Oyster Recovery Partnership's Oyster BMP Expert Panel Recommendations

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Purpose of Briefing

- Present recommendation to convene an oyster best management practice (BMP) expert panel to evaluate nutrient reduction effectiveness of oyster practices for application in the Chesapeake Bay TMDL water quality/watershed model.

- Present recommended panel goals and objectives that will help facilitate a positive outcome.

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Oyster Practices in Chesapeake Bay

Oyster Aquaculture

Oyster Reef Restoration

Oyster Practices
Intensive Off Bottom Suspended Aquaculture
Intensive Near Bottom Cage or Rack-and-Bag Aquaculture
Intensive Spat-on-Shell Bottom Aquaculture
Intensive Spat-on-Shell Bottom Public Fishery
Intensive/Extensive Spat-on-Shell Bottom Restoration
Extensive Shell Planting Aquaculture
Extensive Shell Planting Public Fishery

* See Appendix A of briefing paper for description of oyster practices.

- Federal and State governments are investing millions of dollars in oyster restoration while concurrently building a robust aquaculture industry.
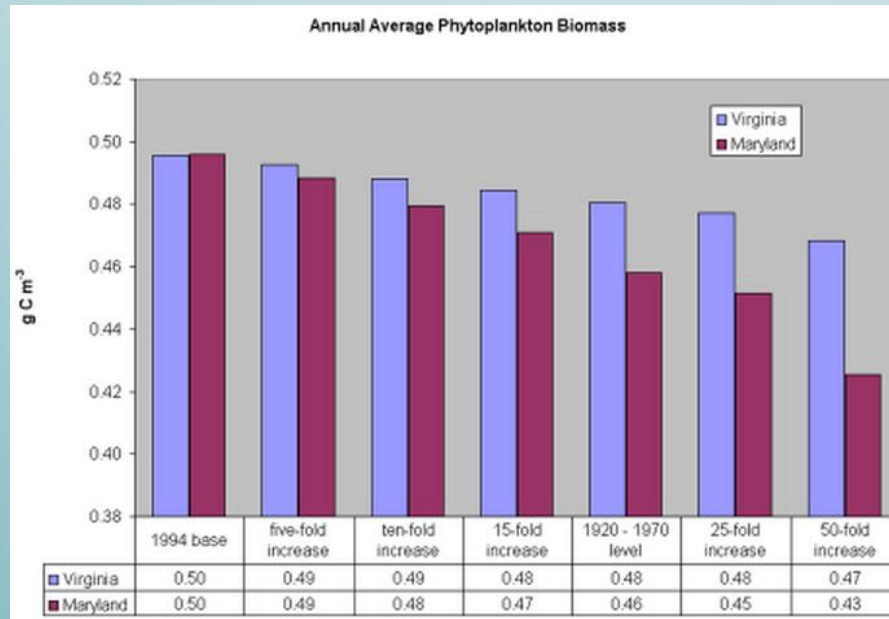
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Oysters Can Improve Water Quality

- Research demonstrates that oysters can effectively remove nutrients from the water column through:
  - Bio-assimilation of N and P in tissues and shells (% content can be reasonably estimated; STAC 2013)
  - Enhancing denitrification via biodeposition of feces and pseudo feces (less is known; research has demonstrated high variability; Kellogg et al. 2014)

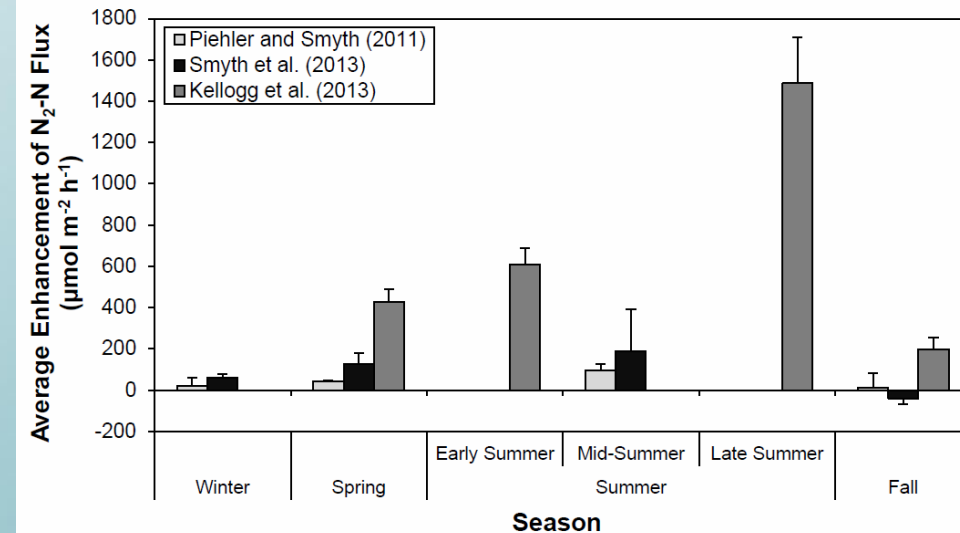Filter-Feeding Effect Based on Oyster Density Scenarios

Denitrification Meta-Analysis

Figure 4. Seasonal patterns of denitrification enhancement relative to reference sites. Error bars represent standard deviaiton.

Cerco and Noel (2005)

Kellogg et al. (2014)

Unresolved Policy and Science Questions

Policy

- How would oyster practices fit in the current BMP construct given that nutrients are removed after they have entered the water (i.e., *in situ*) versus the typical BMP practice of removing nutrients before they enter the water?

- How should the crediting of oyster practices occur given that practices would likely differ in the amount of permanent nutrient removal?
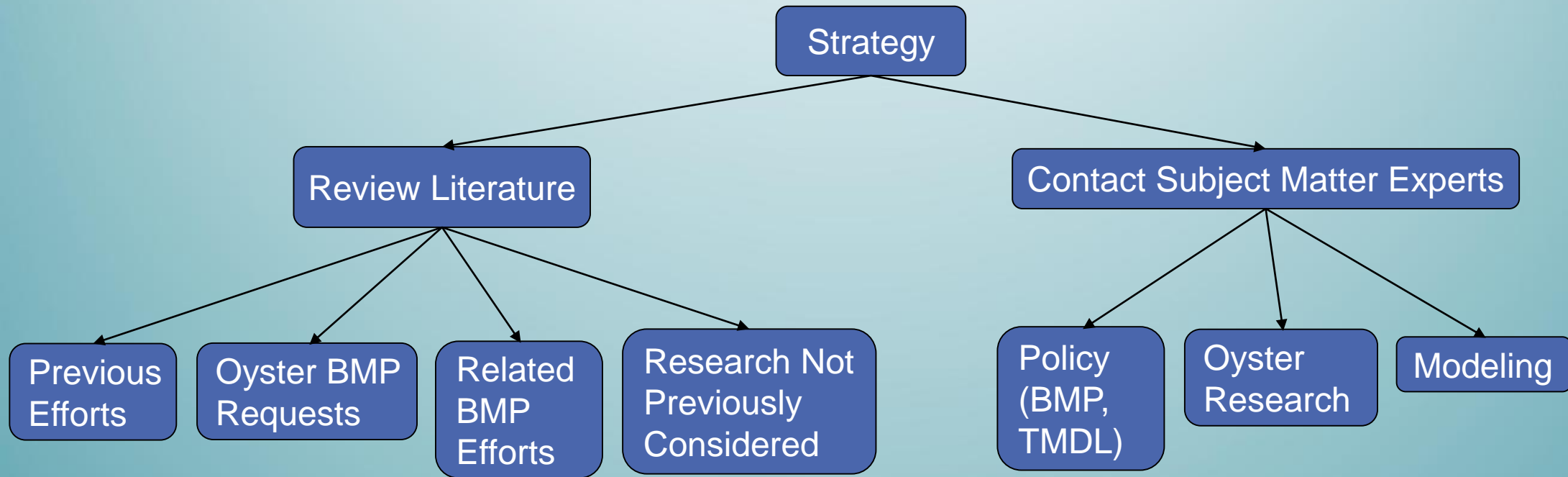
Science

- How to handle the science gaps regarding enhanced denitrification?

- How to deal with the variability in enhanced denitrification rates of oyster reefs?

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Should an Oyster BMP Expert Panel be Convened?

- The Oyster Recovery Partnership analyzed existing information and contacted several subject matter experts to answer this question and develop recommendations.

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                            Strategy
                       /              \
         Review Literature        Contact Subject Matter Experts
        /    |      |      \          /        |         \
Previous  Oyster  Related  Research  Policy   Oyster   Modeling
Efforts   BMP     BMP      Not       (BMP,    Research
          Requests Efforts Previously TMDL)
                           Considered
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Literature Reviewed

Previous Efforts

- Scientific and Technical Advisory Committee (STAC) report, "Evaluation of the Use of Shellfish as a method of Nutrient Reduction in Chesapeake Bay" (STAC 2013)

- Workshop report, "Quantifying Nitrogen Removal by Oysters" (Kellogg et al. 2013)

Oyster BMP Request

- City of Virginia Beach Oyster Request Memo to Water Quality Goal Implementation Team (McLaughlin 2013; see Appendix D for copy of memo)

Related BMP Efforts

- NOAA and Long Island Sound Study International Workshop on Bioextractive Technologies for Nutrient Remediation (Rose et al. 2010)

- Urban Stream Restoration BMP Expert panel report, "Recommendation of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects" (Schueler and Stack 2014)

Oyster Literature Not Previously Considered

- Literature search identified 12 studies that were not previously considered during the STAC review that would be beneficial for an oyster expert panel to review (see Table 1 in Appendix E for list of studies).

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* See Appendix E of briefing paper for literature review summaries.

Yes, an Oyster BMP Expert Panel should be Convened

Conclusions	Reasons
Existing information and unresolved questions support the need for an oyster BMP expert panel	• Substantial effort has been expended on this topic (STAC 2013). • New research and modeling studies are available (see Table 1 in Appendix E of briefing paper). • There is a need for experts to resolve outstanding policy questions.
Interest in an oyster BMP expert panel is high	• City of Virginia Beach sent formal request proposing CBP consider denitrification rates for a "sanctuary oyster reef" BMP. • Citizen request from Dan Watson asking CBP to evaluate new research that would support oyster aquaculture as a BMP (see Appendix B of briefing paper for copy of e-mail correspondence).
An oyster BMP expert panel would be timely	• Would help inform the oyster modeling efforts for the Chesapeake Bay water quality model. • Could help inform various nutrient trading efforts.

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Ultimate Goals of the Oyster BMP Expert Panel

1. Reach a consensus on acceptable nutrient reduction effectiveness estimates for the various oyster practices in Chesapeake Bay based on existing science.

2. Establish a methodology and process to update these estimates when new science becomes available.

3. Establish crediting and verification guidelines for their use in the Chesapeake Bay TMDL watershed model.

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Recommended Objectives the Panel Should Address

1. Establish a crediting framework that evaluates oyster practices and associated nutrient cycling processes on an individual basis.

2. Resolve outstanding policy questions.

3. Evaluate the suitability of modeling approaches to fill in current knowledge gaps.

4. Evaluate existing scientific information using the established crediting framework to determine nutrient reduction effectiveness of individual oyster practices.

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Objective 1: Establish a crediting framework that evaluates oyster practices and associated nutrient cycling processes on an individual basis

Panel Recommendation: Develop crediting framework for individual practices and nutrient cycling processes.

*Concept derived from similar approved framework established by the Urban Stream Restoration BMP Expert Panel.

Oyster Practice

- Crediting Protocol 1 Nitrogen Assimilation in Tissue
- Crediting Protocol 2 Nitrogen Assimilation in Shell
- Crediting Protocol 3 Denitrification
- Crediting Protocol 4 Phosphorus Assimilation in Tissue
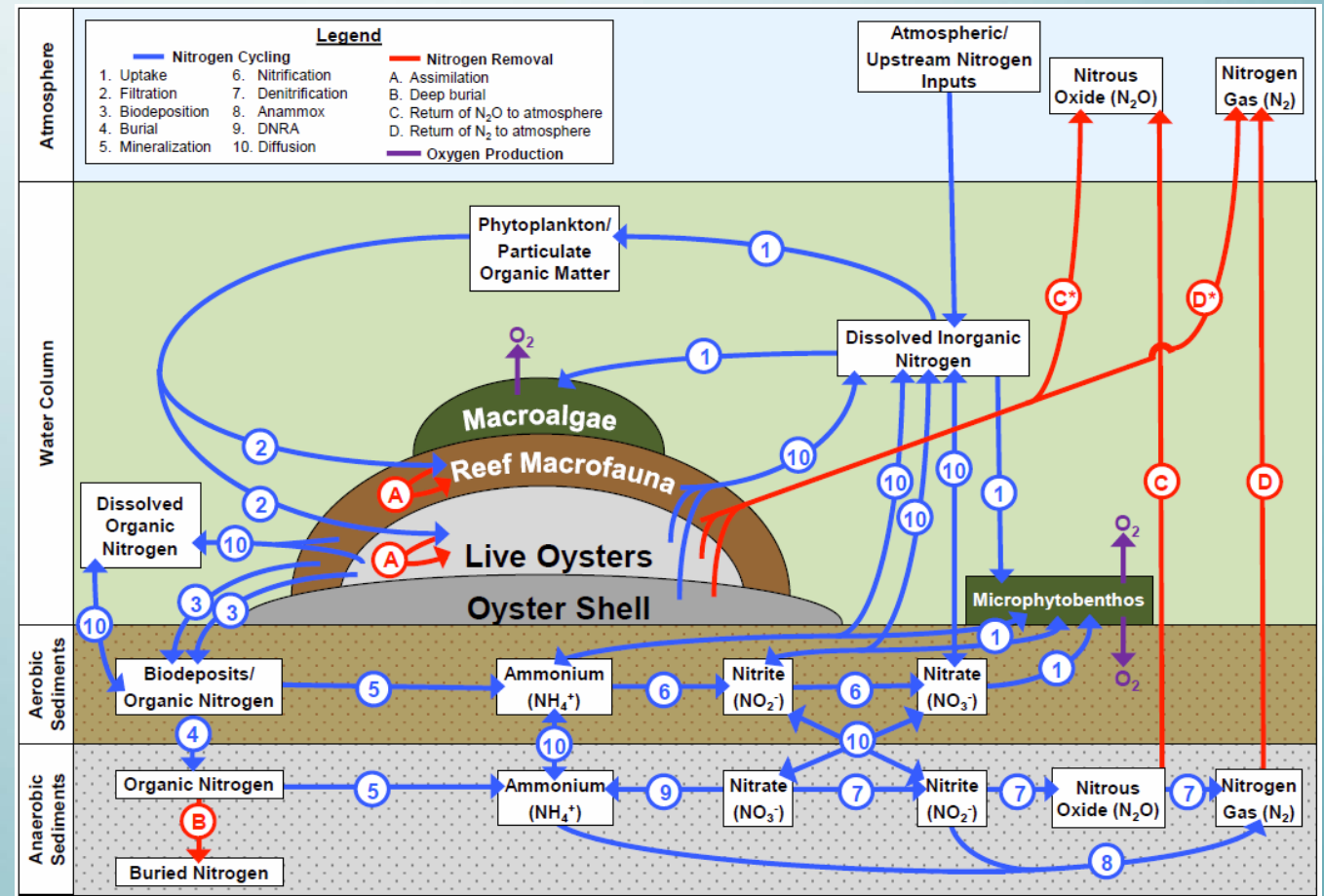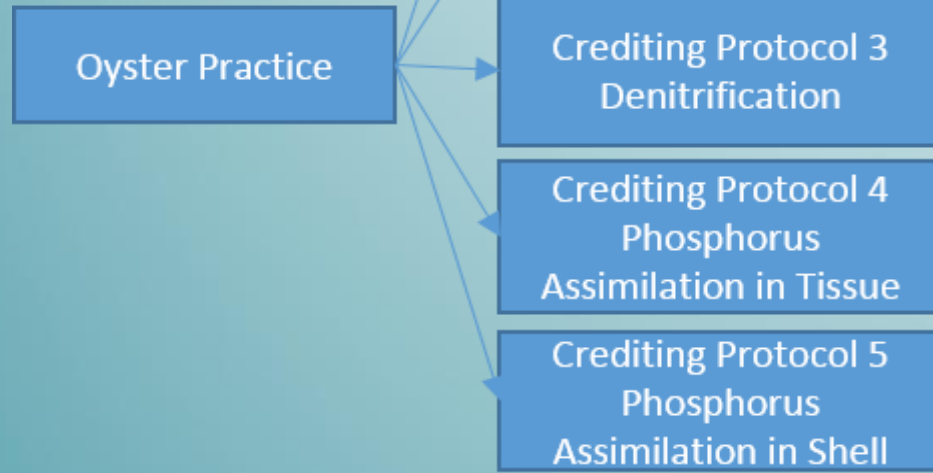- Crediting Protocol 5 Phosphorus Assimilation in Shell

Figure 1. Primary nitrogen cycling and nitrogen removal pathways for a shallow subtidal or submerged intertidal oyster reef in the euphotic zone. (Kellogg et al. 2014)

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Objective 2: Resolve outstanding policy questions

- *In situ* BMP?
- Permanent nutrient removal?

Panel Recommendations:

- Include policy and industry subject matter experts for differing perspectives on how best to fit oyster practices as BMPs.

- Determine if oyster BMPs should be given their own BMP classification.

- Use Long Island Sound's International Bioextractive Technologies for Nutrient Remediation Workshop as a resource to help structure conversation.

- Develop crediting and verification guidelines for each practice following crediting framework.

- Evaluate the need for pilot studies.

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Objective 3: Evaluate the suitability of modeling approaches to fill in current knowledge gaps

Panel Recommendations:

- Review modeling approaches and determine if they would be applicable and acceptable to estimate nutrient reduction.

- Evaluate how updates to the oyster model component within the Chesapeake Bay water quality model could be used to inform nutrient reduction estimates.
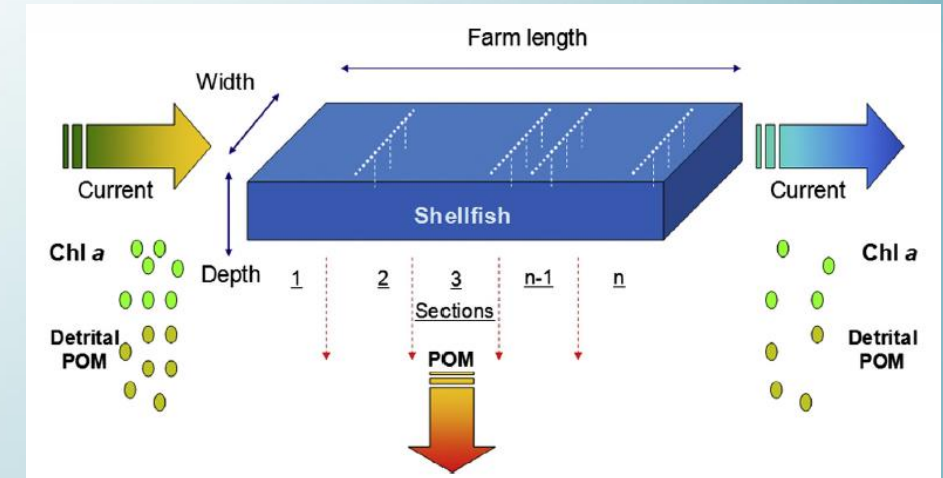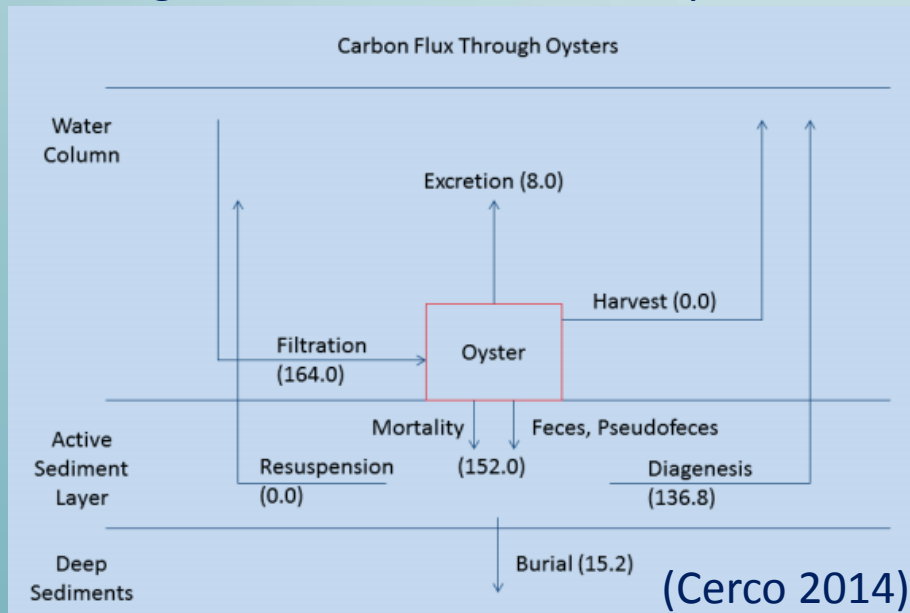
- Include modeling experts on panel.

Fig. 1.Farm layout (rope and bottom culture) for the Farm Aquaculture Resource Management Model. (Rose et al. 2014)

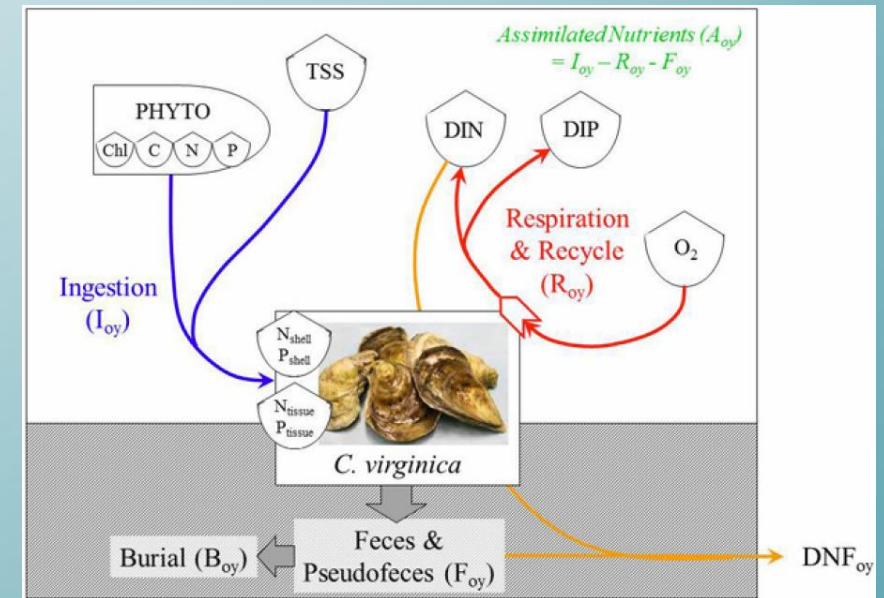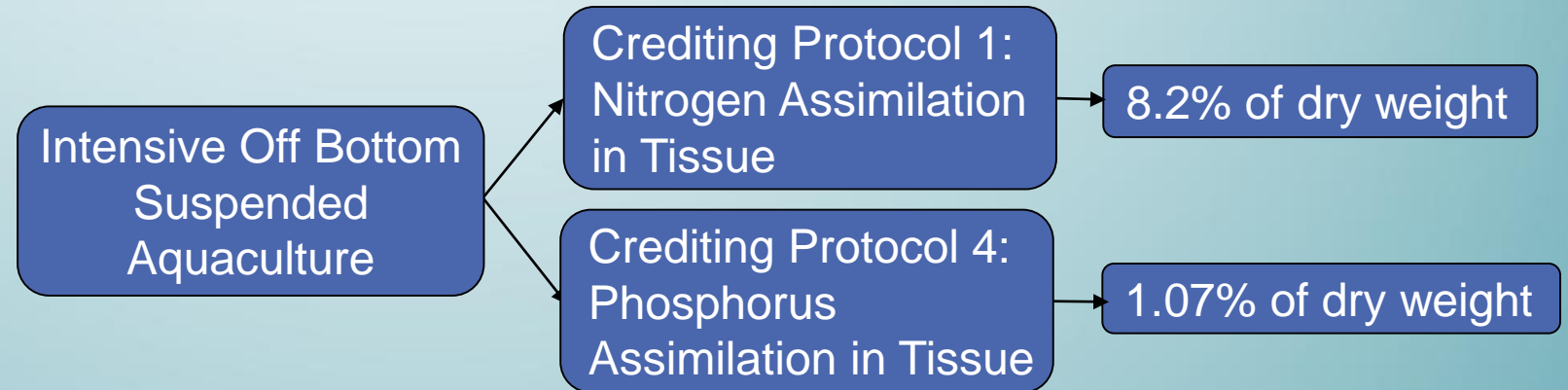### Bioenergetics Model to Calculate Oyster Benefits

(Cerco 2014)

Fig. 3. Oyster sub-model coupled to estuarine ecosystem model in Harris Creek. (Kellogg et al. 2014)

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Objective 4: Evaluate existing scientific information using the established crediting framework to determine nutrient reduction effectiveness of individual oyster practices

Panel Recommendation:

Apply crediting framework, policy guidelines, and modeling decisions to determine whether existing information supports acceptable nutrient reduction estimates for any of the oyster practices.

Hypothetical Example:

Intensive Off Bottom Suspended Aquaculture

→ Crediting Protocol 1: Nitrogen Assimilation in Tissue → 8.2% of dry weight

→ Crediting Protocol 4: Phosphorus Assimilation in Tissue → 1.07% of dry weight

Example Guidelines:

- Credit only applies for harvested oysters.

- Denitrification credit not supported at this time.

- Assimilation in shell not credited because shell is returned to Bay.

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Conclusions

- An oyster expert panel is warranted and should be formed within the year in order to complement other related oyster efforts (e.g., Chesapeake Bay oyster modeling effort, Virginia nutrient trading pilot)
- The panel should include science, policy, and industry subject matter experts.
- The panel should build on the work of previous efforts (e.g., STAC Review, oyster workshop) instead of repeating them.
- The panel should first develop a crediting framework for oyster practices and resolve outstanding policy questions.
- The panel should determine how to handle science gaps (e.g., use of models).

ORP Role in Expert Panel

- ORP would like to continue supporting this effort by offering to chair the oyster BMP panel.

Thank You for Your Time

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