Oyster Futures

Stakeholder Workgroup

MEETING VII SUMMARY REPORT

Saturday, January 6, 2018
Horn Point Laboratory, University of Maryland
Cambridge Maryland

Summarized by:

FCRC CONSENSUS CENTER

"Facilitating Consensus Solutions, Supporting Collaborative Action."

THE FLORIDA STATE UNIVERSITY

OYSTER FUTURES STAKEHOLDER WORKGROUP
MEETING VII SUMMARY REPORT

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OYSTER FUTURES WORKGROUP MEETING VII
EXECUTIVE SUMMARY
JANUARY 6, 2018

On behalf of the Oyster Futures Research Team, Elizabeth North welcomed the Workgroup Members to the seventh meeting of the Oyster Futures Workgroup and introduced new member Bob Whaples, who is President of the Dorchester Seafood Heritage Association, member of the Maryland Watermen's Association and Chesapeake Bay Commercial Fishing Association. She then introduced the facilitation team of Jeff Blair and Bob Jones with the FCRC Consensus Center at Florida State University. Following a workgroup member roll call, the facilitator noted the importance of full participation in the upcoming Workgroup meetings as they develop consensus recommendations to the Department of Natural Resources in 2018.

The facilitators reviewed the agenda and the Workgroup approved the agenda and accepted the November 2017 Workgroup meeting summary without changes. The facilitator reminded the members of the workgroup guidelines that were adopted at the organizational meeting in February 2016, and the goal of developing a package of Workgroup consensus recommendations informed by the model which has been collaboratively developed by the Workgroup and the Oyster Futures project research team. As in past meetings, members also completed a short Social Science Study survey at the outset and after the review and rating of the modeling options on Saturday afternoon.

Mike Wilberg provided the Workgroup with a brief overview of the research objectives for the model and focused his presentation on the changes that had been made based on the November 2017 meeting and the Workgroup direction. Other members of the Team provided comments as appropriate on the larval transport, nutrient, seston and economic model components.

To prepare for rating the newly modeled options, Mike Wilberg provided an initial overview of the results of the 21 options that were identified by the Workgroup and simulated following the November 2017 meeting. The options were captured on dashboard and year plot charts that featured the options and the related performance measures over several intervals up to 25 years. For each option the Workgroup rated its acceptability and support, discussed concerns and offered suggestions to the modelers for new or combined options. Each of the 21 modeled options reviewed was also ranked from 1 to 21 (1 being the best) for its positive results for both abundance and harvest. Since several Workgroup members were not able to participate in the meeting, the Workgroup agreed to continue modeling options receiving 60% or more support. Options ratings with a green shading indicate 60% or more support. Options ratings with a red shading indicate less than 60% support.

A. STATUS QUO OPTION

Option #1: Status quo (SQ) [5% non-compliance with size limit, 1% Sanctuary harvest, and bushel price of $47.22]. *(**19th** abundance/18th harvest)*

Support Rating: 100% (4-9s, 3-2s, 2-0s,1-0s)

B. Enforcement Options

Option 2: SQ with complete compliance with size, 1% Sanctuary harvest. (*12th abundance/19th harvest)*

Support Rating: 100% (4-8s, 3-3s, 2-0s,1-0s)

Option #3: Full compliance with the current size limit and sanctuary regulations. (*4th abundance/ 21st harvest) (100%)*

Support Rating: 100% (4-11s, 3-0s, 2-0s,1-0s)

C. Rotational Harvest

Option #8: 2-yr rotation in smaller areas (10-20% of least productive bars in each area, with annual costs of shell ~ $2M) – just shell. *(9th abundance/14th harvest)*

Support Rating: 9% (4-0s, 3-1s, 2-8s,1-2s)

Option 9: 2-yr rotation in smaller areas (10-20% of least productive bars in each area, with annual costs of spat on shell ~ $2M) – spat on shell. *(6th abundance/12th harvest)*

Support Rating: 64% (4-0s, 3-7s, 2-4s,1-0s)

Option 10: 2-yr rotation in smaller areas (10-20% of least productive bars in each area, with annual costs of shell on shell ~ $600K) – just shell. *(15th abundance/20th harvest)*

Support Rating: 0% (4-0s, 3-0s, 2-6s,1-5s)

Option 11: 2-yr rotation in smaller areas (10-20% of least productive bars in each area, with annual costs of spat on shell ~ $600K) – spat on shell. *(11th abundance/15th harvest)*

Support Rating: 27% (4-0s, 3-0s, 2-6s,1-5s)

***Option 12*:** 2-yr rotation in smaller areas & include Middle Chop sanctuary - just shell. *(20th abundance, 7th harvest)*

Support Rating: 0% (4-0s, 3-0s, 2-10s,1-1s)

Option 13: 2-yr rotation in smaller areas & include Middle Chop sanctuary - spat on shell. (2M year) *(8th abundance 8th harvest)*

Support Rating: 45% (4-0s, 3-5s, 2-6s,1-0s)

Option 13a: 2-yr rotation with Middle Chop sanctuary (cost ~$600K/yr.) – spat on shell *(7th abundance/6th harvest)*

Support Rating: 64% (4-0s, 3-7s, 2-4s,1-0s)

Option 14: 2-yr rotation in smaller areas in Little Choptank tributaries – just shell. Work with shell committee/stakeholders to site. (1.4M/3 years) *(21th abundance/11th harvest)*

Support Rating: 36% (4-0s, 3-4s, 2-7s,1-0s)

Option 15a: 2-yr rotation in smaller areas in Little Choptank tributaries – spat on shell on the same areas as in Option 14. [Model different spat densities and 6.8M $$ over 3 years] *(13th abundance/9th harvest)*

Support Rating: 82% (4-3s, 3-6s, 2-2s,1-0s)

D. Habitat Modification/Restoration Options

Option 17a: Add shell to each bar every year –move all 4 sites to Broad Creek (smaller areas so less than 2M per year, just under 500 acres). Work with the Talbot Co. Shell Committee/stakeholders. *(10th abundance/10th harvest)*

Support Rating: 100% (4-5s, 3-6s, 2-0s,1-0s)

Option 17a2: Add shell to each bar every year. Broad Creek (cost 600K/yr.) *(14th abundance/13th harvest)*

Support Rating: 100% (4-5s, 3-6s, 2-0s,1-0s)

Option 18: Open tributaries in the Little Choptank River to hand tonging, and provide added shell (every 3 years) ($1.4M/3 years) *(18th abundance/4th harvest)*

Support Rating: 91% (4-5s, 3-5s, 2-1s,1-0s)

Option 19/20: Combined: Implement Little Choptank and Tred Avon Restoration with 6" and 12" substrate. *(2nd abundance/3rd harvest)* (*1st abundance/2nd harvest)*

Support Rating: 91% (4-5s, 3-5s, 2-1s,1-0s)

Option 23a: Place reefballs (placed near/around the bridge, channel markers, etc.?) in the Middle Choptank region (reef balls, 1 foot apart) (2 acres) (1 time $2M) not in conflict with fishing activities. Work with watermen for placement options. *16th abundance/16th harvest)*

Support Rating: 91% (4-0s, 3-10s, 2-0s,1-1s)

E. STOCKING

Option 26a: Add spat to every year in the Middle Choptank ($600K per year). *(5th abundance, 5th harvest)*

Support Rating: 100% (4-1s, 3-10s, 2-0s,1-0s)

Option 26b: Add spat every year in the Middle Choptank (cost $2M/year). *3rd abundance 1st harvest*

Support Rating: 100% (4-3s, 3-8s, 2-0s,1-0s)

F. New Options for Modeling

The Workgroup unanimously agreed to ask the Research Team to model the following new options:

- **New Option:** Open tributaries in the Little Choptank River to hand tonging, and provide spat on shell (every 3 years)
- **New Option** (combine 19 and 20): Implement Little Choptank and Tred Avon Restoration with 6" and 12" substrate.
- **New Option**: Implement Little Choptank Restoration with 6" and 12" substrate. (2nd abundance/3rd harvest)
- **New Option** (combine 19 and 20): Tred Avon Restoration with 6" and 12" substrate. (2nd abundance/3rd harvest)

G. Combined Options for Modeling

The Workgroup agreed to combine several options and review the results at the next meeting. These included:

Combine Option 9 and 13a for Modeling

- *Option 9*: 2-yr rotation in smaller areas (10-20% of least productive bars in each area, with annual costs of spat on shell ~ $2M) – spat on shell. *(6th abundance/12th harvest)*

  Support Rating: 64% (4-0s, 3-7s, 2-4s,1-0s)
- *Option 13a*: 2-yr rotation with Middle Chop sanctuary (cost ~$600K/yr.) – spat on shell *(7th abundance, 6th harvest)*

  Support Rating: 64% (4-0s, 3-7s, 2-4s,1-0s)

Combine Options 3, 15a, 19/20 for Modeling

- Option 15a: 2-yr rotation in smaller areas in Little Choptank tributaries – spat on shell on the same areas as in Option 14. [Model different spat densities and 6.8M $$ over 3 years] *[Updated in Model to be 3-yr rotation.] (13th abundance/9th harvest)*
  Support Rating: 82% (4-3s, 3-6s, 2-2s,1-0s)
- Option 19/20: Implement Little Choptank and Tred Avon Restoration with 6" and 12" substrate. (2nd abundance/3rd harvest) (*1st abundance/2nd harvest)*
  Support Rating: 95% (4-3s, 3-6s, 2-2s,1-0s)
- Option #3: Full compliance with the current size limit and sanctuary regulations. (*4th abundance/ 21st harvest)*
  Support Rating: 100% (4-11s, 3-0s, 2-0s,1-0s)

Following the rating of the options, the Workgroup offered reflections on the progress to date and the current set of options including:

- Some options will cost a lot of money but may not result in significant benefits;
- There is no silver bullet and timeframe for positive changes in the fishery is relatively long term (i.e. 25 not 5 years); and
- "Go big or go home" i.e. more investment produces better results.

The Workgroup discussed the OysterFutures Workgroup final report, the treatment of options not receiving consensus support and the role of DNR in reviewing the Workgroup recommendations.

The Workgroup discussed the meeting schedule and agreed to schedule 2 more meetings in 2018 tentatively set for February 4 or March 4, 2018 and a final meeting on March 23-24 to reach consensus on the Workgroup recommendations to DNR. Elizabeth North agreed to contact the members unable to participate in the January meeting to determine availability on either Sunday, February 4 or Sunday, March 4 and send out the schedule in the following week.

The meeting adjourned at 4:00 p.m.

OYSTER FUTURES
WORKGROUP MEETING VII SUMMARY
JANUARY 6, 2018

I. WELCOME, WORKGROUP INTRODUCTIONS, REVIEW OF AGENDA AND WORKGROUP SUMMARY

On behalf of the Oyster Futures Research Team, Elizabeth North welcomed the Workgroup Members to the seventh meeting of the Oyster Futures Workgroup. She introduced new member Bob Whaples, who is President of the Dorchester Seafood Heritage Association, member of the Maryland Watermen's Association and Chesapeake Bay Commercial Fishing Association. The facilitation team of Jeff Blair and Bob Jones with the FCRC Consensus Center at Florida State University then facilitated the meeting. Following a workgroup member roll call *(See Appendix #2 for the Workgroup members list and meeting participants)*, the facilitator noted the importance of full participation in the upcoming Workgroup meetings as they develop consensus recommendations to the Department of Natural Resources in 2018.

The facilitators reviewed the agenda and the Workgroup approved the agenda and accepted the November 2017 Workgroup meeting summary without changes. The facilitator reminded the members of the workgroup guidelines that were adopted at the organizational meeting in February 2016 which call for the development of a package of Workgroup consensus recommendations informed by the model which has been collaboratively developed by the Workgroup and the Oyster Futures project research team. As in past meetings, members also completed a short Social Science Study survey at the outset and after the review and rating of the modeling options on Saturday afternoon.

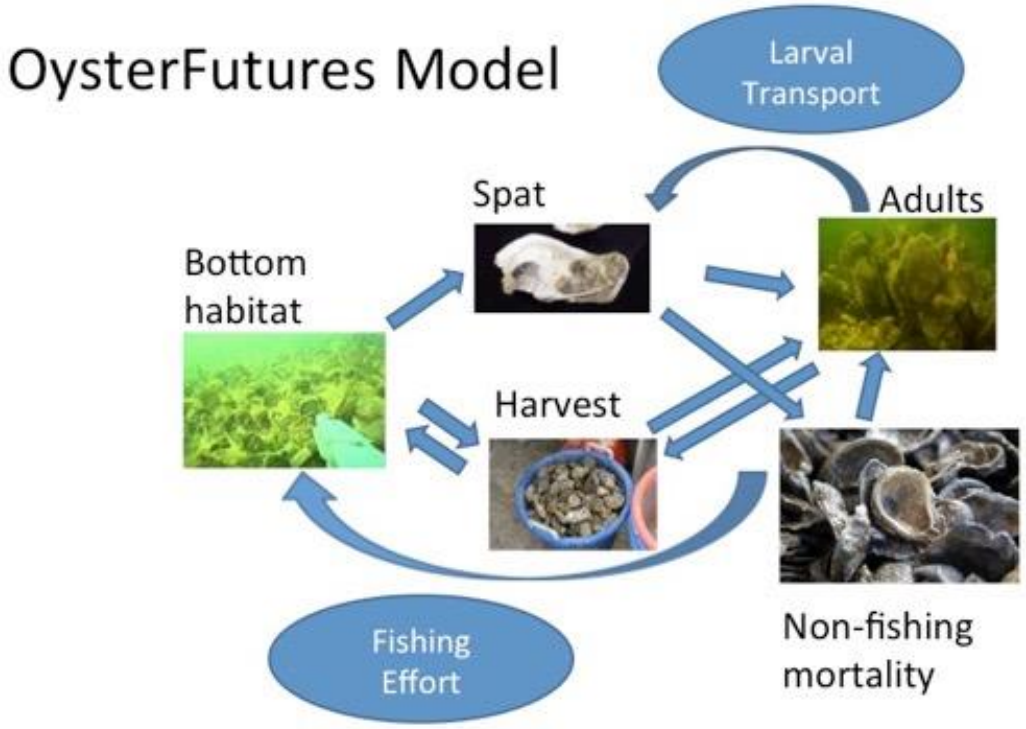
II. OVERVIEW OF THE OYSTER FUTURES MODELING

A. Reviewing the Model Components

Mike Wilberg provided the Workgroup with a brief overview of the research objectives for the Population Models, Oyster Futures Simulation Model, Economics Model, and Water Quality Model. He noted the modeling was nearing completion and focused his presentation on the changes that had been made based on the November 2017 meeting and the Workgroup's direction. Other members of the Research Team provided comments as appropriate on the larval transport, nutrient, seston and economic model components.

He noted the purpose of model which has been to give extra information for decision making to the Workgroup of likely outcome in terms of achieving performance measures for different options they identified. As the model has been developed, the Workgroup has agreed it is a reasonable way to represent the fishery.

Dr. ElizabthNorth highlights the OysterFutures Dashboard Model Results



B. Operation of the Model

The Model includes biological processes (spawning, growth, mortality, larval dispersal, and shell production) and how people decide where to harvest and how much. The model performance measures are displayed on the Dashboard *(see Appendix #7 for the Base Dashboard for 25 years)* and include: abundance; habitat; harvest; revenue; # licenses; # full time watermen; seston deposited, water clarity, reef N removed; catch N removed; social value N removed; cost/year; revenue-cost; and social N-cost+revenue. The Base Run charts reflect results of running the model 100 times for each option. The middle result (median) for all the runs is used for the Dashboard. The Last column (social N-cost+revenue) was added after the November 2017. This aggregate value reflects both the ecosystem service and the harvest/cost of the option.

Status quo
Compliant with minimum size limit and sanctuaries
Rotational harvest (with shell or spat on shell)
Shell additions
Spat on shell additions
Open prongs of Lit. Choptank
Complete Lit. Choptank and Tred Avon restorations
Middle Choptank restoration (with reefballs)

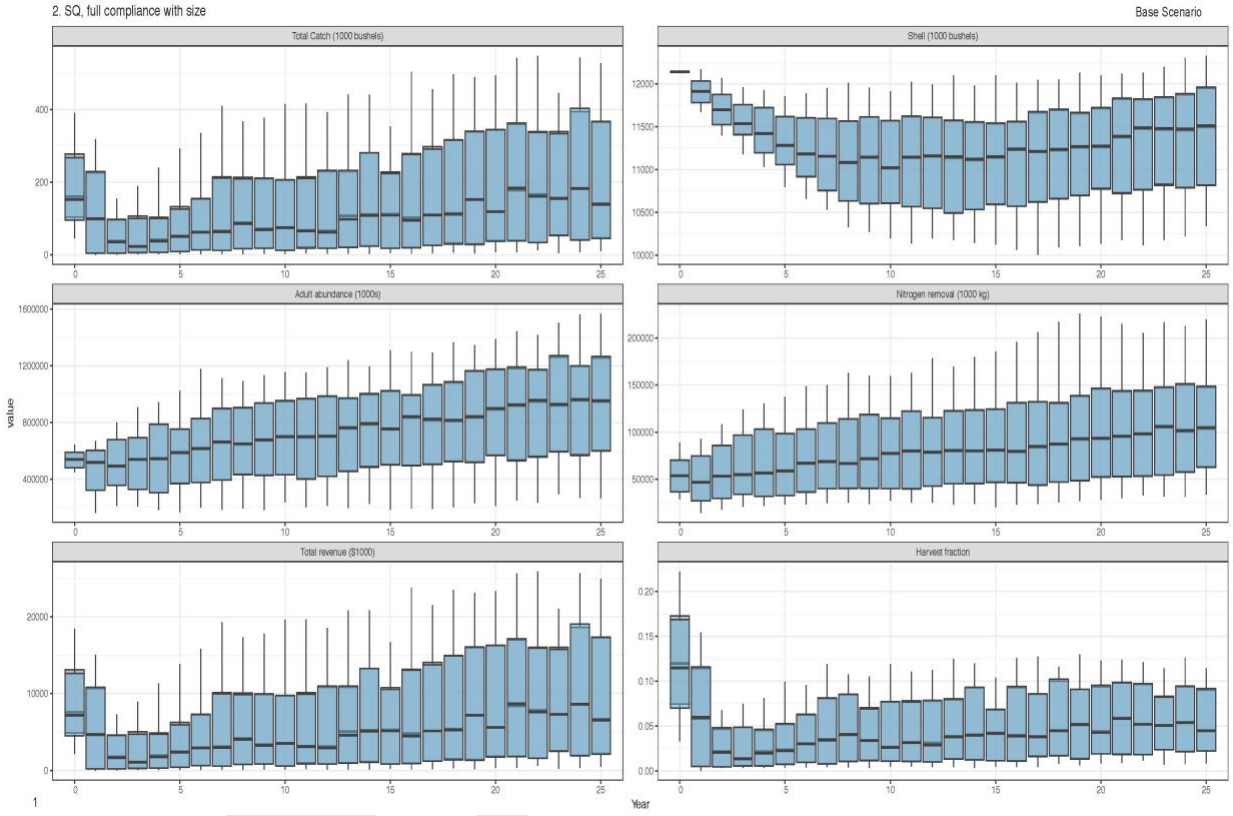
The current run includes the price per bushel at $47.22 average price from the 2016-2017 season and a high price run at $52.22 average from early in the 2017-2018 season. Mike Wilberg also noted that there are important things related to oyster management that the model couldn't address but may be the subject of Workgroup recommendations.

Workgroup Comments & Questions

- How has the model address the price per bushel? The price has increased each of the past 3 years. *A: Since November, the Research Team did an additional suite of model runs with a higher price per bushel closer to current price in order to see how much it affected model results. Although the median values changed slightly between model runs, the patterns in model predictions did not.*

- How is nitrogen removal estimated? *A: For nitrogen removed in the catch, the model uses nitrogen in meats based on oyster size not in shells (because shells go back into the water). For nitrogen from oyster meats, Jeff Cornwell said that the numbers are based on measurements of nitrogen in the ments of over 5,000 oysters of different sizes. For nitrogen removed by oysters in the water, it is based on studies conducted by Jeff Cornwell which estimated the relationship between nitrogen removal and oyster biomass.*

OysterFutures Base Year Plot Example



III. REVIEW, DISCUSSION AND CONSENSUS RATING OF MODELED OPTIONS

Following a general overview and review of the modeling results , the Workgroup rated each option based on its acceptability and support, discussed concerns and offered suggestions to the modelers for new or combined options. Each of the 21 modeled options reviewed was ranked for its positive results for both abundance and harvest from 1 to 21. Since several Workgroup members were not able to participate in the meeting, the Workgroup agreed to consider modeling those options receiving 60% or more support. Options with ratings of 60% or more support are highlighted with a green shading. Options rated with less than 60% support are highlighted with a red shading..

A. STATUS QUO OPTION

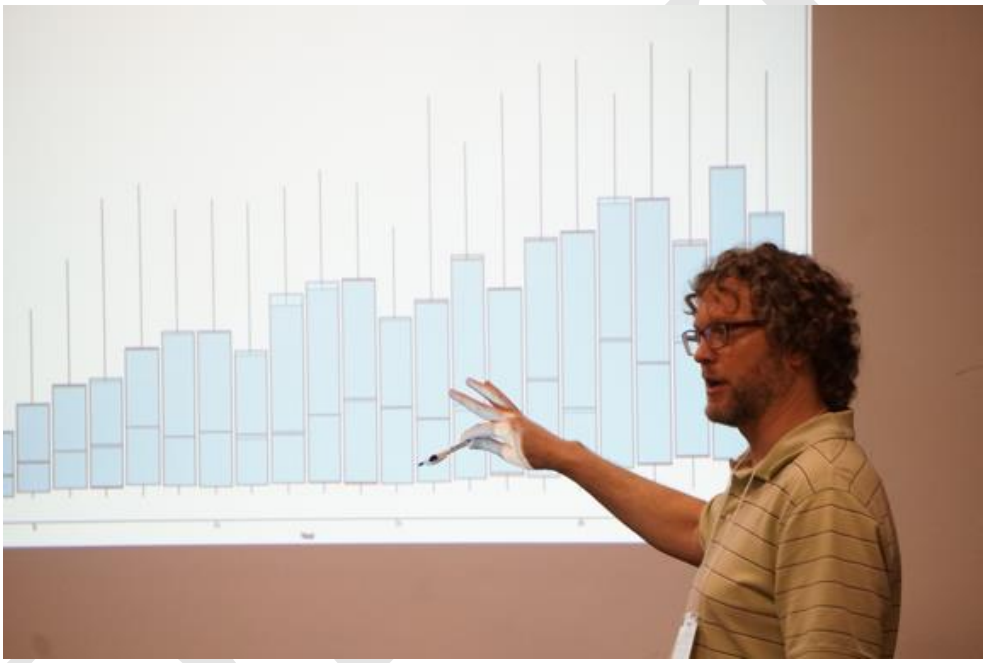
Option #1: Status quo (SQ) [5% non-compliance with size limit, 1% Sanctuary harvest, and bushel price of $47.22]. *(**19th** abundance/18th harvest)*
Support Rating: 100% (4-9s, 3-2s, 2-0s,1-0s)

Workgroup Comments/Questions before Rating

- More confidence in model. Model now reflects logically what would happen in this case scenario. *A: Research Team feels confident there are no errors in model and the results make more sense.*
- The harvest fraction of % taken out seems stable.
- How does the model handle inflation? Consider including a footnote. *A: The model increases the price with inflation with an assumption built into numbers. Will make a note. The Research team ran the higher price scenarios to look at the potential for prices increasing at a rate higher than inflation. The results generally stay the same.*
- The model appears useful and we can see the relationship of one option to another.

Workgroup Comments after Rating

- Minor reservations: Want to look at these results with some caution, hard to get 100% on all options.



Dr. Mike Wilberg reviews the Oyster Futures Base Year Plots model results

B. ENFORCEMENT OPTIONS

Option 2: SQ with complete compliance with size, 1% Sanctuary harvest. (*12th abundance/19th harvest)*

Support Rating: 100% (4-8s, 3-3s, 2-0s,1-0s)

Option #3: Full compliance with the current size limit and sanctuary regulations. (*4th abundance/ 21st harvest) (100%)*

Support Rating: 100% (4-11s, 3-0s, 2-0s,1-0s)

Workgroup Comments

- Look at enforcement options in combination with some of the other options (e.g. rotational harvest, etc.)

C. ROTATIONAL HARVEST OPTIONS

Option #8: 2-yr rotation in smaller areas (10-20% of least productive bars in each area, with annual costs of shell ~ $2M) – just shell. *(9th abundance/14th harvest)*
Support Rating: 9% (4-0s, 3-1s, 2-8s,1-2s)

Workgroup Comments/Questions before Rating

- Does this address changes in shell fish closures? A: Restricted areas are treated as closed in the model. We will see if we can fix the maps for the next meeting.
- What is the size of acreage in year 1 vs. 2? What is quality of habitat? *A: Considers quality and location. Some areas worse in getting spat. Less pronounced than in November.*
- Shell increase in this option is pretty big? *A: $2 million results in a lot of shell, so this is not surprising.*
- Will the placement of shells be up to Shell Committees? *A: Yes, it is expected that the placement of shells and spat would be up to Shell Committees. Note, this option got 75% support in previous ratings, but now members are not in support.*
- Whatever scenario or recommendations, DNR always works with County Shell Committees.
- Will Shell Committee recommendations be modeled before implementation? A: *That is not part of this project but the model will be shared with DNR. The model only covers the Choptank and Little Choptank systems.*

Option 9: 2-yr rotation in smaller areas (10-20% of least productive bars in each area, with annual costs of spat on shell ~ $2M) – spat on shell. *(6th abundance/12th harvest)*
Support Rating: 64% (4-0s, 3-7s, 2-4s,1-0s)

Option 10: 2-yr rotation in smaller areas (10-20% of least productive bars in each area, with annual costs of shell on shell ~ $600K) – just shell. *(15th abundance/20th harvest)*
Support Rating: 0% (4-0s, 3-0s, 2-6s,1-5s)

Option 11: 2-yr rotation in smaller areas (10-20% of least productive bars in each area, with annual costs of spat on shell ~ $600K) – spat on shell. *(11th abundance/15th harvest)*
Support Rating: 27% (4-0s, 3-0s, 2-6s,1-5s)

Option 12: 2-yr rotation in smaller areas & include Middle Chop sanctuary - just shell. *(20th abundance, 7th harvest)*
Support Rating: 0% (4-0s, 3-0s, 2-10s,1-1s)

Workgroup Comments/Questions before Rating

- Abundance a little less than status quo and nitrogen revenue the same, higher exploitation fraction than status quo.
- What is the driver of the model that has most influence? Can we take away the least productive sites to see if other sites are driving the results for abundance? *A: Theoretically yes, but this would take lots of work in terms of modeling. Get down to looking at locations. The Research Team has a worry about how well model predictions represents each specific location but feels comfortable overall.*
- We shouldn't disregard local knowledge which may be needed to make the selection. Make sure as a group we communicate this in our recommendations. *A: The model has been built to*

rank different options based on average performance but was not built for site selection. Site-specific data would be needed before the model could be tested to see if could be used for site selection.

Option 13: 2-yr rotation in smaller areas & include Middle Chop sanctuary - spat on shell. (2M year) *(8th abundance 8th harvest)*
Support Rating: 45% (4-0s, 3-5s, 2-6s,1-0s)

Workgroup Comments/Questions before Rating

- Bobby Whaples described a proposed rotational plan he submitted to the Oyster Advisory Committee. The plan included using a small area within the Sanctuary to allow a rotational harvest program for hand tonging. He also suggested a way to enhance enforcement would be monitoring at checking stations.

Option 13a: 2-yr rotation with Middle Chop sanctuary (cost ~$600K/yr.) – spat on shell *(7th abundance/6th harvest)*
Support Rating: 64% (4-0s, 3-7s, 2-4s,1-0s)

Option 14: 2-yr rotation in smaller areas in Little Choptank tributaries – just shell. Work with shell committee/stakeholders to site. (1.4M/3 years) *(21th abundance/11th harvest)*
Support Rating: 36% (4-0s, 3-4s, 2-7s,1-0s)

Option 15a: 2-yr rotation in smaller areas in Little Choptank tributaries – spat on shell on the same areas as in Option 14. [Model different spat densities and 6.8M $$ over 3 years] *(13th abundance/9th harvest)*
Support Rating: 82% (4-3s, 3-6s, 2-2s,1-0s)

OysterFutures Workgroup Options Consensus Rating

Combined Rotation Options for Modeling

After reviewing the modeling results and ranking each of the updated options, the Workgroup agreed to combine several options and review the results at the next meeting. These included:

Combine Option 9 and 13a for Modeling

- *Option 9*: 2-yr rotation in smaller areas (10-20% of least productive bars in each area, with annual costs of spat on shell ~ $2M) – spat on shell. *(6th abundance/12th harvest)*
  Support Rating: 64% (4-0s, 3-7s, 2-4s,1-0s)

- *Option 13a*: 2-yr rotation with Middle Chop sanctuary (cost ~$600K/yr.) – spat on shell *(7th abundance, 6th harvest)*
  Support Rating: 64% (4-0s, 3-7s, 2-4s,1-0s)

Combine Options 15a, 19/20 for Modeling

- Option 15a: 2-yr rotation in smaller areas in Little Choptank tributaries – spat on shell on the same areas as in Option 14. [Model different spat densities and 6.8M $$ over 3 years] *[Updated in Model to be 3-yr rotation.] (13th abundance/9th harvest)*
  Support Rating: 82% (4-3s, 3-6s, 2-2s,1-0s)

- Option 19/20: Implement Little Choptank and Tred Avon Restoration with 6" and 12" substrate. (2nd abundance/3rd harvest) (*1st abundance/2nd harvest)*
  Support Rating: 95% (4-3s, 3-6s, 2-2s,1-0s)

Combine Options 3, 15a, 19/20 for Modeling

- Option 15a: 2-yr rotation in smaller areas in Little Choptank tributaries – spat on shell on the same areas as in Option 14. [Model different spat densities and 6.8M $$ over 3 years] *[Updated in Model to be 3-yr rotation.] (13th abundance/9th harvest)*
  Support Rating: 82% (4-3s, 3-6s, 2-2s,1-0s)

- Option 19/20: Implement Little Choptank and Tred Avon Restoration with 6" and 12" substrate. (2nd abundance/3rd harvest) (*1st abundance/2nd harvest)*
  Support Rating: 95% (4-3s, 3-6s, 2-2s,1-0s)

- Option #3: Full compliance with the current size limit and sanctuary regulations. (*4th abundance/ 21st harvest)*
  Support Rating: 100% (4-11s, 3-0s, 2-0s,1-0s)

Workgroup Comments

- Look at Sandy Hill and Oyster Shell Point- locations. (13 a)
- Not keen on rotating what we have now. Would like to combine with 13a.
- Where is the best place for rotational harvest?
- Probably the Little Choptank. Good location for enforcement
- Is there still a permit for near-shore restoration? *A: Yes*
- Haven't updated the Little Choptank Restoration plan. Interagency workgroup hasn't fleshed these out yet. *A: If fleshed out by mid/late January the Research Team can do modeling for the February meeting.*

- Combining 15a with #19/20 would influence 19/20 options.
- Most restoration efforts in main stem of Little Choptank.
- In the prongs, is there hard area modeled? *A: Yes. 15a map shows the reefs.*
- Why open up this area for sustainable commercial purposes? Invested in commercial fishery programs that are supported by economic incentives. There are valuable tributaries of the Little Choptank River.
- Aquaculture can happen in the sanctuary outside of the bars.
- If we put Little Choptank & Tred Avon together, it will remove an opportunity for the Workgroup to consider some use of the Sanctuary.

D. HABITAT MODIFICATION/RESTORATION OPTIONS

Option 17a: Add shell to each bar every year –move all 4 sites to Broad Creek (smaller areas so less than 2M per year, just under 500 acres). Work with the Talbot Co. Shell Committee/stakeholders. *(10th abundance/10th harvest)*
Support Rating: 100% (4-5s, 3-6s, 2-0s,1-0s)

Workgroup Comments
- Every year? Think there will be a greater increase in harvest. *A: yes. Lots of factors for harvest- larvae, mortality etc. Modeling-farther from what we have seen, skeptical. Larger effort here. Shell consistently not showing abundance. Model suggests its more cost effective to plant spat on shell vs. just shell.*
- Is overplanting mortality captured? *A: Yes, it takes effect if 3 inches or more but is not cumulative.*
- Putting shell on same spot every year? *A: Yes. Each would get every year.*

Option 17a2: Add shell to each bar every year. Broad Creek (cost 600K/yr.) *(14th abundance/13th harvest)*
Support Rating: 100% (4-5s, 3-6s, 2-0s,1-0s)

Option 18: Open tributaries in the Little Choptank River to hand tonging, and provide added shell (every 3 years) ($1.4M/3 years) *(18th abundance/4th harvest)*
Support Rating: 91% (4-5s, 3-5s, 2-1s,1-0s)

Workgroup Comments
- Concern that shell alone won't work as well. Also do rotation with hand tongs.

Option 19/20: Combined: Implement Little Choptank and Tred Avon Restoration with 6" and 12" substrate. *(2nd abundance/3rd harvest)* (*1st abundance/2nd harvest)*
Support Rating: 91% (4-5s, 3-5s, 2-1s,1-0s)

Workgroup Comments before rating:
- Consider separating these. Large proposals and systems. Model Little Chop and Tred Avon options separately.
- Look at these differently. Little Choptank should be looked at from a commercial perspective. Rebuild into a sustainable commercial tributary.
- Combine 19 and 20- will be in between. Make model run going forward.

Workgroup Comments after rating:

- How much is put in there already? Consider the history of the Little Choptank management experience.

Option 23a: Place reefballs (placed near/around the bridge, channel markers, etc.?) in the Middle Choptank region (reef balls, 1 foot apart) (2 acres) (1 time $2M) not in conflict with fishing activities. Work with watermen for placement options. *16th abundance/16th harvest)*
Support Rating: 91% (4-0s, 3-10s, 2-0s,1-1s)

Workgroup Comments before rating:
- No conflict with fishing activities? How will this be accomplished? Marked where they are at? *A: Use other markers in place e.g. channel markers.*
- Put between bridges in the Choptank? Agency works with watermen to help figure the best way to mark these.

Workgroup Comments after rating:
- 1- Unacceptable. Don't see what you get for the 25-year period. The gain is negligible for the investment.

Option 24a: Place reef balls (placed near/around the bridge, channel markers, etc.) in the Middle Choptank region (reef balls, 3 foot apart) (2 acres) (1 time $2M) not in conflict with fishing activities. Work with watermen for placement options. (*17th abundance/17th harvest)*
Support Rating: 91% (4-0s, 3-10s, 2-0s,1-1s)

Workgroup Comments after rating:
- Same reason as Option 24 above.
- While this option may not get a big benefit, but there is some benefit. Other benefits include getting kids involved in putting them in. *A: Don't have Biodiversity performance measures.*
- This is good publicity and education. While I have some concerns, I am willing to compromise and I want to help on an option important to some Workgroup members.

Following the discussion, the Workgroup agreed the only difference was the spacing on 23a and 24a and agreed to proceed with Option 23a.

Habitat/Restoration Options for Modeling

The Workgroup unanimously agreed to ask the Research Team to model the following new Habitat Modification/Restoration options:

- **New Option 18a:** Open tributaries in the Little Choptank River to hand tonging, and provide spat on shell (every 3 years)

- **New Option 19a:** Combined: Implement Little Choptank Restoration with 6" and 12" substrate. (2nd abundance/3rd harvest) (*1st abundance/2nd harvest)*

- **New Option 19b:** Combined: Implement Tred Avon Restoration with 6" and 12" substrate. *(2nd abundance/3rd harvest) (1st abundance/2nd harvest)*

- **Option 23a:** Place reefballs (placed near/around the bridge, channel markers, etc.?) in the Middle Choptank region (reef balls, 1 foot apart) (2 acres) (1 time $2M) not in conflict with fishing activities. Work with watermen for placement options. *16th abundance/16th harvest)*

E. STOCKING OPTIONS

Option 26a: Add spat to every year in the Middle Choptank ($600K per year). *(5th abundance, 5th harvest)*
Support Rating: 100% (4-1s, 3-10s, 2-0s,1-0s)

Option 26b: Add spat every year in the Middle Choptank (cost $2M/year). *3rd abundance 1st harvest*
Support Rating: 100% (4-3s, 3-8s, 2-0s,1-0s)

F. REFLECTIONS ON MODELING.

Following the rating of the options, the Workgroup offered reflections on the progress to date and the current set of options including:

- Some options will cost a lot of money but may not result in significant benefits;
- There is no silver bullet and timeframe for positive changes in the fishery is relatively long term (i.e. 25 not 5 years); and
- "Go big or go home" i.e. more investment produces better results.

G. REVIEW OF FINAL REPORT OUTLINE

The Workgroup discussed the final report, the treatment of options not receiving consensus support and the role of DNR in reviewing the Workgroup recommendations. Members reviewed the draft outline of the final report *(See Appendix #6)* and suggested some refinements including:

- Add Social Science findings to the description of the collaboration process;
- Add a section on Member reflections and testimonials on the consensus process;
- Consider recommendations to DNR on the strategy for implementation; and
- Produce a "magazine" style final report for public distribution and education and include appendices and background information on the website.

IV. NEXT STEPS

The Workgroup discussed the meeting schedule and agreed to schedule 2 more meetings in 2018 tentatively set for February 4 or March 4, 2018 and a final meeting on March 23-24 to reach consensus on the Workgroup recommendations to DNR. Elizabeth North agreed to contact the members unable to participate in the January meeting to determine availability on either Sunday, February 4 or Sunday, March 4 and send out the schedule in the following week.

Workgroup members were asked to comment on the meeting by completing meeting evaluations *(see Appendix #3).* The meeting adjourned at 4:00 p.m. on Saturday afternoon.

Appendix #1 Workgroup Meeting VI Agenda, January 6, 2018

OYSTERFUTURES WORKGROUP

MEETING VII—SATURDAY, JANUARY 6, 2018

Horn Point Laboratory—AREL Conference Room
2020 Horns Point Road—Cambridge, Maryland

WORKGROUP MEETING OBJECTIVES
✓ To Approve Agenda and Meeting VI Summary Report
✓ To Provide Overview of the OysterFutures Modeling Tool
✓ To Receive Results of New and Revised Options Evaluated by OysterFutures Model
✓ To Acceptability Rate the Results of Options Modeled Relative to Project Goals and Consistency With Performance Measures
✓ To Identify, Discuss and Acceptability Rate Additional Options to be Modeled
✓ To Discuss Outline of Workgroup's Report and Recommendations
✓ To Identify Needed Next Steps, Information Needs, and Agenda Items for Next Meeting

MEETING AGENDA—SATURDAY, JANUARY 6, 2018		
All Agenda Times—Including Adjournment—Are Approximate and Subject to Change		
8:30 AM		*BREAKFAST AND SOCIAL SCIENCE STUDY SURVEY (ON CAMPUS)*
1.)	**9:00 AM**	**WELCOME AND INTRODUCTIONS**
2.)	**9:05 AM**	**AGENDA REVIEW AND APPROVAL**
3.)	**9:10 AM**	**APPROVAL OF FACILITATOR'S SUMMARY REPORT (November 10 - 11, 2017)**
4.)	**9:15 AM**	**REVIEW OF OYSTERFUTURES CONSENSUS-BUILDING PROCESS**
5.)	**9:20 AM**	**OVERVIEW OF THE OYSTERFUTURES MODELING TOOL**
6.)	**9:40 AM**	**OVERVIEW AND DISCUSSION OF THE RESULTS OF OPTIONS MODELED**
~10:30 AM		*BREAK*
7.)	**10:45 PM**	**EVALUATION AND ACCEPTABILITY RATING OF MODELED OPTIONS RELATIVE TO PERFORMANCE MEASURES AND PROJECT GOALS**
~12:30 PM		*LUNCH (ON CAMPUS)*
7.)	**1:00 PM**	**ACCEPTABILITY RATING OF MODELED OPTIONS—CONTINUED**
8.)	**2:30 PM**	**REVIEW OF OPTIONS FOR MODELING—IDENTIFICATION OF NEW OPTIONS, COMBINATIONS OF OPTIONS, AND OPTIONS TO BE REMOVED FROM FURTHER EVALUATION**
9.)	**3:15 PM**	**REVIEW OF WORKGROUP REPORT AND RECOMMENDATIONS OUTLINE**
10.)	**3:45 PM**	**NEXT STEPS: AGENDA ITEMS AND INFORMATION FOR THE NEXT MEETING**
~4:00 PM		*ADJOURN*

Appendix #2 Workgroup & Research Team Membership & Participation

WORKGROUP MEMBERSHIP PARTICIPATION- SATURDAY, JANUARY 6, 2018

MEMBER (***Bold***= Present, *Italics= Absent)*	AFFILIATION
WATERMAN	
J.D. Buchanan	Preston, MD, Caroline County, Talbot County Waterman
Robbie Casho	St. Michaels, MD, Dorchester County Waterman
Jeff Harrison	Tilghman, MD, Talbot County, President Talbot Waterman's Association
Gregory Kemp	McDaniel, MD, Talbot County, Vice President Talbot Waterman's Association
Cody Paul	Church Creek, MD, Dorchester County Commercial Oyster Committee Chair
Bobby Whaples	Vienna, MD, Dorchester County, President Dorchester Seafood Heritage Ass.
AQUACULTURE	
Bobby Leonard	Tred Avon Treats, Ruff-N-Ready, LLC.
Johnny Shockley	Hoopers Island Oyster Aquaculture Co.
SEAFOOD BUYERS	
Aubrey Vincent	Lindy's Seafood
ENVIRONMENTAL CITIZEN GROUPS	
Kelly Cox	Phillips Wharf Environmental Center
Allison Colden	Chesapeake Bay Foundation
Joe Fehrer	The Nature Conservancy
RECREATIONAL FISHING GROUP	
David Sikorski	Coastal Conservation Association (CCA)
MARYLAND DEPARTMENT OF NATURAL RESOURCES	
Dave Blazer	Maryland Department of Natural Resources
OYSTER RECOVERY PARTNERSHIP	
Ward Slacum	Oyster Recovery Partnership
FEDERAL AGENCY	
Stephanie Westby	National Oceanic and Atmospheric Administration (NOAA)

PROJECT SCIENTISTS AND FACILITATORS	
NAME	**AFFILIATION**
UNIVERSITY OF MARYLAND CENTER FOR ENVIRONMENTAL SCIENCE	
Elizabeth North	Fisheries Scientist
Jeffery Cornwell	Estuarine Biogeochemist
Raleigh Hood	Biological Oceanographer
Thomas Miller	Fisheries Ecologist
Lisa Wainger/Chris Hayes	Environmental Economist (Social Scientist)
Michael Wilberg	Fisheries Scientist
VIRGINIA INSTITUTE OF MARINE SCIENCE	
Troy Hartley	Environmental and Natural Resource Policy (Social Scientist)
FCRC CONSENSUS CENTER, FLORIDA STATE UNIVERSITY	
Jeff Blair	Workgroup Facilitator
Robert Jones	Workgroup Facilitator

Appendix #3 Workgroup Meeting Evaluation Summary

OYSTERFUTURES WORKGROUP
JANUARY 6, 2018—CAMBRIDGE, MARYLAND
MEETING EVALUATION SUMMARY

Members used a 0 to 10 Rating Scale where a 0 meant Totally Disagree and a 10 meant Totally Agree. All 11 members in attendance submitted evaluation forms. The average ratings and comments are featured below.

1. Please assess the overall meeting.

8.9 The background information was very useful.
9.2 The agenda packet was very useful.
9.5 The objectives for the meeting were stated at the outset.
9.1 Overall, the objectives of the meeting were fully achieved.

2. Do you agree that each of the following meeting objectives was achieved?

8.9 Update and Feedback Regarding Development of the OysterFutures Modeling Tool.
9.3 Discussion of Results of New and Revised Options Evaluated by the OysterFutures Model.
8.9 Acceptability Rating of Options Modeled Relative to Project Goals and Performance Measures.
9.9 Identification and Evaluation of Any Additional Options and/or Performance Measures.
9.2 Discussion and Rating of Workgroup's Draft Preliminary Recommendations.
9.5 Review of Next Steps and Agenda Items for the Next Meeting.

3. Please tell us how well the Facilitator helped the participants engage in the meeting.

9.6 The members followed the direction of the Facilitator.
9.6 The Facilitator made sure the concerns of all members were heard.
9.7 The Facilitator helped us arrange our time well.
9.4 Participant input was documented accurately in Facilitator's Summary Report (last meeting).

4. Please tell us your level of satisfaction with the meeting?

9.4 Overall, I am very satisfied with the meeting.
9.6 I was very satisfied with the services provided by the Facilitator.
9.4 I am satisfied with the outcome of the meeting.

5. Please tell us how well the next steps were communicated?

9.1 I know what the next steps following this meeting will be.
9.1 I know who is responsible for the next steps.

6. What did you like best about the meeting?

- Facilitation, open dialogue and the data dashboards
- The facilitators and staff and organization.
- All good!
- Excellent again. Thanks for getting done early
- Open discussion of all stakeholder's opinions

- Meeting with others in the Oyster business.
- Organized well, clarification of issue.

7. How could the meeting have been improved?

- None
- As good as can be as far as I can see
- No improvements.
- All good!
- Make shorter
- No comment

8. Do you have any other comments? Please use the back of this page if needed.

- Well done
- Great job being flexible for the adjustment to one day!
- I have more faith in this process now than I did coming in.
- All good!

Appendix #4 Oyster Futures Workgroup Purpose, Goal and Project Summary

STATEMENT OF PURPOSE. The goal of Oyster Futures is to develop recommendations for oyster policies and management that meet the needs of industry, citizen, and government stakeholders in the Choptank and Little Choptank Rivers.

With funding from the National Science Foundation, we will hold a series of workgroup meetings with a representative group of stakeholders. Through these meetings, the stakeholders will produce a collective vision for the future of oysters in this region and build consensus on policy and regulatory options which will be informed by stakeholder and scientific knowledge and by the joint development and use of a modeling tool. The Maryland Department of Natural Resources has agreed to evaluate the consensus recommendations that result.

The stakeholders participating on the workgroup will be representatives from the key interest groups that affect and are affected by the oyster fishery. Researchers from the University of Maryland Center for Environmental Science and the Virginia Institute of Marine Science will serve as consultants to the stakeholders. Professional independent facilitators with experience in fisheries issues will convene the stakeholder meetings. The facilitators will ensure that a consensus-based approach which includes the input of diverse stakeholders is used to develop the collective vision and recommended actions for a sustainable and profitable future for the oyster industry in the Choptank and Little Choptank Rivers.

WORKGROUP'S ADOPTED GOAL STATEMENT: *(Adopted Unanimously February 26, 2016)* The goal of the Oyster Futures Workgroup is to develop a package of consensus recommendations informed by a model collaboratively developed by the Workgroup and the Oyster Futures project research team. The model will be designed so that it can be used to evaluate oyster fishery practice and management options and restoration policies in the Choptank and Little Choptank Rivers. The Workgroup's recommendations will be directed to Secretary Mark Belton of the Maryland Department of Natural Resources. The project's ultimate goal is to ensure that the regulation and management of the oyster fishery, and oyster restoration polices are informed by the best available science and shared stakeholder stewardship values, resulting in an economically viable, healthy and sustainable Choptank and Little Choptank Rivers oyster fishery and ecosystem.

PROJECT SUMMARY. Achieving effective natural resource management is challenging because of the multiple and often competing objectives of different stakeholder groups, a limited set of policy options, and uncertainty in the performance of those options. Yet, managers need policies that allow continued use of natural resources while ensuring access for future generations and maintenance of ecosystem services. Formal approaches are needed that will assist managers and stakeholders in choosing policy options that have a high likelihood of achieving social, ecological, and economic goals. The goal of this project, Oyster Futures, is to address this need by improving the use of predictive models to support sustainable natural resource policy and management. A stakeholder-centered process will be used to build an integrated model that combines estuarine physics, oyster life history, and the ecosystem services that oysters provide (e.g., harvest, water quality) to forecast outcomes under alternative management strategies. Through a series of facilitated meetings, stakeholders will participate in a science-based collaborative process which will allow them to project how well policies are expected to meet their objectives using the integrated model. This iterative process will ensure that the model will incorporate the complex human uses of the ecosystem as well as focus on the outcomes most important to the stakeholders. In addition, a study of the socioeconomic drivers of stakeholder involvement, information flow, use and influence, and policy formation will be undertaken to improve the process, enhance implementation success of recommended policies, and provide new ideas for integrating natural and social sciences, and scientists, in sustainable resource management. In this presentation, the strategy for integrating natural system models, stakeholder views, and sociological studies as well as methods for selecting stakeholders and facilitating stakeholder meetings will be described and discussed.

Appendix #5 Oyster Futures Project Schedule

OYSTER FUTURES WORKGROUP MEETING SCHEDULE		
PHASE I MEETING SCHEDULE—2016 AND 2018		
I.	February 26 - 27, 2016	Horn Point Laboratory
II.	April 30 – May 1, 2016	Horn Point Laboratory
--	October 23, 2016 (*Oyster Symposium*)	St. Michael's Maritime Museum
III.	November 5 - 6, 2016	Horn Point Laboratory
IV.	March 24 – 25, 2017	Horn Point Laboratory
V.	July 22 – 23, 2017 (Management Options)	Horn Point Laboratory
VI.	November 10 -11, 2017 (Management Options)	Horn Point Laboratory
VII.	January 5-6, 2018	Horn Point Laboratory
VIII.	February 4, 2018	Horn Point Laboratory
IX.	March 23-24, 2018	Horn Point Laboratory

PROJECT WEBPAGE (URL): https://Oyster Futures.wordpress.com/

PROCESS DESIGN AND PROJECT FACILITATION: Process design and meeting facilitation by Jeff Blair and Bob Jones from the FCRC Consensus Center at Florida State University. Information at: http://consensus.fsu.edu/

FCRC CONSENSUS CENTER

Appendix #6- Draft Outline of Final Report and Recommendations-January 2018

(Underline reflect additional Workgroup Suggestions)

Executive Summary Outline

- OysterFutures Goal, Membership and Vision of Success Themes
- The OysterFutures Workgroup Consensus Building Process and Collaboration Model and Social Science Findings
- Reflections on the Process
- Recommendations
- Next Steps

OysterFutures Report Outline

I. BACKGROUND

A. Statement of Purpose and Research Project Description
B. OysterFutures Goal and Vision Themes
C. The OysterFutures Workgroup Consensus Building Process
D. Collaboration Model and Social Science Findings
E. Collaborative Modeling: Description and Assumptions
F. Reflections on the Process

II. CONSENSUS RECOMMENDATIONS *(For example)*

A. Stakeholder Collaboration
B. Enforcement
C. Rotational Harvest
D. Oyster Habitat Enhancement
E. Stocking
F. Limited Entry
G. Business Practices and Marketing
H. Education

III. CONCLUSIONS AND NEXT STEPS

A. Workgroup reflections, perspectives and testimonials on the consensus process.
B. Recommendations to DNR and Strategy for Implementation

APPENDICES

A. Workgroup and Research Team Members
B. Meeting Schedule and Summary and Overview of Meetings
C. Overview of Model Components
D. Archive of Options Evaluated

Member Comments

- Adding observations- reflections from the modeling.
- All produced improvements over the status quo.
- Time series plot- how long before benefits appear- long view. Takes a longer time.
- Social information? Feedback from group on the process- social side of the process.
- Workgroup elect representatives to present the report?
- Format- magazine, good looking handout. Appendices on line.
- Available to the public?
- Elizabeth will meet with any group before publishing and after.
- Presentations- after finishing.
- Public television piece?
- After March meeting get back to the Workgroup for final suggestions/edits.

Appendix #7- Example- Base Run Model Results Dashboard-January 2018

OysterFutures Model

Base Run - 1/3/2018

YEAR 2-5 (average)

Performance Measures (difference from Status Quo)

Options	Abundance (10,000s) Spat	Abundance (10,000s) Adults	Habitat (1000 bu)	Harvest (1000 bu)	Revenue (1000 $)	Number Licenses	Number Full Time	Seston Deposited	Water clarity	Reef: N removed	Catch: N removed	Social value N removed	Cost/yr (1000 $)	Revenue - Cost	Social N-Cost +Revenue
A. Status quo (SQ) (median)	19,613	54,017	11,484	38	$1,799	212	23	115,898		122,726	246	$102,559	$0	$1,799	$104,358
2. SQ, full compliance with size	68	190	2	-1	-$48	-11	-2	417		520	-6	$429	$0	-$48	$381
3. SQ, full compliance	540	762	5	-11	-$538	-10	-2	2,009		2,324	-73	$1,877	$0	-$538	$1,340
8. 2-yr Rotation (R), small, $2M – shell	420	611	1,588	5	$227	28	5	769		1,316	30	$1,122	$2,001	-$1,774	-$652
9. 2-yr R, small, $2M – spat	2,523	1,430	170	6	$294	29	5	2,200		1,926	39	$1,639	$2,023	-$1,729	-$90
10. 2-yr R, small, $600K – shell	278	333	433	3	$118	12	2	382		438	16	$379	$544	-$426	-$47
11. 2-yr R, small, $600K – spat	642	362	49	2	$84	6	1	573		421	11	$360	$596	-$513	-$153
12. 2-yr R, small, MidC, $2M – shell	411	580	1,567	7	$315	37	7	538		432	44	$396	$1,972	-$1,657	-$1,261
13. 2-yr R, small, MidC, $2M – spat	2,361	1,388	168	5	$251	24	5	2,268		1,956	33	$1,659	$1,992	-$1,741	-$83
13a. 2-yr R, small, MidC, $600K – spat	901	842	52	2	$98	9	1	1,092		937	13	$792	$603	-$505	$287
14. 3-yr R, Little Choptank tribs – shell	224	325	370	3	$137	12	2	380		451	17	$391	$408	-$272	$119
15a. 3-yr R, Little Choptank tribs – spat	2,643	1,237	196	6	$273	19	3	2,020		1,814	37	$1,544	$2,068	-$1,794	-$251
17a. Shell every yr in BC, $2M	57	423	1,537	2	$116	19	3	173		324	14	$283	$1,939	-$1,823	-$1,541
17a2. Shell every yr in BC, $600K	6	114	460	1	$40	5	1	0		84	5	$74	$581	-$540	-$467
18. Open LitChop tribs, shell every 3 yr	110	118	244	1	$44	3	0	146		30	6	$30	$672	-$628	-$598
19. LitChop & Tred restored (6" high)	5,525	2,849	1,638	0	$14	0	0	3,393		3,824	2	$3,191	$2,014	-$2,000	$1,191
20. LitChop & Tred restored (12" high)	5,565	2,889	3,134	0	$14	0	0	3,460		3,937	2	$3,285	$2,348	-$2,333	$952
23a. Reef balls in MidC SCA (1' apart)	45	48	13	0	$0	0	0	48		90	0	$75	$66	-$65	$9
24a. Reef balls in MidC SCA (3' apart)	55	54	18	0	$0	0	0	59		83	0	$70	$79	-$79	-$10
26a. Spat every yr in MidC, $600K	2,005	2,021	60	17	$791	82	14	3,444		2,123	104	$1,857	$602	$189	$2,046
26b. Spat every yr in MidC, $2M	4,408	2,990	178	31	$1,487	144	25	4,840		2,851	192	$2,538	$2,001	-$513	$2,025
B. All areas open to hand tonging	-10,437	-18,084	-105	45	$2,119	226	39	-37,843		-42,054	280	-$34,840	$0	$2,119	-$32,721
C. All areas closed	4,289	8,203	55	-22	-$1,059	-127	-23	15,306		25,816	-144	$21,411	$0	-$1,059	$20,351
D. All areas closed, full compliance	4,997	9,207	60	-38	-$1,799	-127	-23	17,565		29,403	-246	$24,317	$0	-$1,799	$22,518
E. SQ, 10% size, 1% sanct harvest	-66	-189	-2	1	$49	9	1	-418		-511	5	-$422	$0	$49	-$373
F. SQ, 0.5% sanctuary harvest	238	292	2	-5	-$214	1	0	832		910	-30	$734	$0	-$214	$520
G. SQ, 1.5% sanctuary harvest	-235	-289	-2	5	$216	-1	0	-766		-890	30	-$717	$0	$216	-$501
H. Restore all areas to 6"	-19,114	-49,956	148,920	-38	-$1,799	-127	-23	-106,810		-111,554	-246	-$93,242	$31,630	-$33,428	-$126,670
I. Full restoration over 25 yrs	-1,177	-4,823	18,616	-10	-$479	-46	-8	-10,439		-16,300	-65	-$13,649	$35,581	-$36,060	-$49,709
J. Implement a slot limit 3" – 5"	152	382	3	-2	-$109	-8	-2	1,011		944	-18	$772	$0	-$109	$663
	Key:		greater than 1		less than -1			(lbs)		(lbs)	(lbs)	(1000 $)	upfront	(1000 $)	(1000 $)

1

OysterFutures Model

Base Run - 1/3/2018

YEAR 7-10 (average)

Performance Measures (difference from Status Quo)

Options	Abundance (10,000s) Spat	Abundance (10,000s) Adults	Habitat (1000 bu)	Harvest (1000 bu)	Revenue (1000 $)	Number Licenses	Number Full Time	Seston Deposited	Water clarity	Reef: N removed	Catch: N removed	Social valu N removed	Cost/yr (1000 $)	Revenue - cost	Social N-Cost +Revenue
A. Status quo (SQ) (median)	23,433	67,005	11,099	75	$3,541	384	55	141,352		156,271	485	$130,735	$0	$3,541	$134,276
2. SQ, full compliance with size	139	347	3	-2	-$75	-3	0	765		788	-11	$648	$0	-$75	$573
3. SQ, full compliance	1,078	2,418	20	-10	-$456	14	3	5,176		6,295	-65	$5,196	$0	-$456	$4,740
8. 2-yr Rotation (R), small, $2M – shell	778	1,799	2,795	10	$490	30	5	2,503		2,178	64	$1,870	$2,001	-$1,511	$359
9. 2-yr R, small, $2M – spat	4,618	3,379	320	27	$1,251	106	20	5,059		4,038	165	$3,506	$2,023	-$772	$2,734
10. 2-yr R, small, $600K – shell	483	550	762	0	$7	-2	0	708		591	0	$493	$544	-$537	-$44
11. 2-yr R, small, $600K – spat	1,147	605	92	4	$183	16	3	1,043		728	25	$627	$596	-$414	$214
12. 2-yr R, small, MidC, $2M – shell	828	907	2,750	10	$467	43	7	800		214	64	$232	$1,972	-$1,504	-$1,272
13. 2-yr R, small, MidC, $2M – spat	4,525	3,326	316	28	$1,323	109	20	5,054		3,800	176	$3,315	$1,992	-$670	$2,646
13a. 2-yr R, small, MidC, $600K – spat	2,126	2,371	107	20	$966	76	14	4,150		3,115	128	$2,704	$603	$364	$3,067
14. 3-yr R, Little Choptank tribs – shell	1,075	1,707	625	15	$690	66	12	2,014		1,169	90	$1,049	$408	$282	$1,331
15a. 3-yr R, Little Choptank tribs – spat	4,645	4,423	355	30	$1,426	128	22	6,158		5,790	189	$4,986	$2,068	-$642	$4,345
17a. Shell every yr in BC, $2M	341	1,402	2,701	8	$365	40	7	1,786		1,540	44	$1,321	$1,939	-$1,574	-$252
17a2. Shell every yr in BC, $600K	58	169	808	1	$39	6	1	300		414	6	$350	$581	-$542	-$192
18. Open LitChop tribs, shell every 3 yr	283	1,097	594	15	$720	67	12	855		737	94	$693	$672	$48	$742
19. LitChop & Tred restored (6" high)	11,630	13,755	1,184	25	$1,183	82	15	22,540		32,026	155	$26,839	$2,014	-$831	$26,008
20. LitChop & Tred restored (12" high)	12,500	14,854	2,164	26	$1,217	85	16	25,584		35,714	160	$29,918	$2,348	-$1,131	$28,787
23a. Reef balls in MidC SCA (1' apart)	94	157	8	0	$9	1	0	329		338	1	$283	$66	-$57	$226
24a. Reef balls in MidC SCA (3' apart)	72	163	10	0	$22	1	0	391		264	2	$223	$79	-$57	$165
26a. Spat every yr in MidC, $600K	3,630	3,455	130	45	$2,104	180	31	5,246		3,778	275	$3,380	$602	$1,501	$4,882
26b. Spat every yr in MidC, $2M	7,829	6,998	364	102	$4,802	413	72	10,014		6,003	631	$5,533	$2,001	$2,801	$8,334
B. All areas open to hand tonging	-14,143	-29,657	-340	-42	-$1,993	-159	-30	-58,573		-67,781	-276	-$56,759	$0	-$1,993	-$58,752
C. All areas closed	7,479	14,754	180	-52	-$2,455	-299	-55	37,112		40,160	-336	$33,213	$0	-$2,455	$30,758
D. All areas closed, full compliance	9,072	18,234	211	-75	-$3,541	-299	-55	43,569		48,668	-485	$40,184	$0	-$3,541	$36,643
E. SQ, 10% size, 1% sanct harvest	-138	-347	-3	3	$124	7	1	-768		-801	13	-$657	$0	$124	-$533
F. SQ, 0.5% sanctuary harvest	470	1,035	8	-3	-$159	9	2	2,174		2,743	-23	$2,269	$0	-$159	$2,109
G. SQ, 1.5% sanctuary harvest	-458	-990	-9	3	$163	-8	-2	-2,155		-2,660	21	-$2,201	$0	$163	-$2,038
H. Restore all areas to 6"	-22,839	-63,453	65,423	-75	-$3,537	-299	-55	-135,081		-145,697	-485	-$121,916	$31,630	-$35,167	-$157,083
I. Full restoration over 25 yrs	-3,919	-11,277	31,229	-10	-$467	-47	-8	-28,130		-31,182	-65	-$26,060	$35,581	-$36,048	-$62,107
J. Implement a slot limit 3" – 5"	280	744	7	-4	-$209	-14	-3	1,679		1,749	-35	$1,430	$0	-$209	$1,221
	Key:		greater than 1		less than -1			(lbs)		(lbs)	(lbs)	(1000 $)	upfront	(1000 $)	(1000 $)

2

OysterFutures Model

Base Run - 1/3/2018

YEAR 12-15 (average) - Percent Change from SQ

Performance Measures percent change from Status Quo)

not %

Options	Abundance (10,000s) Spat	Abundance (10,000s) Adults	Habitat (1000 bu)	Harvest (1000 bu)	Revenue (1000 $)	Number Licenses	Number Full Time	Seston Deposited	Water clarity	Reef: N removed	Catch: N removed	Social value N removed	Cost/yr (1000 $)	Revenue - Cost	Social N-Cost +Revenue
A. Status quo (SQ) (median)	29,811	74,997	11,138	99	$4,678	451	68	157,261		175,580	637	$146,965	$0	$4,678	$151,643
2. SQ, full compliance with size	0.6	0.6	0.1	-4.8	-4.8	-3.9	-4.7	0.7		0.7	-4.3	0.7	$0	-4.8	0.5
3. SQ, full compliance	6.9	5.1	0.5	-12.8	-12.8	3.0	3.9	5.2		4.9	-13.0	4.9	$0	-12.8	4.3
8. 2-yr Rotation (R), small, $2M – shell	5.7	3.1	30.2	13.3	13.3	15.7	17.9	2.7		1.6	12.7	1.7	$2,001	-29.5	0.7
9. 2-yr R, small, $2M – spat	19.0	5.7	3.6	18.8	18.8	20.6	23.7	3.7		2.4	18.9	2.4	$2,023	-24.4	1.6
10. 2-yr R, small, $600K – shell	2.5	0.8	8.2	1.7	1.7	4.0	4.3	0.6		0.5	1.7	0.5	$544	-9.9	0.2
11. 2-yr R, small, $600K – spat	5.1	1.3	1.0	5.3	5.3	4.3	4.8	1.0		0.4	5.4	0.4	$596	-7.4	0.2
12. 2-yr R, small, MidC, $2M – shell	5.9	1.8	29.7	18.7	18.7	20.3	23.0	0.6		-0.1	18.3	-0.1	$1,972	-23.4	-0.8
13. 2-yr R, small, MidC, $2M – spat	18.0	4.6	3.5	15.9	15.9	17.5	20.2	2.9		1.8	16.0	1.8	$1,992	-26.7	0.9
13a. 2-yr R, small, MidC, $600K – spat	7.4	5.3	1.3	24.1	24.1	19.6	23.3	3.6		2.5	24.0	2.6	$603	11.2	2.9
14. 3-yr R, Little Choptank tribs – shell	6.5	1.9	7.0	16.8	16.8	17.3	20.1	0.9		-0.2	17.1	-0.2	$408	8.1	0.1
15a. 3-yr R, Little Choptank tribs – spat	17.7	7.0	4.1	29.5	29.5	30.3	35.4	3.4		1.3	29.6	1.4	$2,068	-14.7	0.9
17a. Shell every yr in BC, $2M	1.6	2.0	29.1	13.3	13.3	18.0	21.6	1.0		1.6	12.3	1.7	$1,939	-28.2	0.7
17a2. Shell every yr in BC, $600K	0.6	0.4	8.7	2.9	2.9	4.7	5.4	0.2		0.5	3.1	0.5	$581	-9.6	0.2
18. Open LitChop tribs, shell every 3 yr	0.6	1.6	7.1	31.7	31.7	29.6	34.5	0.2		-1.3	31.0	-1.1	$672	17.4	-0.6
19. LitChop & Tred restored (6" high)	53.4	29.2	6.8	47.2	47.2	36.8	43.9	28.0		26.6	47.0	26.7	$2,014	4.1	26.0
20. LitChop & Tred restored (12" high)	62.8	36.5	11.2	55.9	55.9	42.1	50.6	34.2		33.6	56.4	33.7	$2,348	5.8	32.9
23a. Reef balls in MidC SCA (1' apart)	0.5	0.4	0.1	0.7	0.7	0.4	0.5	0.4		0.3	0.7	0.3	$66	-0.7	0.3
24a. Reef balls in MidC SCA (3' apart)	0.3	0.3	0.1	0.8	0.8	0.6	0.8	0.3		0.3	0.8	0.3	$79	-0.9	0.2
26a. Spat every yr in MidC, $600K	13.7	5.9	1.5	47.1	47.1	46.7	54.3	4.3		2.3	46.5	2.5	$602	34.3	3.5
26b. Spat every yr in MidC, $2M	28.3	12.3	4.2	124.4	124.4	117.2	137.4	9.5		5.1	118.8	5.5	$2,001	81.6	7.8
B. All areas open to hand tonging	-66.6	-48.4	-5.3	-62.4	-62.4	-46.4	-39.6	-47.7		-47.4	-62.4	-47.5	$0	-62.4	-47.9
C. All areas closed	40.0	28.9	3.2	-69.6	-69.6	-81.2	-67.6	33.3		41.7	-69.0	41.3	$0	-69.6	37.9
D. All areas closed, full compliance	50.6	36.4	3.8	-100.0	-100.0	-81.2	-67.6	42.0		50.4	-100.0	49.9	$0	-100.0	45.2
E. SQ, 10% size, 1% sanct harvest	-0.6	-0.6	-0.1	3.2	3.2	4.6	3.7	-0.7		-0.7	3.0	-0.7	$0	3.2	-0.5
F. SQ, 0.5% sanctuary harvest	3.1	2.2	0.2	-3.6	-3.6	3.3	2.7	2.2		2.1	-3.6	2.1	$0	-3.6	1.9
G. SQ, 1.5% sanctuary harvest	-3.0	-2.2	-0.2	2.5	2.5	-3.0	-2.7	-2.3		-2.0	2.7	-1.9	$0	2.5	-1.8
H. Restore all areas to 6"	-93.9	-94.9	253.4	-99.7	-99.7	-81.2	-67.6	-96.8		-92.3	-99.7	-92.4	$31,630	-775.9	-113.4
I. Full restoration over 25 yrs	50.4	13.8	409.5	10.5	10.5	19.3	15.4	0.6		-1.3	8.3	-1.3	$35,581	-750.1	-24.4
J. Implement a slot limit 3" – 5"	1.3	1.4	0.1	-4.2	-4.2	-1.2	-1.4	1.3		1.5	-4.9	1.4	$0	-4.2	1.3
Key:			greater than 1		less than -1			(lbs)		(lbs)	(lbs)	(1000 $)	upfront	(1000 $)	(1000 $)

8

OysterFutures Model

Base Run - 1/3/2018

YEAR 17-20 (average) - Percent Change from SQ

Performance Measures percent change from Status Quo)

not %

Options	Abundance (10,000s) Spat	Abundance (10,000s) Adults	Habitat (1000 bu)	Harvest (1000 bu)	Revenue (1000 $)	Number Licenses	Number Full Time	Seston Deposited	Water clarity	Reef: N removed	Catch: N removed	Social value N removed	Cost/yr (1000 $)	Revenue - Cost	Social N-Cost +Revenue
A. Status quo (SQ) (median)	35,606	83,984	11,240	124	$5,835	547	85	177,426		196,339	793	$164,408	$0	$5,835	$170,244
2. SQ, full compliance with size	0.7	0.7	0.1	-0.4	-0.4	-0.8	-1.1	0.7		0.8	0.5	0.8	$0	-0.4	0.7
3. SQ, full compliance	7.2	6.1	0.6	-4.2	-4.2	9.0	10.4	6.9		6.2	-3.6	6.2	$0	-4.2	5.8
8. 2-yr Rotation (R), small, $2M – shell	4.8	2.8	32.0	1.8	1.8	4.0	3.6	1.4		1.2	2.4	1.2	$2,001	-32.5	0.1
9. 2-yr R, small, $2M – spat	15.3	5.3	3.9	17.9	17.9	20.0	22.6	3.5		3.4	18.6	3.5	$2,023	-16.7	2.8
10. 2-yr R, small, $600K – shell	2.4	1.1	8.7	-1.8	-1.8	-0.1	-0.7	0.5		0.5	-1.5	0.4	$544	-11.1	0.1
11. 2-yr R, small, $600K – spat	4.1	1.0	1.1	1.4	1.4	3.1	3.0	0.6		0.9	1.8	0.9	$596	-8.8	0.6
12. 2-yr R, small, MidC, $2M – shell	4.6	1.5	31.4	18.6	18.6	19.9	21.5	-1.2		-0.3	20.0	-0.2	$1,972	-15.2	-0.8
13. 2-yr R, small, MidC, $2M – spat	14.9	4.5	3.8	21.0	21.0	23.1	25.9	2.7		2.8	21.8	2.9	$1,992	-13.2	2.4
13a. 2-yr R, small, MidC, $600K – spat	7.0	3.5	1.4	9.1	9.1	10.5	11.8	1.7		3.6	9.5	3.7	$603	-1.2	3.5
14. 3-yr R, Little Choptank tribs – shell	9.2	0.8	7.4	18.0	18.0	18.2	19.7	-0.2		-0.4	19.0	-0.3	$408	11.0	0.1
15a. 3-yr R, Little Choptank tribs – spat	17.7	4.0	4.5	23.0	23.0	23.4	26.1	1.9		0.6	23.7	0.7	$2,068	-12.4	0.3
17a. Shell every yr in BC, $2M	1.2	3.1	30.9	10.0	10.0	12.0	13.4	1.0		1.2	9.9	1.2	$1,939	-23.2	0.4
17a2. Shell every yr in BC, $600K	0.3	1.0	9.3	2.6	2.6	3.8	3.6	0.3		0.2	2.7	0.2	$581	-7.4	-0.1
18. Open LitChop tribs, shell every 3 yr	1.8	1.2	6.9	32.7	32.7	33.0	36.7	-0.8		-1.5	32.5	-1.3	$672	21.2	-0.5
19. LitChop & Tred restored (6" high)	45.8	28.7	5.9	57.9	57.9	52.2	62.3	29.6		27.7	57.6	27.8	$2,014	23.4	27.7
20. LitChop & Tred restored (12" high)	56.1	36.6	8.5	69.4	69.4	59.7	71.0	37.7		36.2	69.1	36.3	$2,348	29.2	36.1
23a. Reef balls in MidC SCA (1' apart)	0.4	0.5	0.1	0.7	0.7	0.6	0.7	0.5		0.6	0.8	0.6	$66	-0.4	0.6
24a. Reef balls in MidC SCA (3' apart)	0.3	0.5	0.1	0.7	0.7	0.6	0.8	0.3		0.3	0.7	0.3	$79	-0.6	0.3
26a. Spat every yr in MidC, $600K	9.5	5.2	1.7	40.2	40.2	38.7	43.8	3.5		2.6	39.9	2.7	$602	29.9	3.7
26b. Spat every yr in MidC, $2M	22.9	10.9	4.8	97.5	97.5	95.0	107.6	9.0		5.4	94.0	5.7	$2,001	63.2	7.7
B. All areas open to hand tonging	-70.1	-51.9	-6.3	-62.5	-62.5	-48.3	-49.5	-52.8		-50.5	-62.4	-50.6	$0	-62.5	-51.0
C. All areas closed	51.1	44.9	4.6	-68.8	-68.8	-84.5	-84.8	48.1		54.5	-68.2	54.0	$0	-68.8	49.8
D. All areas closed, full compliance	62.6	56.3	5.6	-100.0	-100.0	-84.5	-84.8	58.3		66.9	-100.0	66.3	$0	-100.0	60.6
E. SQ, 10% size, 1% sanct harvest	-0.7	-0.6	-0.1	0.9	0.9	1.3	1.0	-0.7		-0.8	0.7	-0.8	$0	0.9	-0.7
F. SQ, 0.5% sanctuary harvest	3.3	2.7	0.2	-2.1	-2.1	4.3	4.2	3.1		2.8	-1.9	2.8	$0	-2.1	2.6
G. SQ, 1.5% sanctuary harvest	-3.4	-2.3	-0.2	1.1	1.1	-4.1	-4.3	-3.1		-2.8	1.8	-2.8	$0	1.1	-2.7
H. Restore all areas to 6"	-87.5	-89.0	104.7	-98.4	-98.4	-84.2	-84.5	-93.6		-87.3	-98.4	-87.4	$31,630	-640.5	-106.3
I. Full restoration over 25 yrs	121.5	61.1	690.7	209.8	209.8	240.2	239.2	48.6		41.1	202.0	41.8	$35,581	-400.0	26.6
J. Implement a slot limit 3" – 5"	1.7	1.4	0.2	-4.2	-4.2	-2.7	-3.0	1.6		1.8	-5.0	1.7	$0	-4.2	1.5
	Key:		greater than 1		less than -1			(lbs)		(lbs)	(lbs)	(1000 $)	upfront	(1000 $)	(1000 $)

9

OysterFutures Model

Base Run - 1/3/2018

YEAR 22-25 (average) - Percent Change from SQ

Performance Measures percent change from Status Quo

not %

Options	Abundance (10,000s) Spat	Abundance (10,000s) Adults	Habitat (1000 bu)	Harvest (1000 bu)	Revenue (1000 $)	Number Licenses	Number Full Time	Seston Deposited	Water clarity	Reef: N removed	Catch: N removed	Social value N removed	Cost/yr (1000 $)	Revenue - Cost	Social N-Cost +Revenue
A. Status quo (SQ) (median)	**35,658**	**94,419**	**11,478**	**161**	**$7,594**	**678**	**108**	**198,588**		**224,887**	**1,032**	**$188,416**	**$0**	**$7,594**	**$196,010**
2. SQ, full compliance with size	0.8	0.7	0.1	-0.9	-0.9	0.0	0.1	0.6		0.7	-0.6	0.7	$0	-0.9	0.7
3. SQ, full compliance	8.8	7.3	0.9	-2.6	-2.6	10.2	11.9	7.5		8.1	-2.2	8.1	$0	-2.6	7.7
8. 2-yr Rotation (R), small, $2M – shell	9.7	2.2	32.2	2.1	2.1	0.1	0.6	2.8		4.2	2.0	4.2	$2,001	-24.3	3.1
9. 2-yr R, small, $2M – spat	17.8	3.8	3.8	13.3	13.3	14.1	15.8	3.6		5.2	12.7	5.2	$2,023	-13.4	4.5
10. 2-yr R, small, $600K – shell	6.5	0.4	8.9	-2.2	-2.2	-2.1	-2.3	1.0		1.3	-2.2	1.2	$544	-9.4	0.8
11. 2-yr R, small, $600K – spat	8.0	0.7	1.1	1.8	1.8	1.0	1.1	0.8		1.4	1.6	1.4	$596	-6.0	1.1
12. 2-yr R, small, MidC, $2M – shell	8.3	-0.3	31.6	17.8	17.8	17.0	19.1	1.5		2.1	18.3	2.2	$1,972	-8.1	1.8
13. 2-yr R, small, MidC, $2M – spat	17.0	3.1	3.7	16.5	16.5	17.7	19.5	2.9		4.2	16.3	4.3	$1,992	-9.7	3.7
13a. 2-yr R, small, MidC, $600K – spat	11.0	3.4	1.3	20.2	20.2	15.9	18.2	5.1		3.5	19.7	3.6	$603	12.3	3.9
14. 3-yr R, Little Choptank tribs – shell	10.2	-0.9	7.0	14.0	14.0	15.1	16.8	-0.5		-0.5	14.5	-0.4	$408	8.6	-0.1
15a. 3-yr R, Little Choptank tribs – spat	16.5	0.7	4.0	16.5	16.5	15.5	17.7	0.4		0.5	16.7	0.6	$2,068	-10.8	0.1
17a. Shell every yr in BC, $2M	2.6	2.2	31.1	14.8	14.8	16.6	18.7	2.6		1.3	14.7	1.4	$1,939	-10.7	0.9
17a2. Shell every yr in BC, $600K	0.5	0.6	9.4	4.0	4.0	1.5	1.8	0.9		0.4	3.8	0.4	$581	-3.6	0.3
18. Open LitChop tribs, shell every 3 yr	-0.1	0.0	7.3	33.5	33.5	36.0	40.1	-0.2		-2.0	32.7	-1.9	$672	24.6	-0.8
19. LitChop & Tred restored (6" high)	44.4	23.7	4.6	39.9	39.9	37.9	44.2	24.9		26.5	40.0	26.6	$2,014	13.4	26.0
20. LitChop & Tred restored (12" high)	54.3	32.0	6.5	50.3	50.3	46.6	54.3	33.1		34.0	49.3	34.1	$2,348	19.4	33.5
23a. Reef balls in MidC SCA (1' apart)	1.0	0.4	0.1	1.5	1.5	0.4	0.5	0.4		0.8	1.4	0.8	$66	0.6	0.8
24a. Reef balls in MidC SCA (3' apart)	0.5	0.3	0.1	1.0	1.0	0.3	0.4	0.4		0.4	1.0	0.4	$79	-0.1	0.4
26a. Spat every yr in MidC, $600K	13.8	4.3	1.6	29.6	29.6	30.0	33.3	4.2		3.2	29.4	3.3	$602	21.7	4.0
26b. Spat every yr in MidC, $2M	28.3	10.1	4.9	82.1	82.1	82.2	90.5	10.2		7.6	79.5	7.9	$2,001	55.7	9.8
B. All areas open to hand tonging	-71.0	-56.9	-8.3	-67.4	-67.4	-54.6	-68.7	-56.7		-55.0	-67.2	-55.0	$0	-67.4	-55.5
C. All areas closed	65.3	50.7	5.9	-71.4	-71.4	-87.5	-108.5	55.2		64.9	-70.6	64.3	$0	-71.4	59.0
D. All areas closed, full compliance	78.0	61.1	7.4	-100.0	-100.0	-87.5	-108.5	70.4		80.5	-100.0	79.6	$0	-100.0	72.7
E. SQ, 10% size, 1% sanct harvest	-0.8	-0.7	-0.1	2.0	2.0	0.8	1.5	-0.7		-0.7	1.4	-0.7	$0	2.0	-0.6
F. SQ, 0.5% sanctuary harvest	3.7	3.3	0.4	-0.4	-0.4	4.9	6.4	3.1		3.6	-0.6	3.5	$0	-0.4	3.4
G. SQ, 1.5% sanctuary harvest	-3.6	-3.3	-0.4	0.0	0.0	-4.4	-5.5	-2.7		-3.2	0.0	-3.2	$0	0.0	-3.1
H. Restore all areas to 6"	-77.9	-82.9	38.0	-95.4	-95.4	-83.8	-103.9	-86.3		-80.6	-95.4	-80.7	$31,630	-511.9	-97.4
I. Full restoration over 25 yrs	121.6	81.6	559.5	263.3	263.3	286.2	362.7	68.3		50.7	253.1	51.6	$35,581	-205.2	41.6
J. Implement a slot limit 3" – 5"	1.8	1.4	0.2	-3.3	-3.3	-3.0	-3.7	1.4		1.6	-4.2	1.5	$0	-3.3	1.3
													upfront	(1000 $)	(1000 $)
Key:			greater than 1		less than -1				(lbs)	(lbs)	(lbs)	(1000 $)			