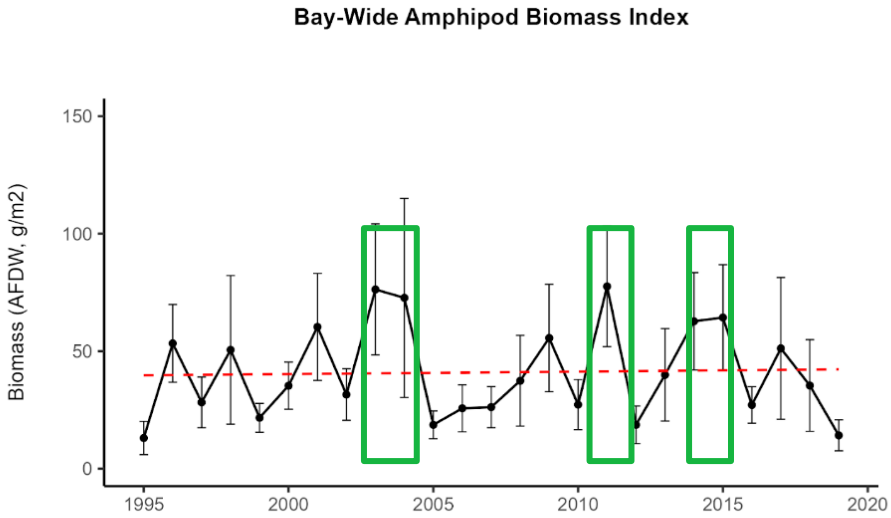

Figure 4. Relative amphipod biomass in the Chesapeake Bay from 1995 to 2019. Error bars represent the 95% confidence intervals of the annual estimates and the dashed red line represents the linear regression model prediction.

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Tier 1: Forage Abundance - Amphipod Biomass

Results

- Fluctuated around average
- Low biomass years: 1995, 2005, 2012, and 2019

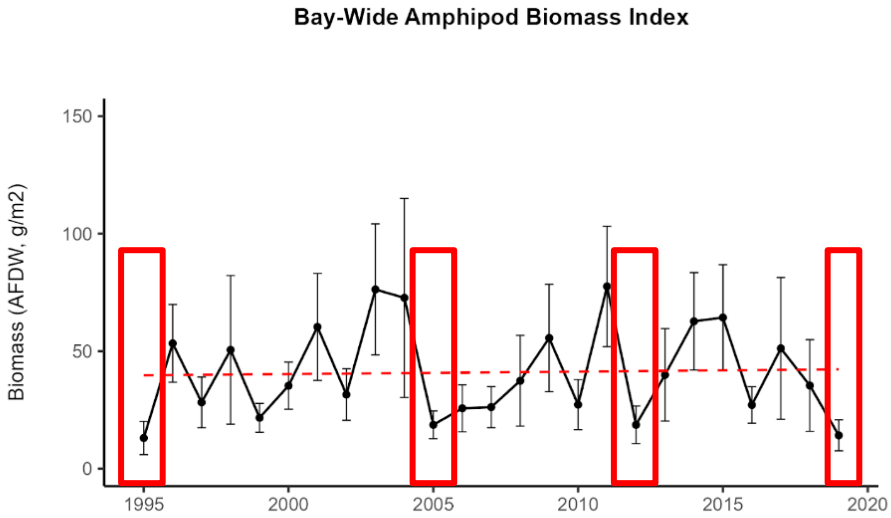

Figure 4. Relative amphipod biomass in the Chesapeake Bay from 1995 to 2019. Error bars represent the 95% confidence intervals of the annual estimates and the dashed red line represents the linear regression model prediction.

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Tier 1: Forage Abundance - Isopod Biomass

Results

- Fluctuated around average
- High biomass years: 1995-1996 and 2015-2019

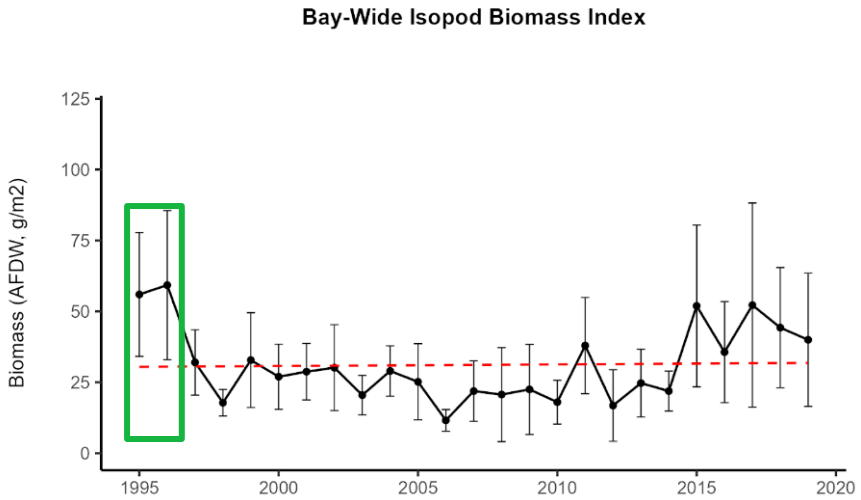

Figure 5. Relative isopod biomass in the Chesapeake Bay from 1995 to 2019. Error bars represent the 95% confidence intervals of the annual estimates and the dashed red line represents the linear regression model prediction.

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Tier 1: Forage Abundance - Mysid Biomass

Results

- Most notable long-term trend
- Decreasing over time

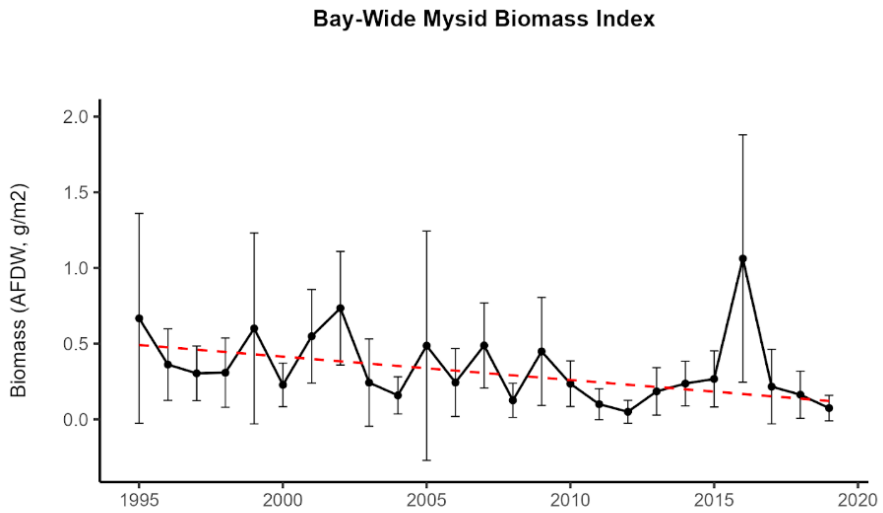

Figure 6. Relative mysid biomass in the Chesapeake Bay from 1995 to 2019. Error bars represent the 95% confidence intervals of the annual and the dashed red line represents the linear regression model prediction.

Tier 1: Forage Abundance - Clam Biomass

Results

- Regular annual variability and no long term trends

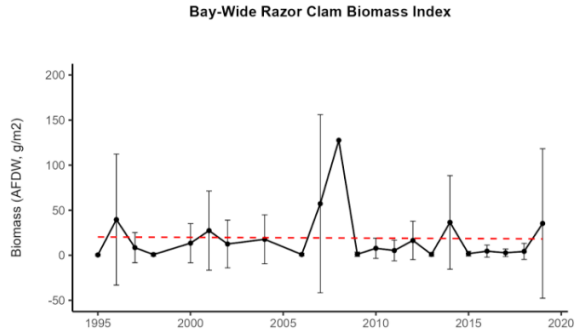

Figure 7. Relative razor clam biomass in the Chesapeake Bay from 1995 to 2019. Error bars represent the 95% confidence intervals of the annual estimates and the dashed red line represents the linear regression model prediction.

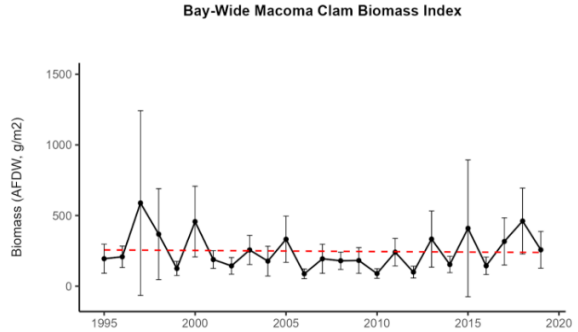

Figure 8. Relative macoma clam biomass in the Chesapeake Bay from 1995 to 2019. Error bars represent the 95% confidence intervals of the annual estimates and the dashed red line represents the linear regression model prediction.

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Tier 1: Forage Abundance - Total benthic biomass

Results/discussion

- Annual variation with fluctuations around an average that increase marginally over time
- Slight increase in total forage biomass over time (likely driven by polychaetes)

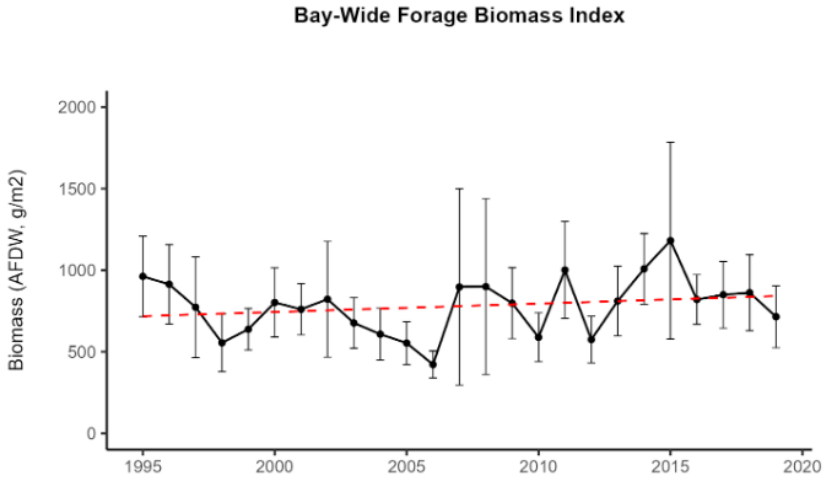

Figure 9. Relative benthic forage biomass in the Chesapeake Bay from 1995 to 2019. Error bars represent the 95% confidence intervals of the annual estimates and the dashed red line represents the linear regression model prediction. Taxa analyzed include polychaetes, amphipods, isopods, mysids, razor clams, and macoma clams.

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Tier 2: Habitat and Environmental Factors - Hardened Shoreline

Overview/methods

- Shoreline hardening linked to lower abundance of some forage fish
- Two main studies
  - Bay-wide study used to assess relationship between shoreline hardening and abundance of forage species
  - York River study: land-use, shoreline data, fishery-independent survey data from VIMS

Tier 2: Habitat and Environmental Factors - Hardened Shoreline

Results/discussion

- Effect of shoreline hardening on forage species varies by species
- Abundance of key species can decrease by 10-30% when shoreline is hardened
- Atlantic croaker, bay anchovy, blue crab, and spot were most vulnerable
- Suggest prioritizing restoration conservation of natural shorelines to improve habitat availability

Tier 2: Habitat and Environmental Factors - Water Quality and Climate Indices

Methods

- Time series of relative forage abundance for each major tributary and salinity regime
- 2017 study environmental variables: salinity, temperature, D.O, springtime chlorophyll-a, DD indices, etc.

Results

- Relative interannual abundance of several forage taxa covaries with springtime warming (DD), winter-spring volume flow, and Atlantic Multidecadal Oscillation (AMO)
- Slow water temperature warming from winter to spring → higher summertime forage abundance
- Relationships with AMO's varied

Tier 2: Habitat and Environmental Factors - Habitat Suitability Indices

Methods

- Forage abundance data from Finfish Trawl Survey and Blue Crab Summer Trawl Survey combined with hindcasts from numerical DO model and 3D hydrodynamic model
- Assigned habitat suitability indices for each species

Tier 2: Habitat and Environmental Factors - Habitat Suitability Indices

Results/discussion

- Varied by species

Species	Season with the greatest extent of most suitable habitat
Juvenile Spotted hake	Spring
Juvenile spot	Summer
Juvenile weakfish	Fall
Bay anchovy	Spring

Tier 3: Predator Consumption- Diet and Consumption Indices

Methods

- Model species-specific prey biomass consumed by predators over time
- Daily per capita consumption estimates for six predator species

Results/discussion

- Prey probability of occurrence in predator stomachs varied across years, predator type, and prey type
- Decline of mysid consumption (corresponds to decline of mysid relative biomass Bay-wide)
- Diets reflected prey availability
- Polychaetes most important prey type overall
    - YOY menhaden and bay anchovy increased over time (diet patterns of piscivores)

Tier 3: Predator Consumption- Foraging in Shallow-Water Habitats

Methods

- Striped bass (YOY-4 years) and Summer flounder collected in Maryland and Virginia various times from 2018-2020
- Genetic metabarcoding on diets

Results/discussion

- Striped bass and Summer flounder diets varied spatially as well and ontogenetically
    - Spatial variation likely due to salinity changes

Conclusions

- Chesapeake Bay forage abundance varies interannual
  - Some long-term trends over time
- Total benthic invertebrate biomass in Bay is stable, fluctuating around averages
  - Some slight increase over time most likely driven by Polychaetes
  - Mysid biomass decreasing over time
- Interannual variability can impact predator populations
- Forage abundance influenced by habitat and environmental conditions
  - Varies by species
  - Shoreline hardening negatively affects some forage species
- Waters are warming more quickly from winter to spring which may positively impact some forage species and negatively affect others
  - Abundance of polychaetes and finfish increase when water temperatures warm quickly in winter-spring time
- Environmental conditions influence juvenile spot and bay anchovy carrying capacity seasonally
- Diet analysis shows that polychaetes are the most important prey taxa, but menhaden and bay anchovy contributions have increased over time

Moving Forward

- Need to understand effects of climate change and other stressors such as shoreline hardening, watershed development/impervious surface area, changes in bay chemistry, and plankton shifts.
- Assess the potential impacts of prey consumption changes on predator body condition
- Track changes in new forage (shrimp) and new predators (Red drum)
- Forage Outcome Team will continue to track the status and trends of the forage base and report on some indicators every 1-2 years.
- Continue Beyond 2025 but tie work more directly to the key management question (Is there enough food for managed predators?)

Questions?

Photo Source: NOAA Photo Library