

Linking Ecological and Economic Models for
**Estimating the Ecosystem Services of
Oyster Reef Restoration**
Choptank River Complex, MD

Tom Ihde
Scott Knoche
Howard Townsend
Giselle Samonte



All Contributors



Scott Knoche

Research Economist
Morgan State University



Tom Ihde

Fisheries Ecologist
Morgan State University



Howard Townsend

Fisheries Ecologist
NOAA



Giselle Samonte

Nat. Resource Economist
ERT, Inc. *for* NOAA



Doug Lipton

Senior Scientist for
Economics, NOAA



Scott Steinback

Economist
NOAA



Kristy Lewis

Aquatic Ecologist
Univ. of Central Florida



Jorge Holzer

Fisheries Economist
University of MD



Bruce Vogt

Program Manager
NOAA



Project Goals

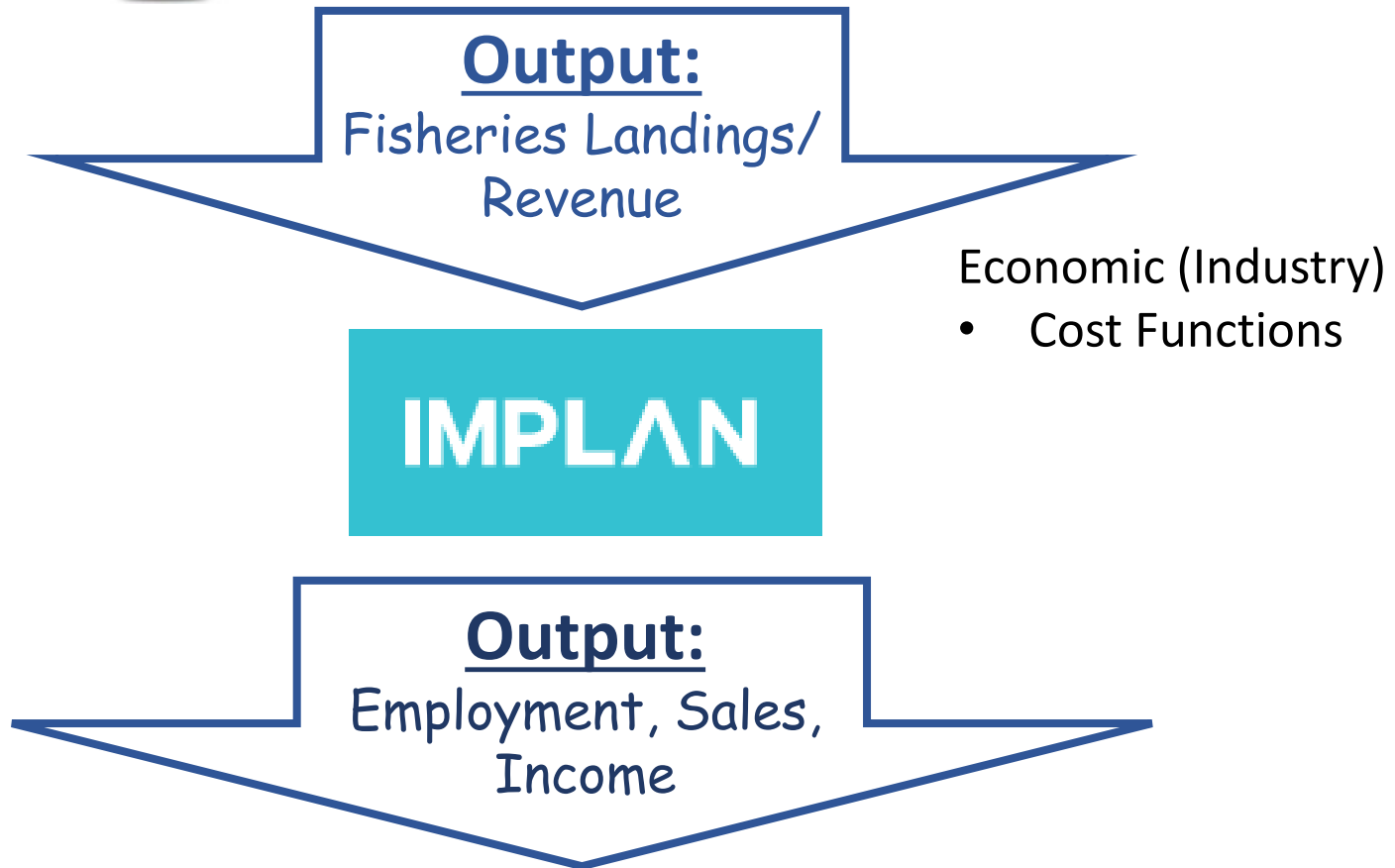
- Develop an Ecopath with Ecosim model of the Choptank and Little Choptank rivers
- Link results to an economic impact model (IMPLAN) *to:*
 - **Estimate the ecosystem services – specifically, the commercial fishing–related socio-economic impacts – generated by different oyster restoration policy options**
 - Compare these estimates to those resulting from alternative management options

Linking Ecology and Economics



Ecopath with Ecosim

No fish is an island



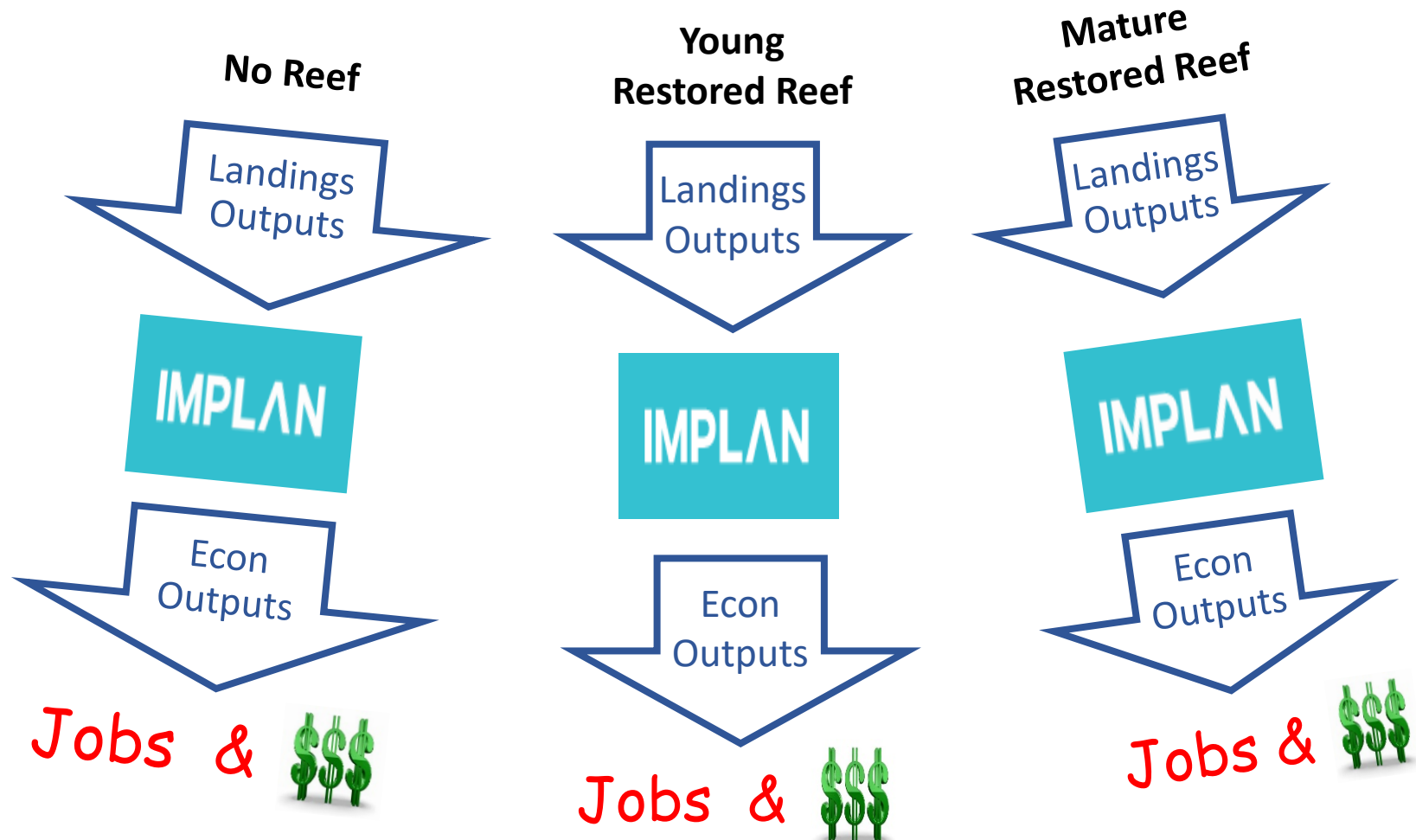
Socio-economic Impact: Jobs & \$\$\$

Restoration Scenarios



Ecopath with Ecosim

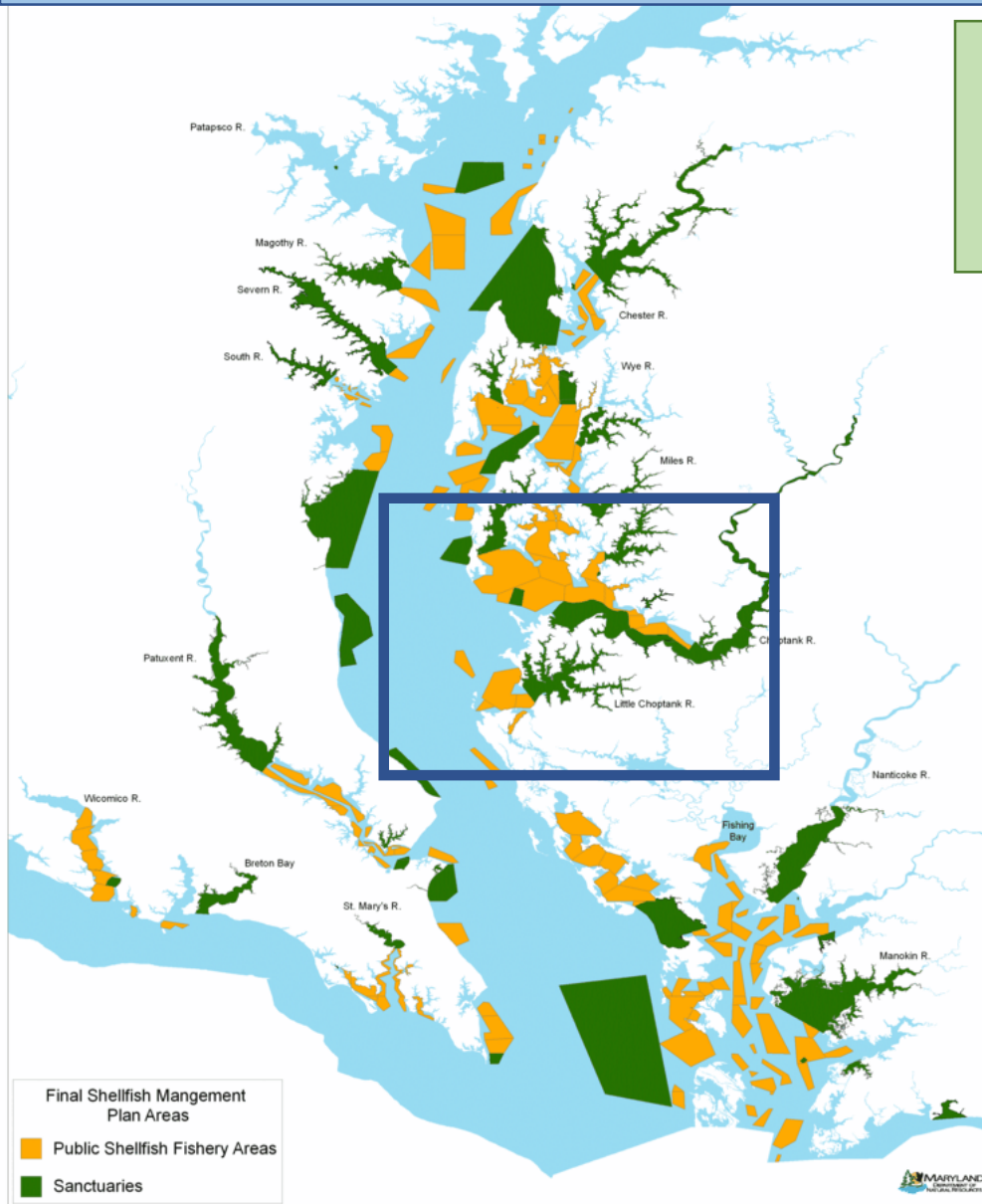
No fish is an island



Maryland Oyster Sanctuaries

Maryland Oyster Restoration and Aquaculture Development Plan (Dec, 2009)

- Prior to 2009, 1,500 acres of bottom habitat in sanctuaries
- In 2009, 3 new sanctuaries now protecting total of 2,600 acres (9% of habitat)
- In 2010, State of Maryland set aside 24% of remaining oyster habitat, for a total of 6,900 acres protected



Maryland Oyster Restoration

First three tributaries in MD

Chesapeake Bay Watershed Agreement: Restore 10 tributaries by 2025

Harris Creek

Goal: 377 restored acres

Status: Completed; ~ 2 billion oysters planted

Tred Avon River

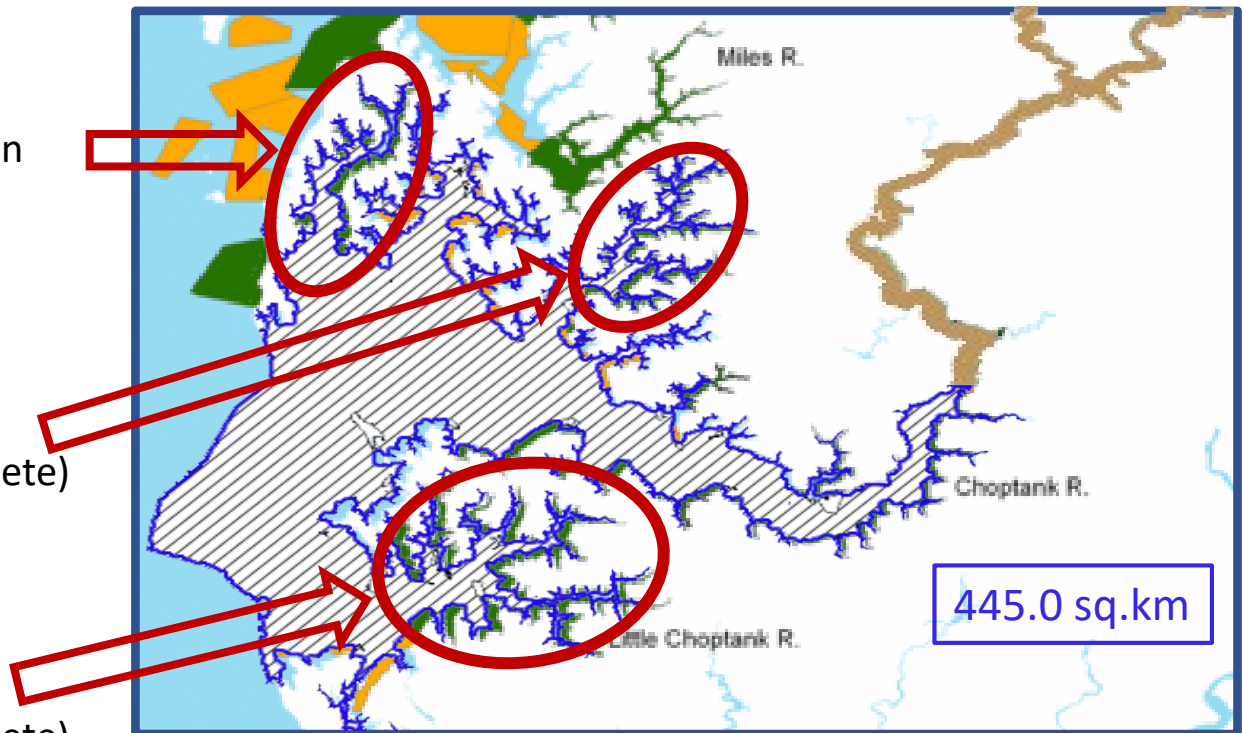
Goal: 191 restored acres

Status: Ongoing (20% complete)

Little Choptank River

Goal: 342 restored acres

Status: Ongoing (82% complete)



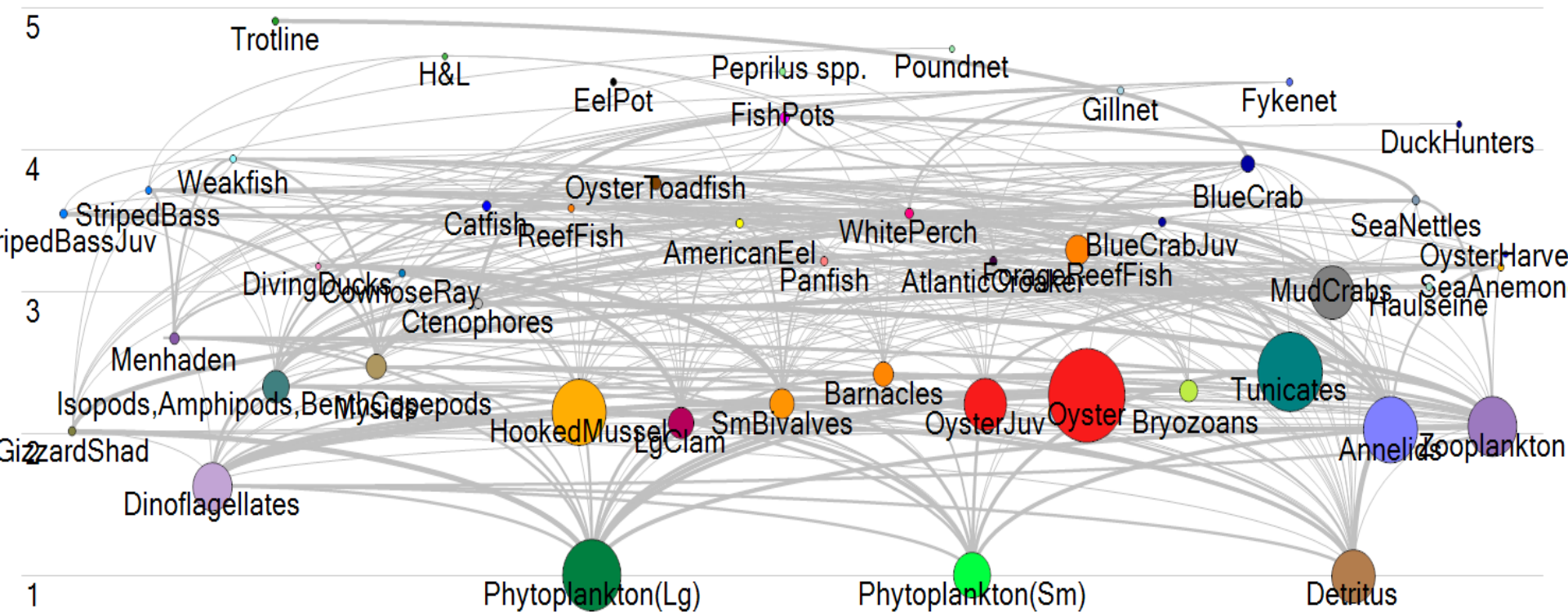
Estimated Cost - \$52 million



Ecopath with Ecosim

No fish is an island

Food web of restored oyster reef in the Choptank & Little Choptank Rivers

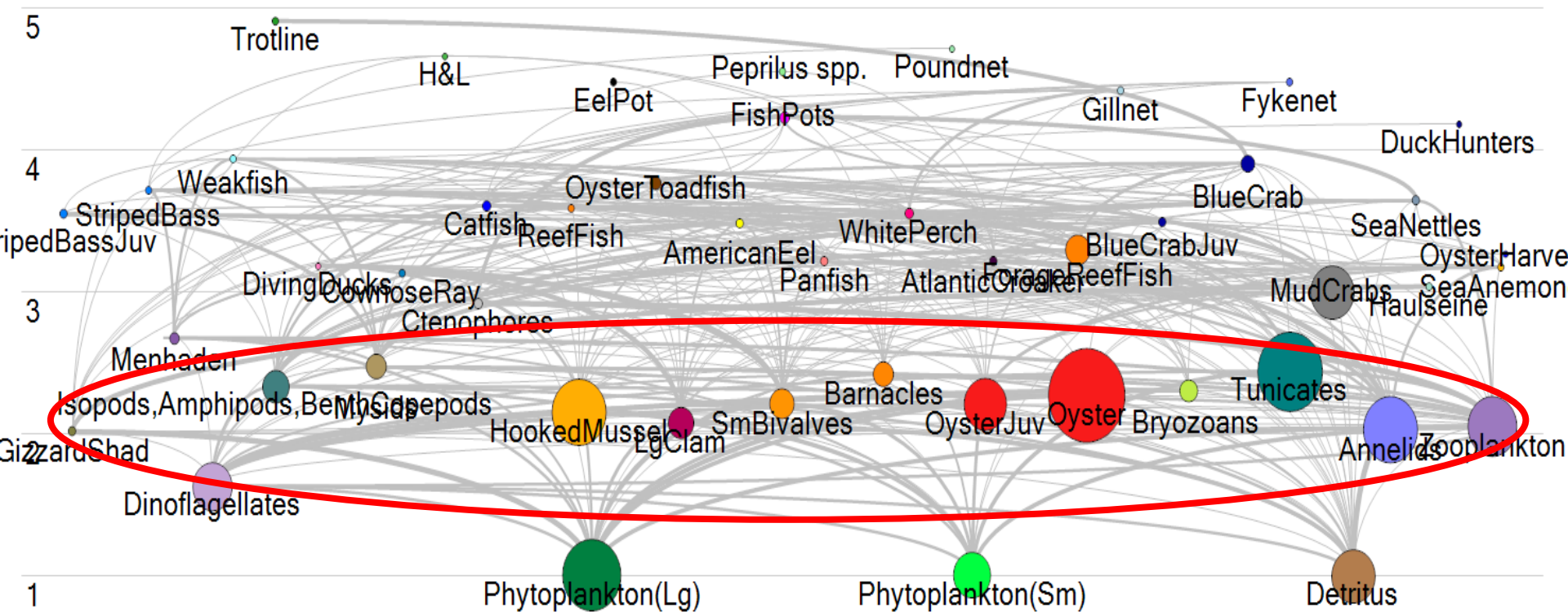




Ecopath with Ecosim

No fish is an island

Food web of restored oyster reef in the Choptank & Little Choptank Rivers



Custom Cost Functions Developed for the Choptank Region

Cost Categories	Clamming					Oyster Harvests			
	(Bait)	Trotline	Poundnet	Gillnet	Eel pots	Power dredge	Skipjack	Hand tongs	Dive
Repair/maint	23.2	6.2	29.2	9.9	14.8	7.7	11.3	3.6	11.7
Mooring	2.7	3.0	0.0	2.9	2.6	2.9	4.7	2.0	4.9
Shop expenses	5.9	2.1	0.0	6.5	1.9	3.6	2.9	2.7	3.8
Office expenses	1.6	1.9	0.0	2.2	0.3	1.7	2.5	3.5	0.9
Permit fees	4.6	4.1	0.9	6.4	1.1	4.4	8.4	3.7	9.6
Vehicle costs	7.2	7.9	14.6	8.7	4.0	8.7	11.3	9.3	10.8
Travel costs	2.5	1.8	0.0	2.3	1.6	2.0	2.5	2.7	0.9
Association fees	1.2	1.8	2.7	1.0	0.7	1.6	2.5	2.7	2.9
Professional fees	2.8	1.3	3.7	2.8	1.1	1.5	5.8	0.7	1.9
Insurance	3.1	2.8	0.0	1.0	0.3	2.0	4.3	1.3	0.0
Fishery monitoring costs	0.5	0.0	0.0	1.7	0.0	0.4	0.0	0.0	2.8
Non-crewshare labor costs	0.9	1.7	0.0	1.5	1.1	0.3	1.5	0.0	0.0
Fuel	13.5	9.9	7.3	14.8	9.0	12.7	5.5	8.2	9.8
Food	0.9	2.8	0.0	4.7	0.9	2.2	2.5	2.1	4.0
Ice	0.0	3.0	0.0	0.0	0.2	0.3	3.3	0.0	0.0
Bait	0.0	9.6	0.0	0.0	11.8	0.0	0.0	0.0	0.0
Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Communications costs	2.8	2.5	3.7	3.2	0.3	2.2	3.3	2.9	3.4
Fishing supplies	3.9	5.9	3.7	5.2	3.7	3.9	4.4	3.1	1.9
Crew supplies	3.6	1.8	3.7	3.8	1.9	2.7	5.1	1.8	5.3
Catch handling costs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other costs	0.0	2.3	0.0	3.1	0.0	2.4	0.0	0.0	0.0
Crew share costs	7.6	0.9	30.7	11.8	15.4	5.3	9.1	0.0	16.2
Proprietary Income	11.8	26.6	0.0	6.5	27.4	31.4	9.1	49.7	9.1

Results – Caveats

- Specific to Talbot and Dorchester Counties
- Estimates are on annual basis
- 3 scenarios:
 - “Current Young Reef” represents present conditions
 - established sanctuaries with restored oysters
 - compared to:
 - retention of sanctuaries to allow oysters & other filter feeders to continue to grow
 - removal of sanctuaries, allowing unrestricted oyster harvest throughout, and a return to pre-restoration condition
- Additional filter feeders (besides oysters) included in most of the analyses are: **Anemones, Barnacles, Hooked Mussel, and Tunicates**; abbreviated “FF”
- Harvests in analysis include the active fisheries of the area

Results

Annual dockside values

Scenario	Clamming (Bait)	Trotline	Poundnet	Gillnet	Eel pots
1 - Current Young Reef	--	--	--	--	--
3 - Mature Oyster Reef (w/ FF)	-6% < \$400	+79% \$4M	+5% ~\$7,000	+44% \$0.1M	+8% \$0.02M
5 - Fished Down Oysters (w/ FF)	+6% < \$400	-31% -\$2M	+5% ~\$7,000	-14% -\$0.1M	-16% -\$0.04M

Some Definitions

Output (sales) – Measure of sales in regional economy

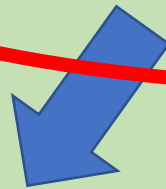
Labor Income – All forms of employment income (employee comp and proprietor)

Value-Added – Difference between gross output (sales) minus cost of inputs.

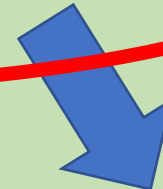
Employment – Full time and part-time workers

Each of the above Socio-economic metrics can be measured in...

Direct Effects – Series of expenditure changes as a result of an activity or policy



Indirect Effects – Impact of local industries buying goods and services from other local industries



Induced Effects – Re-spending of labor income – employee compensation and proprietor income

Total Impacts = Direct Effects + Indirect Effects + Induced Effects

Some Definitions

Output (sales) – Measure of sales in regional economy

Labor Income – All forms of employment income (employee comp and proprietor)

Value-Added – Difference between gross output (sales) minus cost of inputs.

Employment – Full time and part-time workers

Each of the above Socio-economic metrics can be measured in...

Direct Effects – Series of expenditure changes as a result of an activity or policy



Indirect Effects – Impact of local industries buying goods and services from other local industries

Induced Effects – Re-spending of labor income – employee compensation and proprietor income

Total Impacts = Direct Effects + Indirect Effects + Induced Effects

Results

Differences in Total Economic Effects, by Economic Measure & Across Scenarios

	Mature Reef (w/ FF) compared to Young Reef	
Sales (Output)	+ \$10.0 million	
Labor Income	+ \$4.8 million	
Value-Added	+ \$8.6 million	
Employment (full and part-time jobs)	+ 183 jobs	

Results

Differences in Total Economic Effects, by Economic Measure & Across Scenarios

	Mature Reef (w/ FF) compared to Young Reef	Mature Reef (w/ FF) compared to No Sanctuary (w/ FF)
Sales (Output)	+ \$10.0 million	+ \$22.8 million
Labor Income	+ \$4.8 million	+ \$9.2 million
Value-Added	+ \$8.6 million	+ \$15.9 million
Employment (full and part-time jobs)	+ 183 jobs	+ 360 jobs

Results

Differences in Total Economic Effects, by Economic Measure & Across Scenarios

	Mature Reef (w/ FF) compared to Young Reef	Mature Reef (w/ FF) compared to No Sanctuary (w/ FF)
Sales (Output)	+ \$10.0 million	+ \$22.8 million
Labor Income	+ \$4.8 million	+ \$9.2 million
Value-Added	+ \$8.6 million	+ \$15.9 million
Employment (full and part-time jobs)	+ 183 jobs	+ 360 jobs

• Multiplier effect for sales = 2.03; i.e., for each \$1 of dockside sales (direct), and **additional** \$1.03 of economic activity (indirect + induced) generated from inter-industry transactions & additional regional spending through employee wages & business owner income

Results

Annual Total Sales Effects

Scenario	Total Effect	Difference from Current Young Reef
Current Young Reef	\$ 23 million	--
Mature (w/ FF)	\$ 33 million	\$ 10 million
No Sanctuary (w/FF)	\$ 10 million	- \$13 million

Summary

- *Substantial increase in commercial fishing – related socio-economic effects to the region from retaining restored oyster reefs and allowing them to mature*
- *Substantial reduction in commercial fishing – related socio-economic effects from eliminating sanctuaries*
- *Model estimates focus on commercial harvester sales and the backwards-linked supply chain effects - this does not include forward-linked industries such as processors, wholesalers, and retailers*
- *Inclusion of other filter feeders has an important impact for ES estimates*
 - *Compared to scenarios that did not accommodate for the increased/decreased production of filter feeders, saw 11-17% change*
- *Blue Crab (and White Perch) harvest change drove the economic impacts*
- *Multiplier effect for sales = 2.03 (direct)*
 - *For each \$1 of dockside sales, an **additional** \$1.03 of economic activity is generated (indirect + induced)*

Next Step?

A spatial modeling approach (Ecospace) will be required to parse changes in oyster harvests by area (i.e., to capture dynamics of oyster growth and harvest effects outside sanctuary areas)

Thank You!

Tom Ihde

Thomas.Ihde@morgan.edu



Project Team



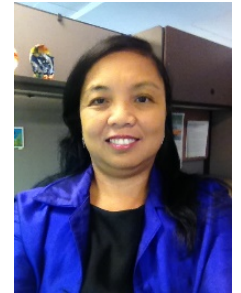
Scott Knoche
Research Economist
Morgan State University



Tom Ihde
Fisheries Ecologist
Morgan State University



Howard Townsend
Fisheries Ecologist
NOAA



Giselle Samonte
Nat. Resource Economist
ERT, Inc. *for* NOAA

