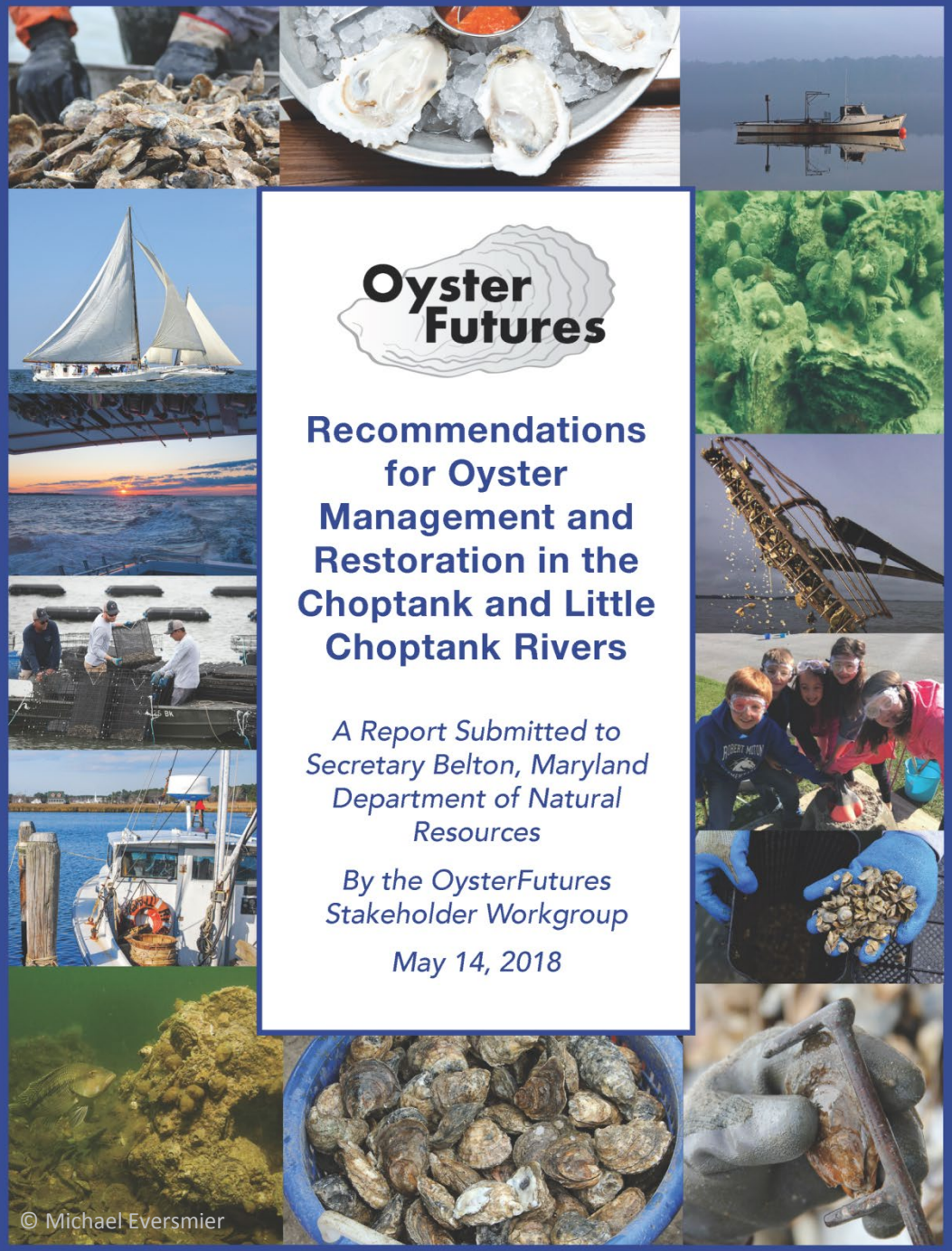

Oyster Futures

A Research Program

Presented by
Elizabeth Watkins North, Ph.D.
Associate Professor
University of Maryland
Center for Environmental Science
Horn Point Laboratory

University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE

FCRC CONSENSUS CENTER

VIMS | WILLIAM & MARY
VIRGINIA INSTITUTE OF MARINE SCIENCE

Research Team

Elizabeth North, Michael Wilberg, Jeff Blair,
Jeffrey Cornwell, Troy Hartley, Raleigh Hood, Robert Jones,
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VIMS | William & Mary
Virginia Institute of Marine Science

University of Maryland
Center for Environmental Science

FCRC Consensus Center

Oysters

Restoration


Horn Point Oyster Hatchery

Oyster Recovery Partnership


Citizen Groups and Schools


Paynter Lab

State and Federal Government

Conflict


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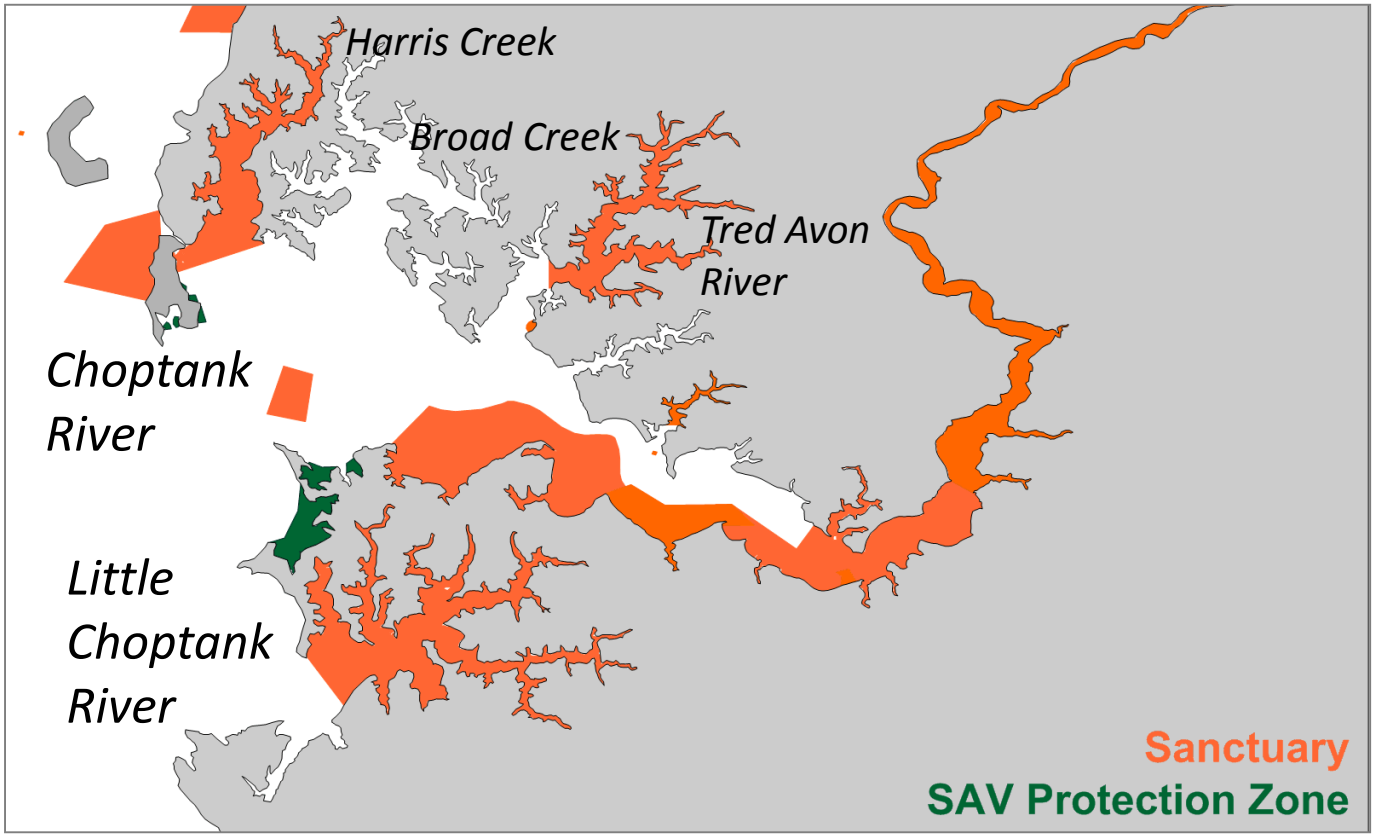
CALENDAR
73°
As oyster planting season ends, debate over Maryland's beloved bivalve continues
By Alex Mann, August 13, 2017
Transferring data from metrics.brightcove.com...

But, what if stakeholders could agree?

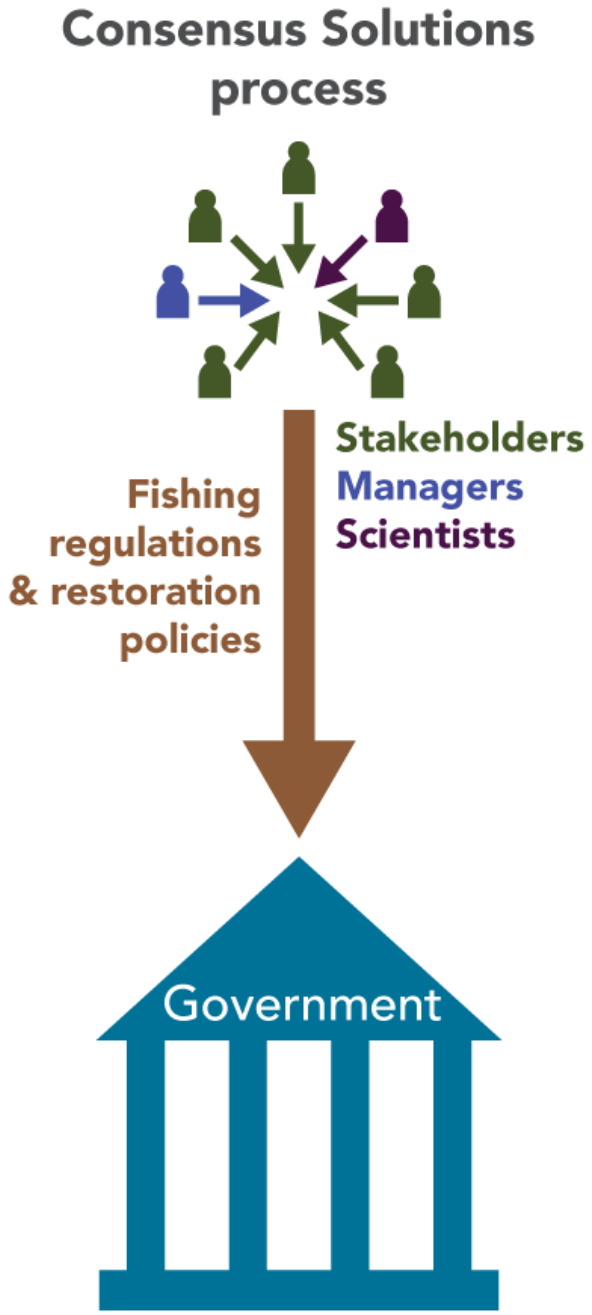
What if they could agree about what to do in the Choptank region?



They already did

OysterFutures Stakeholders

How did this happen?



The Consensus Solutions process is designed to be:

- Fair
- Transparent
- Powerful
- Representative

It provides a respectful place for people to speak their truth to power and to each other.

Stakeholders are at the center of the *Consensus Solutions* process

Stakeholders propose objectives, options, and performance measures

Develop and improve model

Scientists

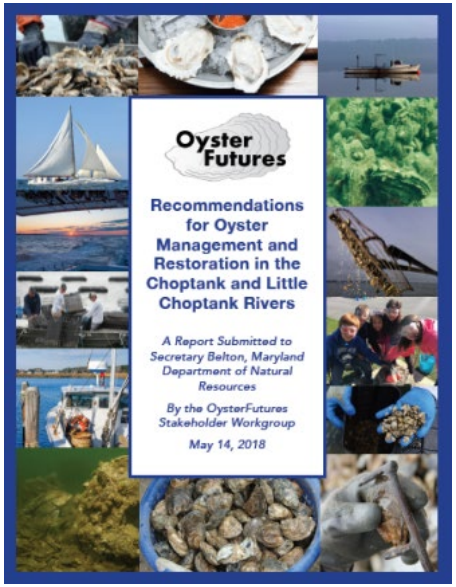
Stakeholders

Review model results

Revise options and performance measures

Options with >75% agreement advance to package of recommendations

One consensus vote on the entire package



Oyster Futures

Objective: test the *Consensus Solutions* process for developing fishing regulations and restoration policies

Study Site: Choptank and Little Choptank Rivers

At the beginning…

OysterFutures Stakeholders
February 27, 2016

Their goal: an economically viable, healthy and sustainable Choptank and Little Choptank Rivers oyster fishery and ecosystem

… and at the end

March, 2018

Stakeholder Workgroup

Workgroup has 16 members:

- 6 commercial fishermen who harvest oysters
- 1 oyster buyer
- 2 aquaculturists
- 5 citizen and nonprofit group representatives
- 2 agency representatives

Invitations to participate based on phone interviews during which we asked for names of people who are *well respected, knowledgeable, and collaborative*

OysterFutures Stakeholder Workgroup

60% Industry

40% Citizen, Nonprofit, and Government

Commercial Fishermen

- **J.D. Buchanan,** Talbot County
- **Robbie Casho**, Dorchester County
- **Jeff Harrison,** Talbot County, President Talbot Waterman's Association
- **Gregory Kemp,** Talbot County, President Talbot Seafood Heritage Association
- **Cody Paul**, Dorchester County, Dorchester Shell Committee Chair
- **Robert Whaples,** Dorchester County, President Dorchester Seafood Heritage Association

Aquaculturalists

- **Bobby Leonard** [Mary-Julia DuBois alternate], Tred Avon Treats, Ruff-N-Ready, LLC.
- **Johnny Shockley**, Hoopers Island Oyster Aquaculture Co.

Seafood Buyer

- **Aubrey Vincent,** Lindy's Seafood

Citizen Groups

- **Allison Colden**, Chesapeake Bay Foundation
- **Kelly Cox**, Phillips Wharf Environmental Center
- **Joe Fehrer,** The Nature Conservancy
- **David Sikorski**, Coastal Conservation Association (recreational fishing)

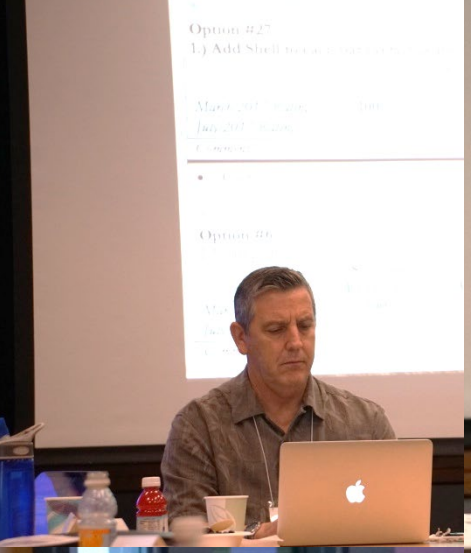
Nonprofit

- **Ward Slacum**, Oyster Recovery Partnership

Government Agency

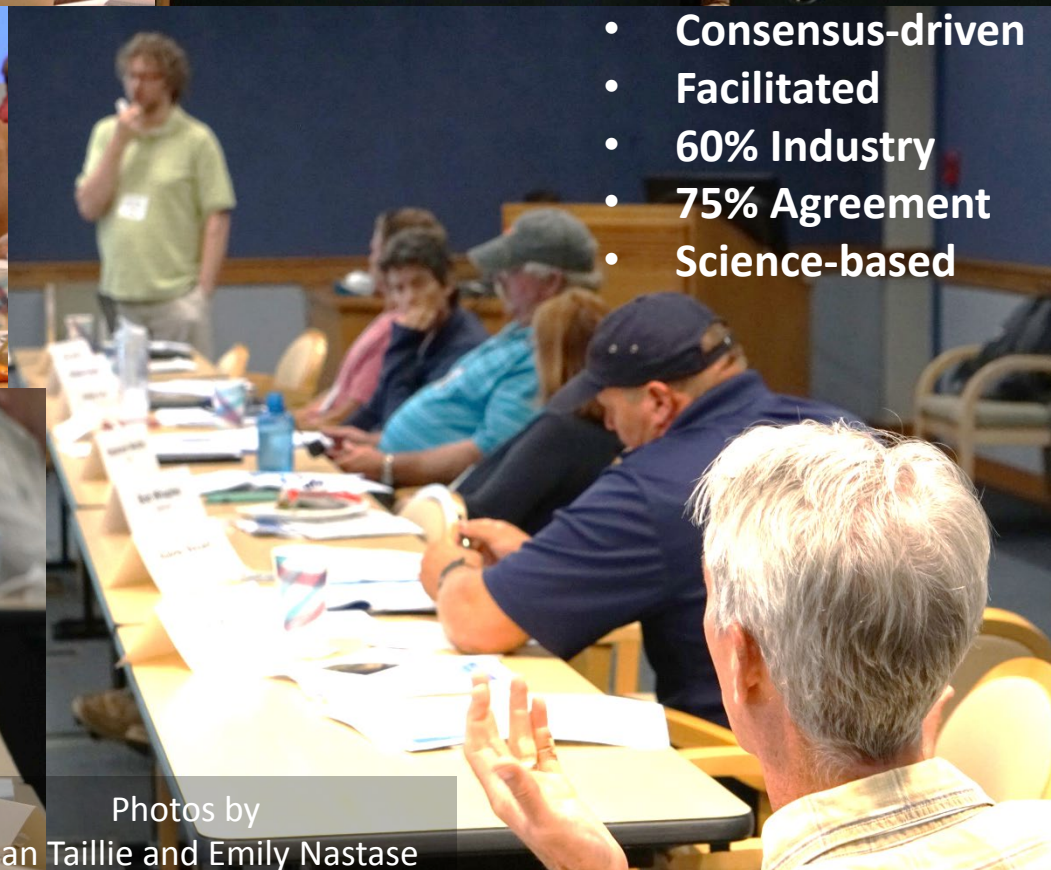
- **Dave Blazer** [Chris Judy alternate], MD Department of Natural Resources
- **Stephanie Westby**, NOAA

Listening, thinking, working together



Key Points

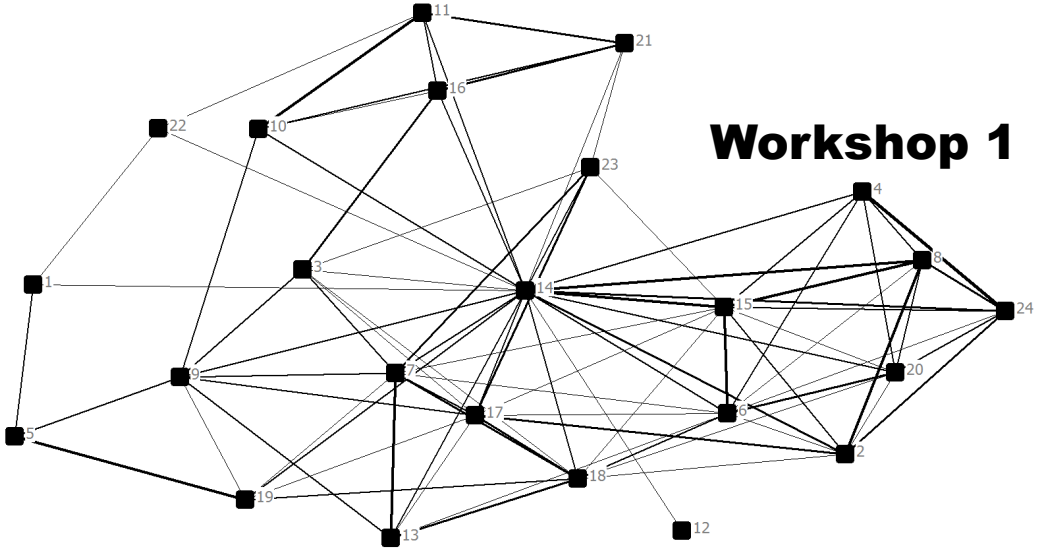
- Consensus-driven
- Facilitated
- 60% Industry
- 75% Agreement
- Science-based

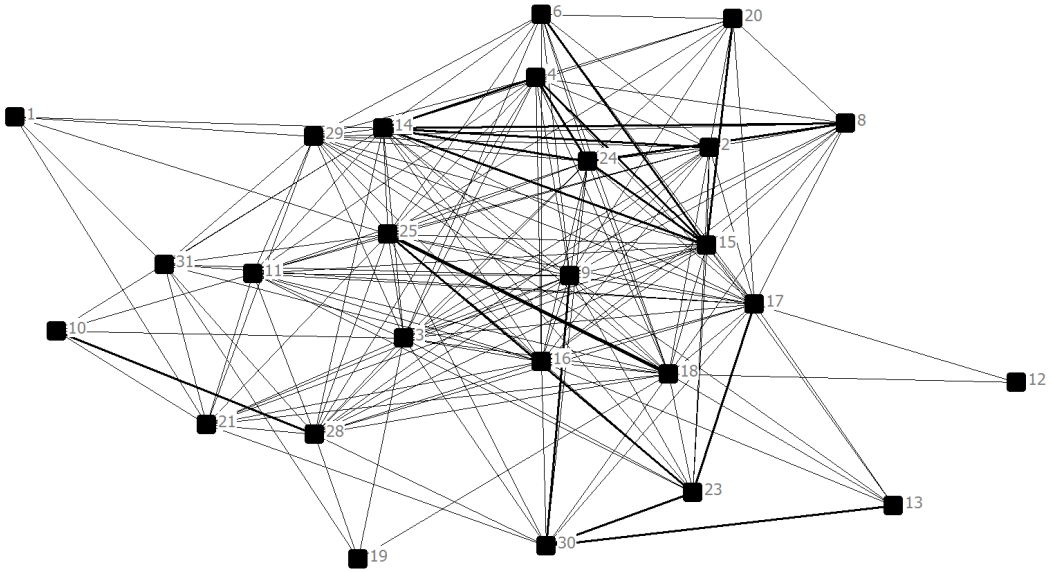


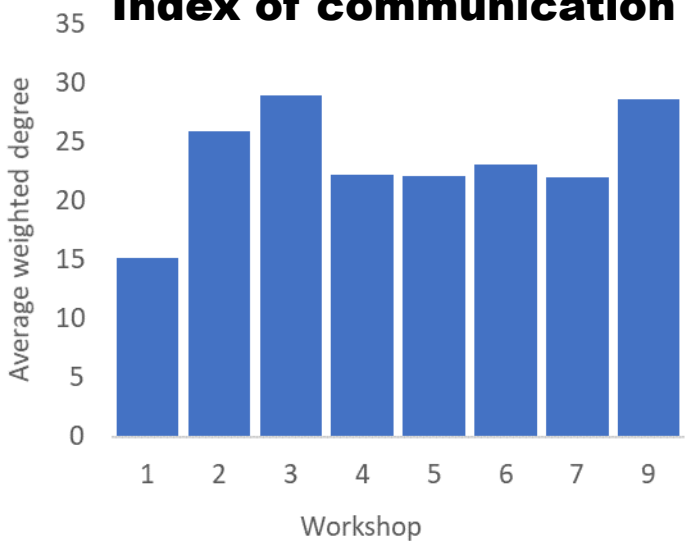
Photos by
Dylan Taillie and Emily Nastase

OysterFutures Communication Network

- Increase in communication (connecting to *more people*)
- Increase in frequency of communication (communicating *more often*)
- Decreased centralization (wider flow of information)

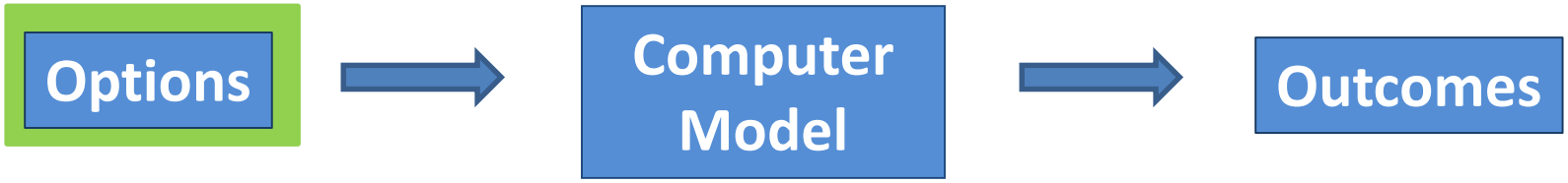






Slide from Goelz and Hartley

Stakeholders decide on options and outcomes to be modeled



- Changing or rotating fishing areas
- Planting shell, spat-on-shell, and reef balls
- Restoring reefs

Computer model includes scientific and stakeholder knowledge

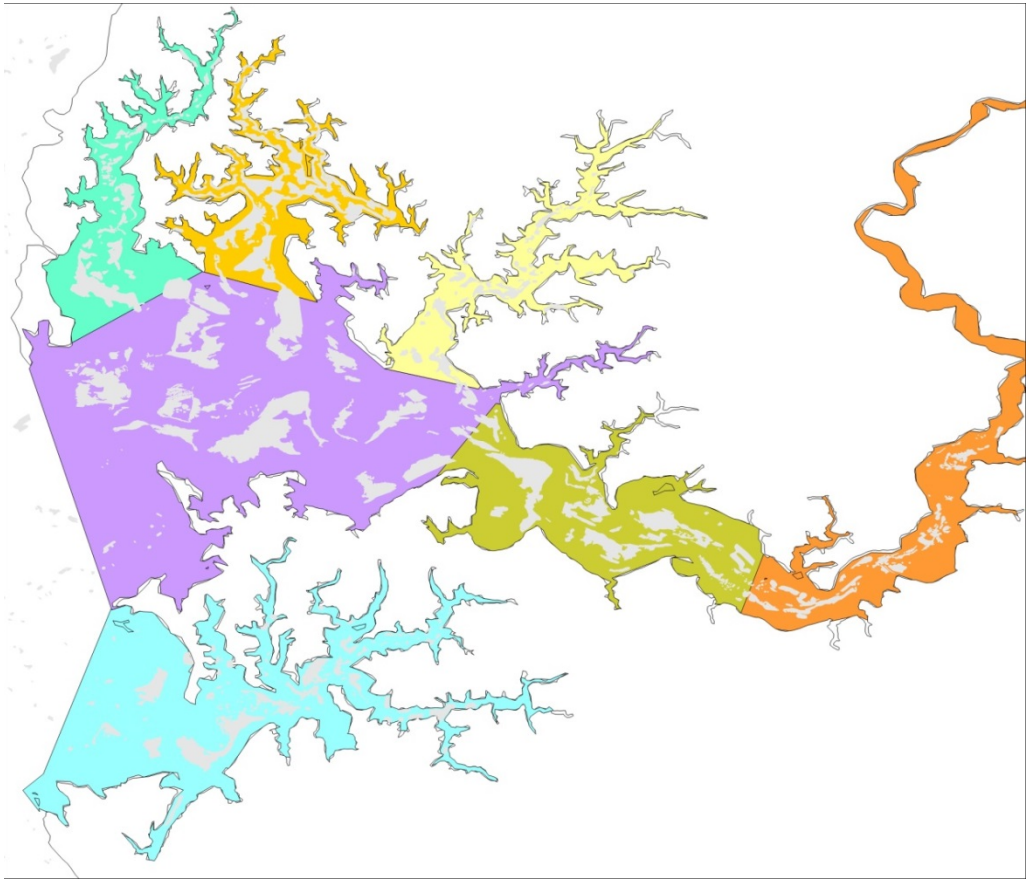
Options → **Computer Model** → **Outcomes**

- Changing or rotating fishing areas
- Planting shell, spat-on-shell, and reef balls
- Restoring reefs

- Economics
- Oyster biology
- Oyster habitat
- Water quality

Simulation model integrates stock assessment, larval transport, and fishing effort models

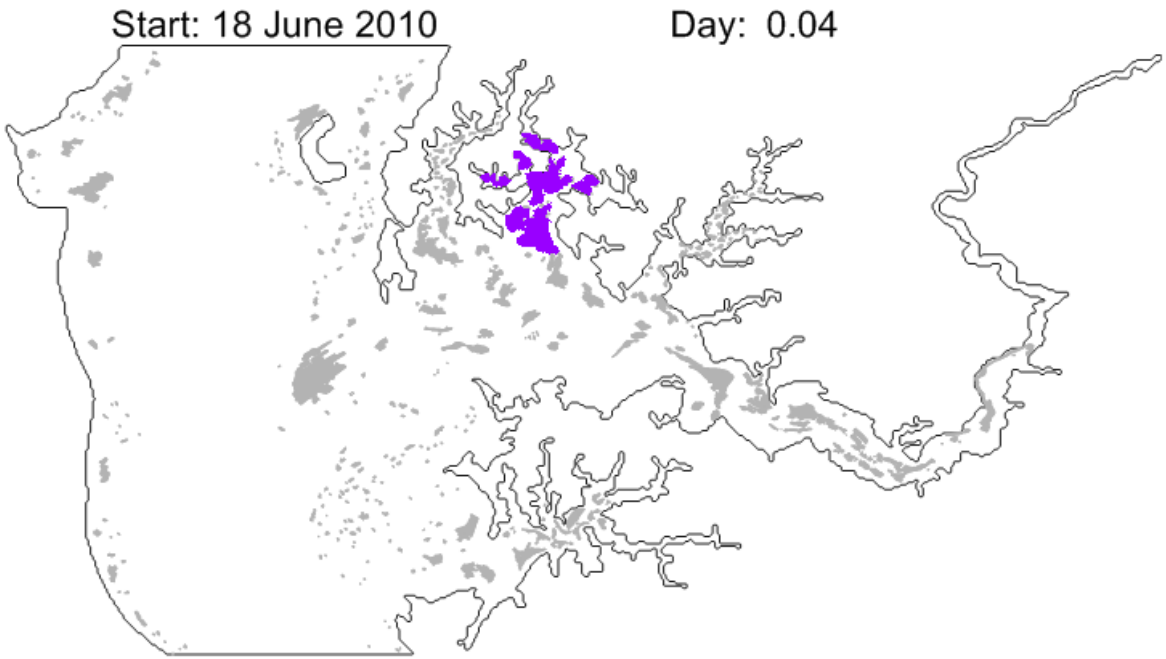
- Tracks separate populations on each of 1,132 habitat polygons
- Projects 25 yrs into future
- Starting abundances and vital rates based on statistical population models



Grey polygons – oyster habitat
Colored areas – reporting regions

Simulation model integrates stock assessment, larval transport, and fishing effort models

- Connectivity estimated with larval transport model
- Model forecasts effects of policy options proposed by stakeholders



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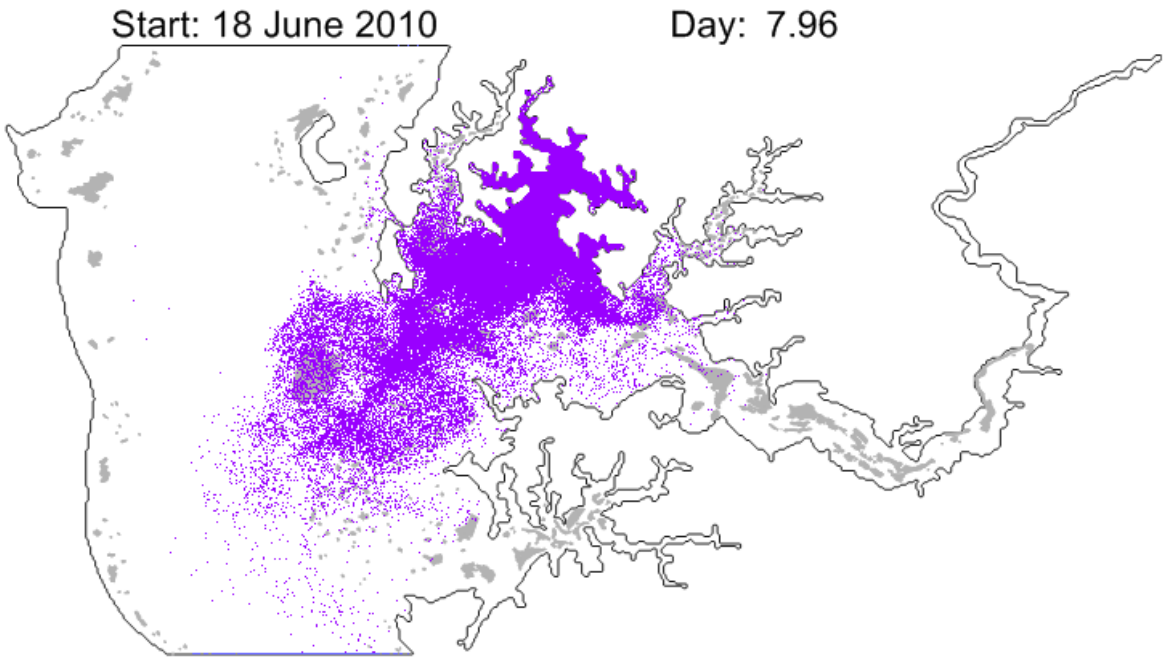

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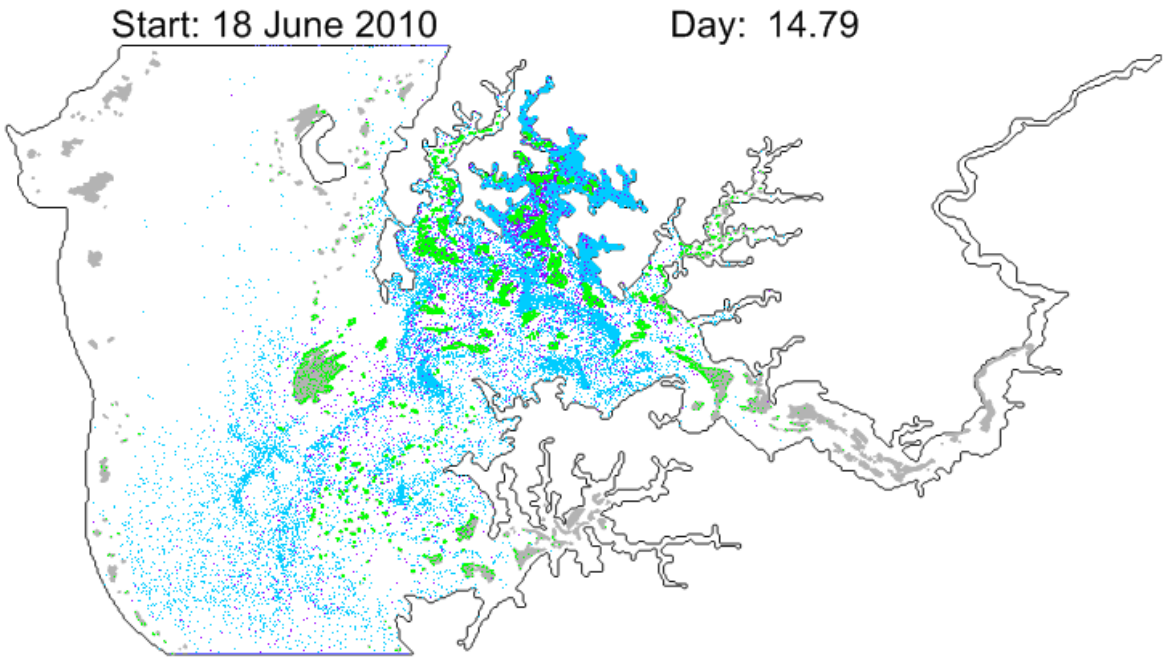

Simulation model integrates stock assessment, larval transport, and fishing effort models

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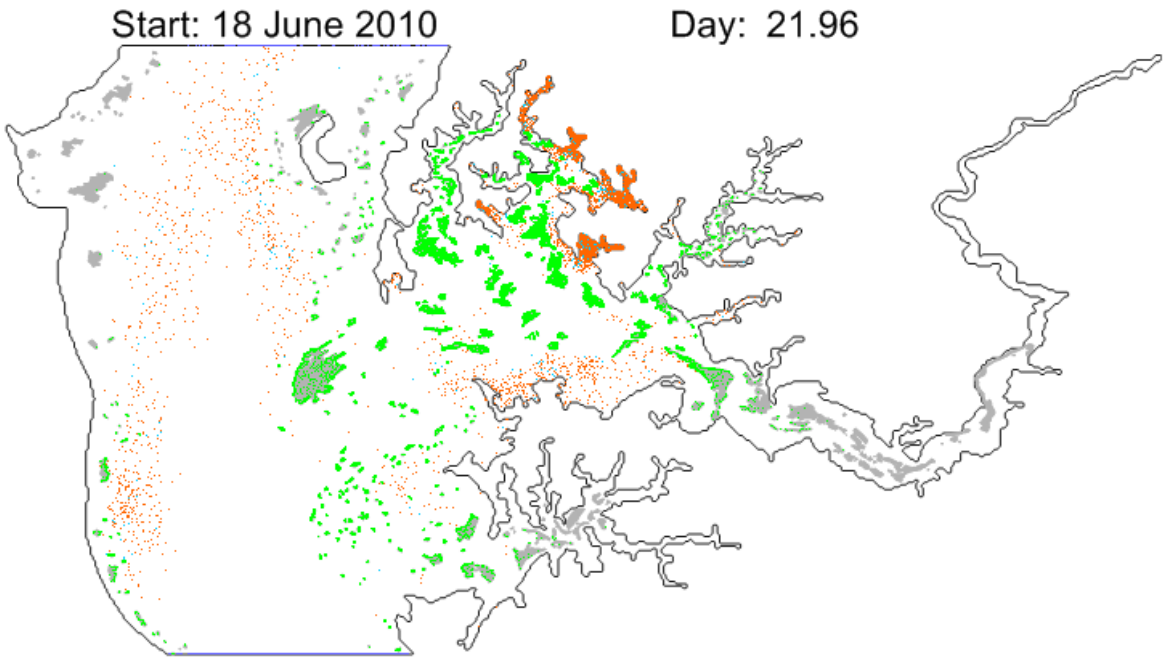


Computer model forecasts outcomes and stakeholders consider results

Options → **Computer Model** → **Outcomes**

- Changing or rotating fishing areas
- Planting shell, spat-on-shell, and reef balls
- Restoring reefs

- Economics
- Oyster biology
- Oyster habitat
- Water quality

- Oyster abundance
- Oyster habitat
- Harvest revenue
- Pollution reduction

OysterFutures Simulation Model
7/22/2017

July 2017

YEAR 25

Performance Measures (difference from Status Quo)

Options	Abundance (1000s) Spat	2-3"	3-4"	4+"	Habitat (L/m2)	Harvest (1000 bu)	Revenue (1000 $)	Number Licenses	Seston (kg) Deposited	Nitrogen Removed
1. Status quo (SQ) - median of simulation results	347,962	297,704	334,796	200,442	57.8	106	3,775	495	84,718	94,417
2. Status quo (10% non-compliance with size regulation)	-3,496	-2,668	-2,878	-1,767	-0.1	0	7	3	-610	-656
3. All open to hand tong (other gears same as SQ)	-233,720	-169,661	-163,545	-94,818	-5.6	-72	-2,565	-263	-40,298	-48,577
4. All closed	231,348	130,646	181,007	122,449	4.1	-66	-2,358	-410	45,824	61,081
5. All closed with full compliance	297,740	163,742	232,334	155,176	5.1	-106	-3,775	-410	58,459	76,427
6. Lit Choptank and Tred Avon restoration (6 in substrate)	198,137	117,193	129,411	83,158	6.4	93	3,302	351	33,754	34,360
7. Lit Chop										
8. 3d artifi										
9. Restore										
10. SQ with										
11. Low ha										
12. High ha										
13. Slot siz										
14. Slot siz										
15. Slot siz										
16. Little C										
17. Little C										
18. 2 year										
19. 3 year										
20. 4 year										
21. 2 year										
22. 3 year										
23. 4 year										
24. 2 year										
25. 3 year										
26. 4 year										
27. Shell i										

>100 options were evaluated

OysterFutures Model
Base Run - 1/3/2018

January 2018

YEAR 22-25 (average)

Performance Measures (difference from Status Quo)

Options	Abundance (10,000s) Spat	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)	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	298	624	12	-1	-$66	0	0	1,248		1,682	-6	$1,398	$0	-$66	$1,333
3. SQ, full compliance	3,141	6,927	106	-4	-$198	69	13	14,877		18,263	-23	$15,212	$0	-$198	$15,014
8. 2-yr Rotation (R), small, $2M – shell	3,449	2,109	3,698	3	$157	1	1	5,544		9,393	21	$7,851	$2,001	-$1,844	$6,007
9. 2-yr R, small, $2M – spat	6,345	3,593	438	21	$1,006	96	17	7,168		11,660	131	$9,834	$2,023	-$1,016	$8,818
10. 2-yr R, small, $600K – shell	2,321	408	1,017	-4	-$169	-14	-3	2,012		2,813	-23	$2,327	$544	-$714	$1,614
11. 2-yr R, small, $600K – spat															
12. 2-yr R, small, MidC, $2M – shell															
13. 2-yr R, small, MidC, $2M – spat															
13a. 2-yr R, small, MidC, $600K – spat															
14. 3-yr R, Little Choptank tribs – shell															
15a. 3-yr R, Little Choptank tribs – spat															
17a. Shell every yr in BC, $2M															
17a2. Shell every yr in BC, $600K															
18. Open LitChop tribs, shell every 3 yr															
19. LitChop & Tred restored (6" high)															
20. LitChop & Tred restored (12" high)															
23a. Reef balls in MidC SCA (1' apart)															
24a. Reef balls in MidC SCA (3' apart)															
26a. Spat every yr in MidC, $600K															
26b. Spat every yr in MidC, $2M															
B. All areas open to hand tonging															
C. All areas closed															
D. All areas closed, full compliance															
E. SQ, 10% size, 1% sanct harvest															
F. SQ, 0.5% sanctuary harvest															
G. SQ, 1.5% sanctuary harvest															
H. Restore all areas to 6"															
I. Full restoration over 25 yrs															
J. Implement a slot limit 3" – 5"															

Performance improved over time

OysterFutures Model
Base Run - 3/5/2018

March 2018

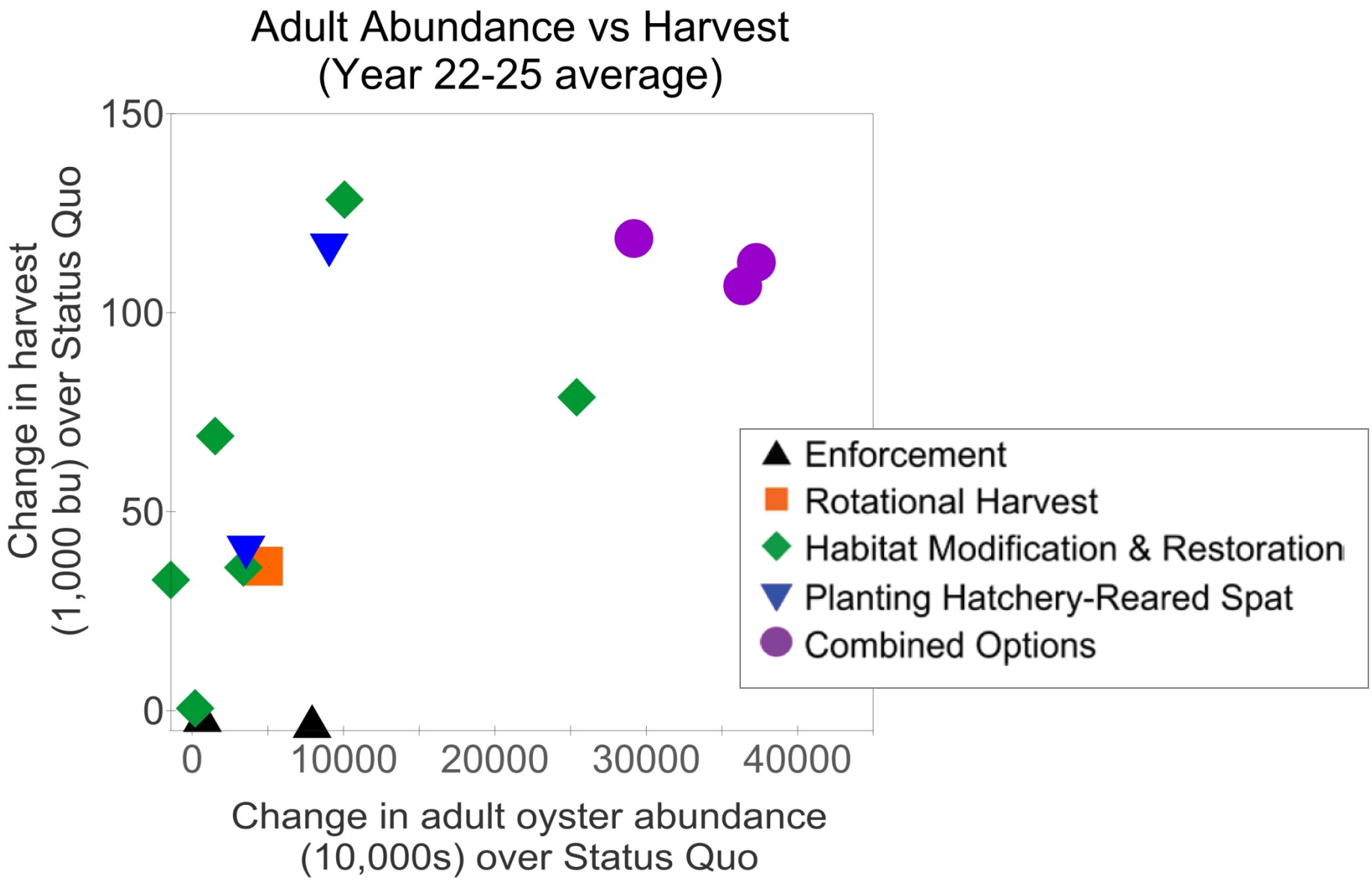
YEAR 22-25 (average)

Performance Measures (difference from Status Quo)

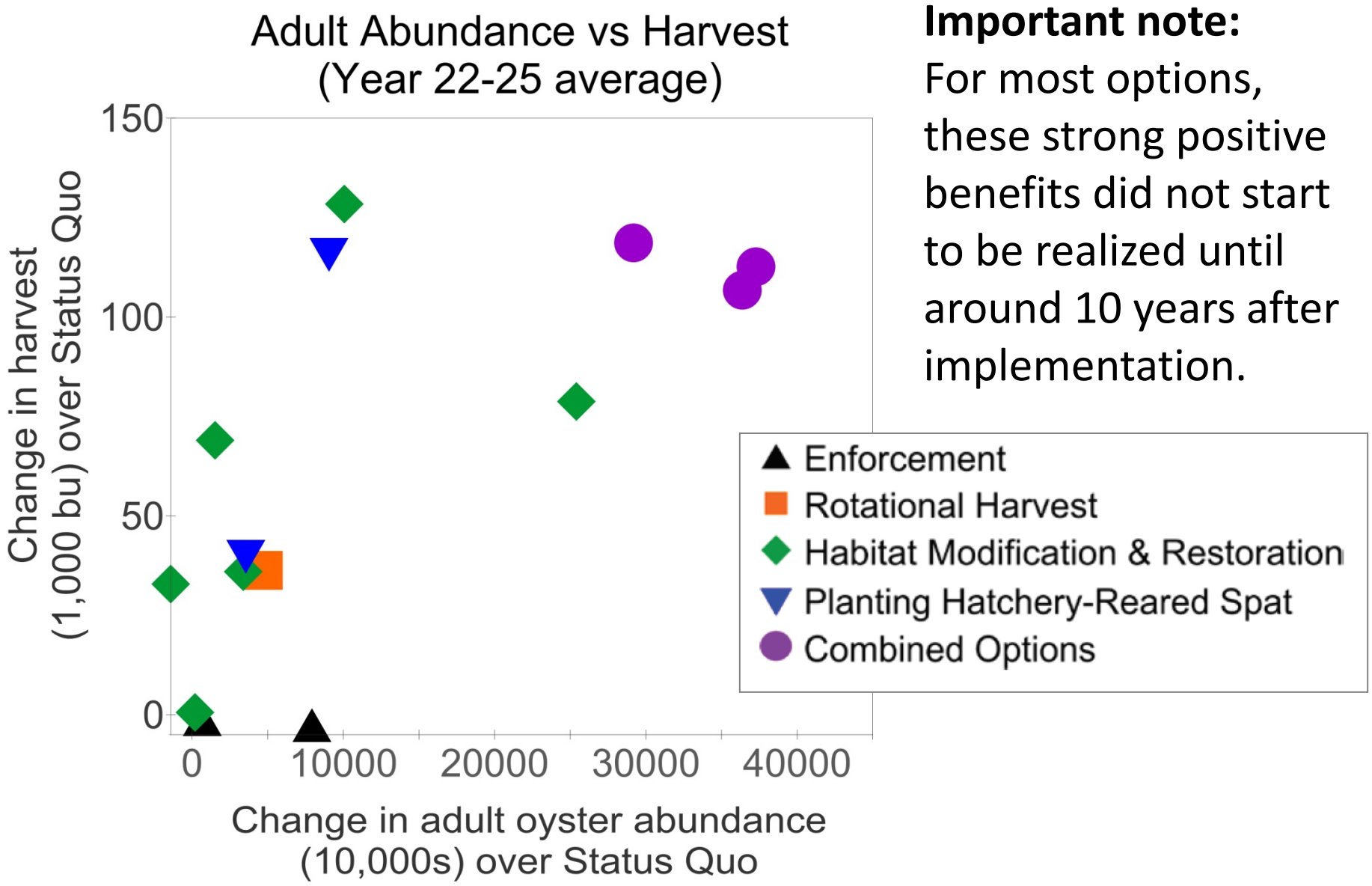
Options	Abundance (10,000s) Spat	Adults	Habitat (1000 bu)	Harvest (1000 bu)	Revenue (1000 $)	Number Licenses	Number Full Time	Seston Deposited	Water clarity	Reef: N removed	Catch: N removed	Social valu N removed	Cost/yr (1000 $)	Revenue - Cost	Social N-Cost +Revenue
A. Status quo (SQ) (median)	39,643	93,792	11,347	152	$7,156	643	102	205,665		232,426	976	$194,657	$0	$7,156	$201,813
2. SQ, full compliance with size	286	686	11	-1	-$55	-3	0	1,403		1,522	-2	$1,268	$0	-$55	$1,213
3. SQ, full compliance	3,757	7,933	110	-3	-$126	71	13	15,677		19,554	-22	$16,289	$0	-$126	$16,163
13a. 2-yr R, MC sanc, $600K – spat	3,169	4,723	198	36	$1,713	152	27	11,385		10,892	226	$9,273	$603	$1,110	$10,382
13b. 2-yr R, MC sanc, $2M – spat	8,833	11,622	586	98	$4,625	406	73	23,596		27,066	624	$23,093	$2,001	$2,624	$25,718
16a. 2-yr R, LC tribs, $600K – spat	1,853	-900	119	41	$1,954	183	32	-1,335		-170	269	$83	$603	$1,352	$1,434
16b. 2-yr R, LC tribs, $2M – spat	4,369	-435	396	43	$2,024	187	34	-459		591	277	$724	$2,001	$23	$748
17a. Shell every yr in BC, $600K	295	427	1,109	6	$280	16	4	713		508	37	$454	$600	-$320	$135
17b. Shell every yr in BC, $2M	726	2,176	3,695	18	$850	84	15	4,105		2,150	111	$1,885	$1,999	-$1,149	$737
18. Open LC tribs, shell 3rd yr	-243	-55	865	51	$2,393	224	40	-1,508		-6,669	316	-$5,298	$424	$1,969	-$3,330
18a. Open LC tribs, spat 3rd yr, $600K	203	-1,403	115	33	$1,554	147	26	-3,504		-5,155	208	-$4,126	$556	$998	-$3,129
18b. Open LC tribs, spat 3rd yr, $2M	2,636	1,527	432	69	$3,256	302	53	1,110		-1,703	422	-$1,068	$1,847	$1,409	$341
19. Complete LC & TA restoration	16,719	25,399	626	79	$3,718	314	58	55,090		73,576	494	$61,774	$686	$3,033	$64,807
23. Reef balls in MC sanc	97	202	4	1	$29	2	0	460		512	4	$431	$63	-$34	$397
26a. Spat every yr in MC, $600K	2,931	3,565	182	40	$1,877	173	31	7,296		7,148	250	$6,170	$602	$1,275	$7,445
26b. Spat every yr in MC, $2M	7,341	9,047	546	116	$5,460	483	86	16,603		14,004	718	$12,278	$2,001	$3,459	$15,737
16b+19. 2-yr R LC, full restoration	20,104	23,259	981	122	$5,748	492	89	50,263		67,295	777	$56,772	$2,686	$3,061	$59,833
16b+19+3. 2-yr R LC, restore, compliance	23,769	31,005	1,093	111	$5,258	562	102	68,151		91,658	711	$77,036	$2,686	$2,572	$79,607
26a+19+3. Spat MC $600K, restore, com	22,918	36,365	925	107	$5,042	544	99	79,694		104,068	673	$87,354	$1,288	$3,754	$91,108
26b+19+3. Spat MC $2M, restore, comp	27,197	41,707	1,281	182	$8,606	852	153	87,840		110,057	1,144	$92,742	$2,686	$5,920	$98,662
26a+16a+19. Spat MC $600K, 2-yr R LC,	20,812	29,189	929	119	$5,603	480	88	62,059		83,217	750	$70,028	$1,890	$3,712	$73,741
26a+17a+19+23+3. Spat MC, Shell BC, re	23,287	37,283	2,034	113	$5,318	568	103	81,686		105,457	707	$88,541	$1,898	$3,420	$91,961
Sensitivity study – spat set 3.4x higher on clean shell															
B. Shell every yr in BC, $600K (#17a)	2,581	3,391	1,171	36	$1,699	163	29	5,354		3,984	231	$3,515	$600	$1,099	$4,614
C. Shell every yr in BC, $2M (#17b)	7,731	10,079	3,901	128	$6,065	574	102	16,342		10,899	801	$9,757	$1,999	$4,066	$13,824
D. Open LC tribs, shell 3rd yr (#18)	2,583	1,920	901	82	$3,856	360	64	1,158		-3,495	511	-$2,489	$424	$3,432	$944

Key:	greater than 1	less than -1	(lbs)	(lbs)	(lbs)	(1000 $)	25-yr ave	(1000 $)	(1000 $)

Win – win options exist: high abundances and high harvest

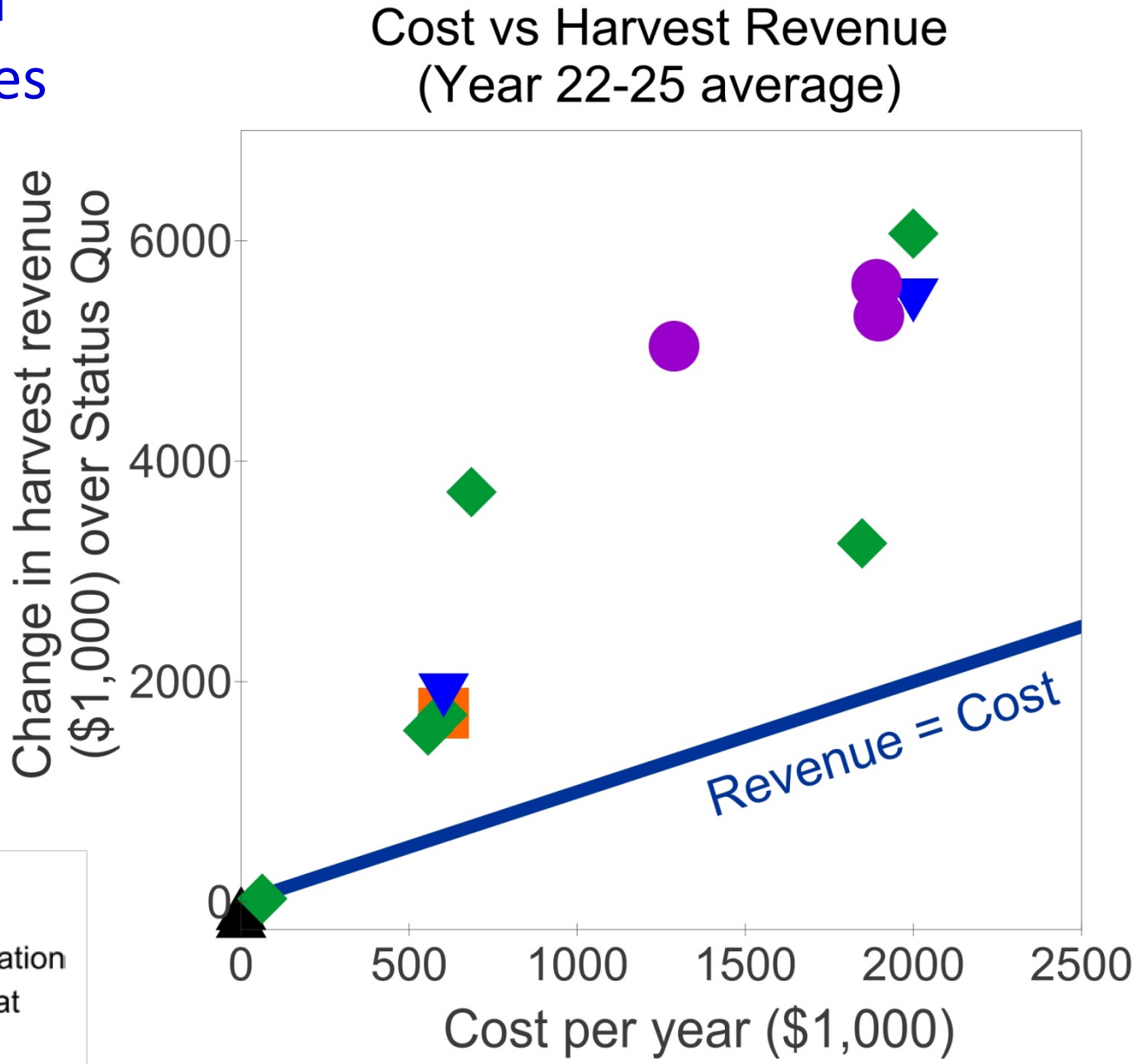


Win – win options exist: high abundances and high harvest

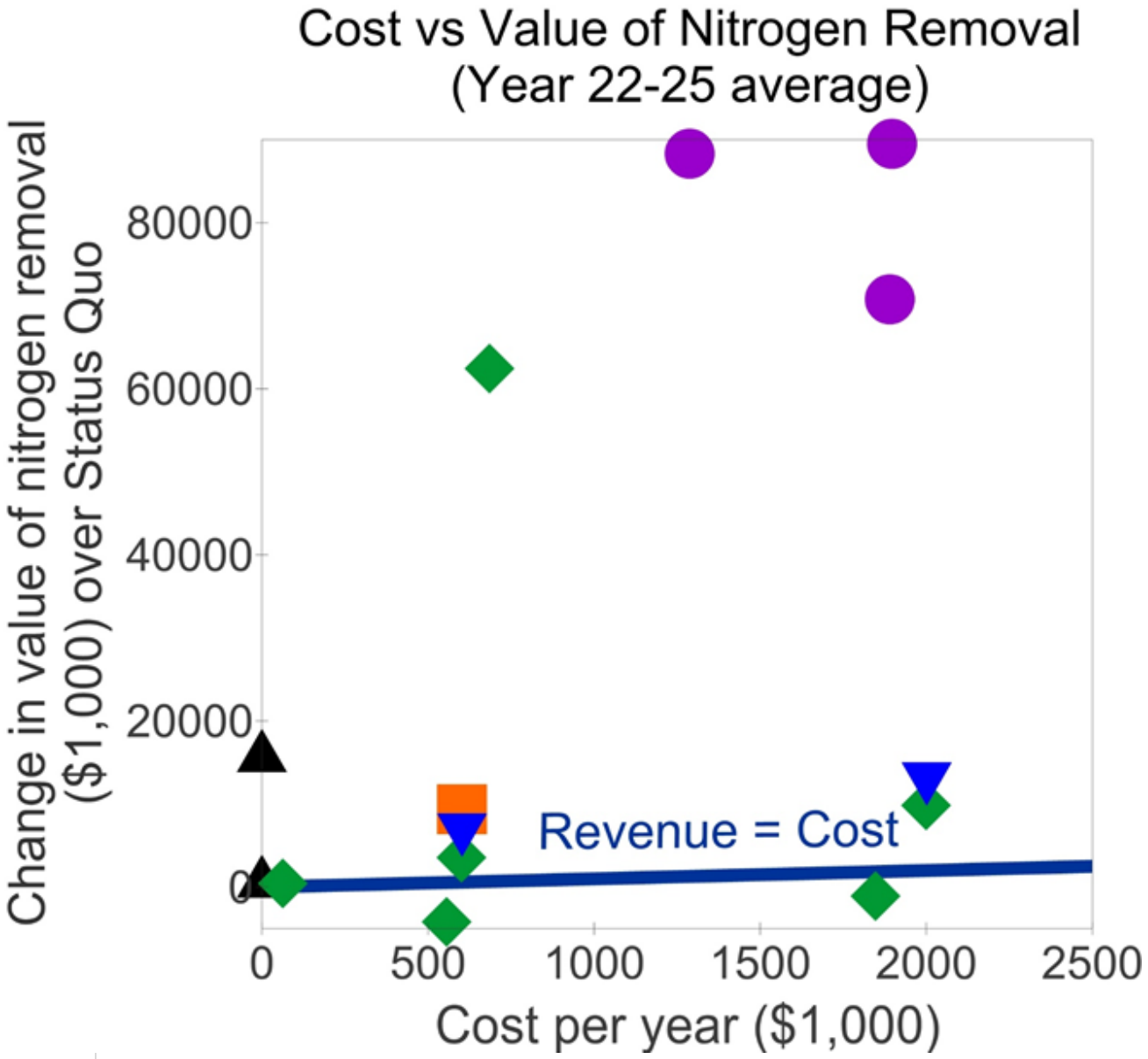


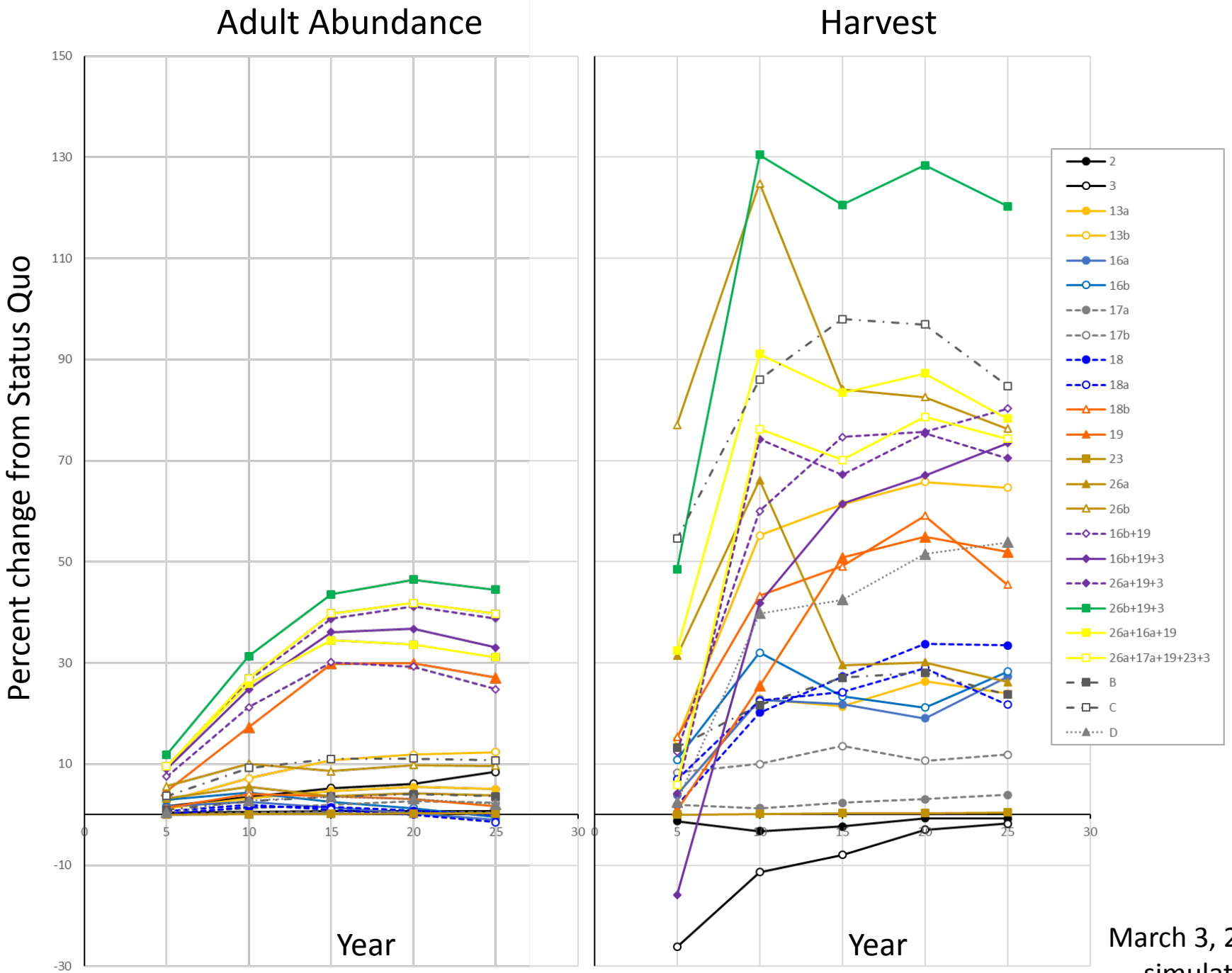
Important note:
For most options, these strong positive benefits did not start to be realized until around 10 years after implementation.

All but two scenarios showed increased revenues to watermen

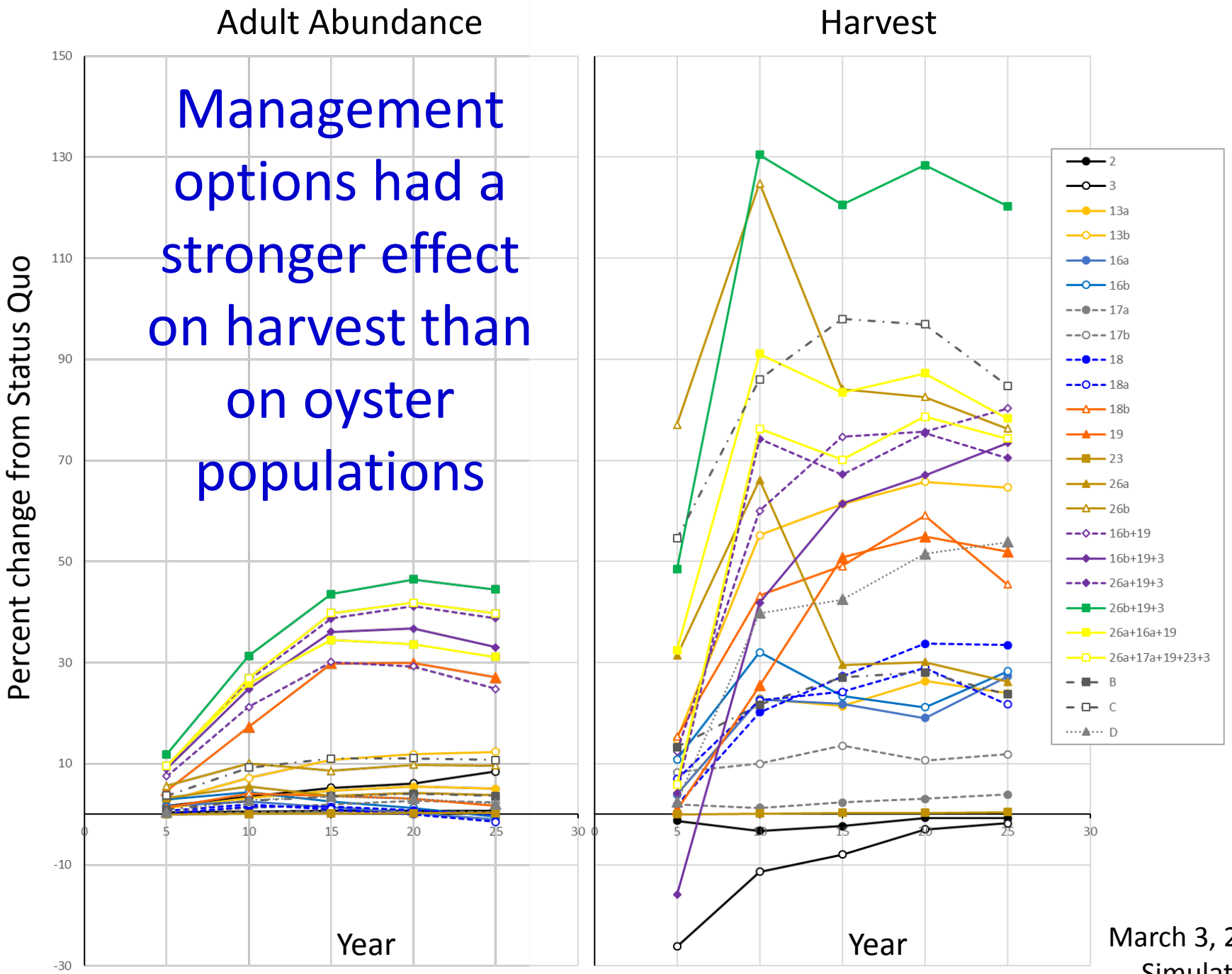


All but two scenarios resulted in higher value of nitrogen removal compared to cost





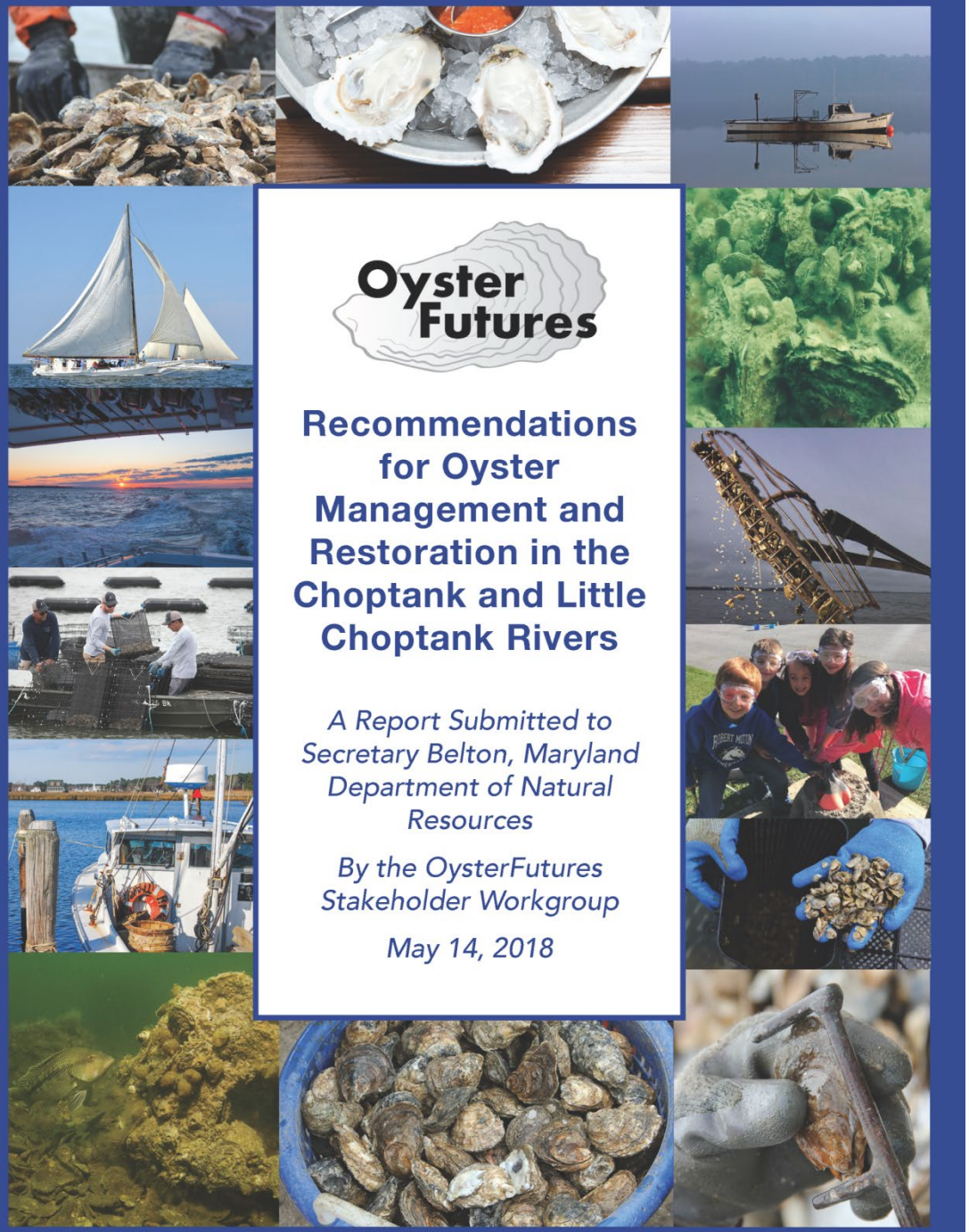
March 3, 2018
simulations



March 3, 2018
Simulations

Take home points from model forecasts

- Win-win-win options exist
- Strong positive benefits were not realized for 10 years
- Combining options led to best overall performance
- After 20 years, harvest revenue could be twice that of annual public investments
- After 20 years, there could be more than an 8-fold return on public investment for pollution reduction
- Choice of options had a stronger control on harvest than on oysters



Package

of Consensus Recommendations

The stakeholders put forward ***all*** of the recommendations and recommend ***continuing to work with stakeholders***.

MANAGEMENT RECOMMENDATIONS

A. THE NEED FOR CHANGE

The OysterFutures Workgroup recommends that DNR take swift and positive action to change existing regulations and policies regarding oyster management in the Choptank and Little Choptank Rivers. Maintaining the Status Quo (current regulations and policies) does not benefit the oyster resource or the ecosystem and human economies that depend on it. Change is needed.

B. ENFORCEMENT RECOMMENDATIONS

The OysterFutures Workgroup reviewed enforcement options that could be modeled to determine their impact on oyster abundance, habitat, and harvest. The Workgroup found that enforcement and compliance play an important role in ensuring the protection of the oyster resource, and has the following recommendations:

1. In consultation with oyster resource stakeholders, DNR should enhance enforcement presence on the water, address noncompliance by providing funding to increase the numbers and training of compliance officers, and support strategies such as checking oysters where they are bought.
2. To enhance compliance, DNR should modify regulations so a single oyster bar is not divided between gear types, or where parts are open and other parts are closed.
3. To help inform and guide oyster resource participants in the Choptank system, DNR should address, correct and update DNR oyster resource mapping issues such as bottom mapping to better define oyster bars, and provide electronic maps that could be used with GPS chart programs.
4. DNR should provide the necessary resources to make its website more user friendly.
5. To protect the oyster resource, oyster populations, and the oyster industry, DNR should strive for full compliance with the current size laws and sanctuary regulations.

C. LIMITED ENTRY RECOMMENDATION

The OysterFutures Workgroup discussed options for maintaining a level of fishing effort which would improve the long-term viability of the oyster fishery and the health of the oyster resource. The workgroup has the following recommendation:

1. Working together with oyster resource stakeholders, DNR should evaluate a limited entry oyster fishery that can provide access to watermen making the majority of their living from commercial fishing, enables generational succession in the fishery, and should have a way for new participants to gain entry that does not solely rely on having a large amount of capital.

D. ROTATIONAL HARVEST RECOMMENDATION

The Workgroup evaluated opening portions of sanctuaries to rotational harvest where no restoration

Consensus Package of Recommendations

- Enhance **enforcement**
- **Complete planned restoration**
- Allow **hand tonging in limited portions of sanctuaries where no federal investment is planned or has occurred**
- **Plant shell and spat-on-shell**
- **Place privately-funded reef balls**
- Explore a **limited entry** program
- Combine the above options
- Use *Consensus Solutions* in MD
- Develop cost effective strategies for shell and substrate
- Coordinate marketing and business plans
- Consider increasing fees/taxes
- Promote education, training, and research

Comments from participants:

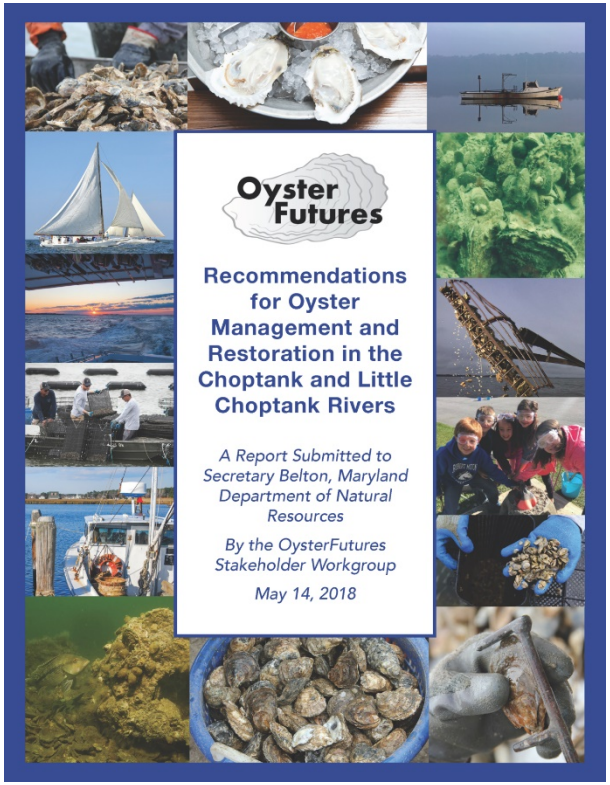
- The right people were at the table
- The *Consensus Solutions* process promotes collaboration, creative problem solving, and sharing of knowledge
- This is the best process that we have ever experienced

Hopefully the State of MD will find the process and our stakeholders' recommendations useful.

Oyster Futures

Take home ideas

- Consensus is possible
- Process is important - it can create or alleviate conflict
- The *Consensus Solutions* process works
- It can help create well-thought-out regulations with broad stakeholder support



Oyster Futures

Many thanks to:

OysterFutures Stakeholders

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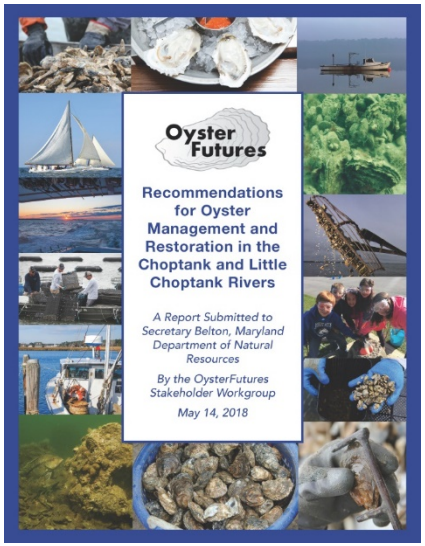

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Page 1: *Map of the Choptank and Little Choptank Rivers in Dorchester and Talbot counties, Maryland. Image credit: Kiri Carini. Watermen on the bay. Image credit: Chesapeake Bay Program. Underwater oyster reef. Image credit: Paynter Laboratory, University of Maryland, Partner, Oyster Recovery Partnership.*

Page 2: *Stakeholders during various workgroup meetings. Image credit: Dylan Taillie.*

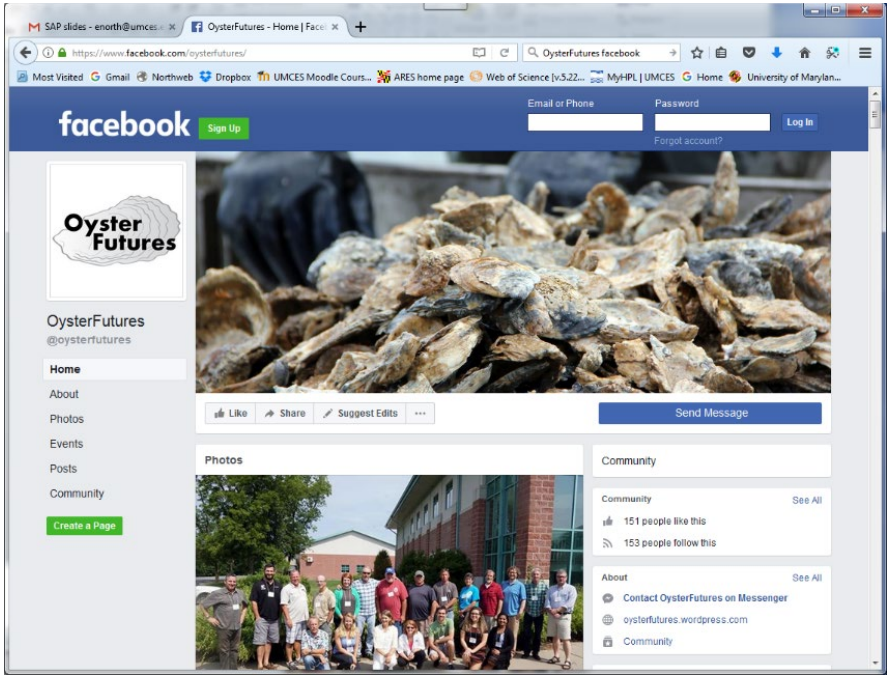
Page 4: *A pile of oysters caught on the Choptank River. Image credit: David Harp/ChesapeakePhotos.com. Community planting oysters in the bay. Image credit: Chesapeake Bay Foundation. Oysters in the market. Image credit: Elizabeth North. Oyster lease lines. Image credit: Jay P. Fleming for the Hoopers Island Oyster Co. Oyster Recovery Partnership boat on the Choptank River. Image credit: Ward Slacum.*

Page 8, 11: *Facilitators, scientists, and stakeholders during a workgroup meeting, February 2018. Image credit: Dylan Taillie. Stakeholders at the Center diagram. Image credit: Mike Wilberg.*

Page 13: *OysterFutures Research Team and Stakeholder Workgroup, March 2018. Image credit: Dylan Taillie.*

https://www.jble.af.mil/News/Article-Display/Article/1214351/cleaning-the-bay-one-oyster-at-a-time/

For more information



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