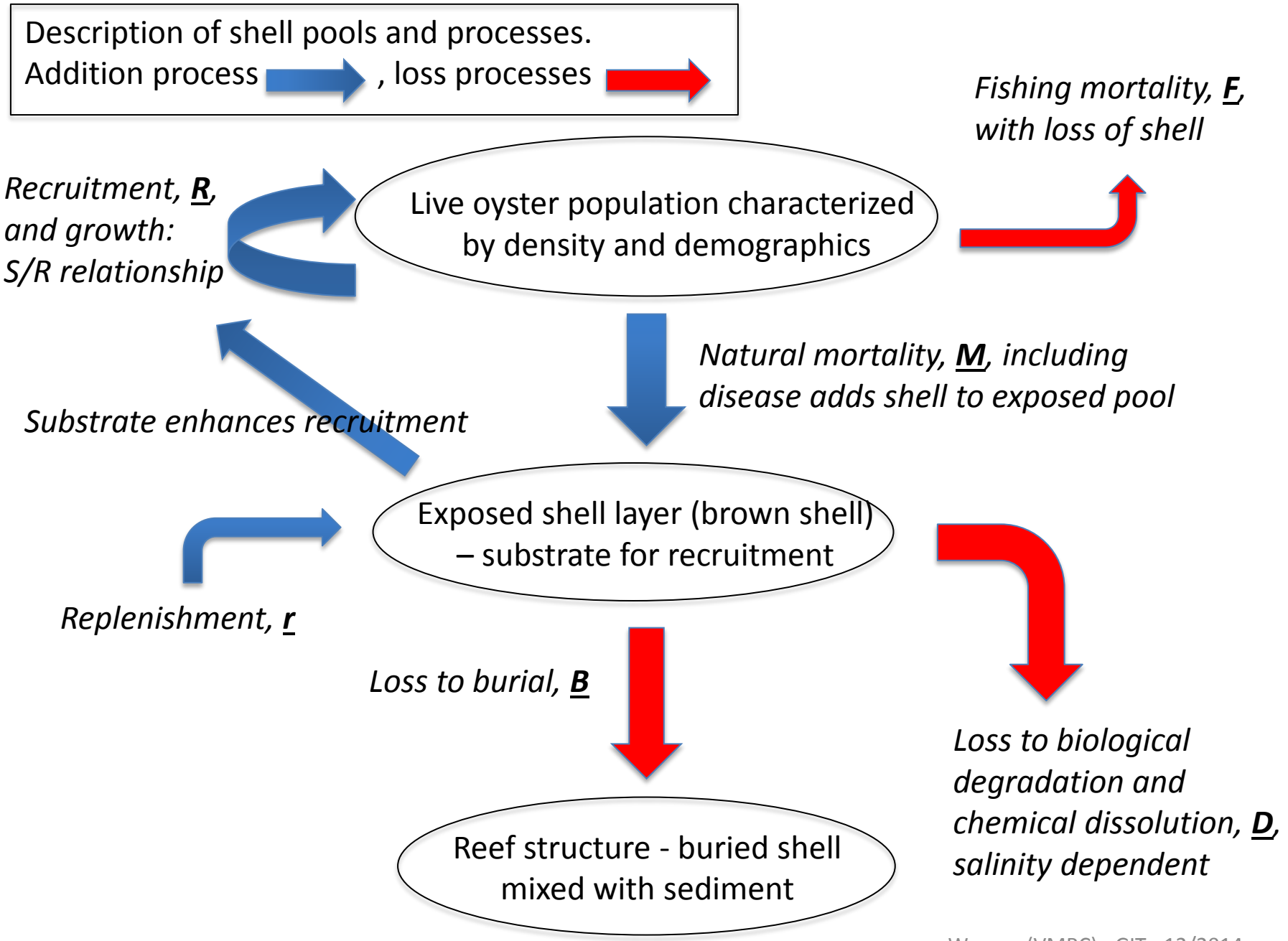
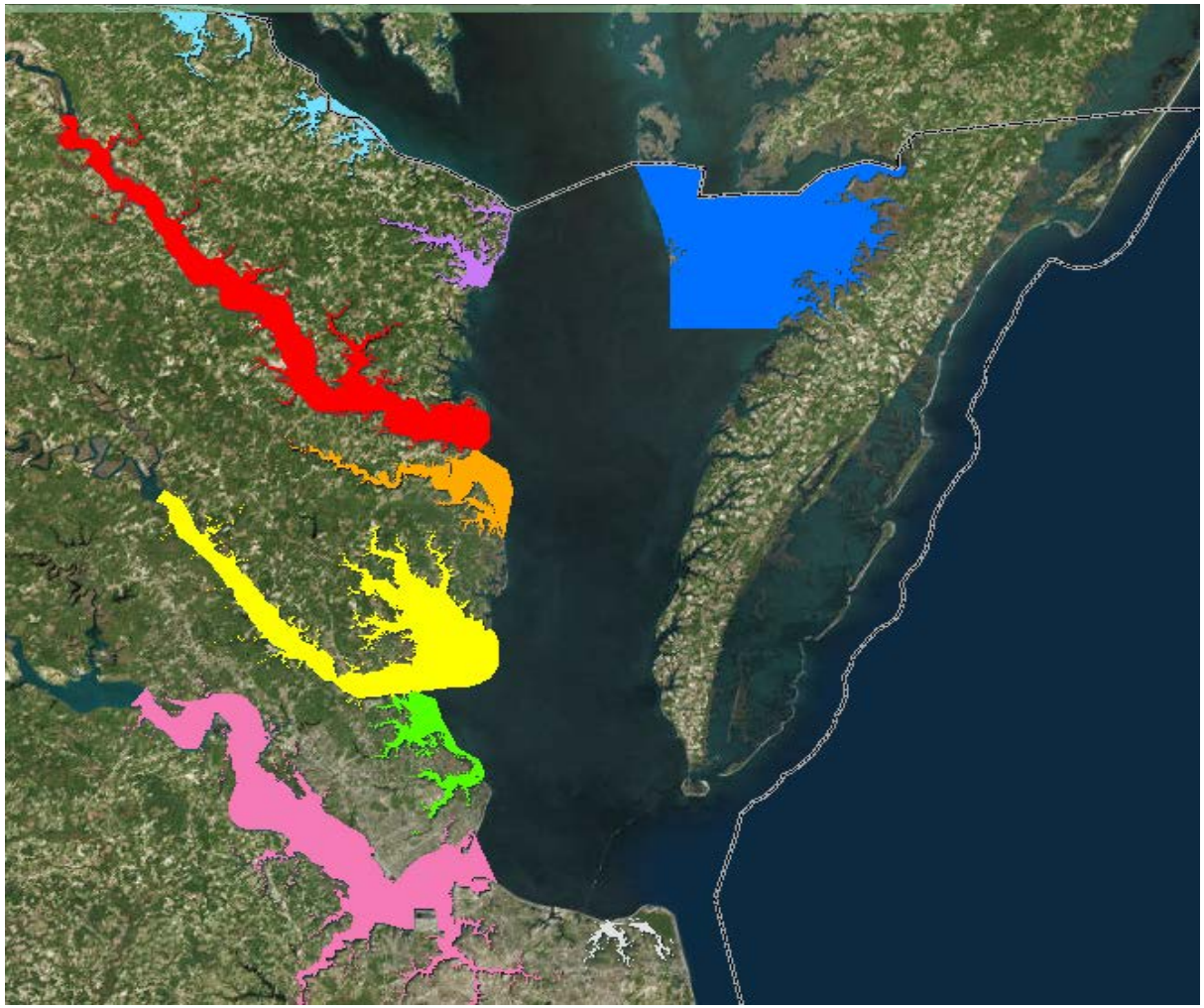
Shell management – a fundamental limitation to oyster rebuilding and restoration in the Chesapeake Bay

Jim Wesson
Virginia Marine Resources Commission
presentation to
Chesapeake Bay Fisheries Goal Implementation Team
December 2014


Description of shell pools and processes.
Addition process , loss processes
Fishing mortality, F, with loss of shell
Recruitment, R, and growth: S/R relationship
Live oyster population characterized by density and demographics
Natural mortality, M, including disease adds shell to exposed pool
Substrate enhances recruitment
Exposed shell layer (brown shell) – substrate for recruitment
Replenishment, r
Loss to burial, B
Loss to biological degradation and chemical dissolution, D, salinity dependent
Reef structure - buried shell mixed with sediment

VOSARA

http://cmap.vims.edu/VOSARA/VOSARA_Viewer/VOSARA.html



Input

New Shells and Recruitment

Input

New Concrete and Recruitment

Input

Oysters and Mortality

Loss

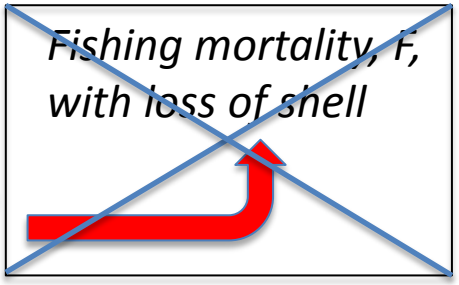
Burial, Biological Degradation,and Dissolution of Shell

Loss
Biological degradation-boring sponge

Shell Degradation Process

Loss
Concrete-Loss of Attachment Locations

#1. Natural reef with accretion, no F, no r, shell accretes
As M>(B+D), **system stable** over extended periods.

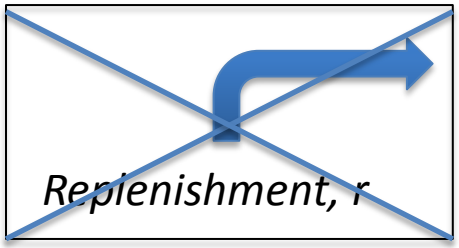


Recruitment, R, and growth: S/R relationship

Live oyster population characterized by density and demographics

Natural mortality, M, adds shell to exposed pool

Substrate enhances recruitment



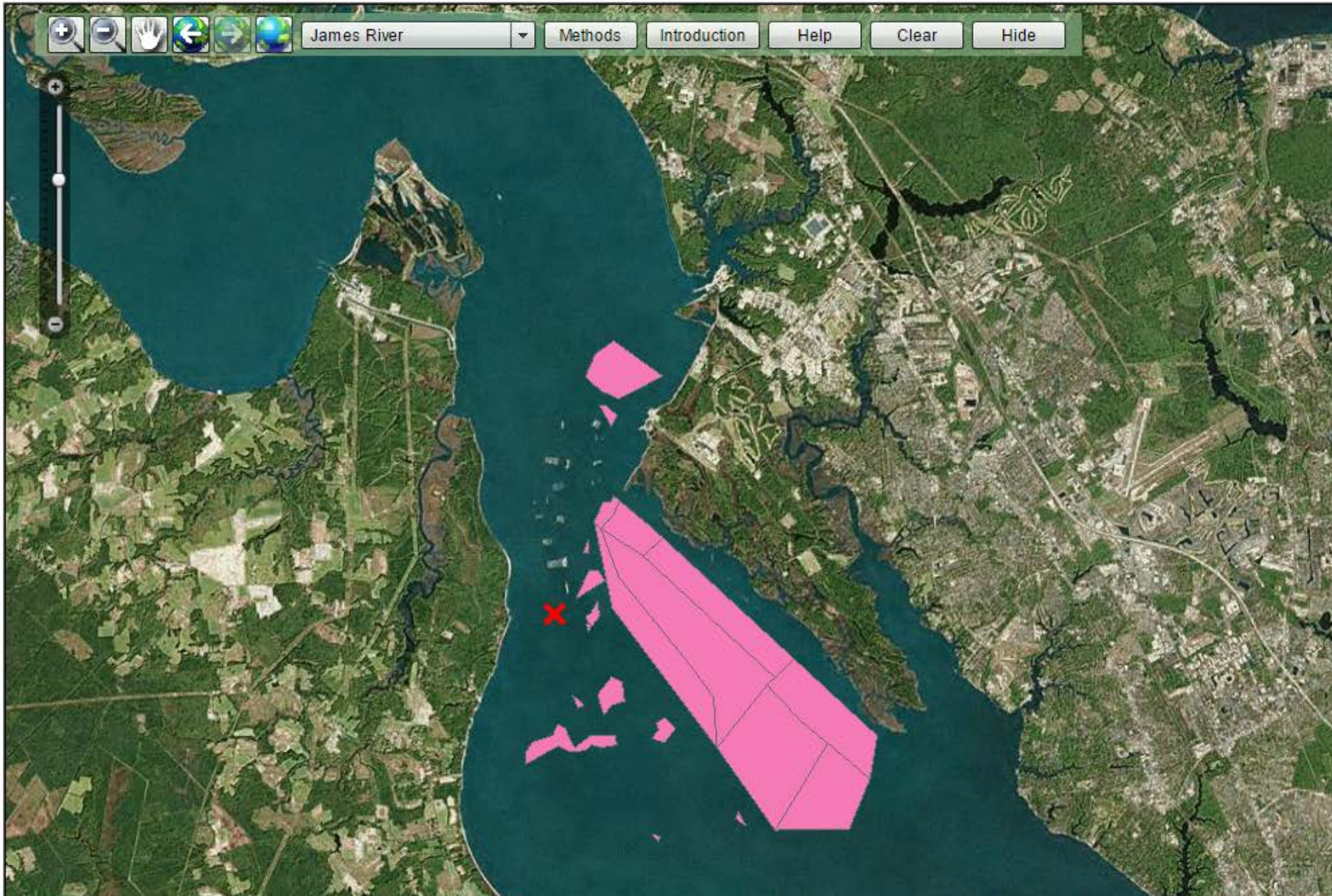
Exposed shell layer (brown shell) – substrate for recruitment

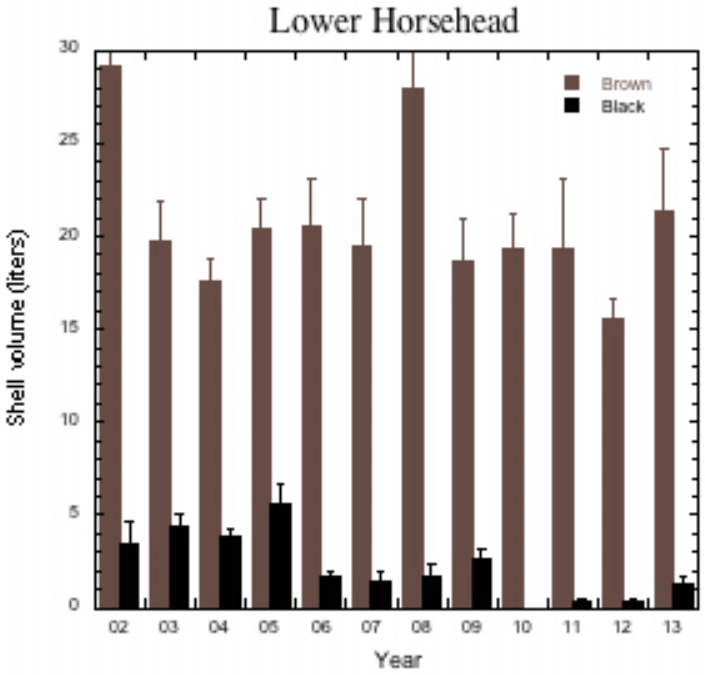
Loss to burial, B

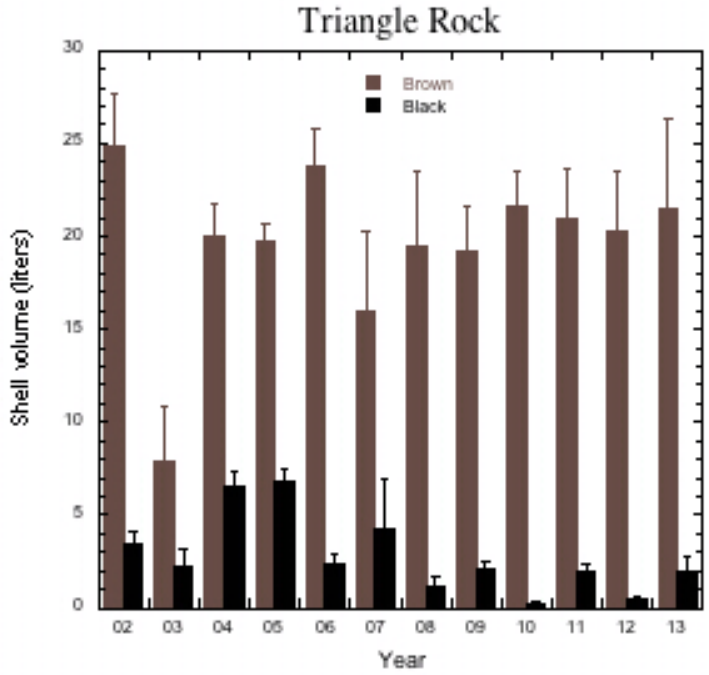
Loss to biological degradation and chemical dissolution, D, salinity dependent

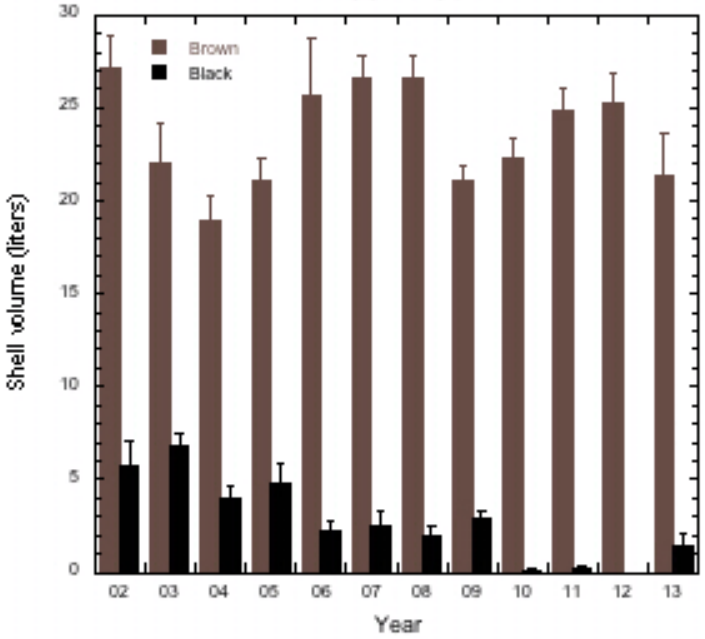
Reef structure - buried shell mixed with sediment

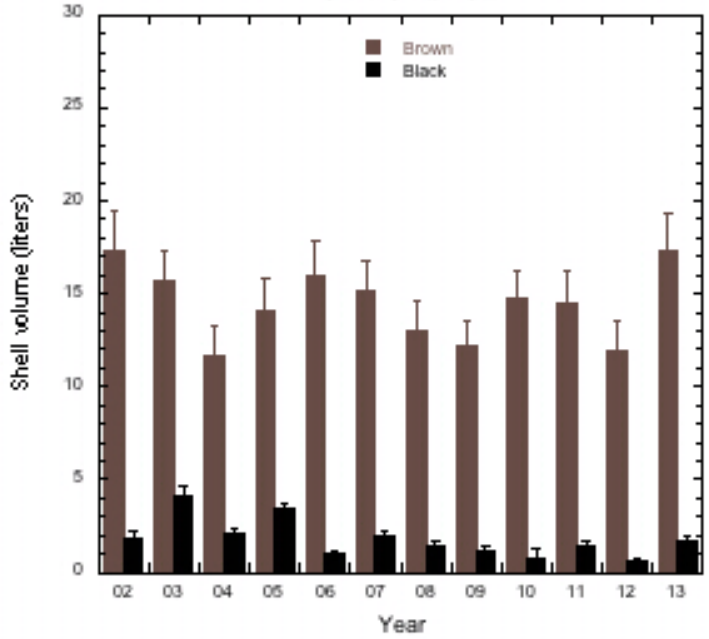
Virginia Oyster Stock Assessment and Replenishment Archive (VOSARA)



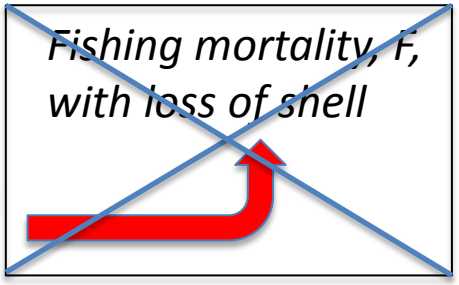

Lower Horsehead
Brown
Black
Shell volume (liters)
0
5
10
15
20
25
30
02
03
04
05
06
07
08
09
10
11
12
13
Year


Triangle Rock
Brown
Black
Shell volume (liters)
0
5
10
15
20
25
30
02
03
04
05
06
07
08
09
10
11
12
13
Year


Moon Rock
Brown
Black
Shell volume (liters)
0
5
10
15
20
25
30
02
03
04
05
06
07
08
09
10
11
12
13
Year


Point of Shoal
Brown
Black
Shell volume (liters)
0
5
10
15
20
25
30
02
03
04
05
06
07
08
09
10
11
12
13
Year

#2. Natural reef, no F, no r, but increased M due to disease. Decreased oyster longevity, lower shell addition rate to exposed layer, no accretion as M<(B+D), **system fails**.

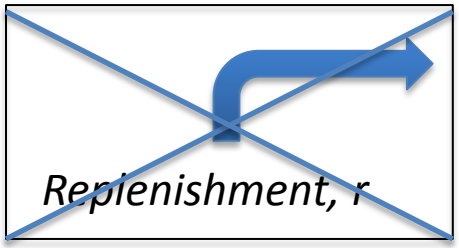


Recruitment, R, and growth: S/R relationship

Live oyster population characterized by density and demographics

Natural mortality, M, including disease adds shell to exposed pool

Decreased substrate enhancement



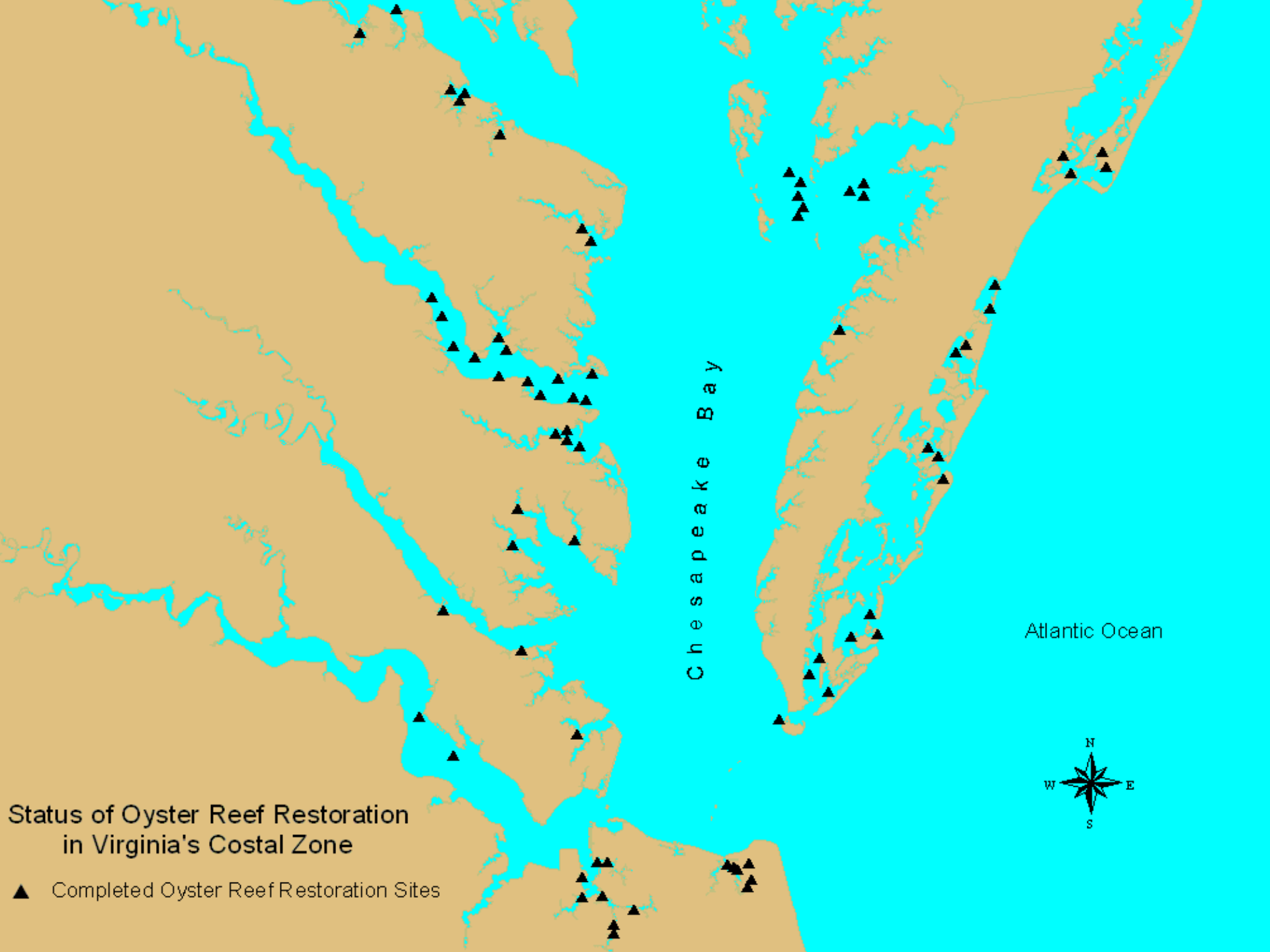
Exposed shell layer (brown shell) – substrate for recruitment

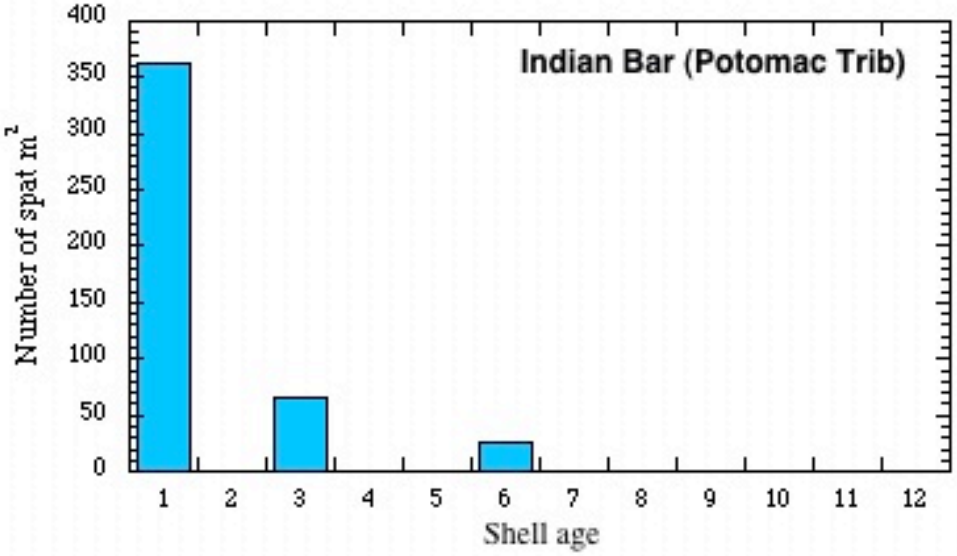
Loss to burial, B

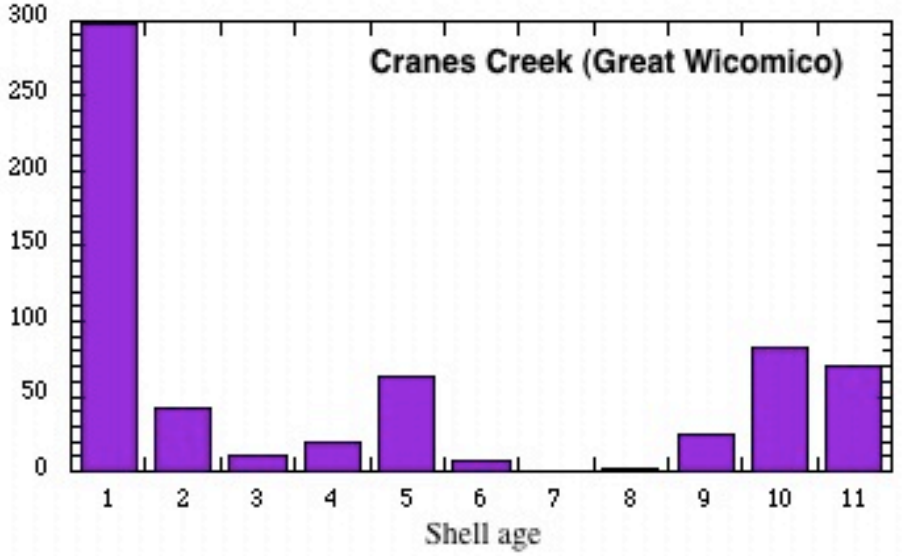
Loss to biological degradation and chemical dissolution, D, salinity dependent

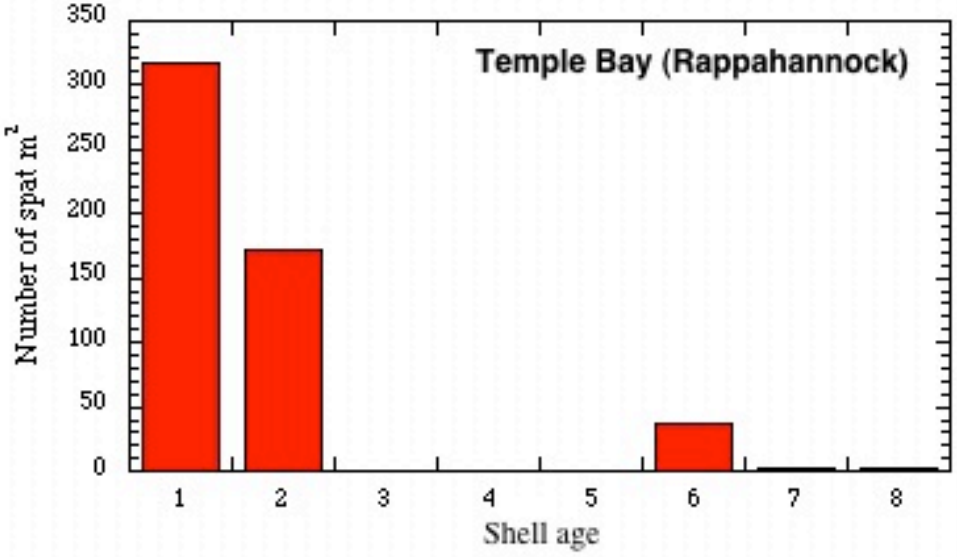
Reef structure - buried shell mixed with sediment

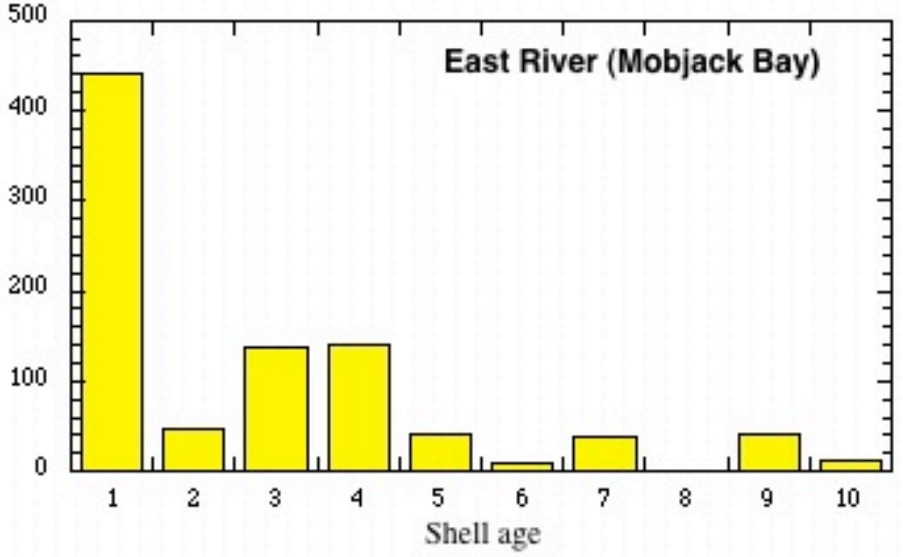

SUBMERGED
DANGER
REEF


Chesapeake Bay
Atlantic Ocean
N
W
E
S
Status of Oyster Reef Restoration
in Virginia's Costal Zone
Completed Oyster Reef Restoration Sites


Indian Bar (Potomac Trib)
Number of spat m-2
Shell age
0
50
100
150
200
250
300
350
400
1
2
3
4
5
6
7
8
9
10
11
12


Cranes Creek (Great Wicomico)
Shell age
0
50
100
150
200
250
300
1
2
3
4
5
6
7
8
9
10
11

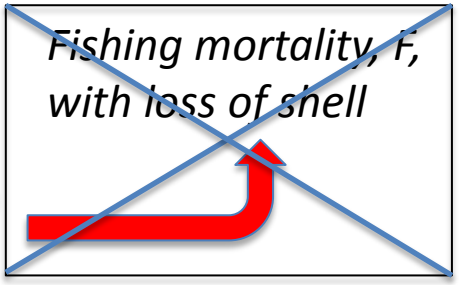

Temple Bay (Rappahannock)
Number of spat m-2
Shell age
0
50
100
150
200
250
300
350
1
2
3
4
5
6
7
8


East River (Mobjack Bay)
Shell age
0
100
200
300
400
500
1
2
3
4
5
6
7
8
9
10

Mill Creek - 2000

Mill Creek -2014

#3. Natural reef, no F, increased M (disease). Decreased oyster longevity, lower shell addition rate to exposed layer, offset by **CONTINUAL** replenishment until M=(B+D), **system stable**.



Recruitment, R, and growth: S/R relationship

Live oyster population characterized by density and demographics

Natural mortality, M, including disease adds shell to exposed pool

Increased substrate enhancement

Exposed shell layer (brown shell) – substrate for recruitment

Replenishment, r

Loss to burial, B

Loss to biological degradation and chemical dissolution, D, salinity dependent

This is the reality of sanctuaries!

Reef structure - buried shell mixed with sediment

Shell loss rates are salinity dependent and independent of supply from mortality.

Accreting reefs require equilibrium between shell addition and loss. This requires sustained recruitment, growth and survival of oysters to large size prior to death.

Offsetting inadequate shell supply from natural processes through repletion (r) is NOT a single addition process – it requires CONTINUING addition forever.

A single replenishment action to suitable bottom is NOT restoration.

Final Thoughts

- Shell supplies are extremely limited and finite.
- Competition between restoration partners has inflated the cost of shell and oyster restoration, thereby reducing acreage that can be replenished for the dollars expended.
- Choosing to invest in new areas, while there is insufficient funding to replenish previously constructed areas, is a decision to allow previously replenished areas to degrade to an unacceptable and non functional condition.