Consideration of Living Resources in Chesapeake Bay Restoration

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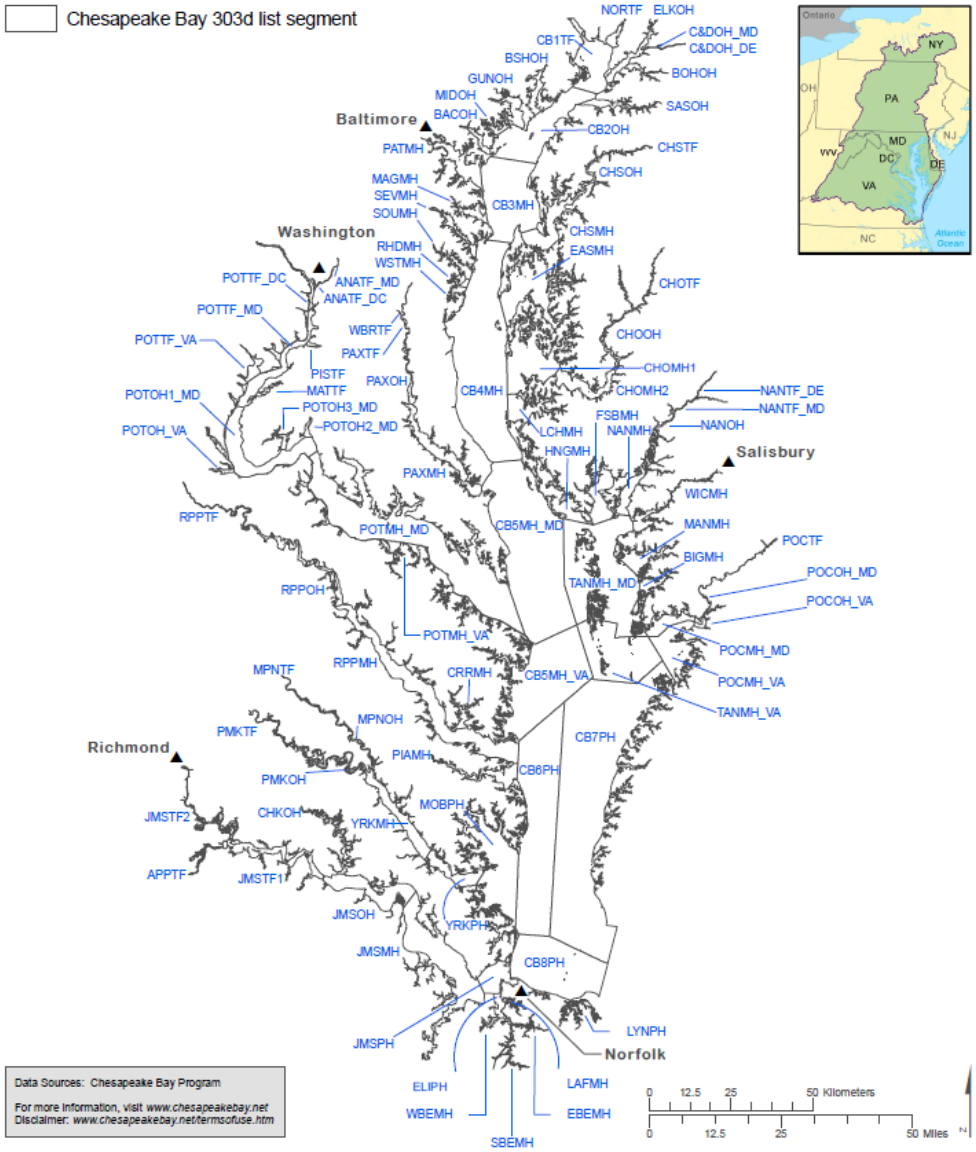
Historically

- Statuary lever is CWA
  - DO, nutrients, chlorophyll, clarity
- Extensive analysis with lab data to derive WQS
  - Covered the entire Bay
  - TMDL performance focused on deep trench
- 2012 Agreement
  - Added many living resources goals
  - Moving towards “in-situ” responses

Chesapeake Bay Segmentation Scheme

(For 303d listing - 92 segments)

Chesapeake Bay Program
A Watershed Partnership



Data Sources: Chesapeake Bay Program

For more information, visit *www.chesapeakebay.net*
Disclaimer: *www.chesapeakebay.net/termsofuse.htm*

Created by HW, 6/4/08

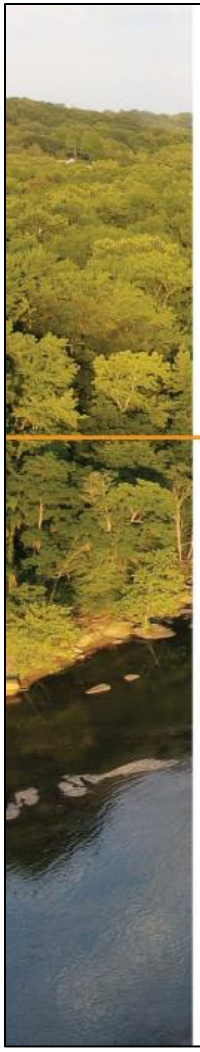
UTM Zone 18N, NAD 83

Strengths of WQS

- Statuary history with CWA
- Well-done
- Seems simple (not really)
- Based on laboratory results – cause-effect
- SAV is assessed
- Stakeholder buy-in

Weaknesses of the Current Implementation of the TMDL

- Limited set of variables – knobs
- Little in-situ context
  - Capacity not responses
  - DO, T, S, Chl, clarity  fish/crab/oyster
  - Ignore other factors
  - Difficulty distinguishing among sites
- Difficult-to-achieve promises (indicators)
- Potentially more efficient for eliciting desired living resource responses
- Keep the good and address the weaknesses
  - Evolution
  - Adaptive



Achieving Water Quality Goals in the Chesapeake Bay: A Comprehensive Evaluation of System Response

An Independent Report from the Scientific and Technical Advisory Committee (STAC)
Chesapeake Bay Program
Annapolis, MD

May 2023

Scientific and Technical Advisory Committee (STAC)

Scientific and Technical Advisory Committee: A Proposed Framework for Analyzing Water Quality and Habitat Effects on the Living Resources of Chesapeake Bay

Kenneth Rose[1], Mark E. Monaco[2], Tom Ihde[3], Jason Hubbart[4], Eric Smith[5], Jay Stauffer[6], Kirk Havens[7]

[1]University of Maryland Center for Environmental Science, [2]National Oceanic and Atmospheric Administration, National Centers for Coastal Ocean Science, [3]Morgan State University, Patuxent Environmental and Aquatic Research Laboratory, [4]West Virginia University, [5]Virginia Tech, [6]Penn State University,

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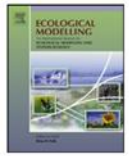
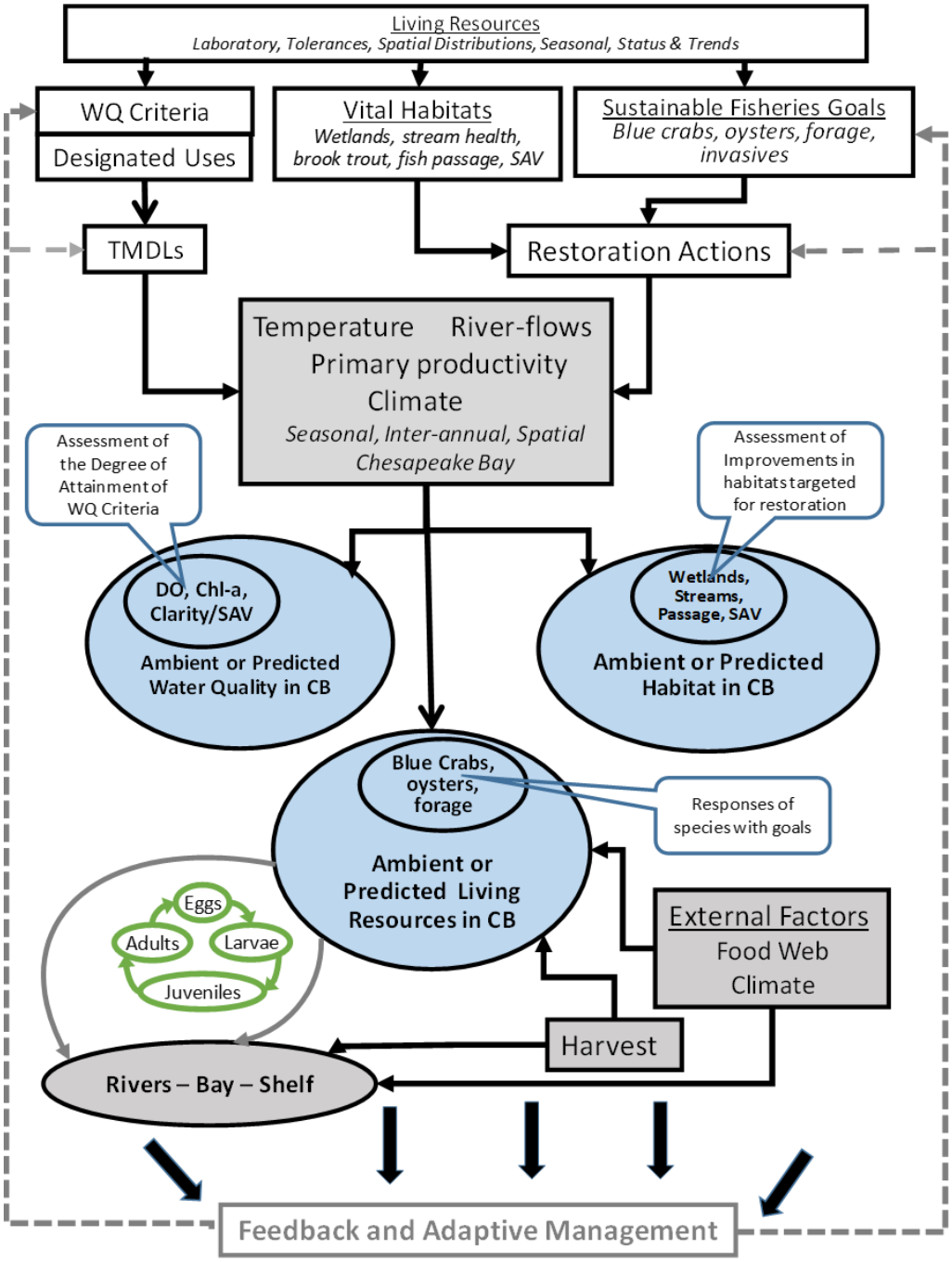
journal homepage: www.elsevier.com/locate/ecolmodel



Proposed best modeling practices for assessing the effects of ecosystem restoration on fish

Kenneth A. Rose[a,*], Shaye Sable[b], Donald L. DeAngelis[c], Simeon Yurek[d], Joel C. Trexler[e], William Graf[f], Denise J. Reed[g]

STAC Publication 23-005

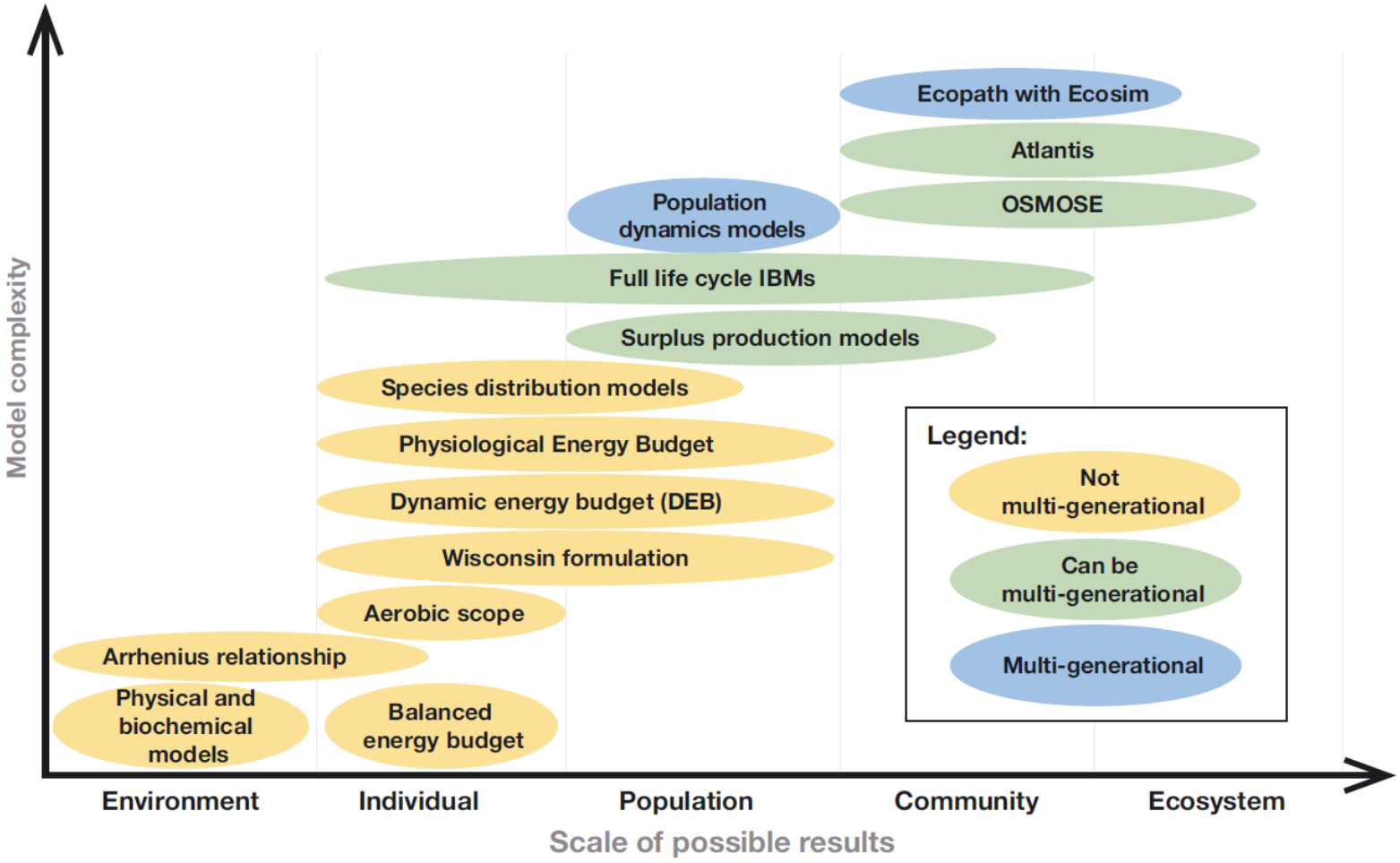

Living Resources
Laboratory, Tolerances, Spatial Distributions, Seasonal, Status & Trends
WQ Criteria
Designated Uses
Vital Habitats
Wetlands, stream health, brook trout, fish passage, SAV
Sustainable Fisheries Goals
Blue crabs, oysters, forage, invasives
TMDLs
Restoration Actions
Temperature River-flows
Primary productivity
Climate
Seasonal, Inter-annual, Spatial
Chesapeake Bay
Assessment of the Degree of Attainment of WQ Criteria
Assessment of Improvements in habitats targeted for restoration
DO, Chl-a, Clarity/SAV
Ambient or Predicted Water Quality in CB
Wetlands, Streams, Passage, SAV
Ambient or Predicted Habitat in CB
Blue Crabs, oysters, forage
Responses of species with goals
Ambient or Predicted Living Resources in CB
Eggs
Adults
Larvae
Juveniles
External Factors
Food Web
Climate
Harvest
Rivers – Bay – Shelf
Feedback and Adaptive Management

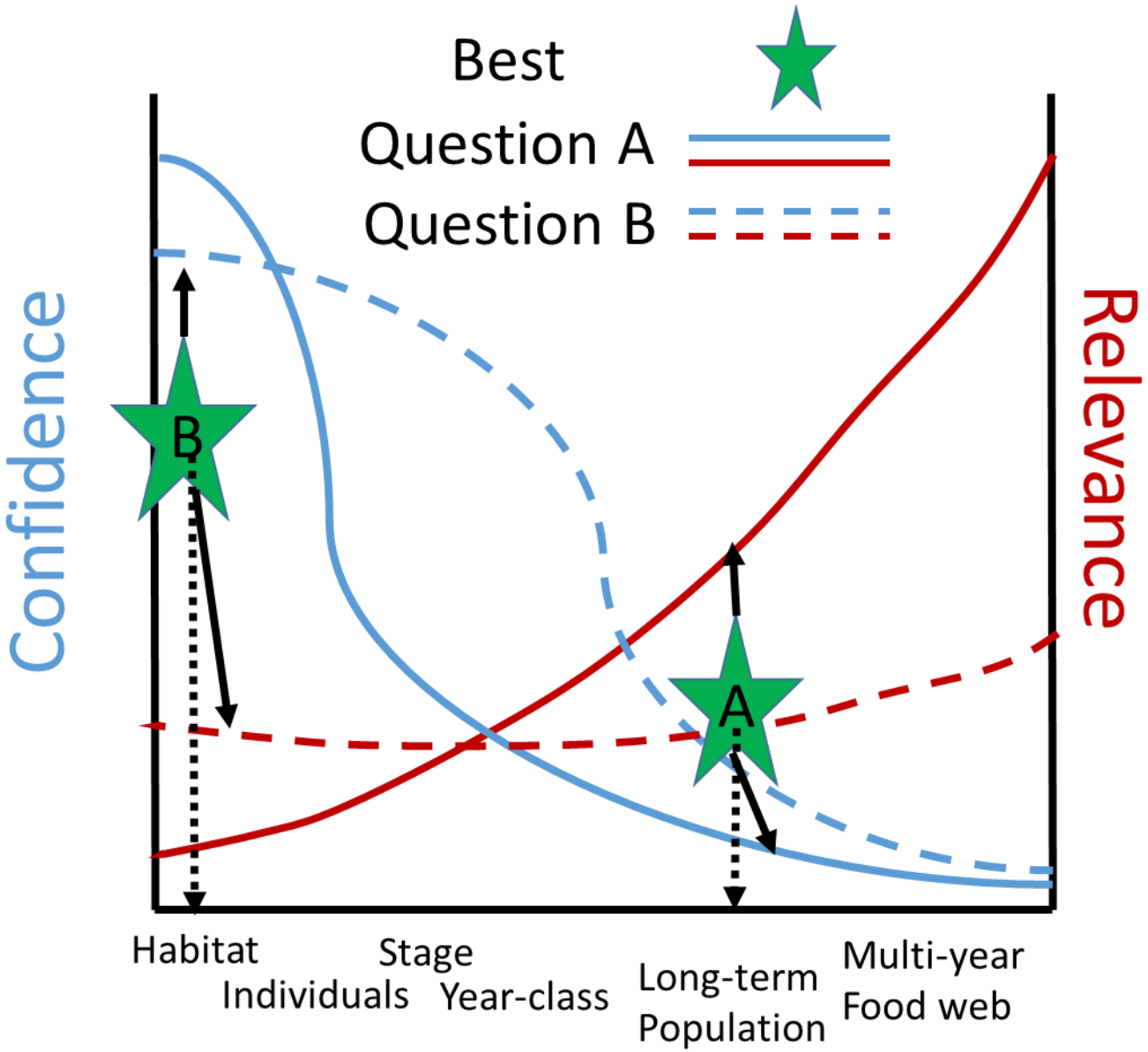
Until Now

Try to achieve dissolved oxygen levels in deep segments

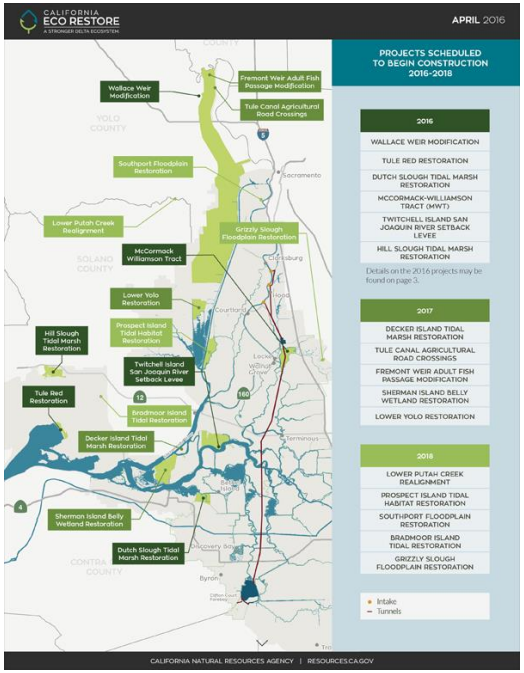
Proposed

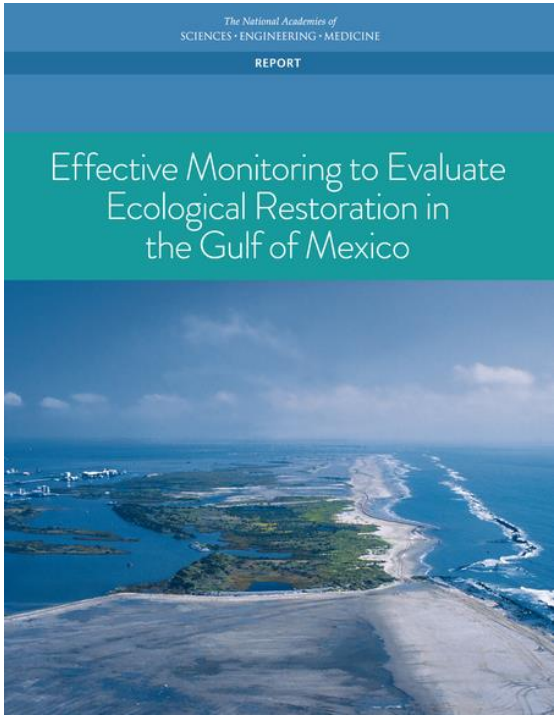
Target and prioritize improvements in water quality to benefit living resource habitats

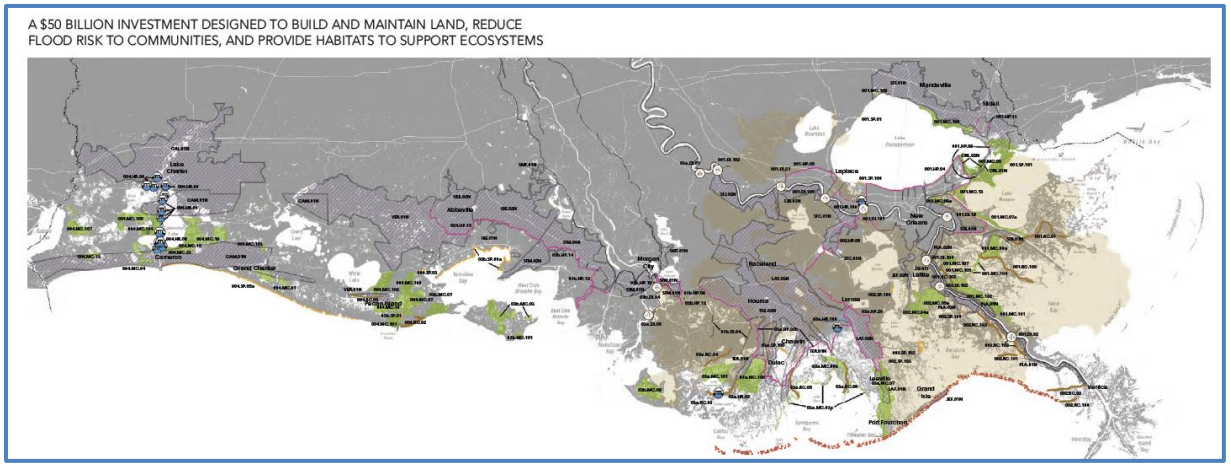

Model complexity
Ecopath with Ecosim
Atlantis
OSMOSE
Population dynamics models
Full life cycle IBMs
Surplus production models
Species distribution models
Physiological Energy Budget
Dynamic energy budget (DEB)
Wisconsin formulation
Aerobic scope
Arrhenius relationship
Physical and biochemical models
Balanced energy budget
Legend:
Not multi-generational
Can be multi-generational
Multi-generational
Environment
Individual
Population
Community
Ecosystem
Scale of possible results


Best
Question A
Question B
Confidence
Relevance
B
A
Habitat
Individuals
Stage
Year-class
Long-term
Population
Multi-year
Food web

Other Places







Living Resources: Framework

1. Selecting species
2. Available data
3. Response and explanatory variables
4. Biological, temporal, and spatial scales
5. Analytical approaches
6. Coordination and combining results

Proposed Implementation Plan for Incorporating CESR Policy Implications Regarding Living Resources into the CBP

January 19, 2024

Prepared by Kenneth Rose and Mark Monaco, STAC members
Co-Authors of CESR[1] and Lead Authors on Living Resources Resource Document[2]

1. Background

A small group (lead by Lee McDonnell) has been meeting to discuss how to effectively address some of the policy implications contained in the Comprehensive Evaluation of System Response (CESR) report that advocate for more explicit consideration of living resources responses in CBP planning and actions. The CESR report consists of a master document, plus three supporting documents (termed Resource Documents). This plan uses the ideas and suggestions in the Living Resources Resource Document to design a demonstration project[2].

Research Article

A Framework for Analyzing Effects of Ecosystem Restoration Actions on Living Resources: A Case Study Using the Chesapeake Bay

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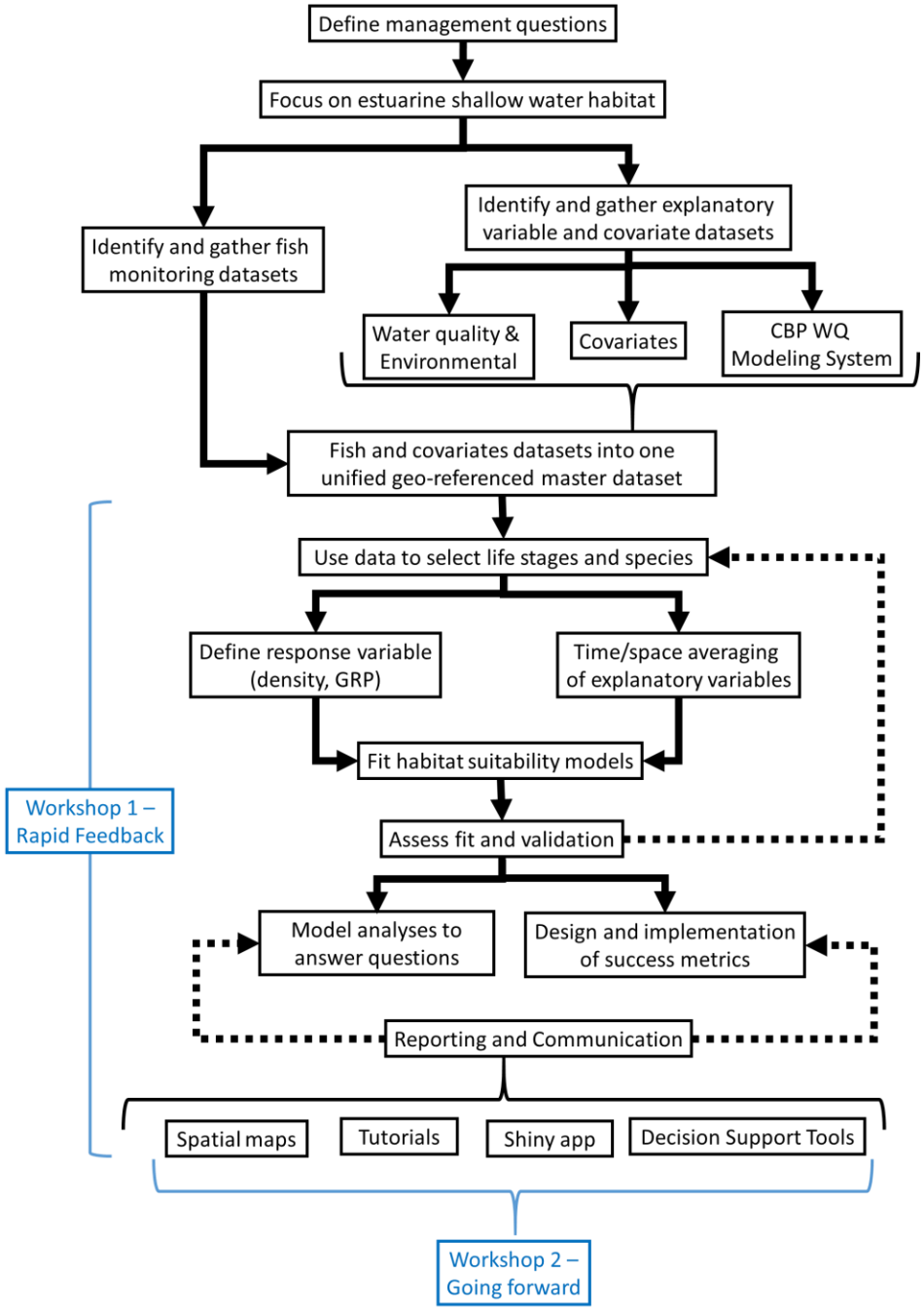
Define management questions
Focus on estuarine shallow water habitat
Identify and gather fish monitoring datasets
Identify and gather explanatory variable and covariate datasets
Water quality & Environmental
Covariates
CBP WQ Modeling System
Fish and covariates datasets into one unified geo-referenced master dataset
Use data to select life stages and species
Define response variable (density, GRP)
Time/space averaging of explanatory variables
Fit habitat suitability models
Assess fit and validation
Model analyses to answer questions
Design and implementation of success metrics
Reporting and Communication
Spatial maps
Tutorials
Shiny app
Decision Support Tools
Workshop 1 – Rapid Feedback
Workshop 2 – Going forward

Needed Models

- WQ models resolved in shallow water

- Habitat
  - Species x life stage x season
  - Venture closer to shore

- Add covariates to complete habitat

https://www.fisheries.noaa.gov/national/habitat-conservation/oyster-reef-habitat
https://www.fisheries.noaa.gov/feature-story/how-will-changes-habitat-affect-fish-and-near-chesapeake-bay
https://www.chesapeakebay.net/news/blog/more-living-shorelines-come-to-chesapeake-bay

Needed Models

- Species/stage specific habitat models
- Supplements improving DO in deep waters
- Segment-specific habitat gains/losses by species
- Same approach and methods with different objective function
- Tradeoffs – decision analysis

Ongoing Activities

- Formed working group
  - 10's of meetings
- Implementation plan
  - Now tactical – workflow
  - Charrette
- Start analyses
  - Demonstration using 2-3 species
  - Provide a template to CBP (~1 year)
- Sustainable Fisheries Goal Implementation Team, CBP, VIMS, and me/Mark plus others