Estimating the Economic Benefits of Oyster Reef Restoration and Marine Preserve Establishment in the Lower Chesapeake Bay

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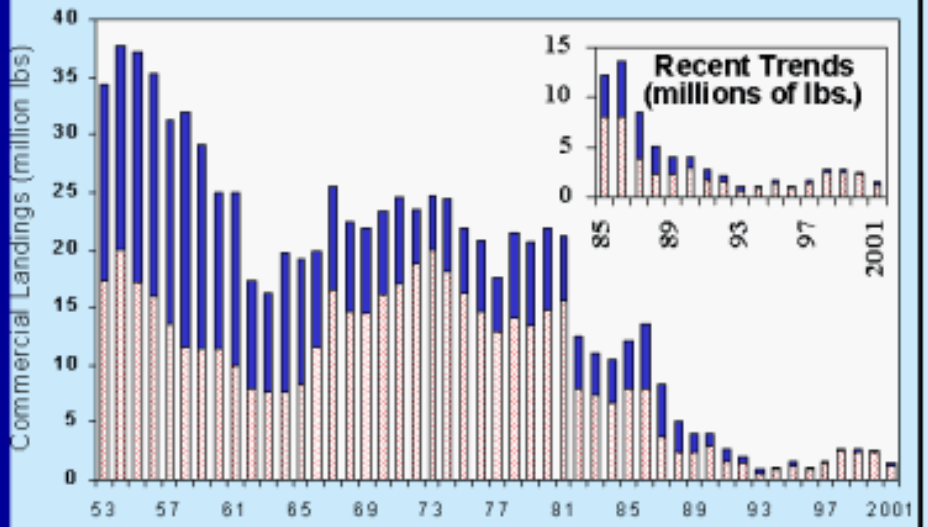
The Problem

CHESAPEAKE BAY PROGRAM - ENVIRONMENTAL INDICATORS

Trends in Shellfish: Oyster Harvest



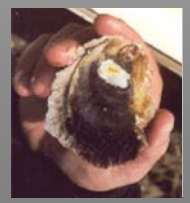
Oyster harvests in the Bay have declined due to overharvesting, disease, pollution and loss of oyster reef habitat.

Two diseases, discovered in the 1950s and caused by the parasites MSX and Dermo, have been a major cause of the oyster's decline during recent times.

Source: NMFS Fisheries Statistics of the U.S.; calendar year data.

CBP 8/15/02

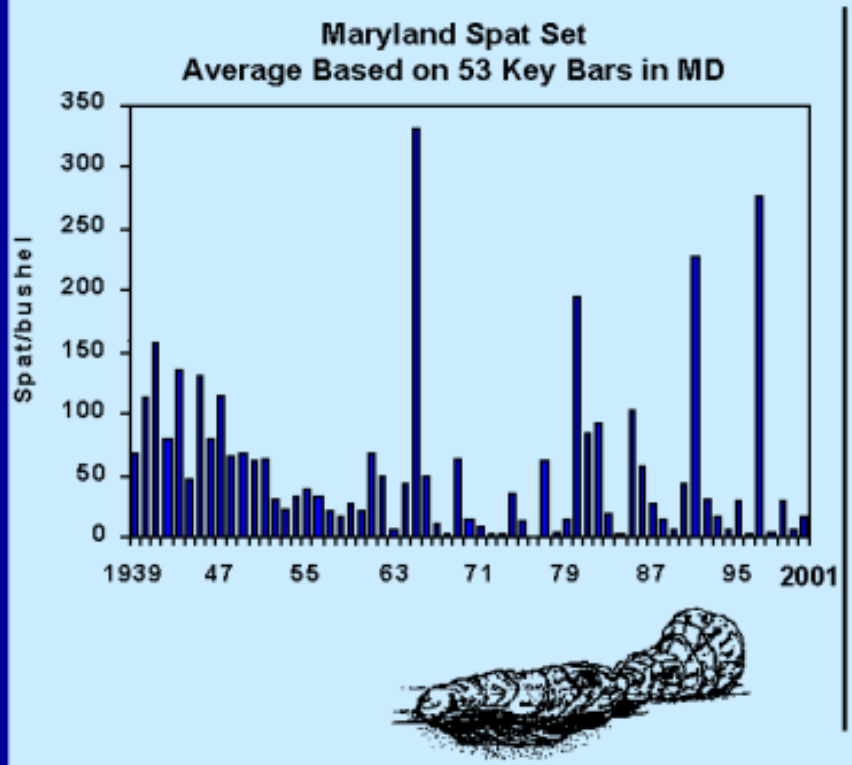
TRACK 2: LIVING RESOURCE INDICATOR



Problem in MD

CHESAPEAKE BAY PROGRAM - ENVIRONMENTAL INDICATORS

Trends in Shellfish: Oyster Spat



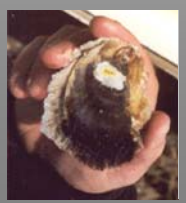
GOAL: Enhance production of oysters by restoring habitat, controlling fishing mortality, promoting aquaculture and continuing repletion programs.

STATUS: Oyster reproduction has continued to show strong annual peaks, even during recent decades, but survival to harvestable size is severely compromised by MSX and Dermo.

Source: MD Department of Natural Resources.

CBP 3/05/02

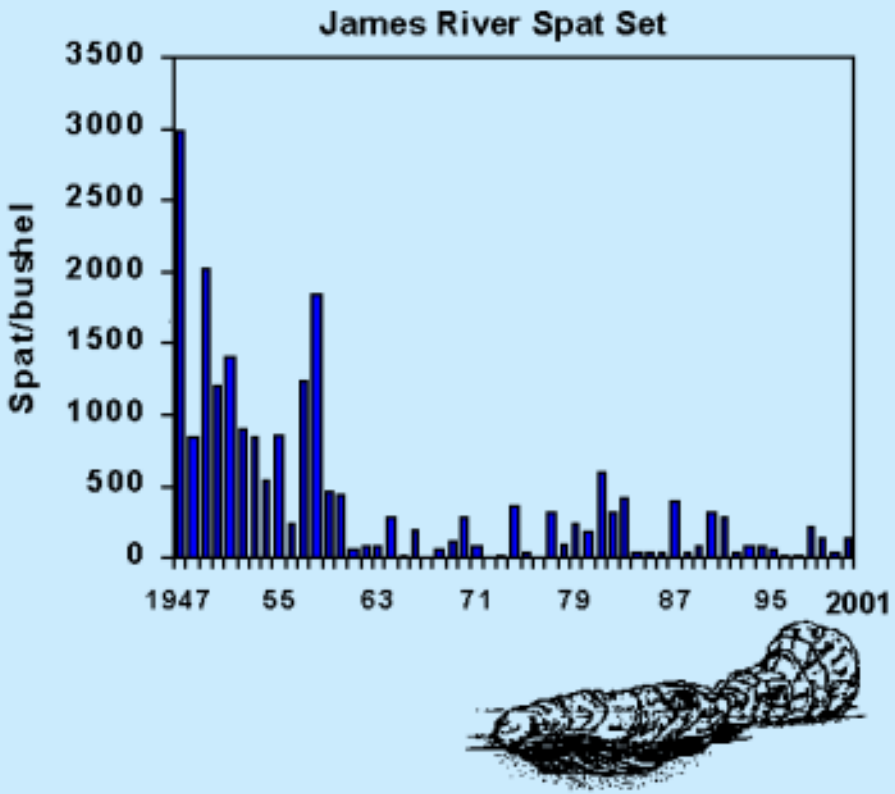
TRACK 2: LIVING RESOURCE INDICATOR



VA Problem

CHESAPEAKE BAY PROGRAM - ENVIRONMENTAL INDICATORS

Trends in Shellfish: Oyster Spat



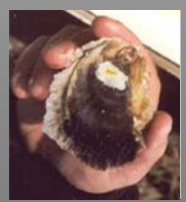
GOAL: Enhance production of oysters by restoring habitat, controlling fishing mortality, promoting aquaculture and continuing the repletion programs.

STATUS: Reproduction has declined from historical levels and survival to harvestable size is severely compromised by MSX and Dermo.

Source: Virginia Institute of Marine Science Fall Bottom Survey. The indicator tracks an average from seven bars on the James River: Horsehead, Long Shoal, Wreck Shoals, Point of Shoals, Dry Shoal, Thomas Rock, and Nansemond Ridge.

CBP 3/05/02

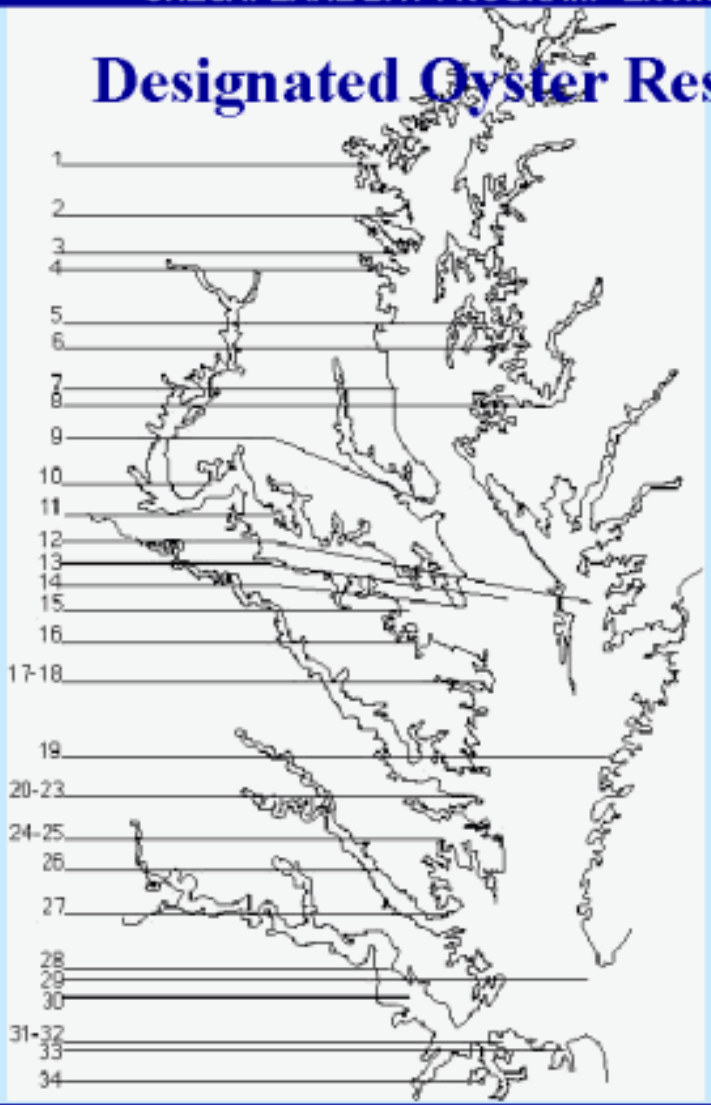
TRACK 2: LIVING RESOURCE INDICATOR



A Proposed Solution?

CHESAPEAKE BAY PROGRAM - ENVIRONMENTAL INDICATORS

Designated Oyster Restoration Areas



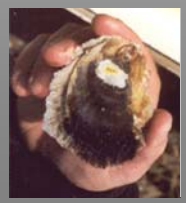
GOAL: Designation of approximately 5,000 acres each in MD and VA and 1,000 acres in the Potomac, and to create new oyster reef habitat within these areas by the year 2000.

STATUS: More than 50,000 acres were designated between 1996 and 2001.
Within those designated areas, 330 acres of oyster habitat have been constructed.

Source: Chesapeake Bay Program
Note: The map shows oyster restoration sites within designated areas. Sites 10 and 11 represent designated areas only.

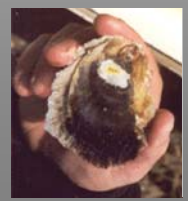
CBP 2/13/02

TRACK 2: LIVING RESOURCE INDICATOR



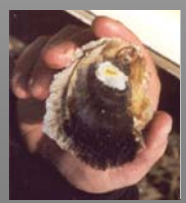
Location of Virginia's Restored Reefs

Cities.shp
Restored Reefs
1970 - 1996
1997 - 1998
1999 - 2000
2001 - 2002



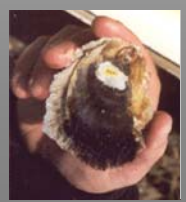
It's An Investment

- The restoration of Chesapeake Bay oyster reefs and habitat either with native oysters or the intentional introduction of C. ariakensis is an investment and should be analyzed to determine whether the return on the investment is sufficient to justify making it.



Public Benefits (Positive Externalities)

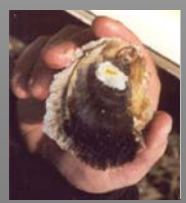
- Will oyster habitat restoration lead to improved water quality and/or habitat in Chesapeake Bay?
  - Beneficiaries
    - Watermen
    - Recreational Fishermen
    - Boaters, Swimmers
    - Bay Users
    - Reduced Costs to Achieve WQ standards
    - General Public (users and non-users)



The Approach

- Random Utility Model of Recreational Fishing Benefits Over Oyster Bottom

- Contingent Valuation Survey of General Public for WTP for Oyster Bottom Restoration



Random Utility Model – Indirect Utility Function

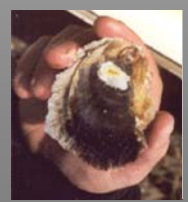
$$V_{j,m} = \alpha_1 * TCOST_j + \alpha_2 \sqrt{ECR_{j,m}} + \alpha_3 LNM_j + \alpha_4 VAC$$

- TCOST = travel and time cost
- ECR = expected catch rate
- LNM = Log of number of intercept sites
- VAC = dummy (=1) if in a vacation destination

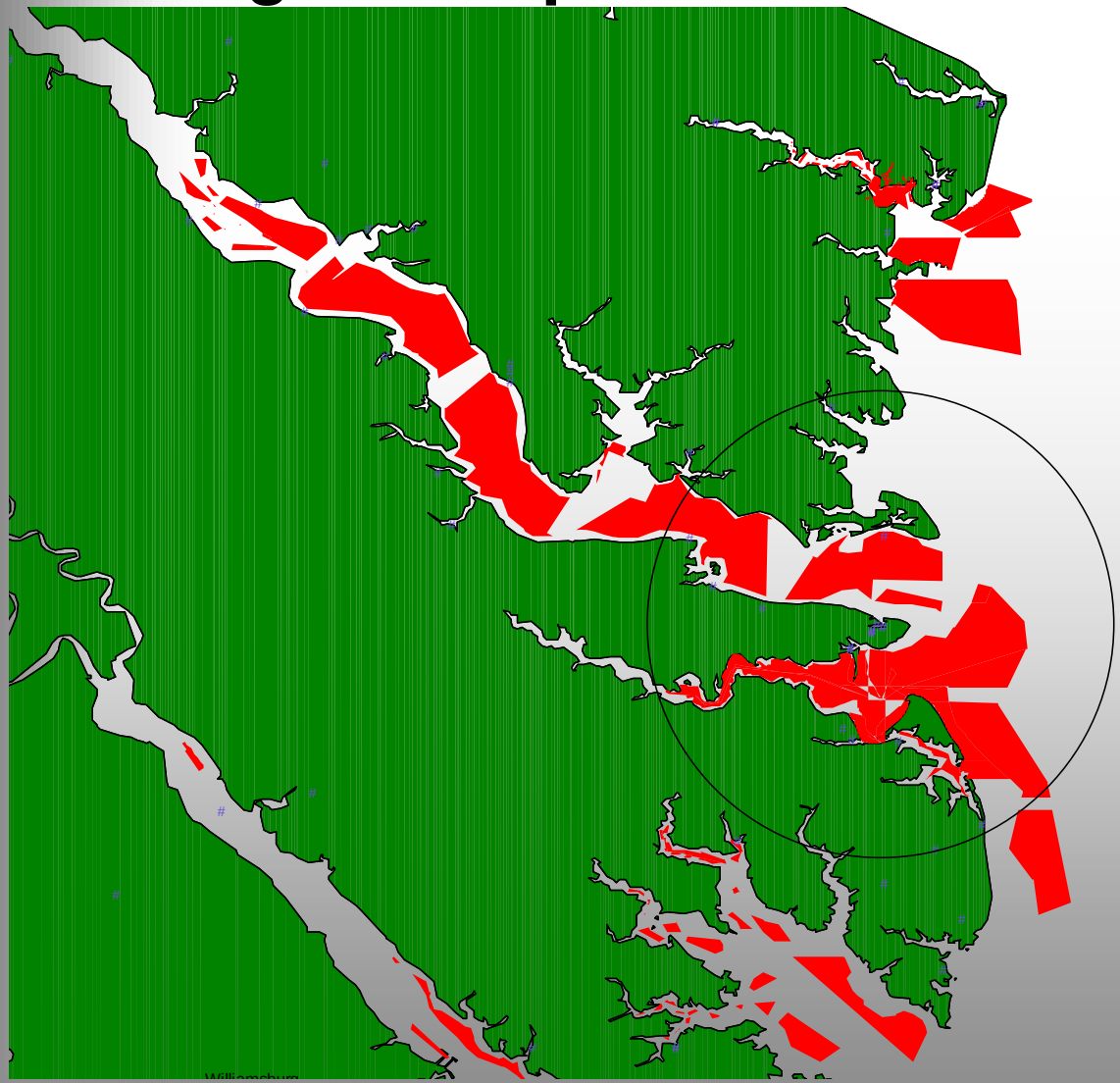
Expected Catch Rate

$$ECR^{i}_{j,m} = \exp(\hat{\beta}_0 + \hat{\beta}_1 CR_{j,m} + \hat{\beta}_2 BOTTOM_j + \hat{\beta}_3 BOTTOM_j * OYSTER + \hat{\beta}_4 YRSF_i + \hat{\beta}_5 HRSF_i)$$

- ECR = expected catch rate
- CR = Historic catch rate
- BOTTOM = area amount of hard bottom
- Oyster = angler indicated fishing on oyster reef
- YRSF = years of fishing experience
- HRSF = time spent fishing on trip



Relating Intercept Sites to Bottom Conditions



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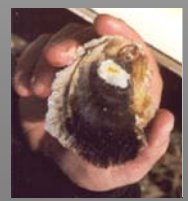
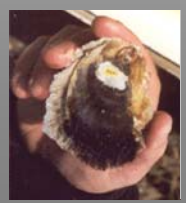
Intercept Sites
Oyster Bottom
Hard Bottom



Spatial Variability – 16 Zones

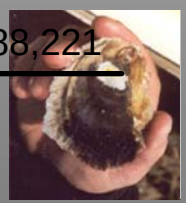
Site	Zone	Base Square Kilometers
Eastern Shore	1	98.94
Upper Peninsula	2	256.32
Isle of Wight	3	56.48
James City County	4	0
Richmond County	5	43.89
Surry County	6	21.61
Westmoreland	7	8.29
York County	8	7.89
Chesapeake City	9	0
Hampton	10	63.35
Newport News City	11	50.3
Norfolk	12	0
Poquoson	13	687.91
Portsmouth	14	12.18
Suffolk	15	24.4
Virginia Beach	16	0



Results

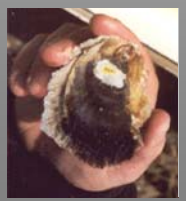
- All coefficient estimates in expected catch rate and RUM were significant at the 95% confidence level

Scenario	CV per Recreation Trip	Total CV	Acreage	Cost	Net Benefits
5% increase	$0.27	$1,855,122	16451	$243,485,013	-$241,629,891
10% increase	$0.62	$4,259,910	32903	$486,970,027	-$482,710,116
25% increase	$2.32	$15,940,311	82258	$1,217,425,068	-$1,201,484,756
50% increase	$9.12	$62,661,914	164516	$2,434,850,136	-$2,372,188,221

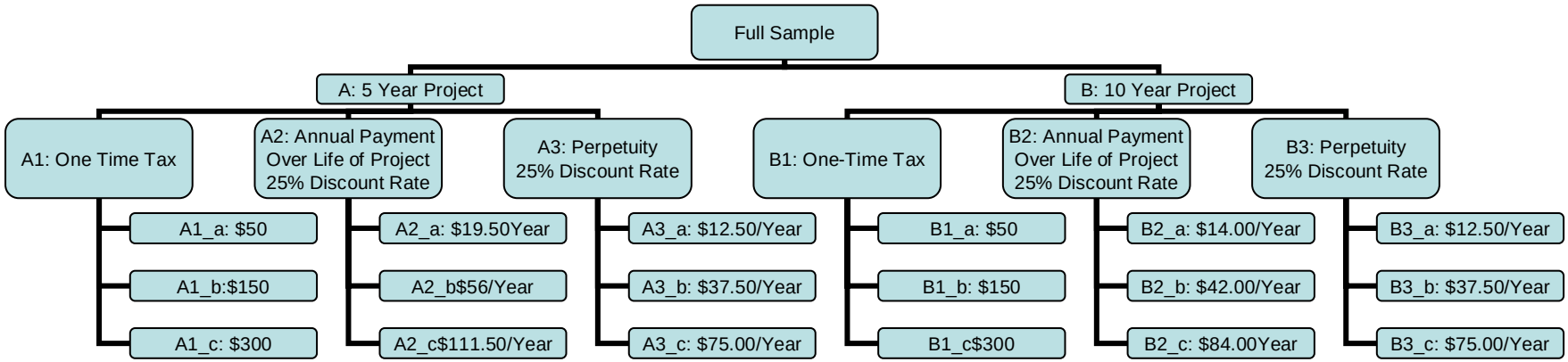


Implications

- While there are positive benefits to anglers from oyster reef restoration, justification of the costs must come from other benefits such as water quality improvements, non-use benefits, etc.

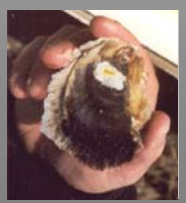


Experimental Design



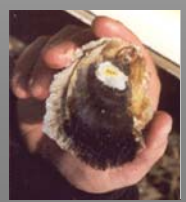
Contingent Value Approach

- Use random digit dial of MRFSS as sample frame for mail survey.
- Survey responses used to bootstrap simulation model parameters
- Conservative estimates:
  - Do not know = $0 WTP
  - Unwilling to participate = $0 WTP



CV Results

- Willingness to pay ranges from $0.26-$0.38 per acre per person
- Aggregate willingness to pay
  - $115,605 to $168,962 per acre
- >>> than $14,800 per acre reef creation cost



Conclusions

- Spatial model shows anglers would have positive benefits from increased oyster reef creation
- General public (which would include anglers) have a much higher aggregate willingness to pay for reef creation that exceeds the costs
- In reality, Virginia has had limited success in reef creation and many now support the introduction of a non-native species which may or may not form reefs and improve water quality conditions.
- Future research – willingness to pay for a habitat creation program with varying probabilities of success.