ABC Stakeholders Meeting 2010

Aquaculture Genetics and Breeding Technology Center
Virginia Institute of Marine Science
College of William and Mary

Aquaculture
genetics & breeding technology

STAKEHOLDERS 2010

Goal

- To apprise industry of progress on ABCs breeding program
- To obtain input on selection goals
- To review and discuss some current events

STAKEHOLDERS 2010

Agenda

- **Introduction and introductions**
  - **News and views 1: Maryland**
- **Wild oysters, resistance and triploidy**
  - **News and views 2: West coast hybrids**
- **SLOT**
- **Selection ’08 superlines**
  - **News and views 3: East Coast Breeding Center**
- **Breeding and economics in Virginia aquaculture**

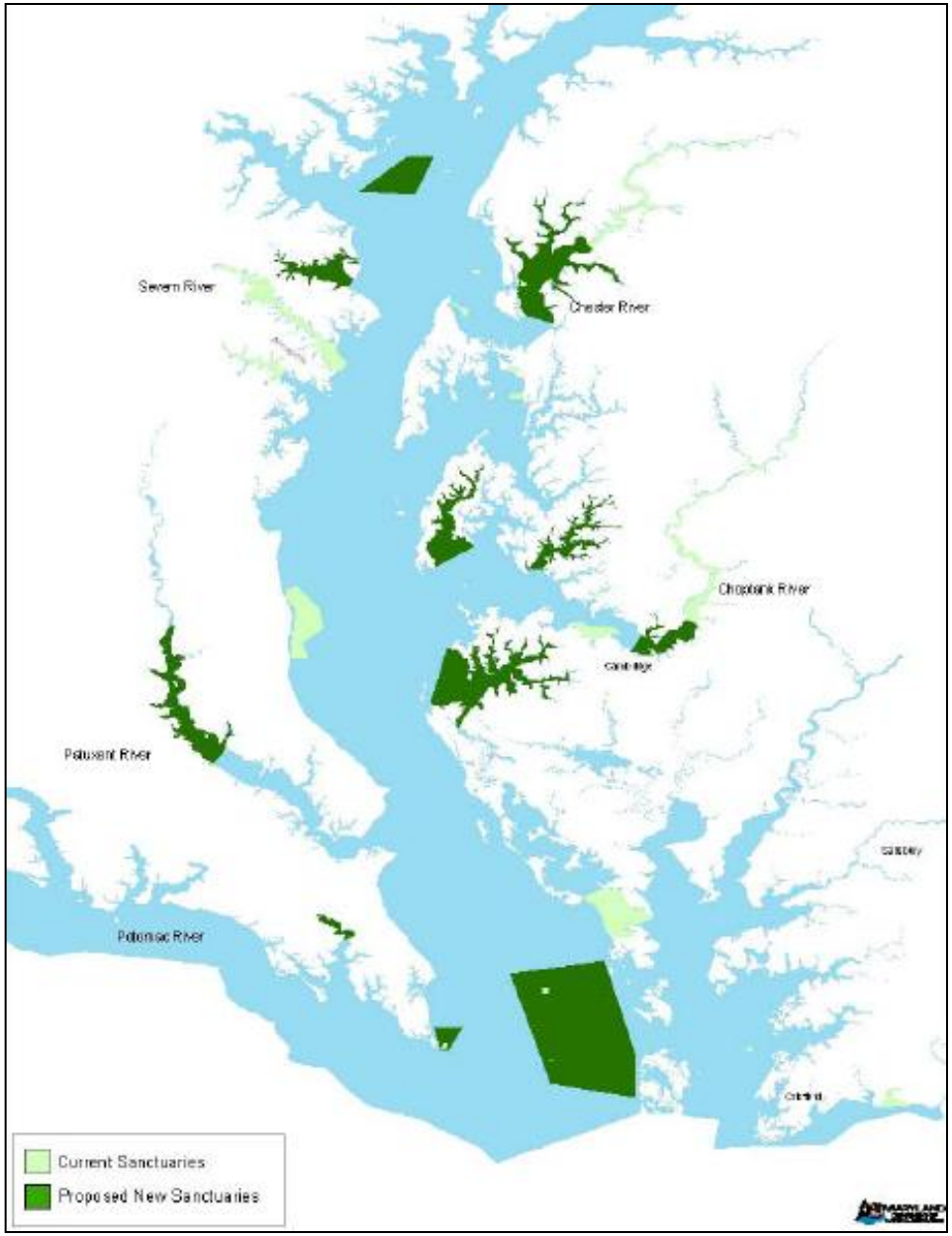
Maryland’s Vision for Oysters

Maryland's Vision for Oysters

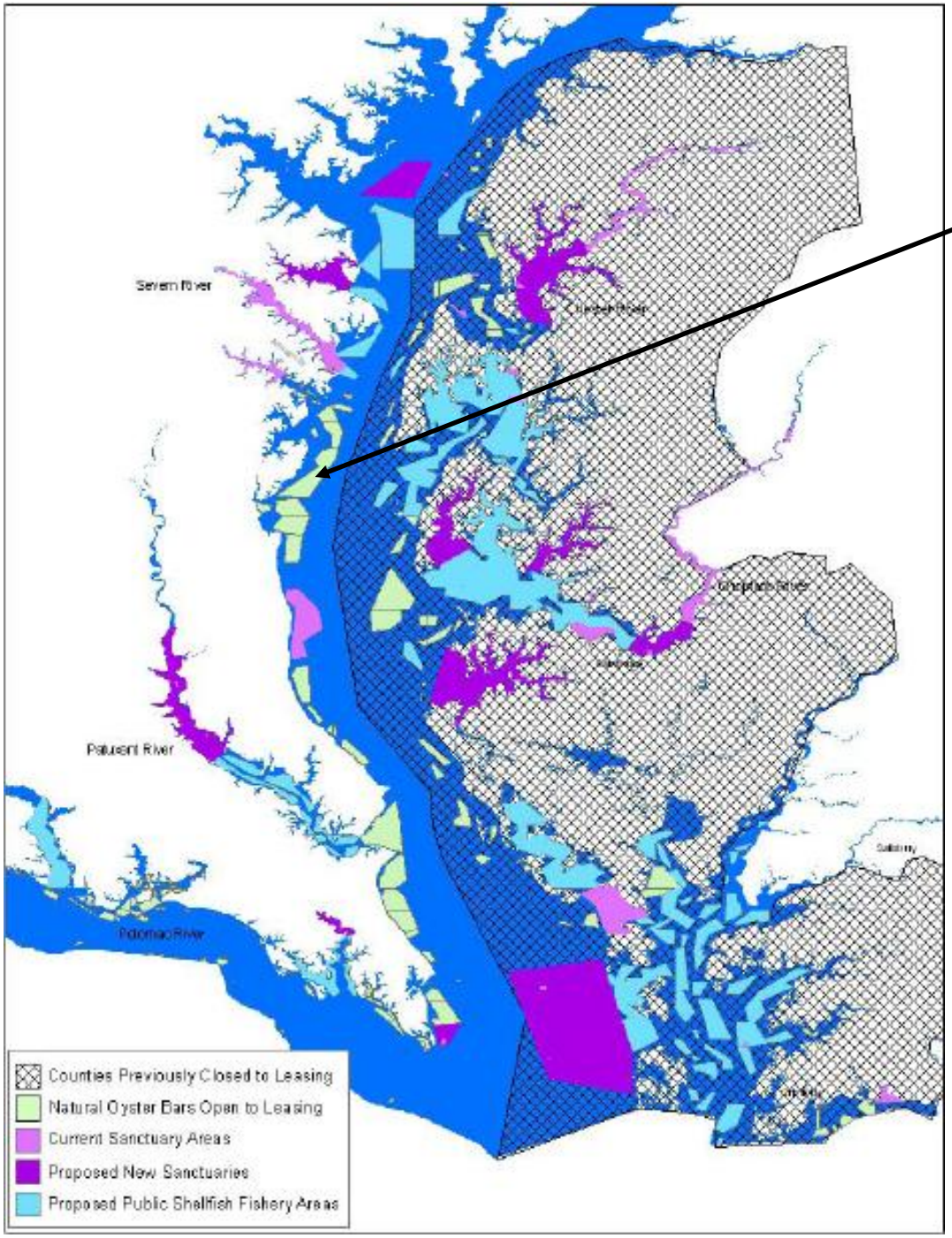
- Establish an expanding and sustainable population of native oysters in significant portions of Chesapeake Bay and its tributaries

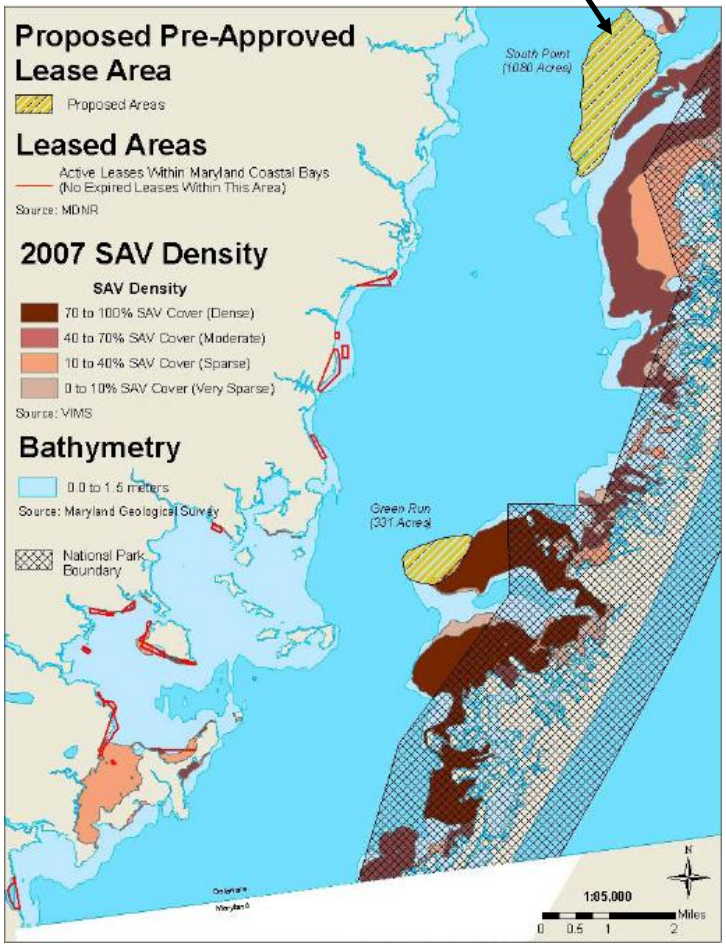
- Establish a private aquaculture industry that emerges as a major economic contributor to the State of Maryland while maintaining a more targeted and scientifically managed fishery.

Proposed new sanctuaries



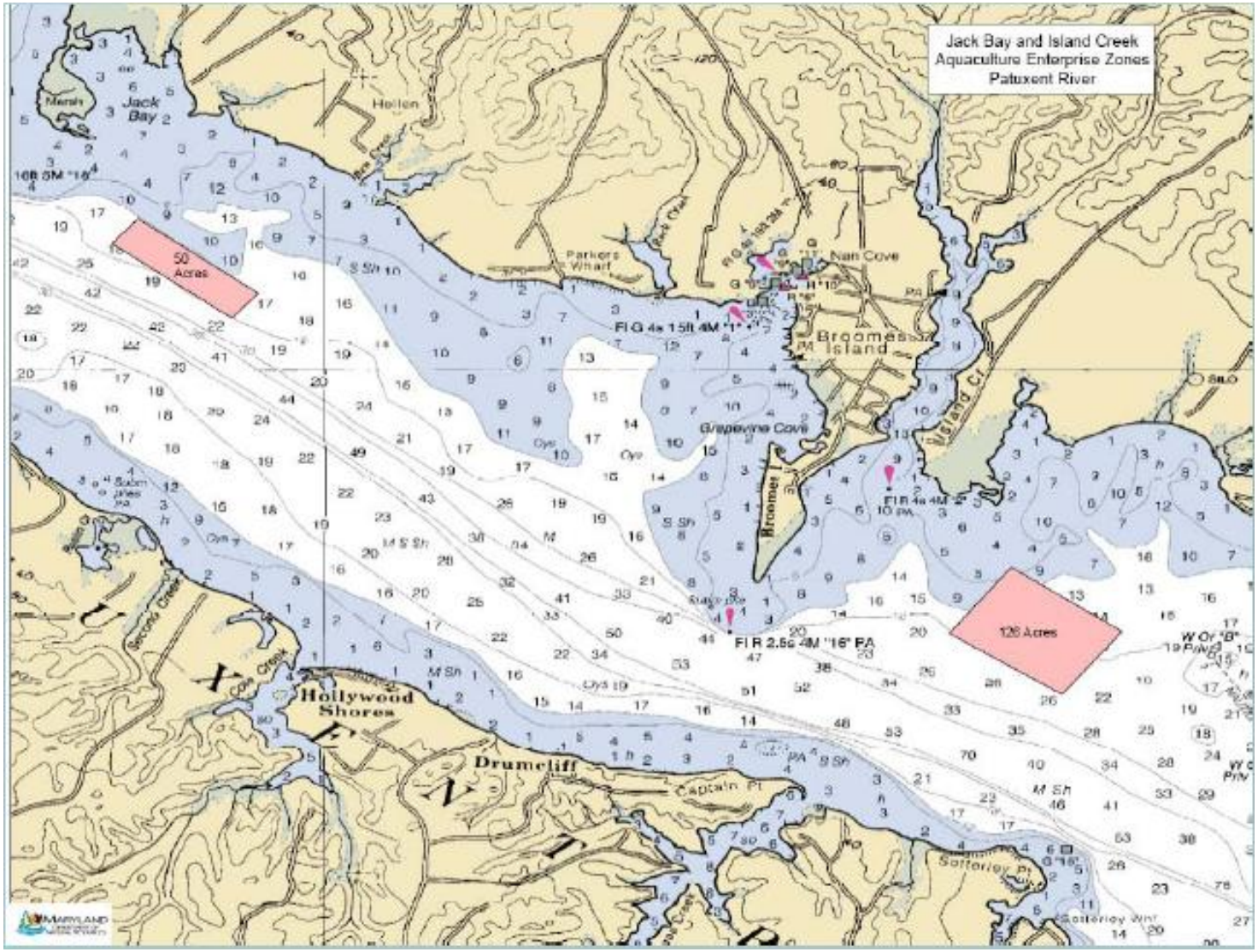
Maryland aquaculture leasing





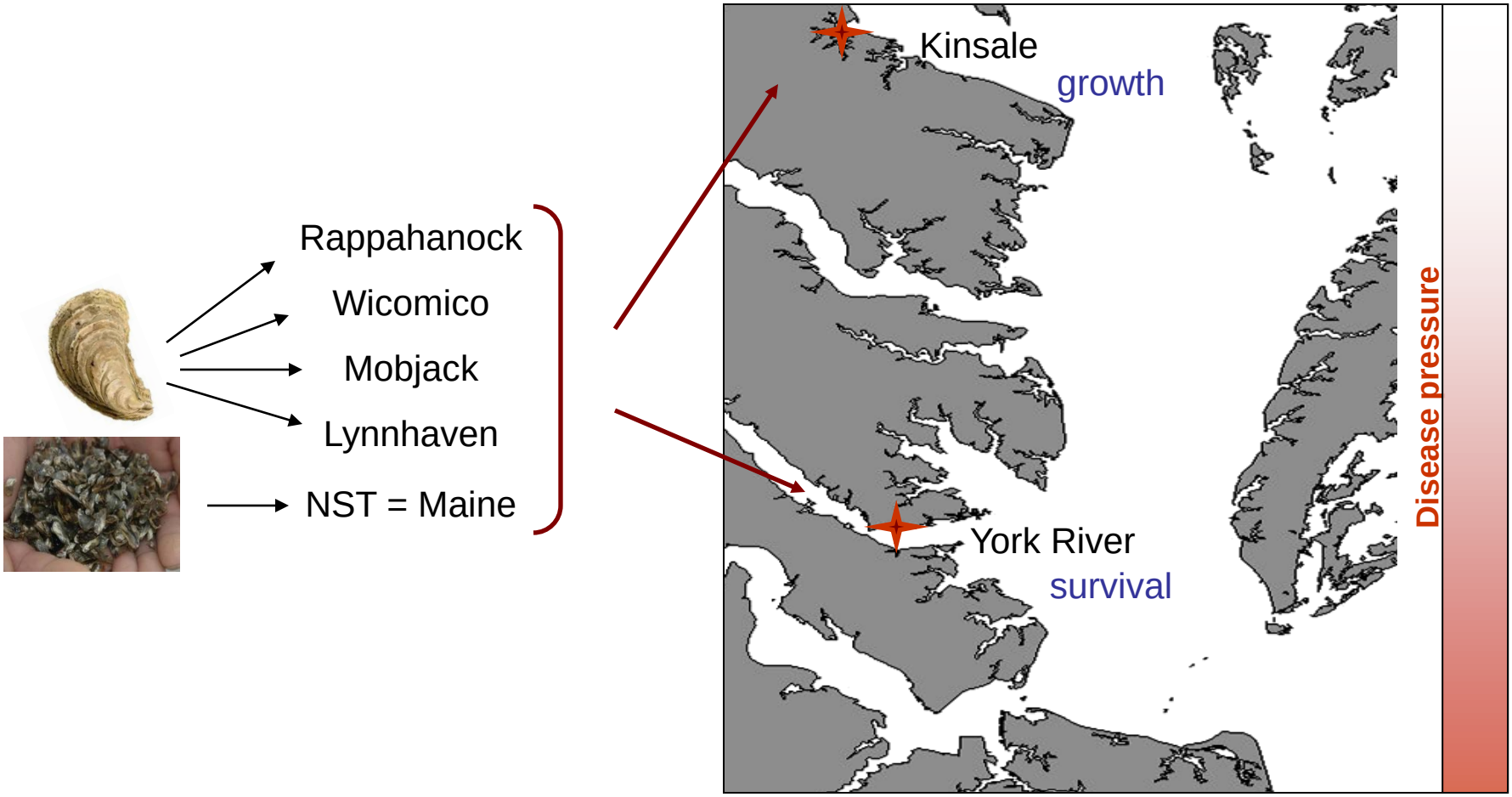
Maryland coastal bays

Maryland's trial aquaculture enterprise zones

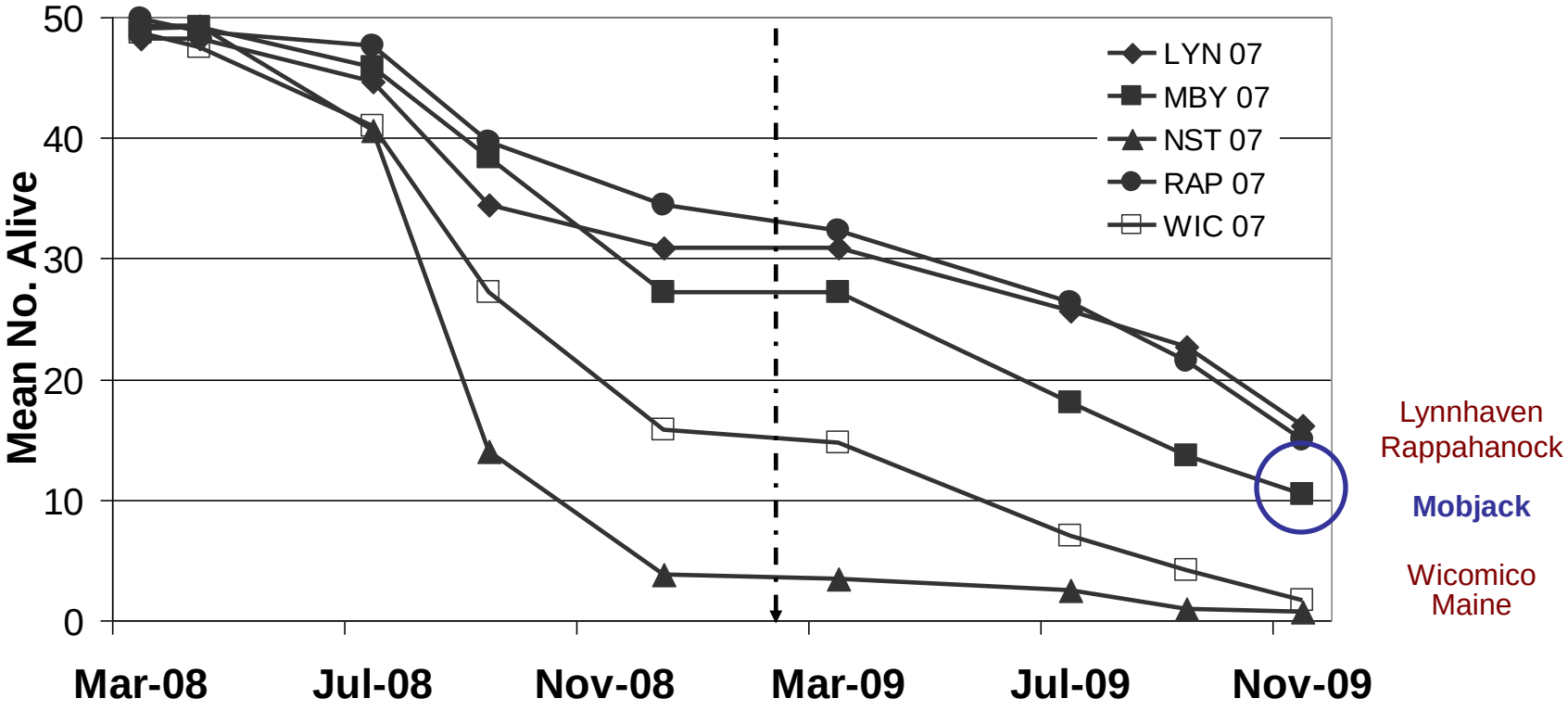


To be [wild], or not to be [wild]

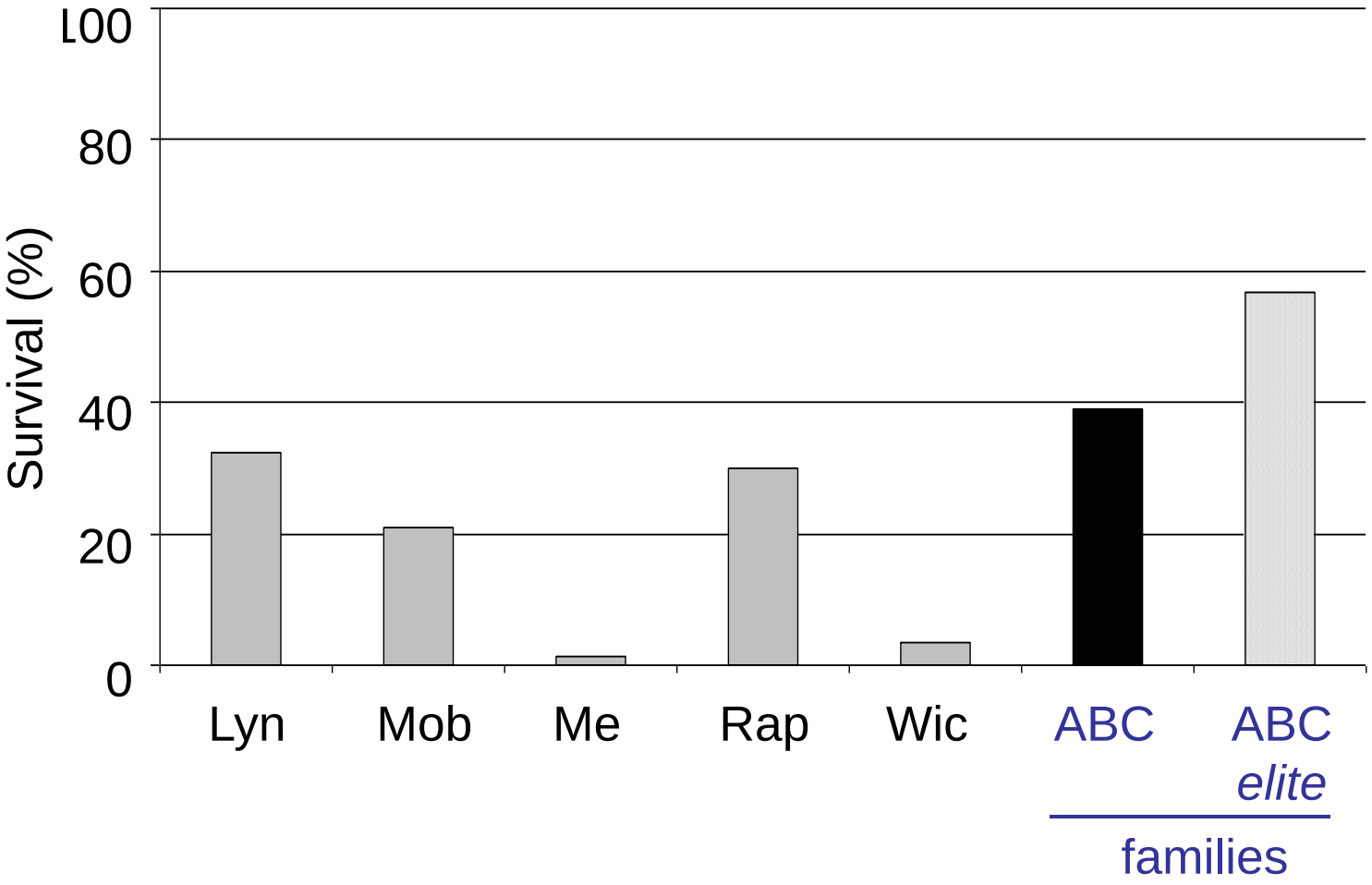
DIPLOID



To be [wild], or not to be [wild]



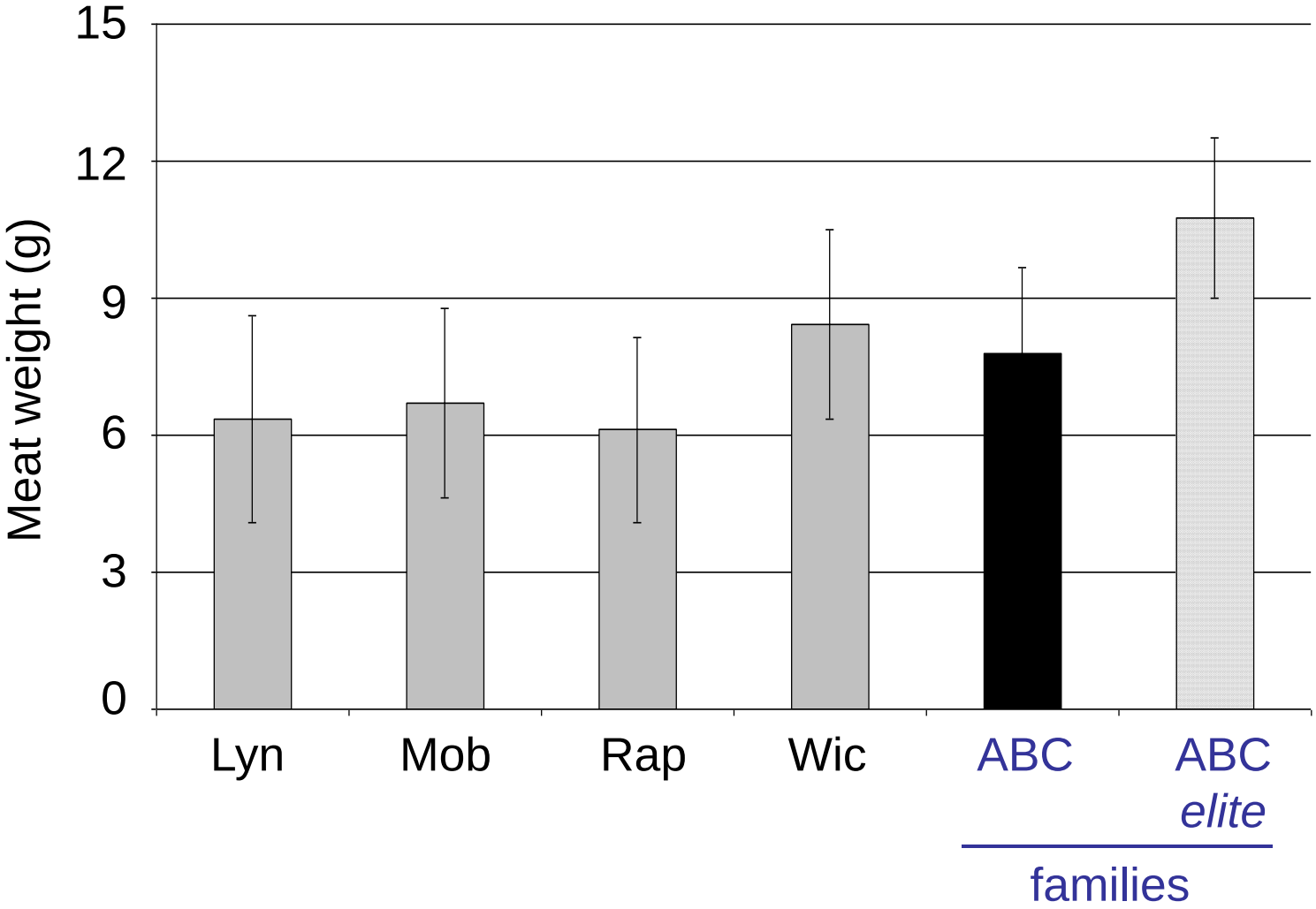
Wild oyster
survival in York (disease)
30 mos.



Wild oyster

meat weight in Kinsale (low disease)

30 mos.



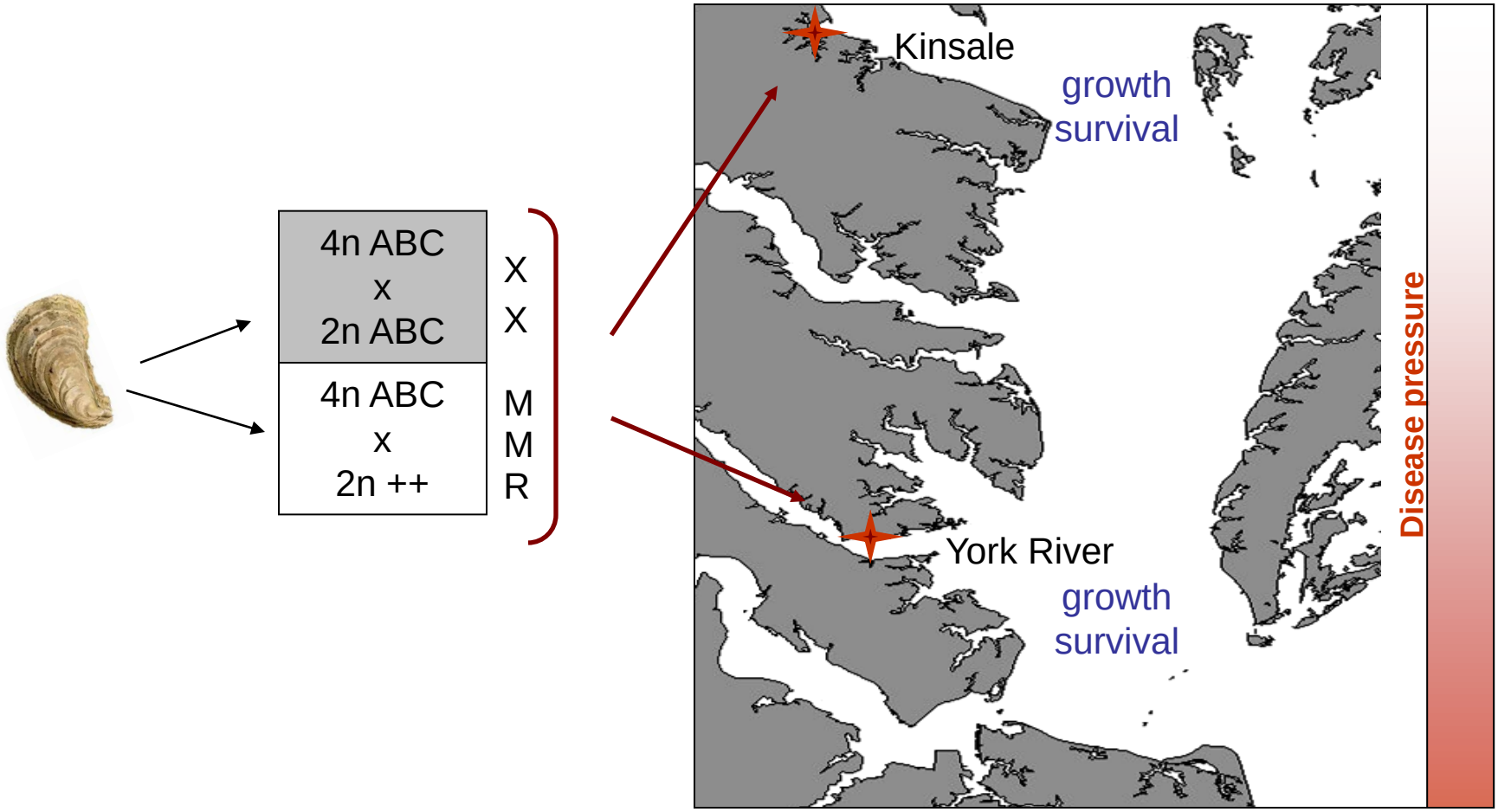
To be [wild], or not to be [wild] (and triploid)

TRIPLOID

Diploid ( ) \ Tetraploid ( )	~~wild (WW)~~	select (SS)
wild (W)	~~WW + W~~	SS + W
select (S)	~~WW + S~~	SS + S

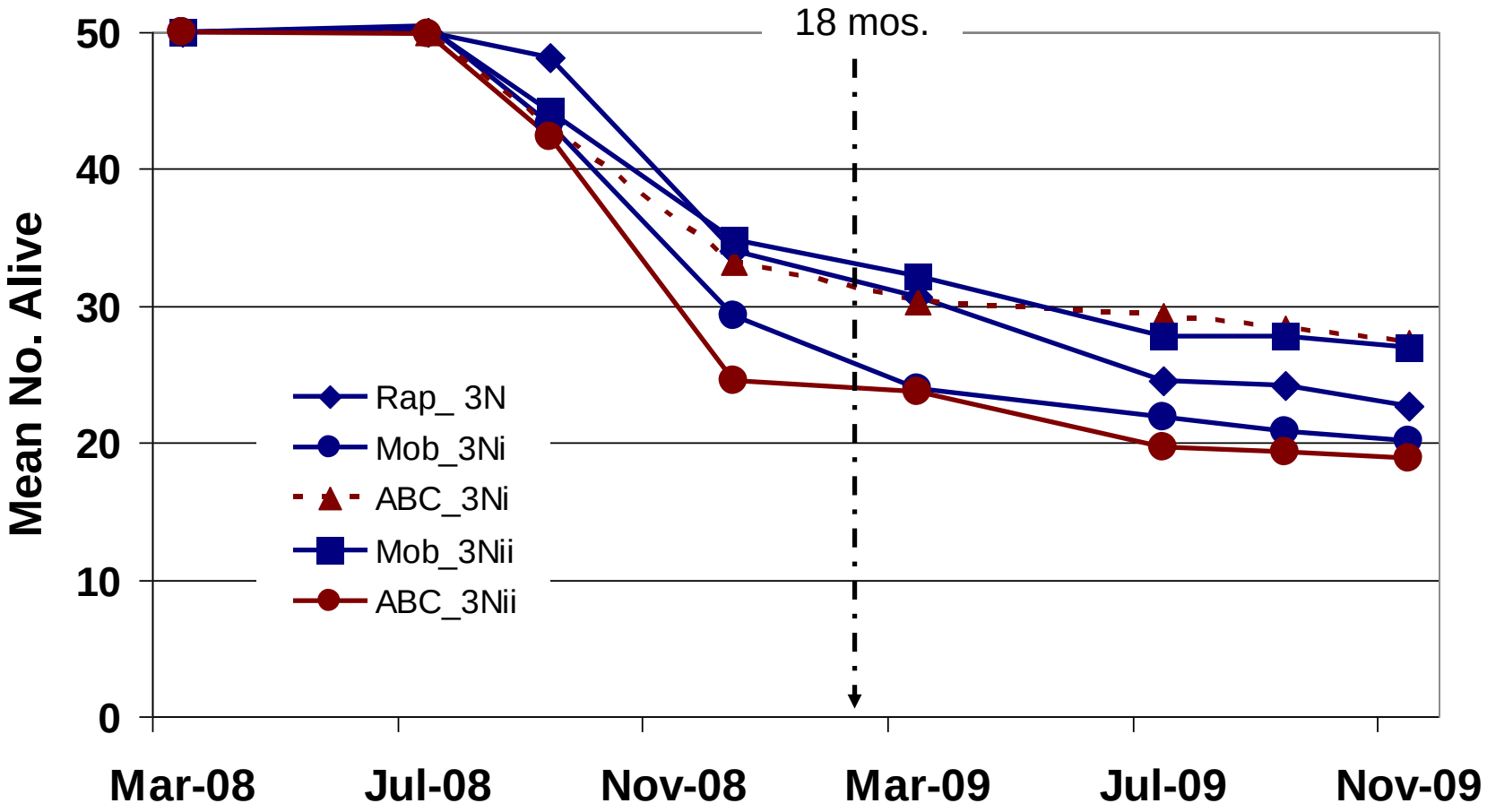
To be [wild], or not to be [wild]

TRIPLOID



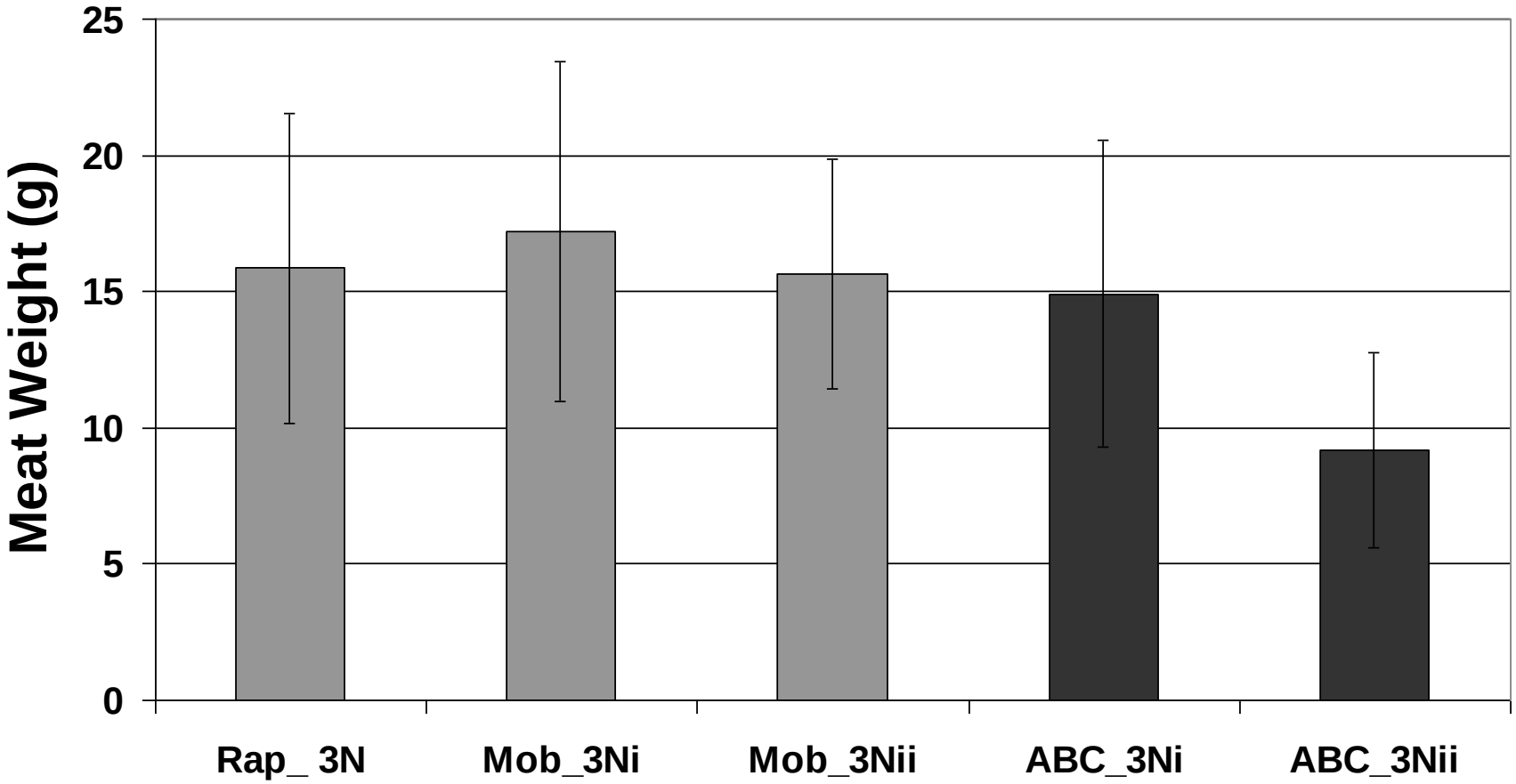
To be [wild], or not to be [wild] (and triploid)

Kinsale survival curves



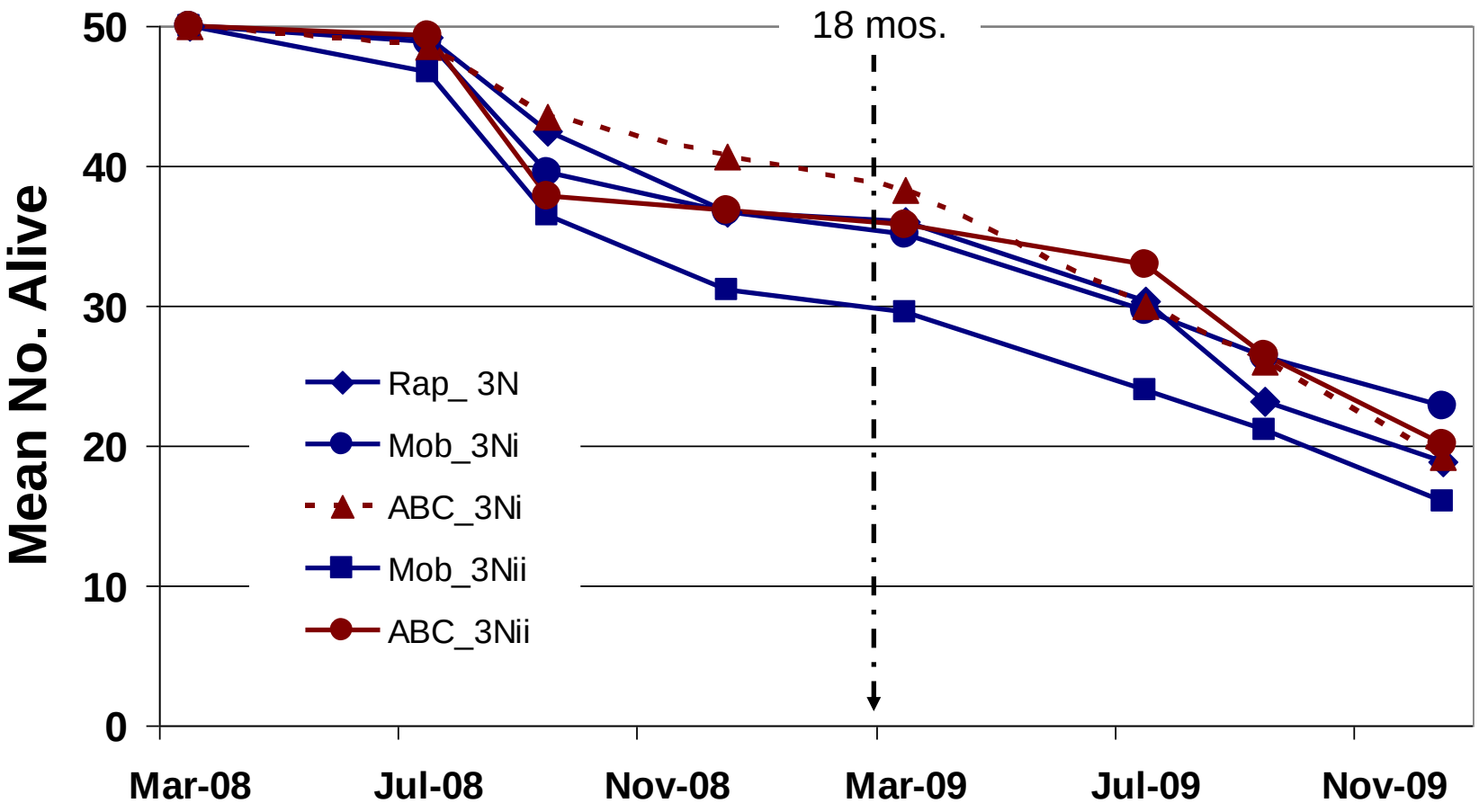
To be [wild], or not to be [wild] (and triploid)

Kinsale – final meat weight (30 mos)



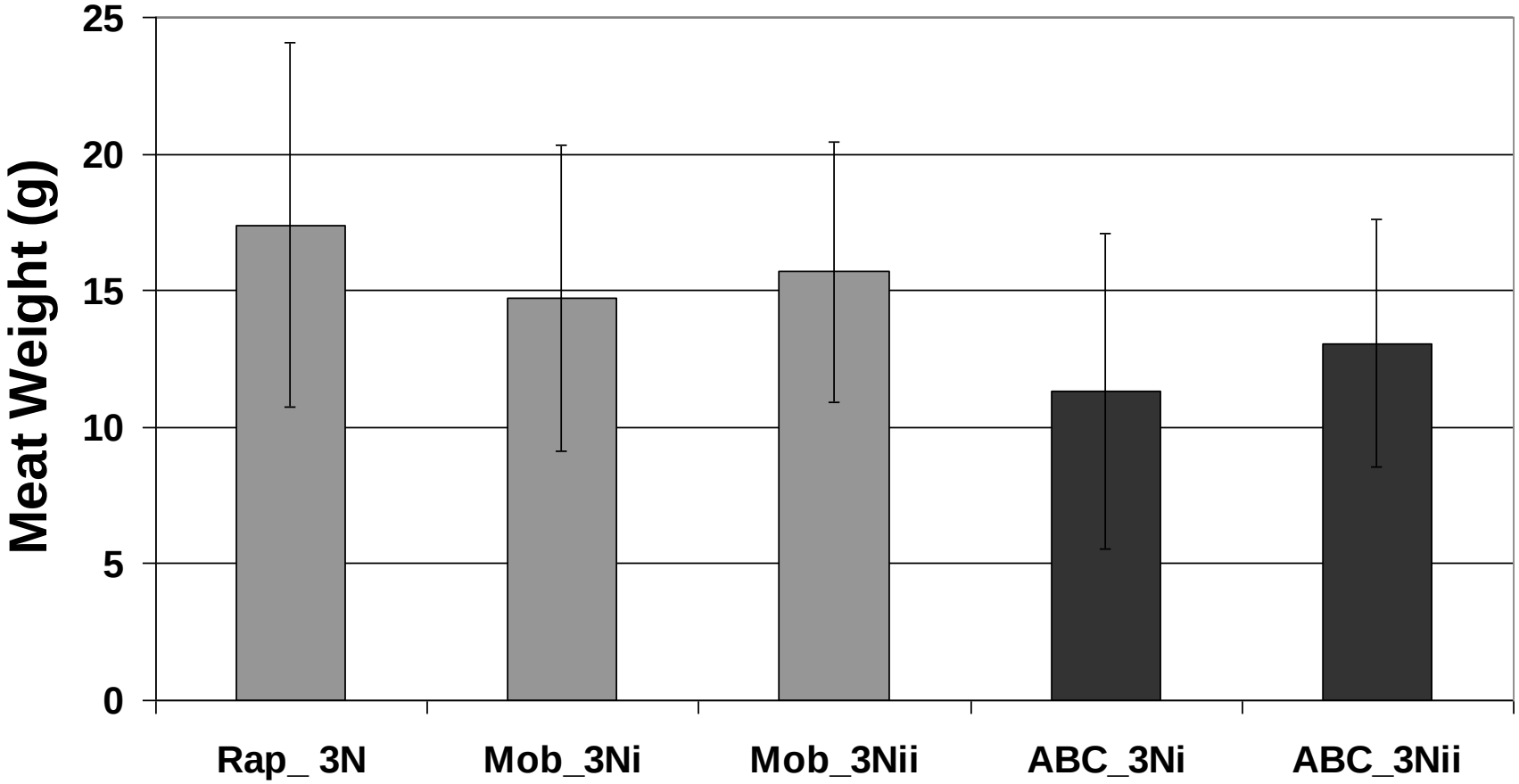
To be [wild], or not to be [wild] (and triploid)

York survival curves



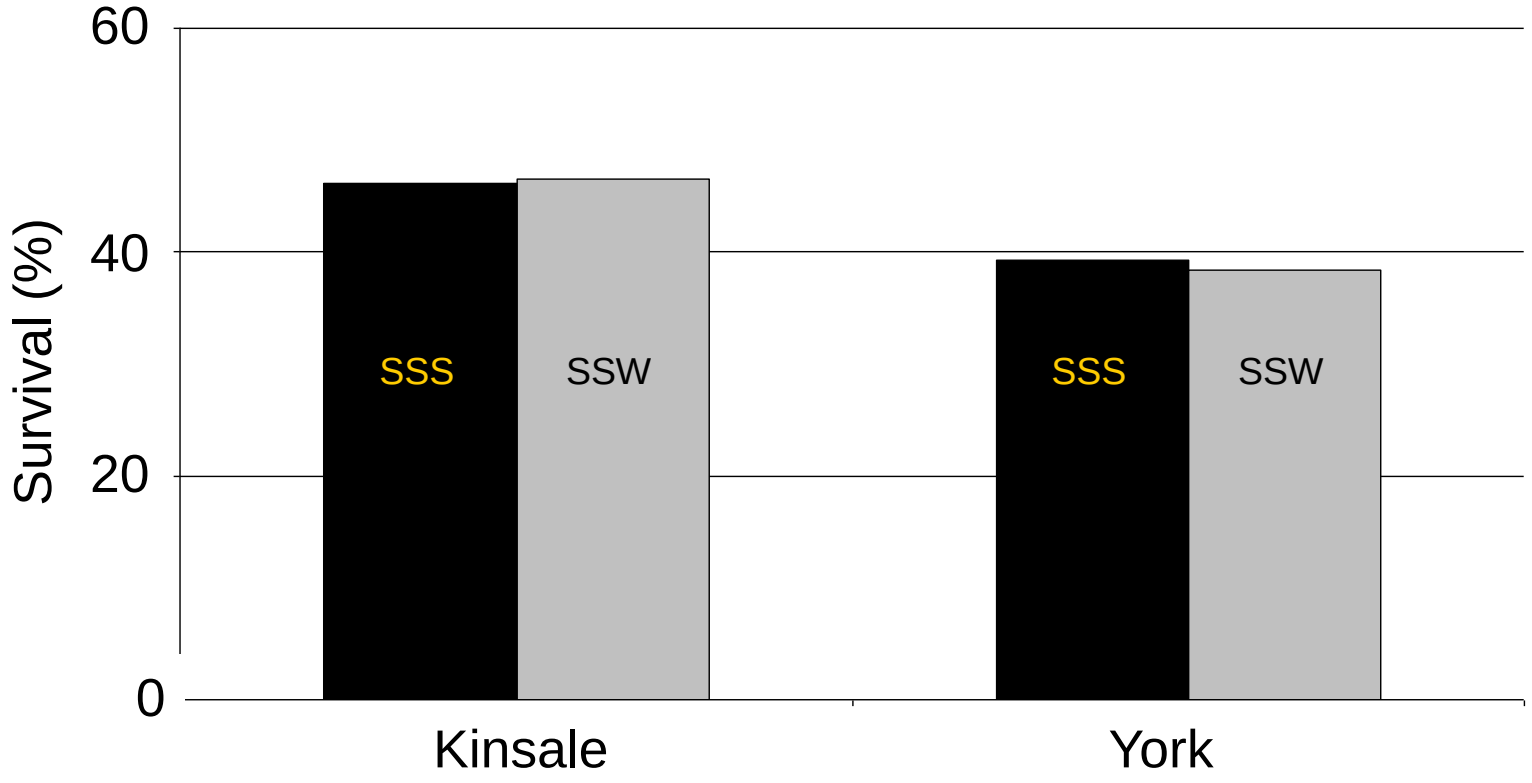
To be [wild], or not to be [wild] (and triploid)

York – final meat weight (30 mos)



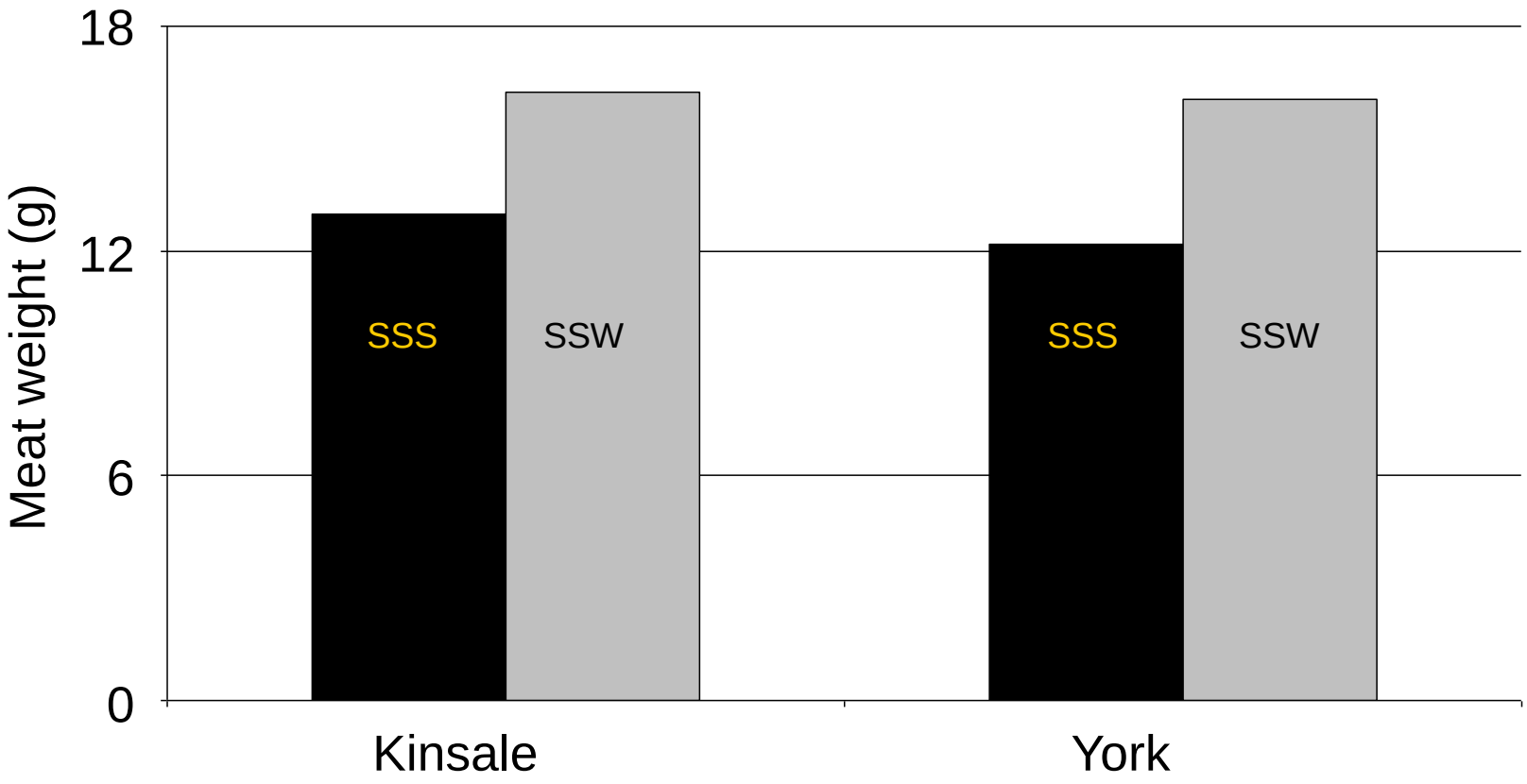
Triploid oysters

survival in York (disease) and Kinsale (low disease) 30 mos.



Triploid oysters

meat weight in York (disease) and Kinsale (low disease) 30mos.



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- Selection ’08 superlines
  - News and views 3: East Coast Breeding Center
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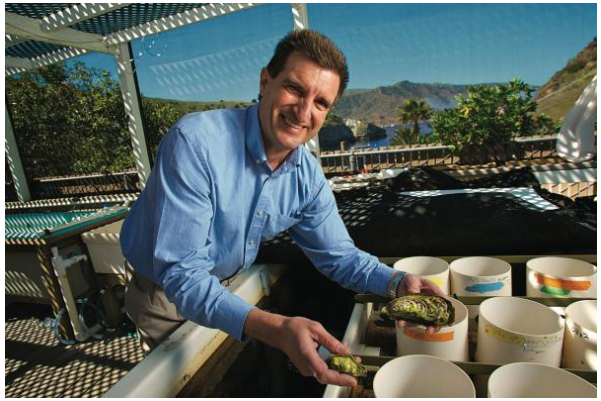


Dennis Hedgecock, USC

Testing hybrids on the Davis farm

Hybrid vigor in Pacific oysters

4.03 cm

6×6

6.55 cm

6×7

6.10 cm

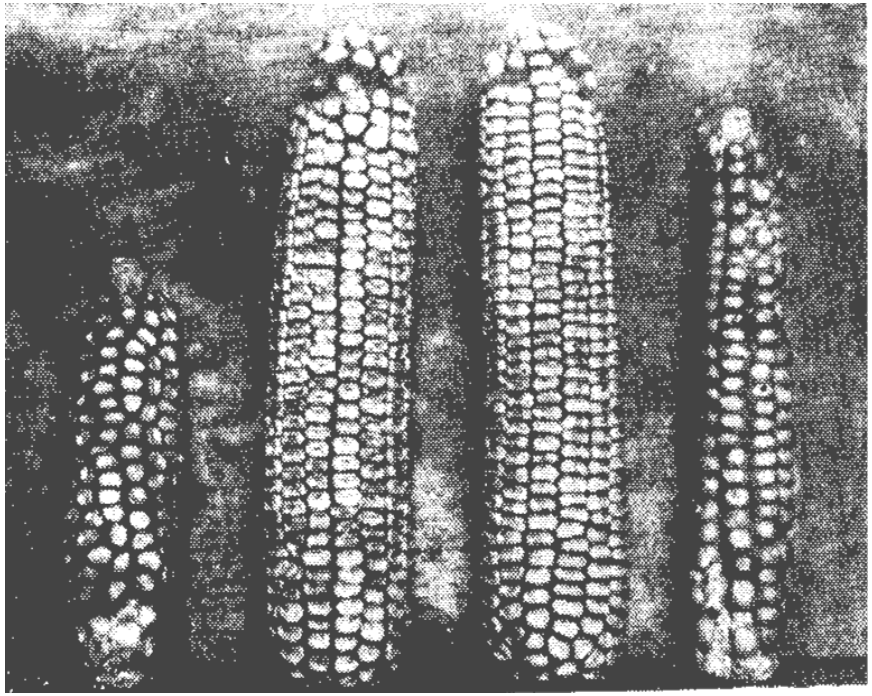
7×6

3.35 cm

7×7

Hybrid vigor in corn

Strain B

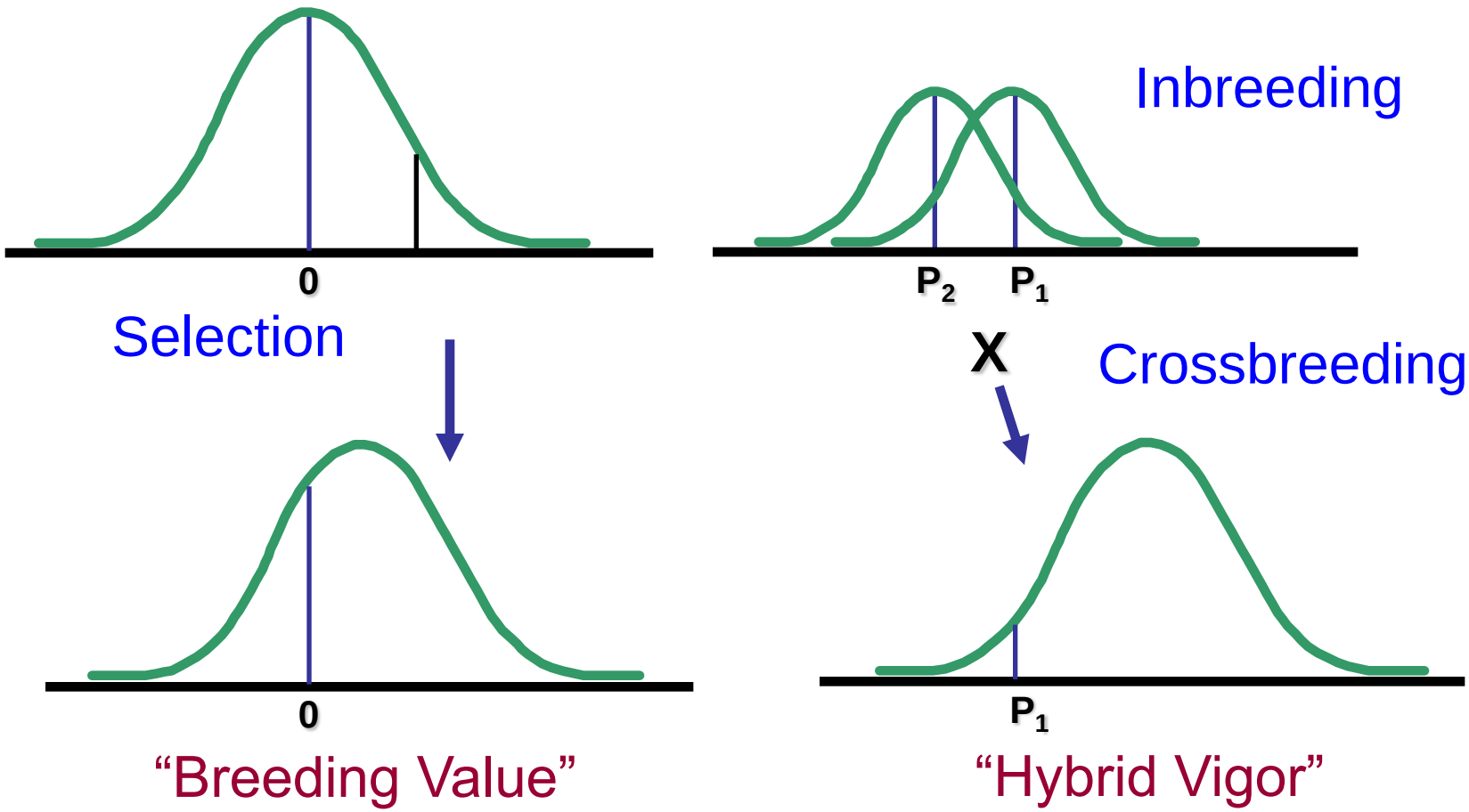


B×B A×B B×A A×A

Strain A

(Shull's 1908 photographs & drawings)

Methods of genetic improvement



Our approach to “hybrid vigor”

selection

tetraploids \ *diploids*	XB	DBY	hANA	Lola	Rapp
XB					
CAMX					
LGT					
DBLA					
DB					

good for low salinity

good for high salinity

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Creation of “super” lines

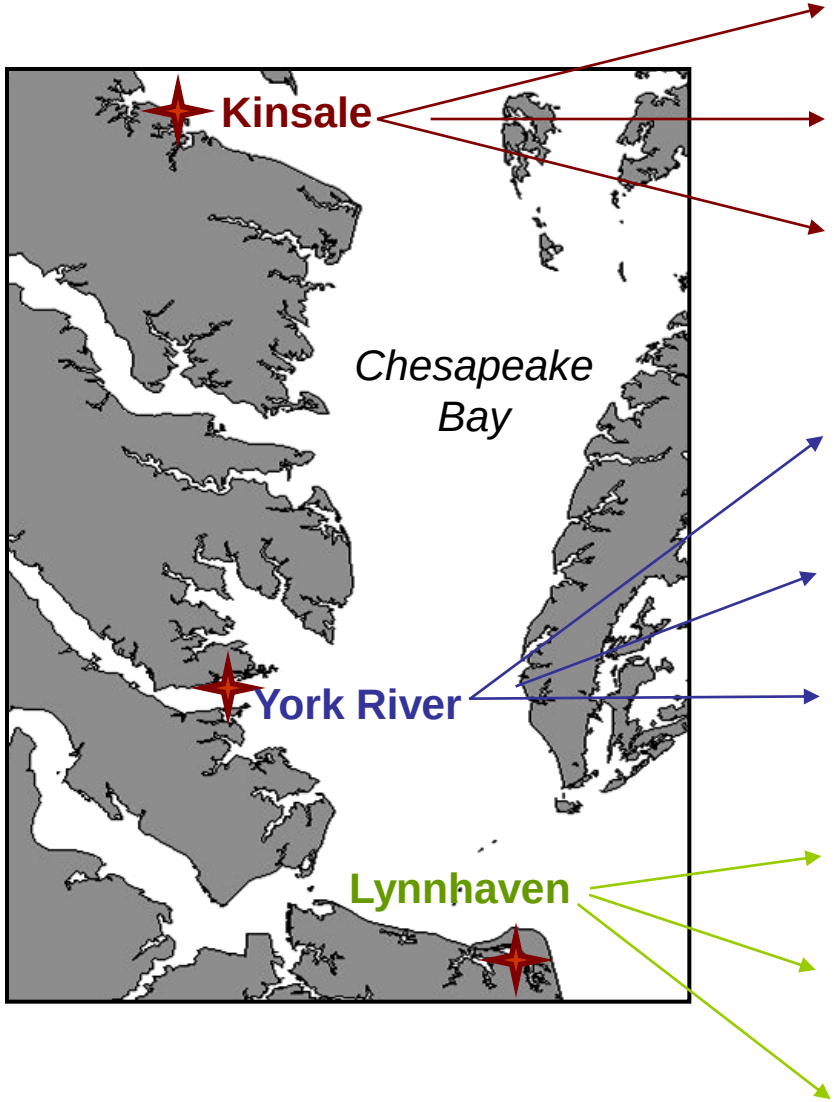
LINE	ORIGIN	GENOTYPE
CDBY	DBY	D
DDBY	DBY	D
FBST	FBST	D
ADMO	DMO	D
ADMOW	DMO	D
ZDMO	DMO	D
ADXB	DXB	D,X
ZDXB	DXB	D,X
ADXBW	DXB	D,X
AXB	XB	X
BXB	XB	X
BXBW	XB	X
CAMX	CAMX	X,L
XCAMX	CAMX	X,L
YLGT	LGT	L
YOBOY	OBOY	L
ZLGT	LGT	L
ZLGTK	LGT	L
ZLGTW	LGT	L
ZOBOK	OBOY	L
ZOBOY	OBOY	L
YDBLA	DBLA	L,D
XDBLA	DBLA	L,D
MBC	MBC	--

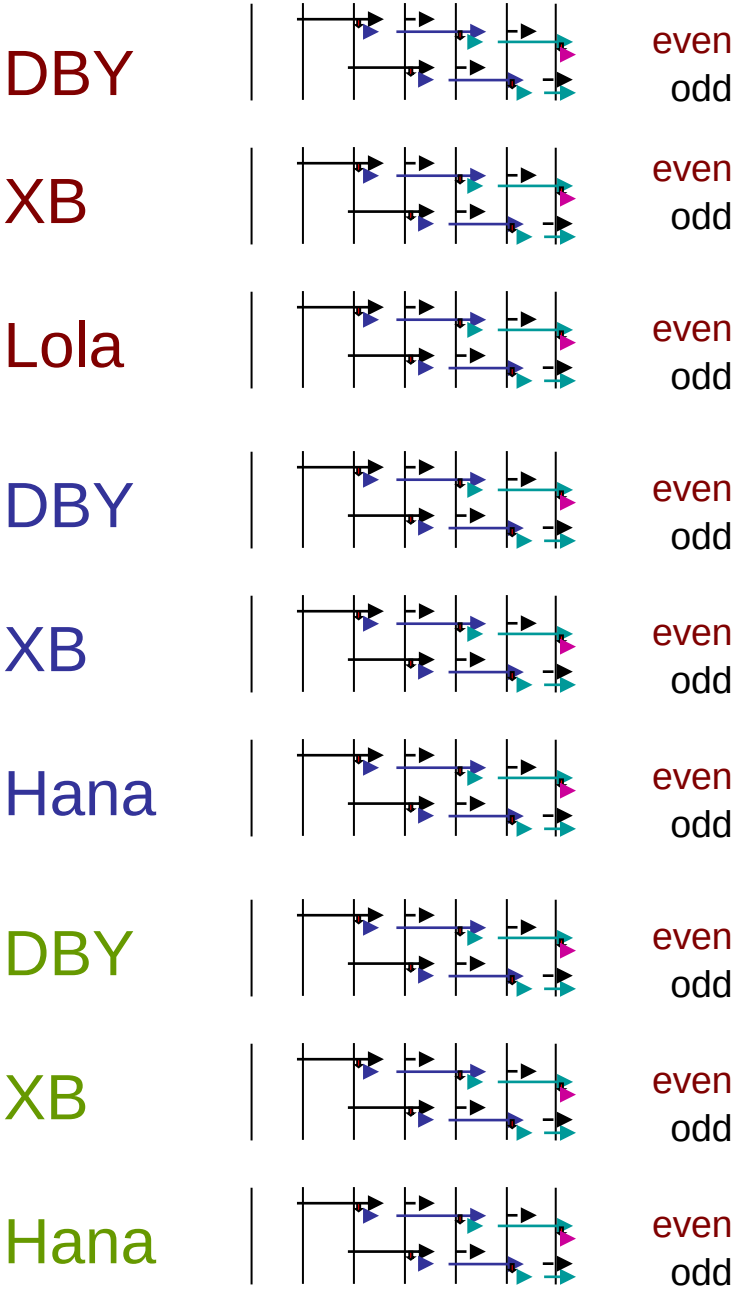
DBY 2008 2009

XB 2008 2009

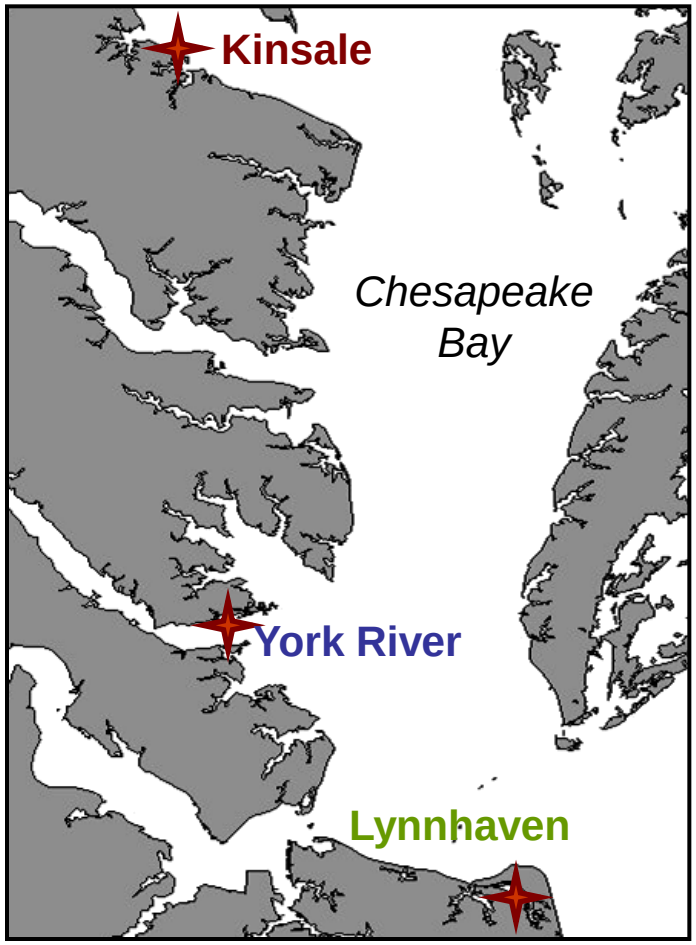
LA 2008 2009

Deployment for *selection*





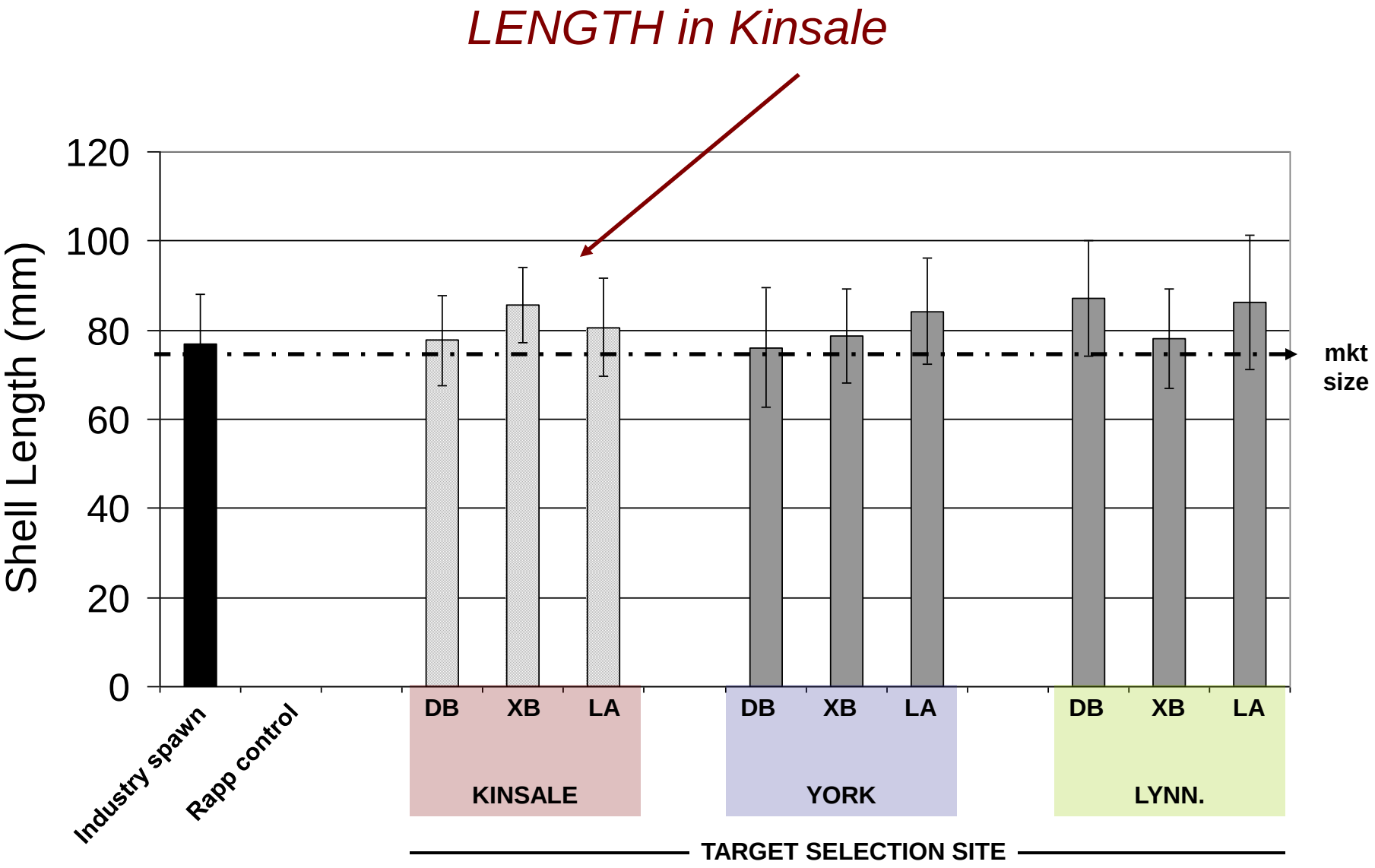
Deployment for *SLOT*



DB XB LA KINSALE	DB XB LA YORK	DB XB LA LYNN.
DB XB LA KINSALE	DB XB LA YORK	DB XB LA LYNN.
DB XB LA KINSALE	DB XB LA YORK	DB XB LA LYNN.

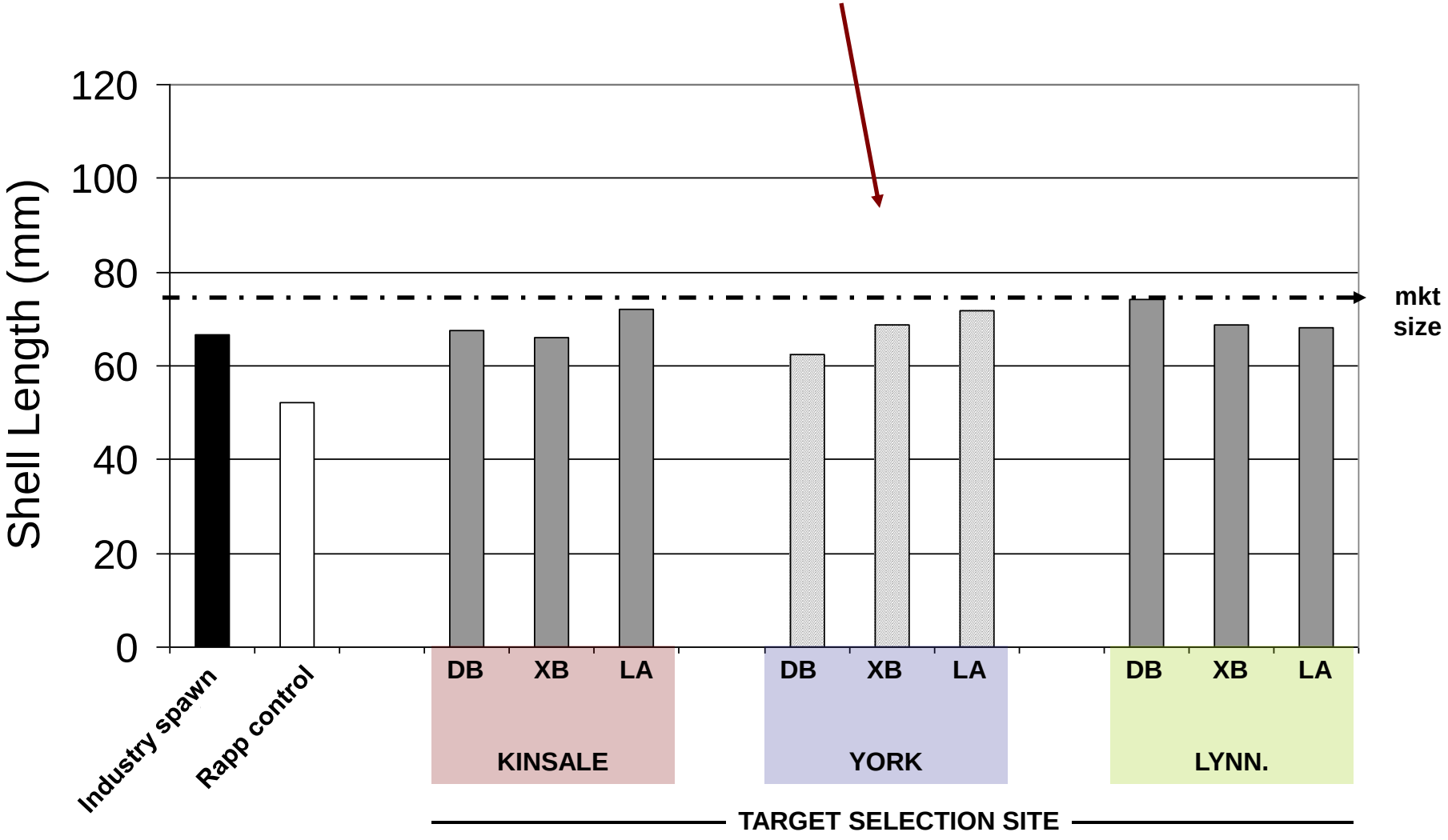
All sites have all lines, targeted and non-targeted

SLOT – how we keep track of the lines



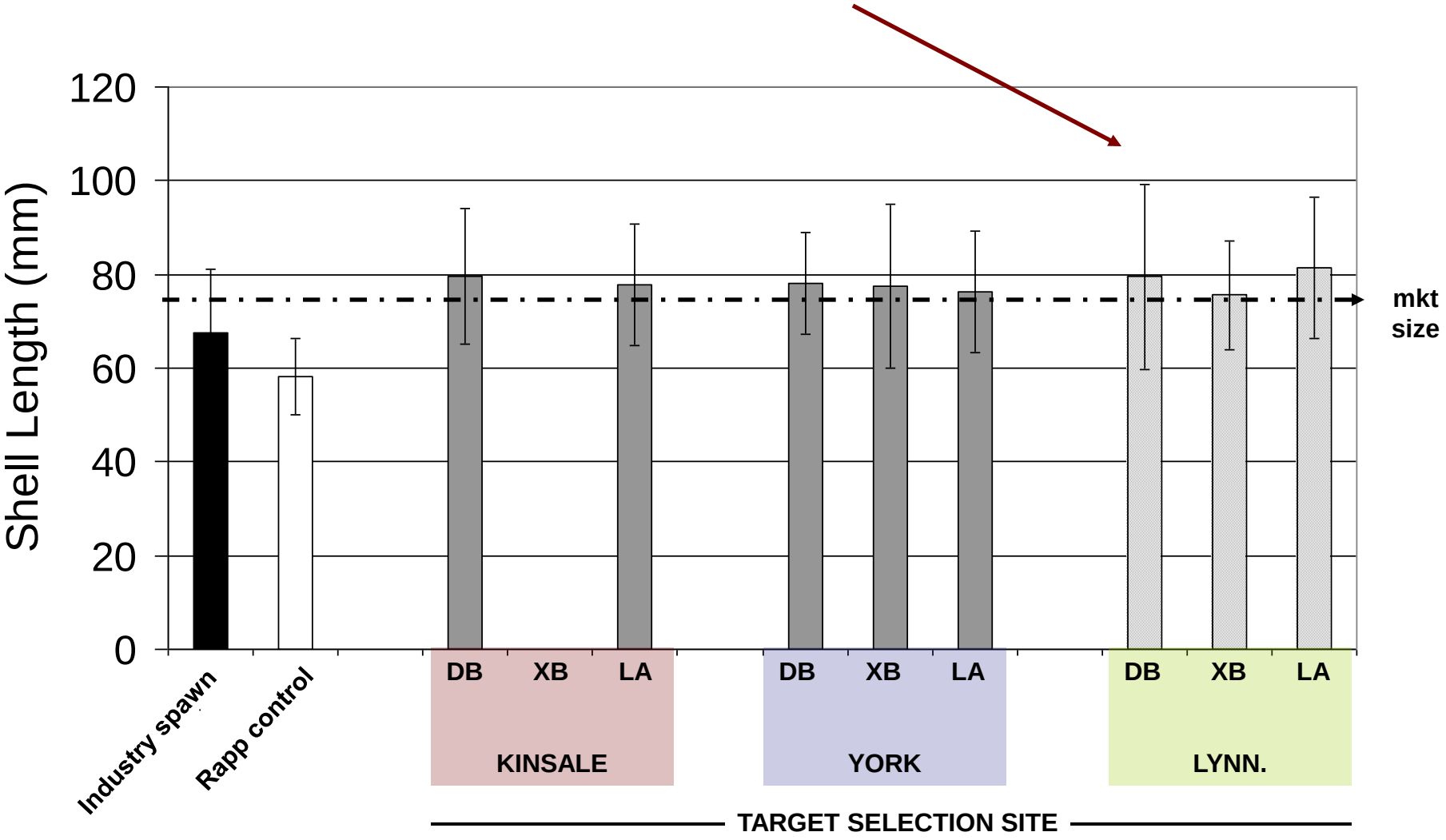
SLOT – how we keep track of the lines

LENGTH in the York



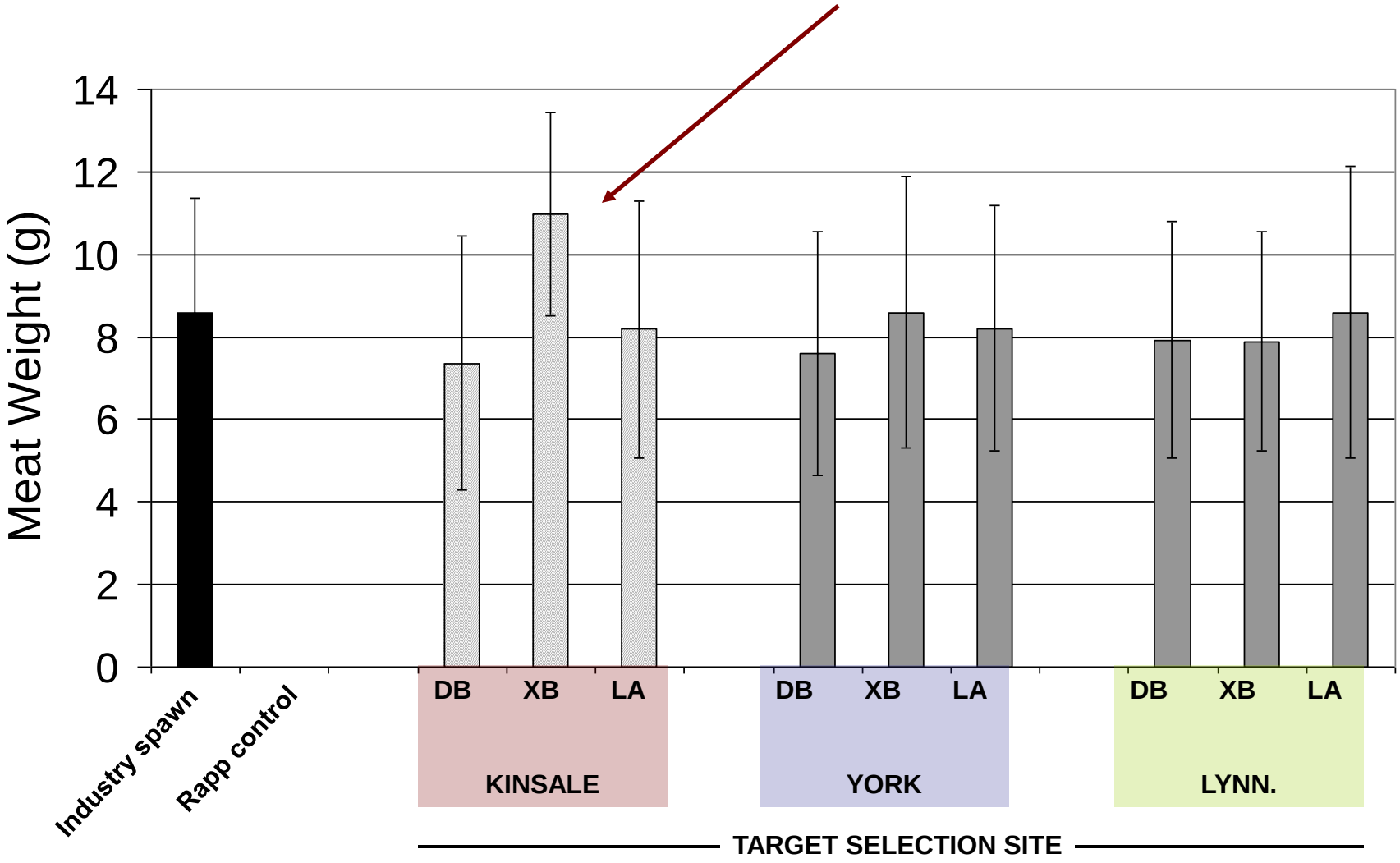
SLOT – how we keep track of the lines

LENGTH in Lynnhaven



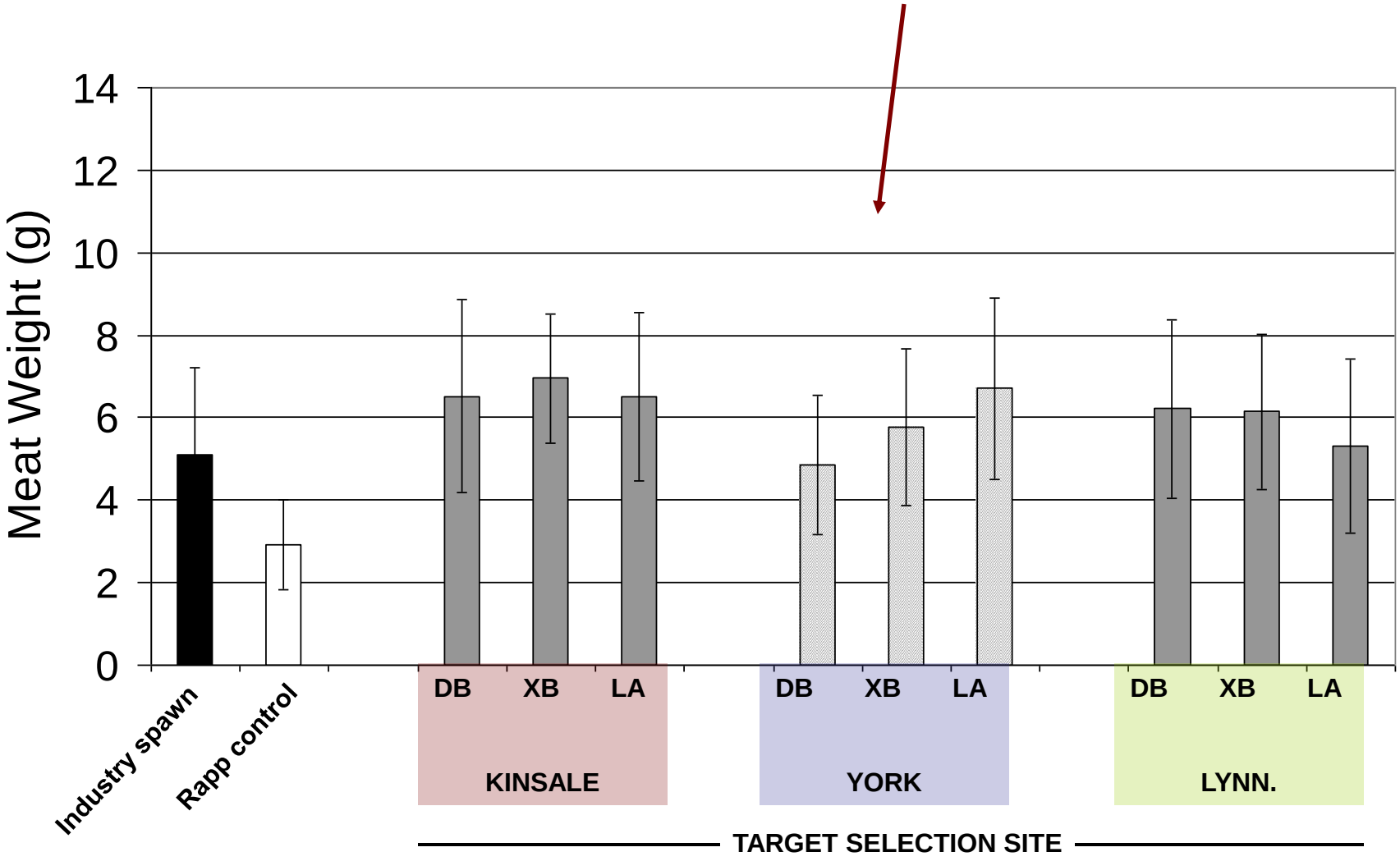
SLOT – how we keep track of the lines

MEAT WEIGHT in Kinsale



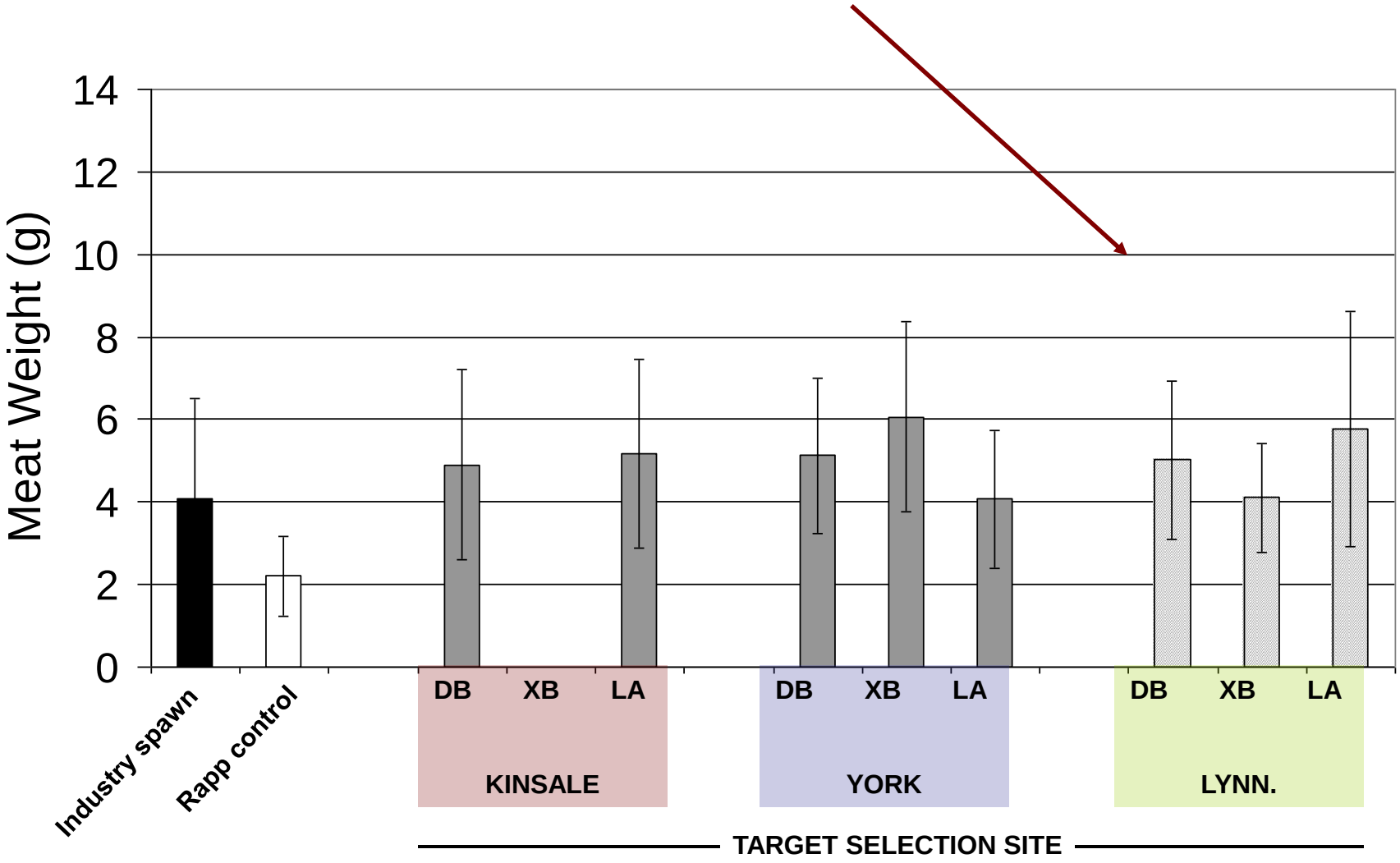
SLOT – how we keep track of the lines

MEAT WEIGHT in the York

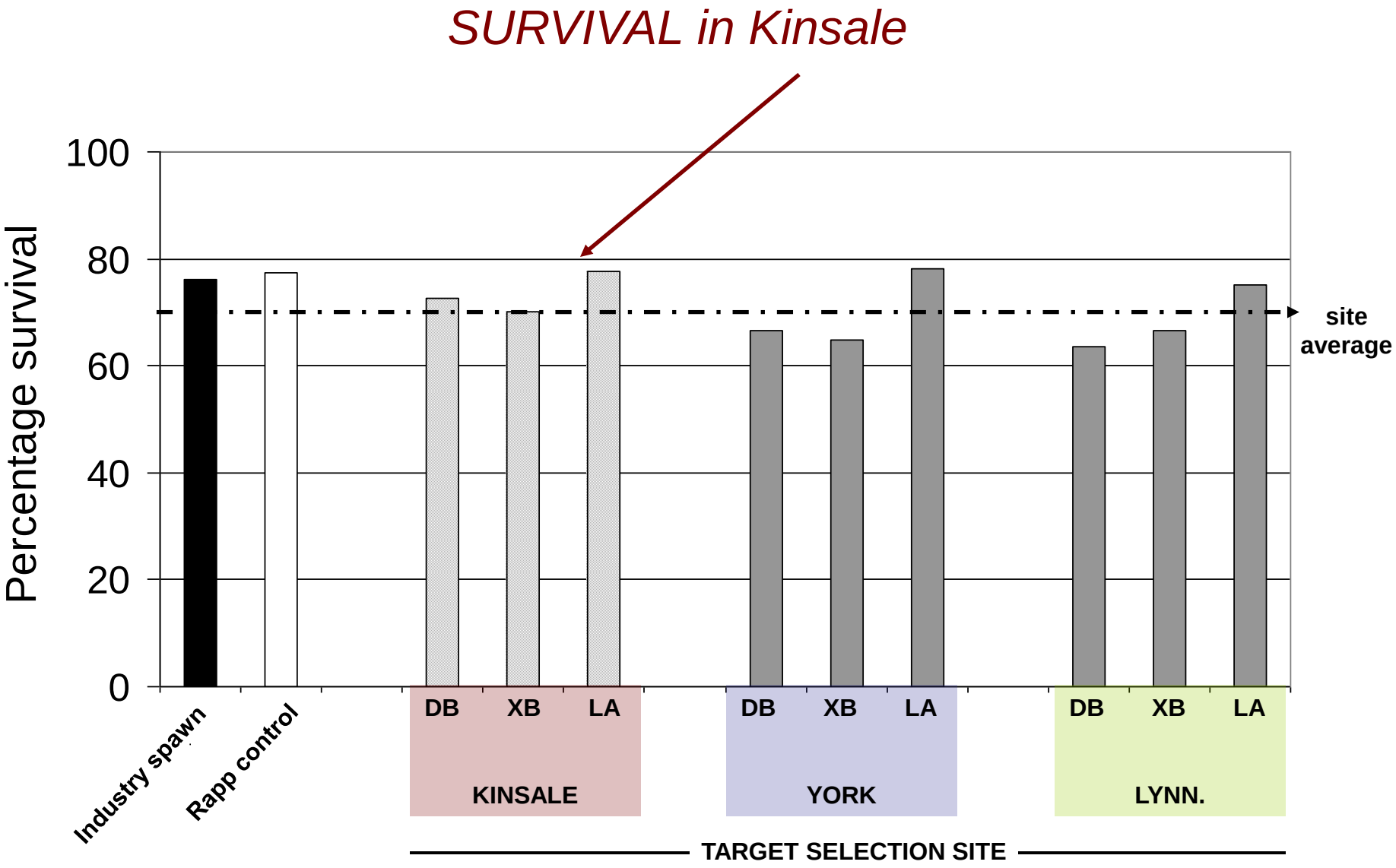


SLOT – how we keep track of the lines

MEAT WEIGHT in Lynnhaven

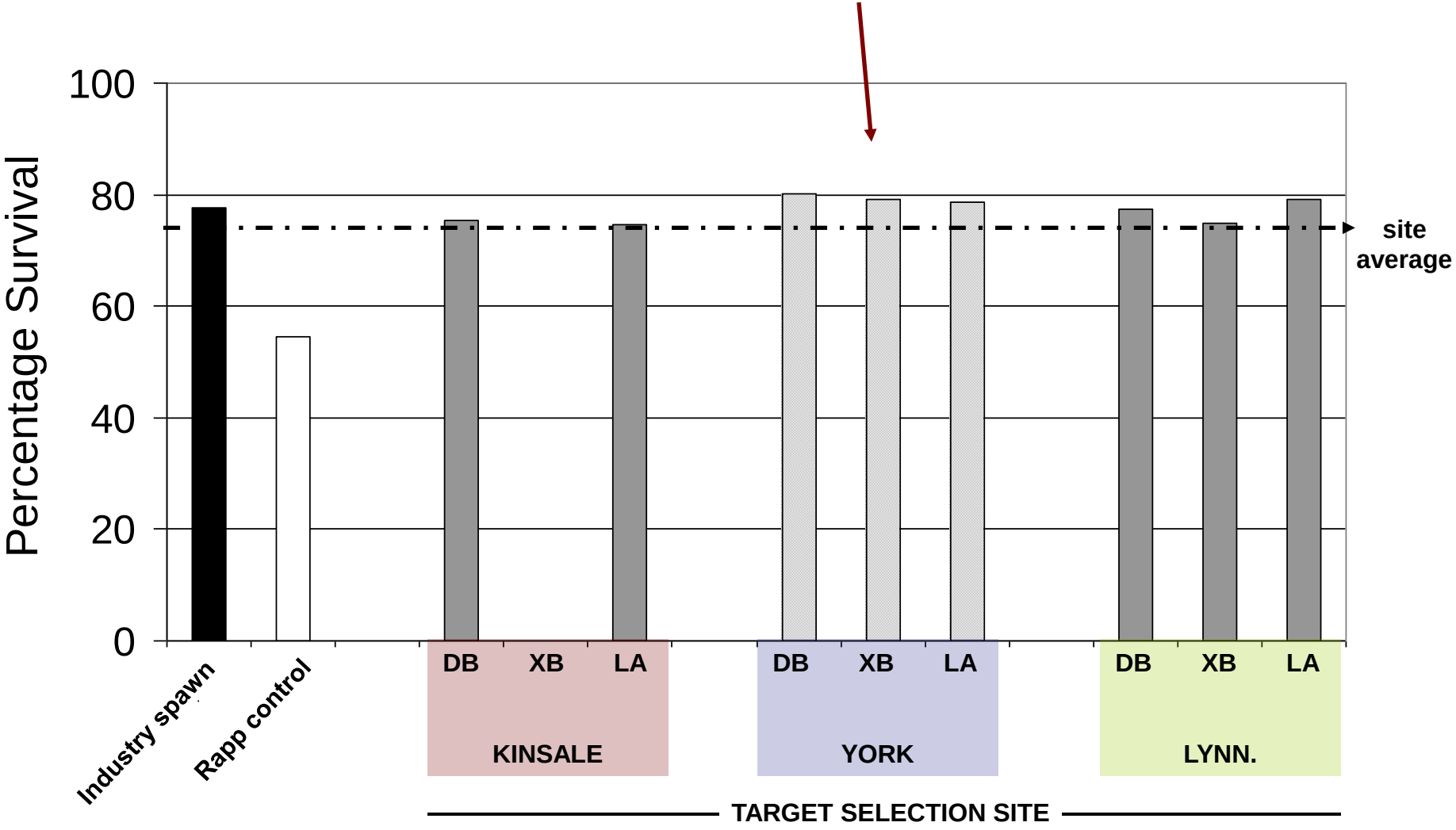


SLOT – how we keep track of the lines



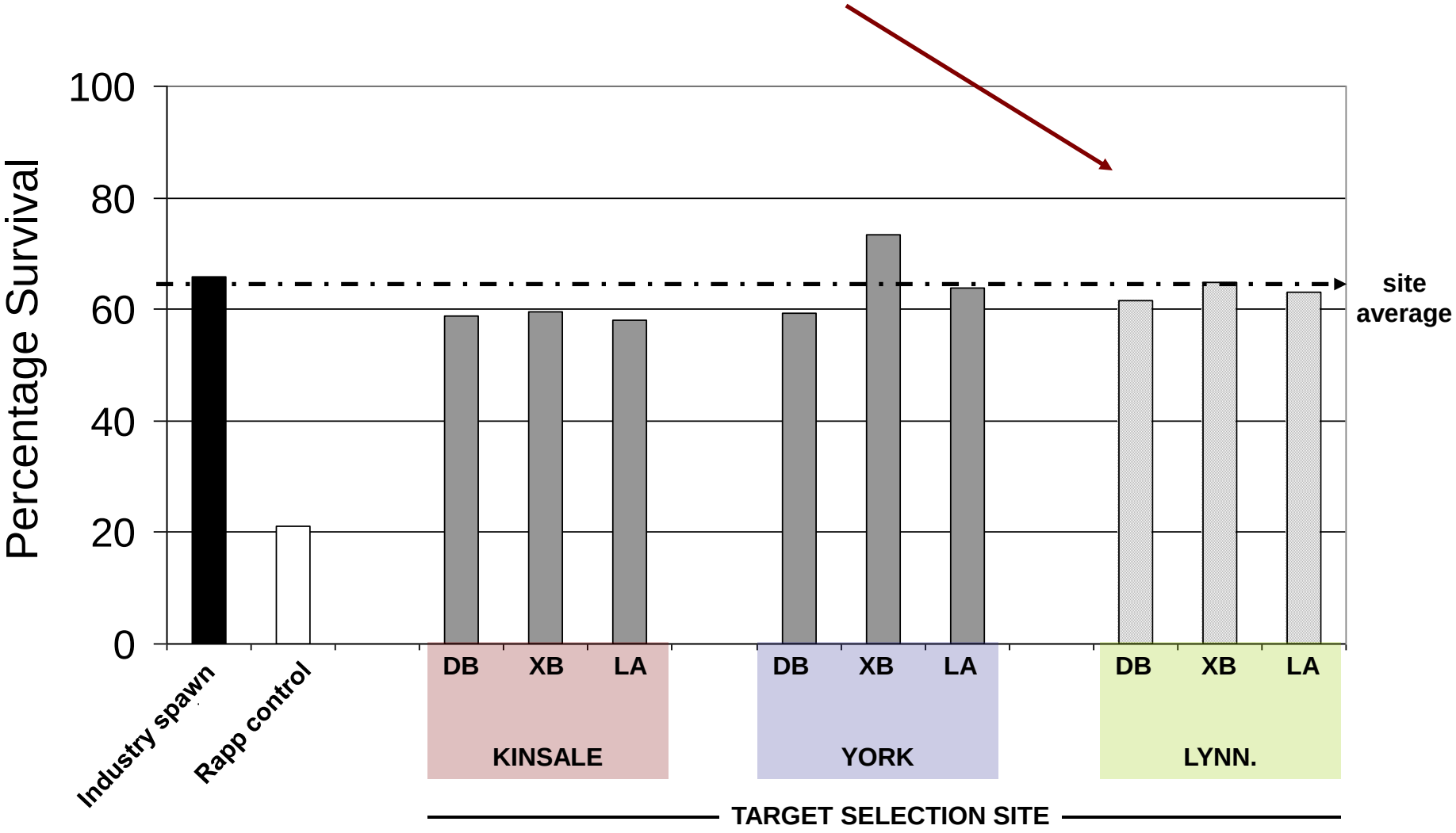
SLOT – how we keep track of the lines

SURVIVAL in the York



SLOT – how we keep track of the lines

SURVIVAL in Lynnhaven



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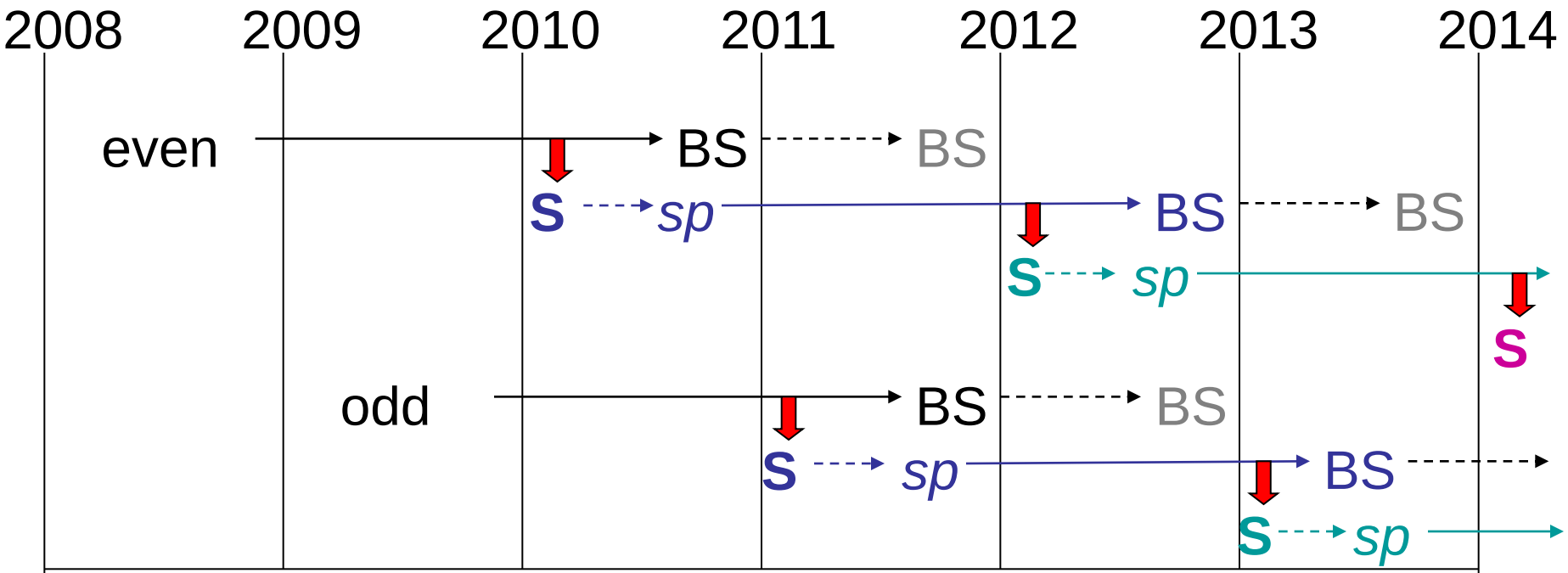
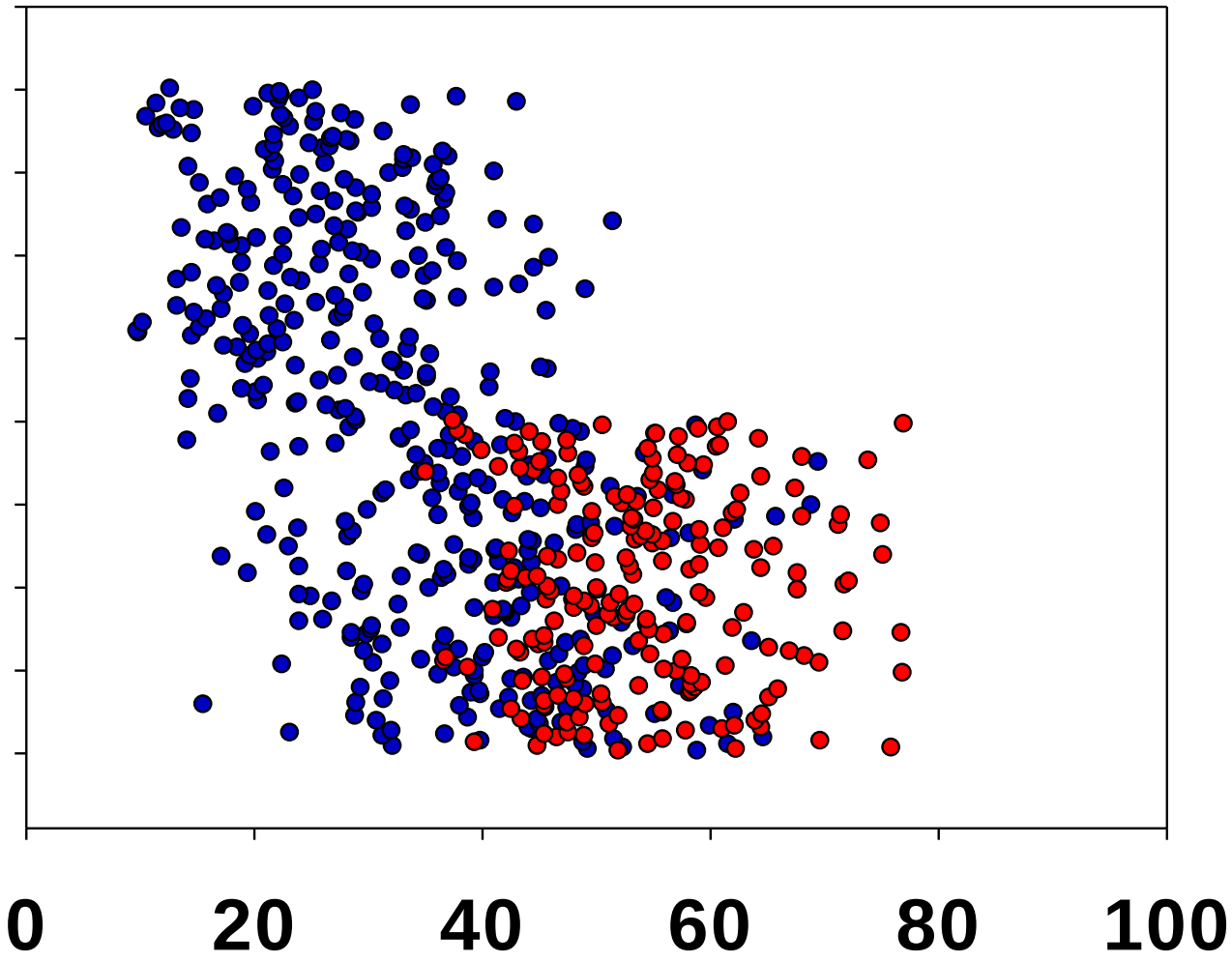
Breeding plan, from 2008



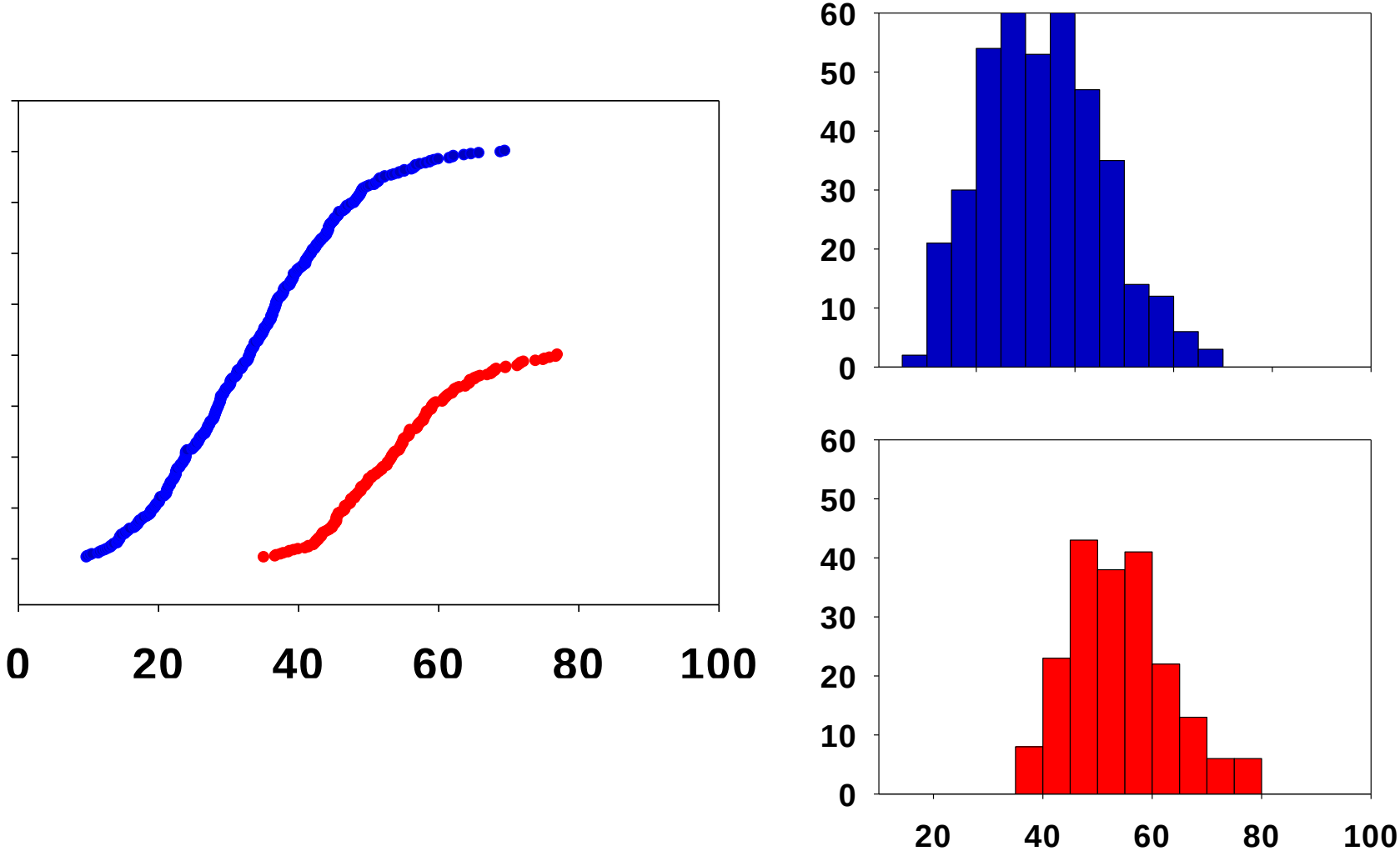
Broodstock				
even	20,000	10,000	20,000	10,000
odd	0	20,000	10,000	20,000

DBY in York River

body weight (g)

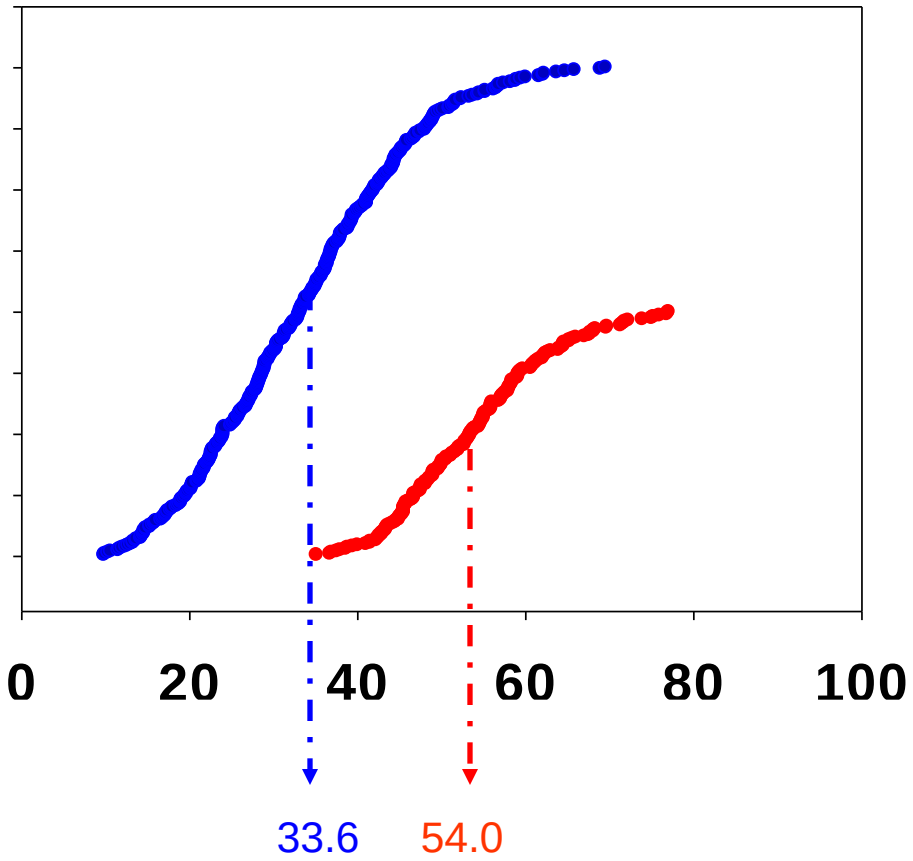


DBY in York River



body weight (g)

DBY in York River



S = 20.4

Quantitative genetics 101

$$R = S \times h^2$$

R = Response to selection

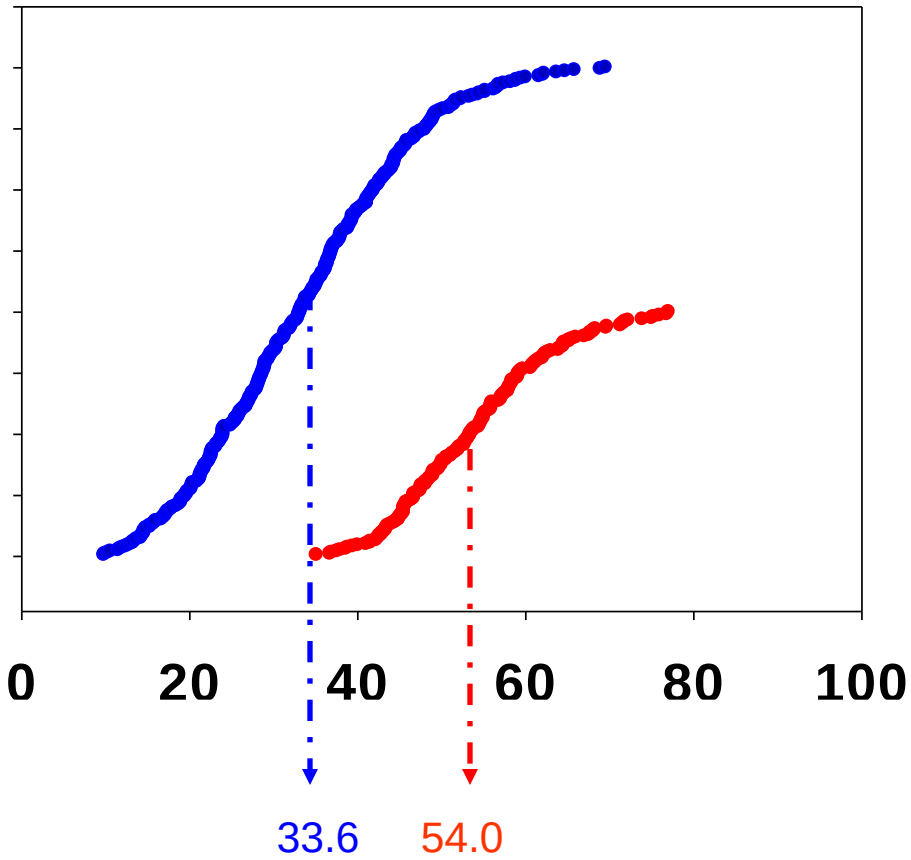
h^2 = heritability = 0.37±0.08

<u>0.37±0.08 ??</u>

Where does that come from? families

Is that good? yes

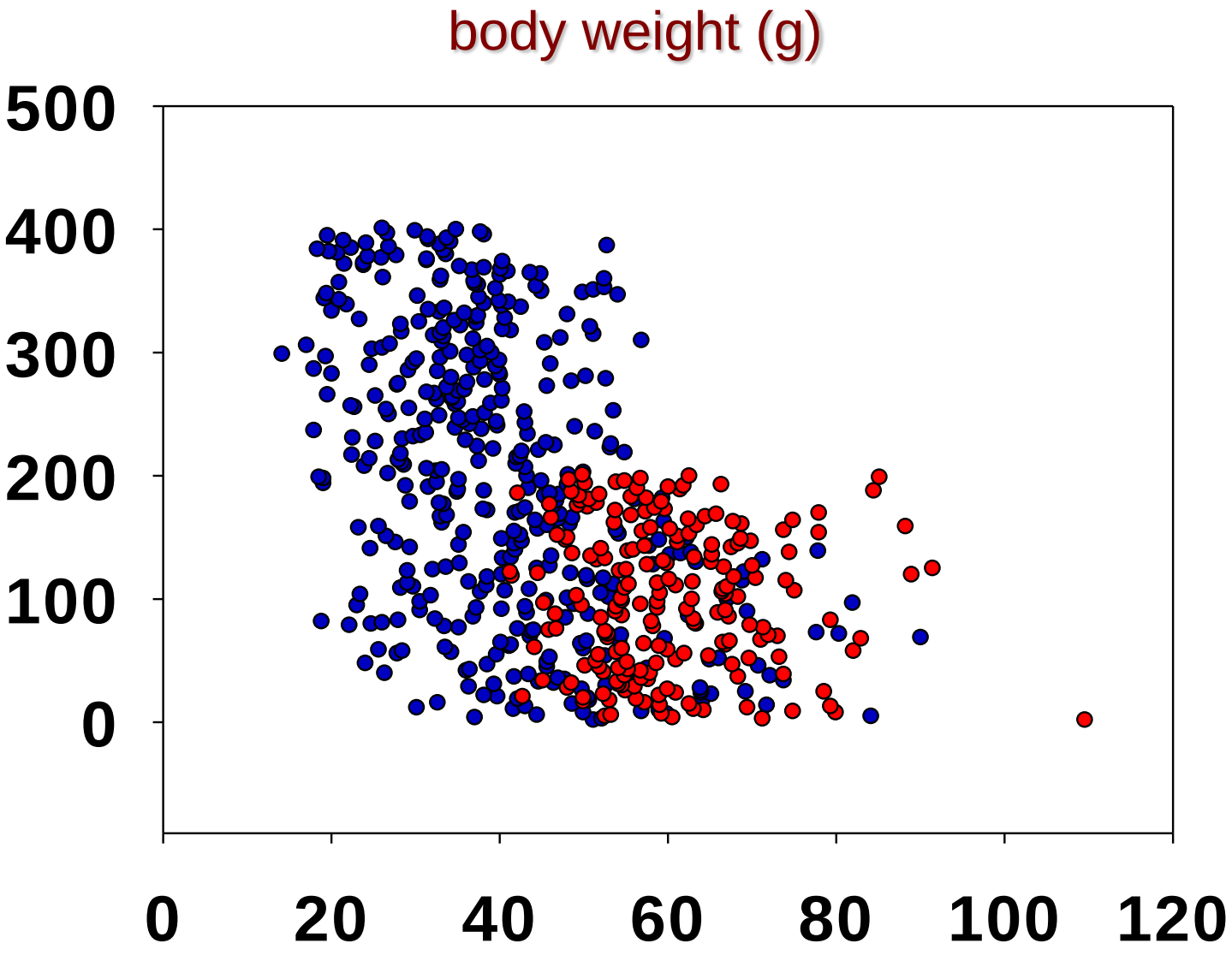
DBY in York River



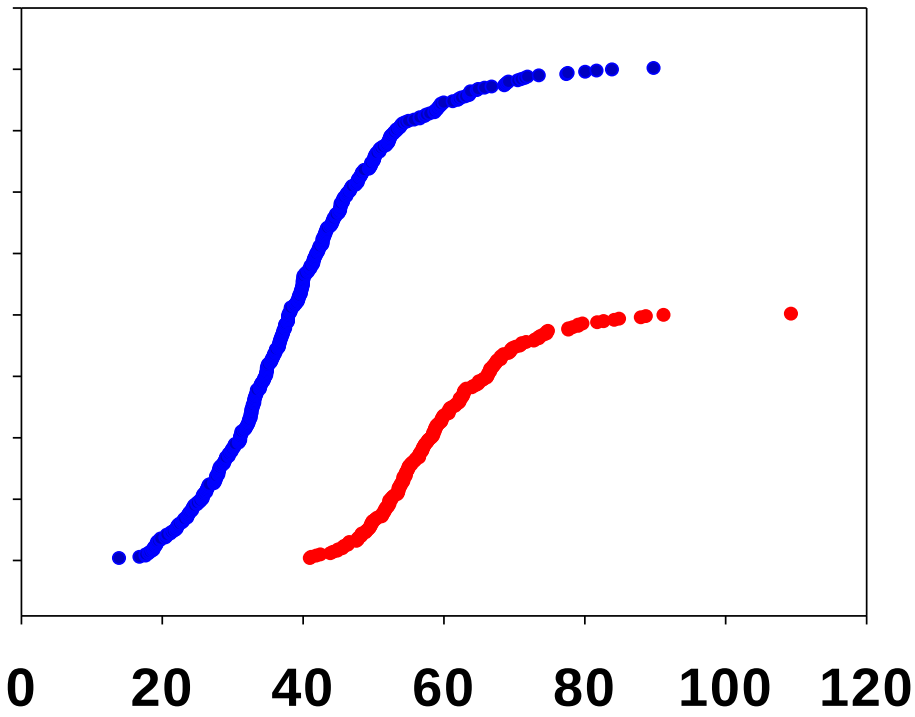
S = 20.4

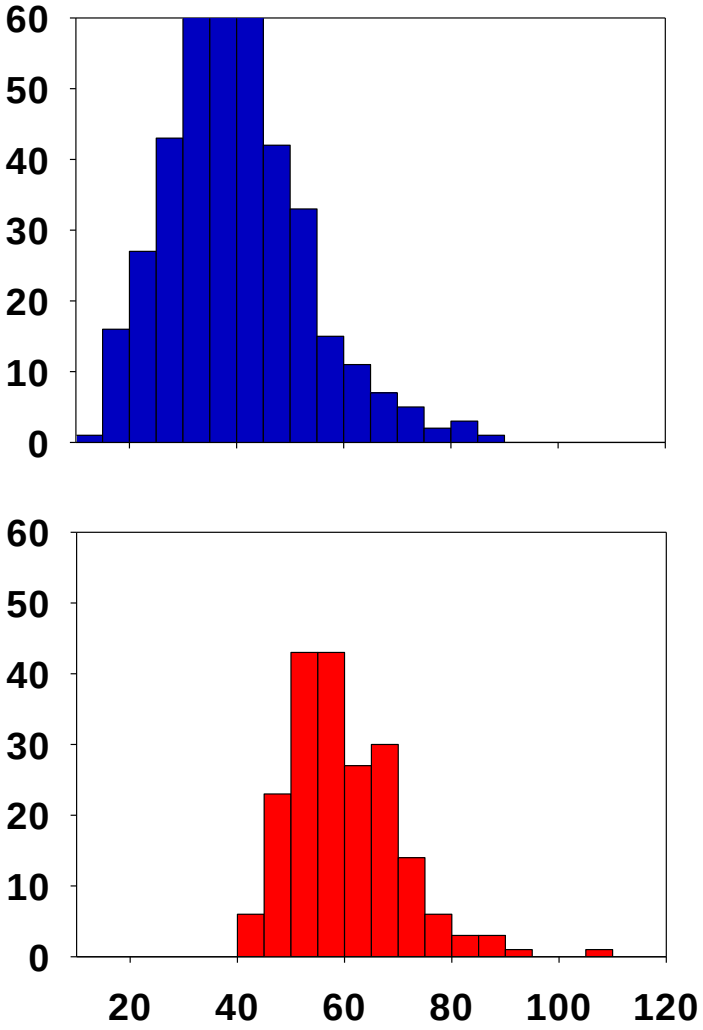
$R = S \times h^2$ 20.4 x 0.37 = **7.5g**

hANA in York River



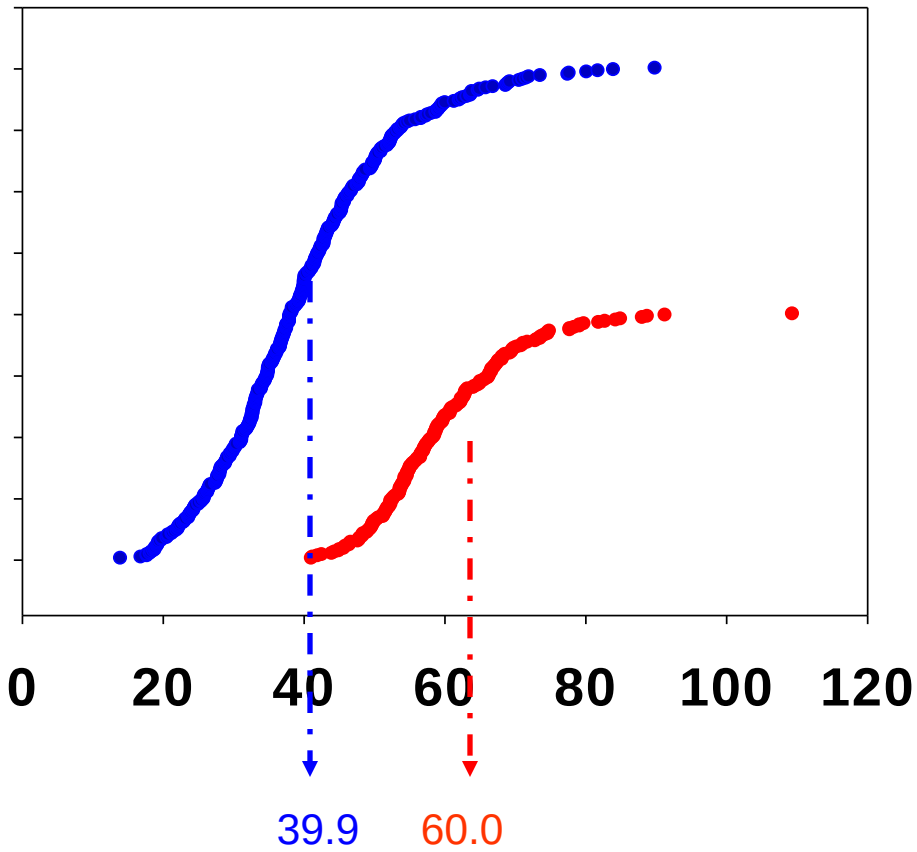
hANA in York River





body weight (g)

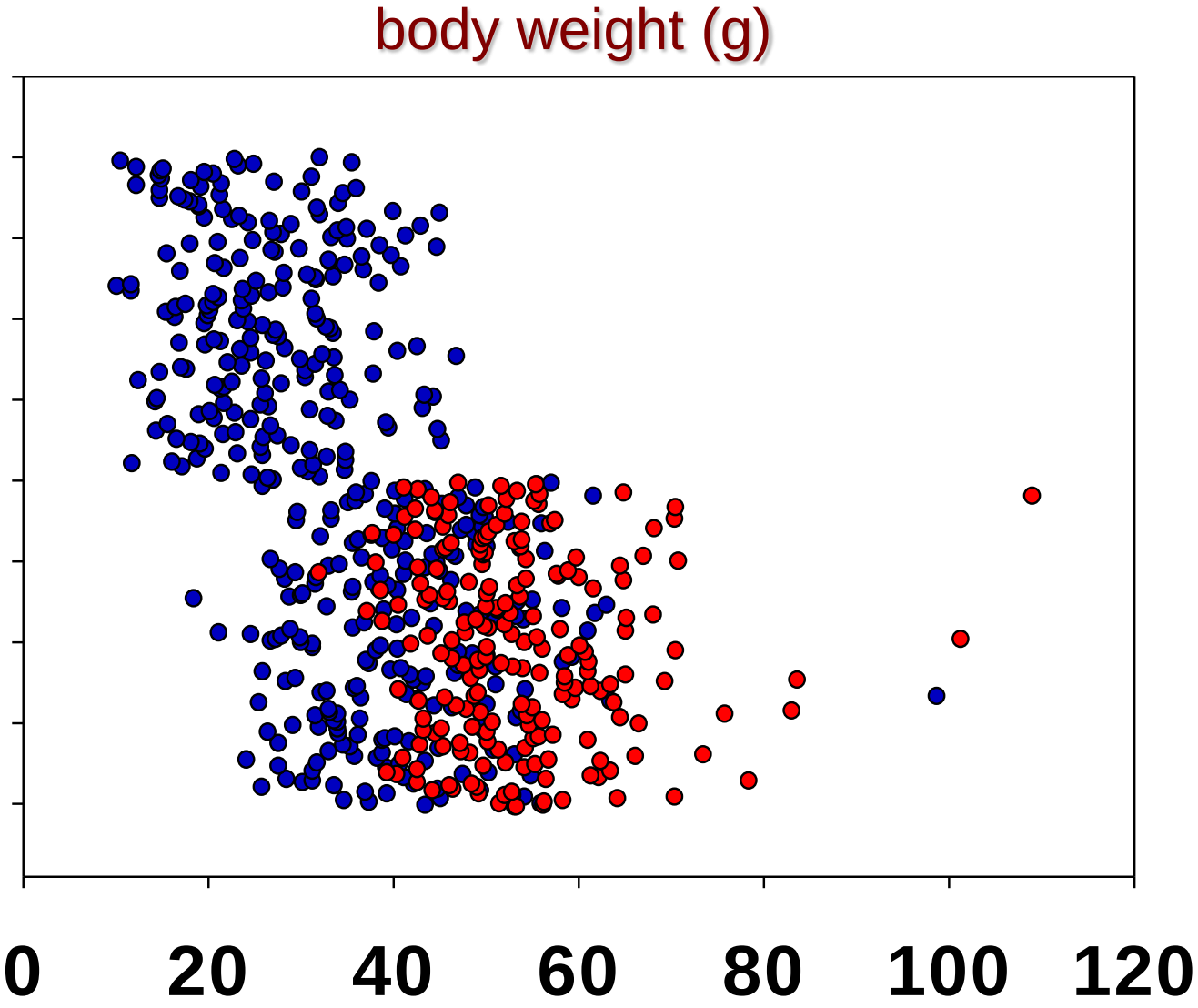
hANA in York River



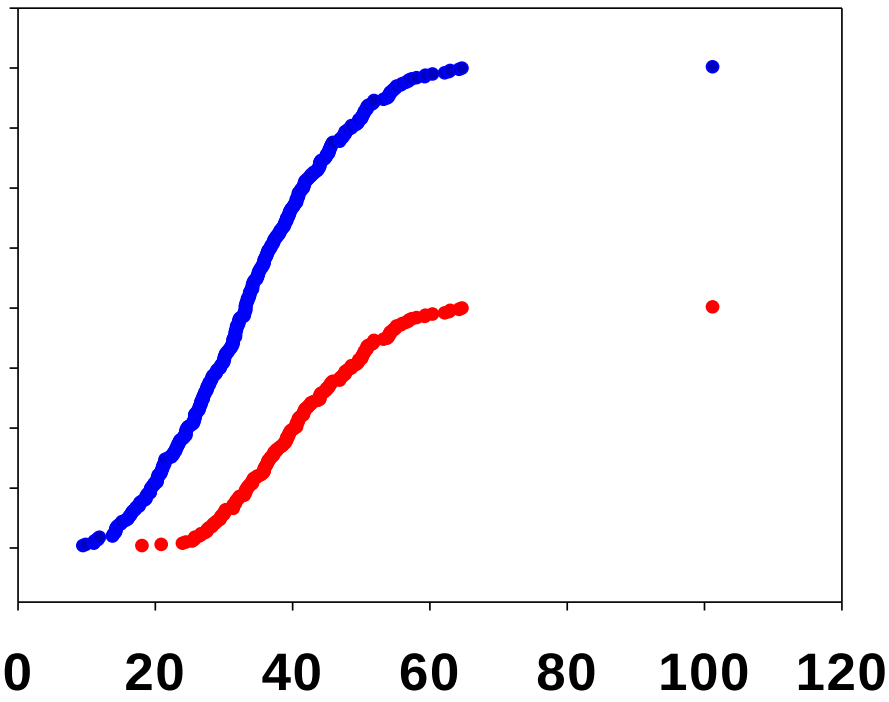
S = 20.1

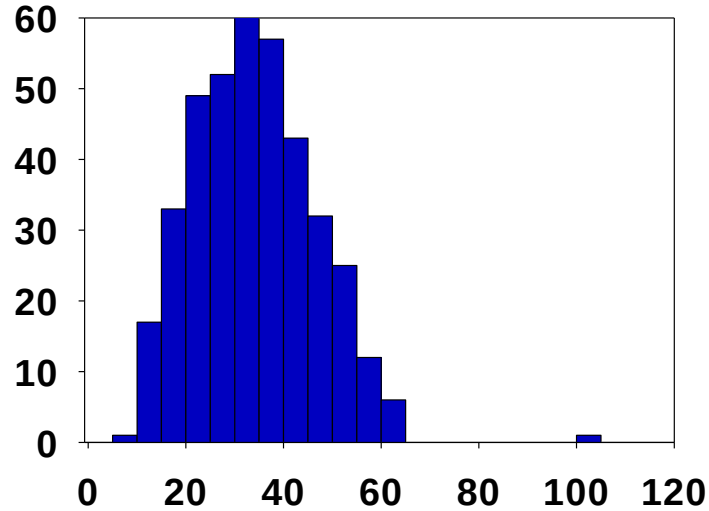
$R = S \times h^2$ 20.1 x 0.37 = **7.4g**

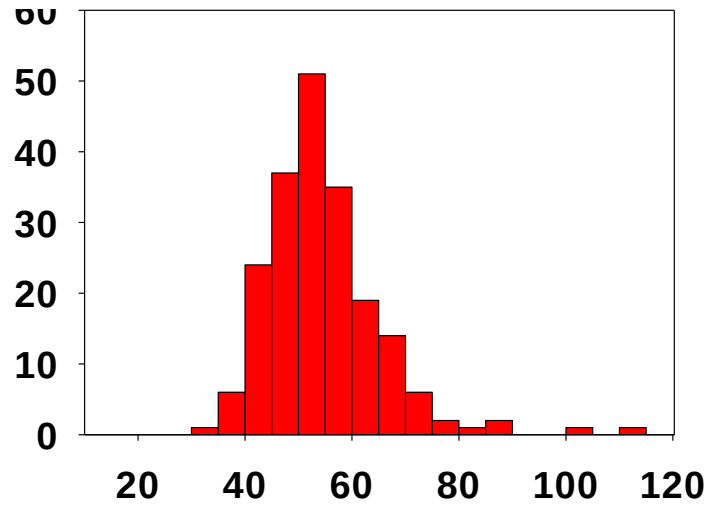
XB in York River



XB in York River

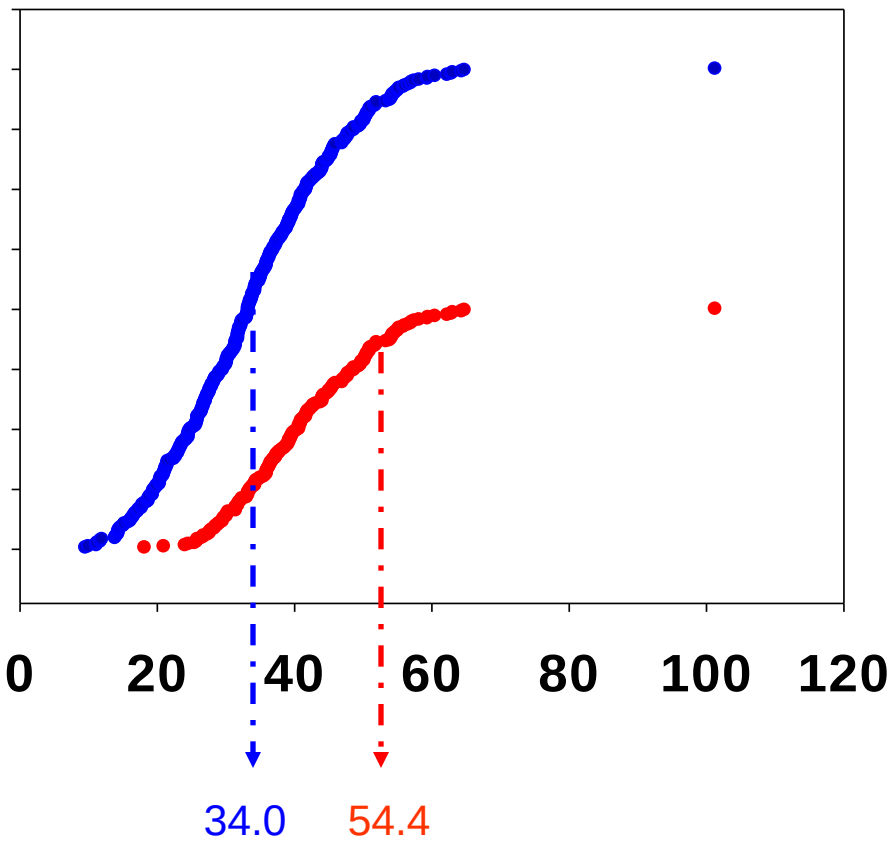






body weight (g)

XB in York River



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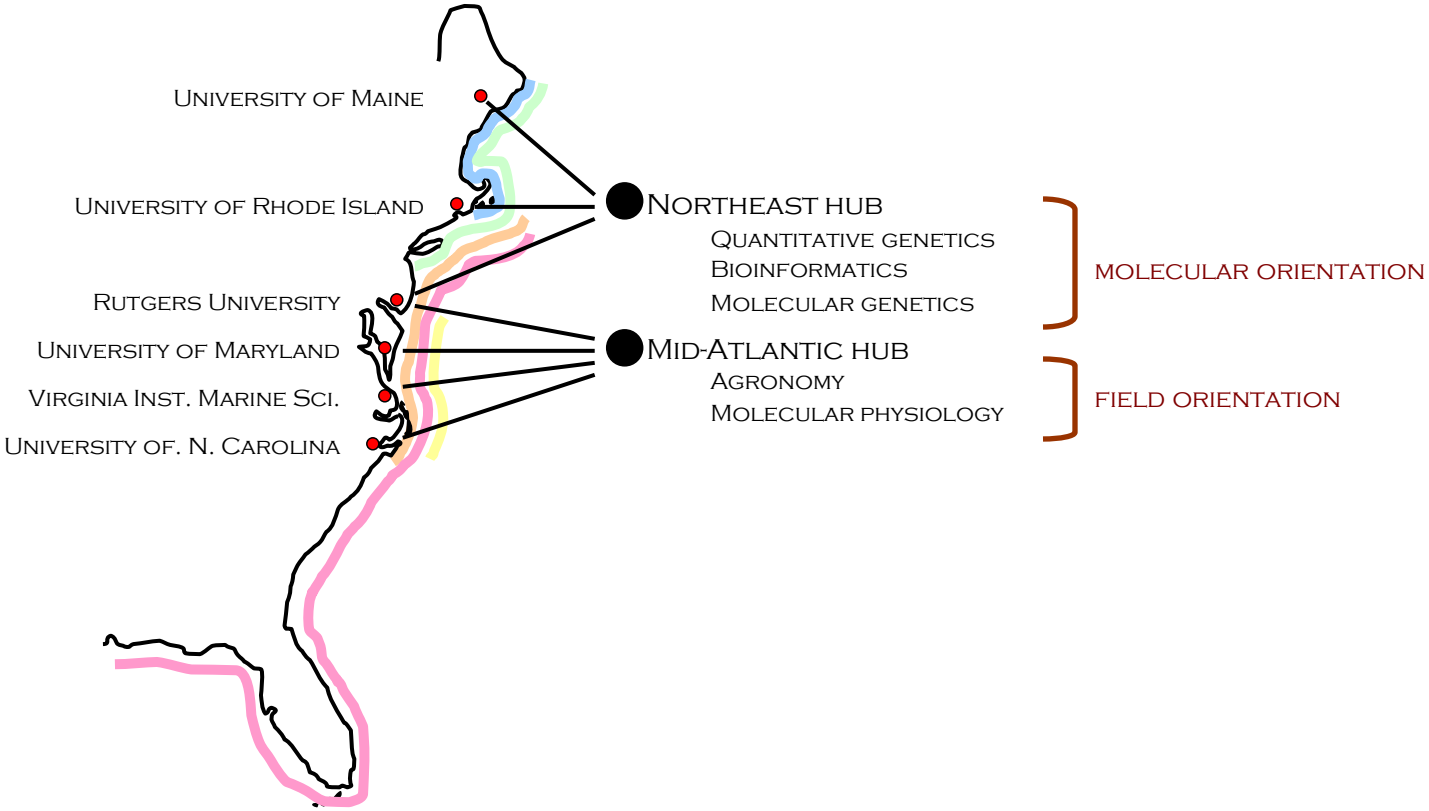
East Coast Shellfish Breeding Center



Confounding conditions for shellfish aquaculture

Cold Water Physiology
Juvenile Oyster Disease
MSX Disease
Dermo Disease
Wide salinity variation

Regional Challenges to Selective Breeding

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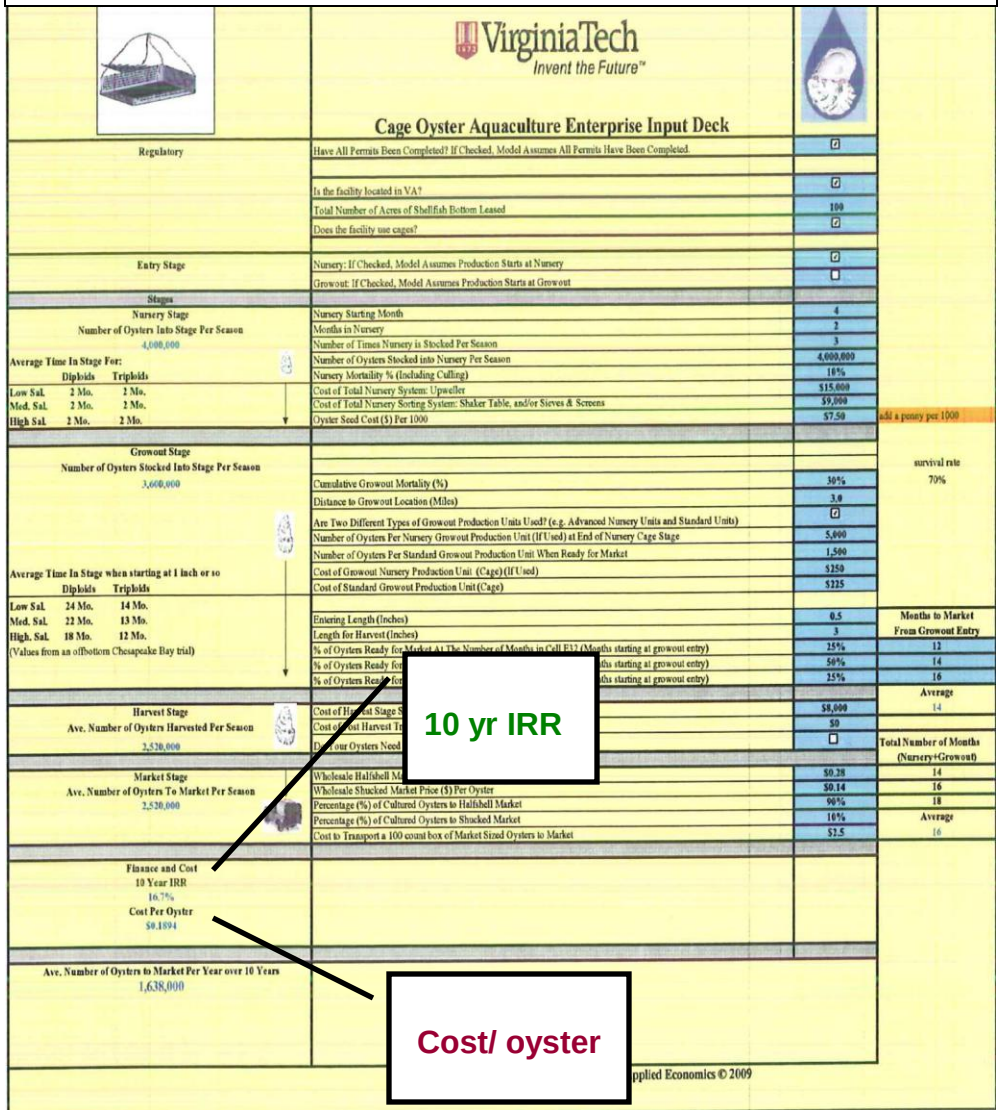
Effects of traits on economics of oyster culture

"Cage oyster aquaculture enterprise budget"



VirginiaTech
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Cage Oyster Aquaculture Enterprise Input Deck

Regulatory	Have All Permits Been Completed? If Checked, Model Assumes All Permits Have Been Completed.	☑
	Is the facility located in VA?	☑
	Total Number of Acres of Shellfish Bottom Leased	100
	Does the facility use cages?	☑
Entry Stage	Nursery: If Checked, Model Assumes Production Starts at Nursery	☑
	Growout: If Checked, Model Assumes Production Starts at Growout	☐
Stages		
Nursery Stage	Nursery Starting Month	4
Number of Oysters Into Stage Per Season	Months in Nursery	2
4,000,000	Number of Times Nursery is Stocked Per Season	3
Average Time In Stage For:	Number of Oysters Stocked into Nursery Per Season	4,000,000
Diploids Triploids	Nursery Mortality % (Including Culling)	10%
Low Sal. 2 Mo. 2 Mo.	Cost of Total Nursery System: Upweller	$15,000
Med. Sal. 2 Mo. 2 Mo.	Cost of Total Nursery Sorting System: Shaker Table, and/or Sieves & Screens	$9,000
High Sal. 2 Mo. 2 Mo.	Oyster Seed Cost ($) Per 1000	$7.50
Growout Stage		
Number of Oysters Stocked Into Stage Per Season		
3,600,000	Cumulative Growout Mortality (%)	30%
	Distance to Growout Location (Miles)	3.0
	Are Two Different Types of Growout Production Units Used? (e.g. Advanced Nursery Units and Standard Units)	☑
	Number of Oysters Per Nursery Growout Production Unit (If Used) at End of Nursery Cage Stage	5,000
	Number of Oysters Per Standard Growout Production Unit When Ready for Market	1,500
Average Time In Stage when starting at 1 inch or so	Cost of Growout Nursery Production Unit (Cage) (If Used)	$250
Diploids Triploids	Cost of Standard Growout Production Unit (Cage)	$225
Low Sal. 24 Mo. 14 Mo.		
Med. Sal. 22 Mo. 13 Mo.	Entering Length (Inches)	0.5
High. Sal. 18 Mo. 12 Mo.	Length for Harvest (Inches)	3
(Values from an offbottom Chesapeake Bay trial)	% of Oysters Ready for Market At The Number of Months in Cell E12 (Months starting at growout entry)	25%
	% of Oysters Ready for [illegible] (Months starting at growout entry)	50%
	% of Oysters Ready for [illegible] (Months starting at growout entry)	25%
Harvest Stage	Cost of Harvest Stage S[illegible]	$8,000
Ave. Number of Oysters Harvested Per Season	Cost of Post Harvest T[illegible]	$0
2,520,000	Do your Oysters Need [illegible]	☐
Market Stage	Wholesale Halfshell Ma[illegible]	$0.28
Ave. Number of Oysters To Market Per Season	Wholesale Shucked Market Price ($) Per Oyster	$0.14
2,520,000	Percentage (%) of Cultured Oysters to Halfshell Market	90%
	Percentage (%) of Cultured Oysters to Shucked Market	10%
	Cost to Transport a 100 count box of Market Sized Oysters to Market	$2.5
Finance and Cost		
10 Year IRR		
16.7%		
Cost Per Oyster		
$0.1894		
Ave. Number of Oysters to Market Per Year over 10 Years		
1,638,000		

survival rate	70%
Months to Market From Growout Entry	
12	
14	
16	
Average	14
Total Number of Months (Nursery+Growout)	
14	
16	
18	
Average	16

add a penny per 1000

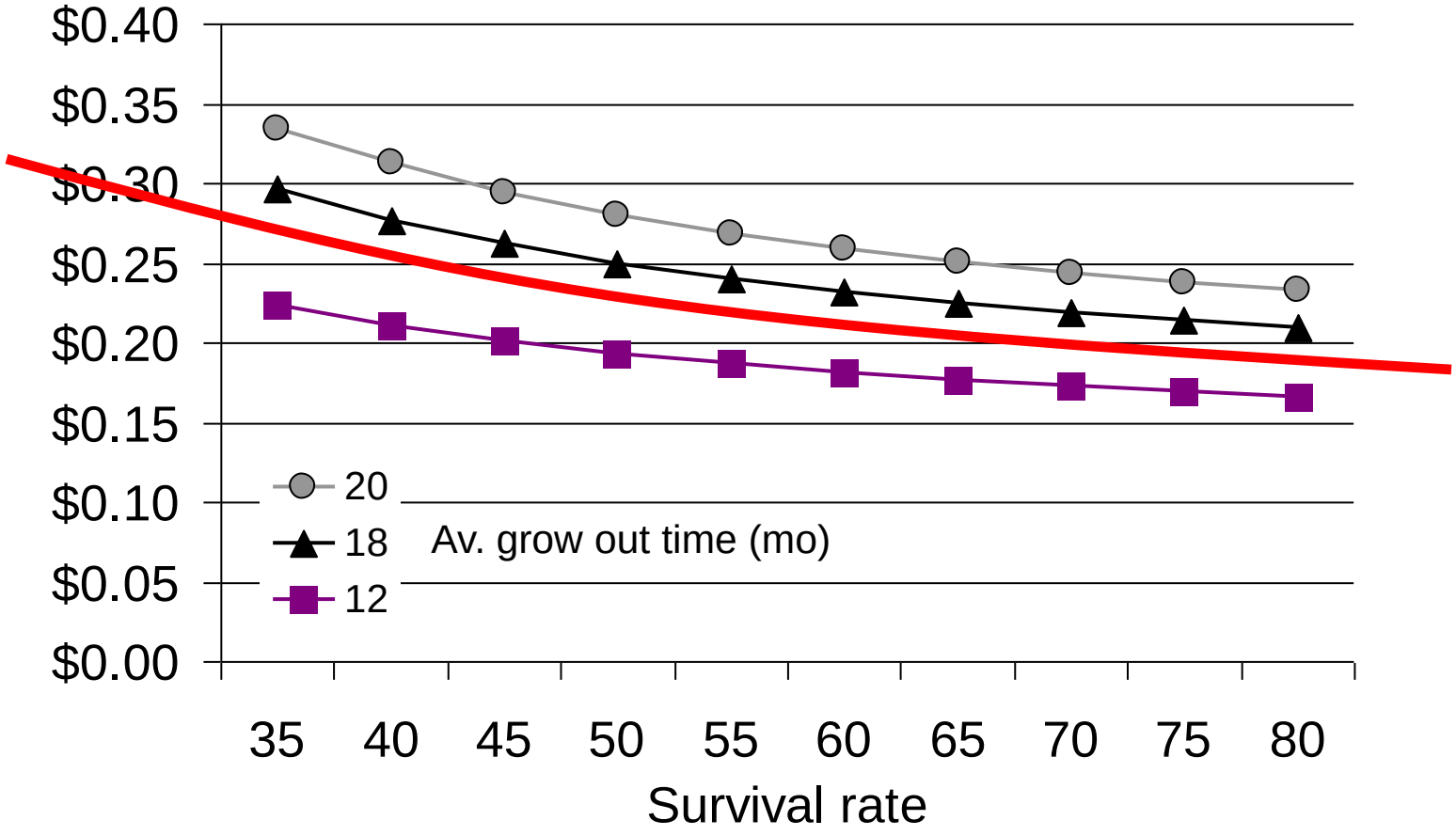
Alex Miller

NUTRIENT CREDIT TRADING FOR ACHIEVING CHESAPEAKE BAY WATER QUALITY GOALS IN VIRGINIA

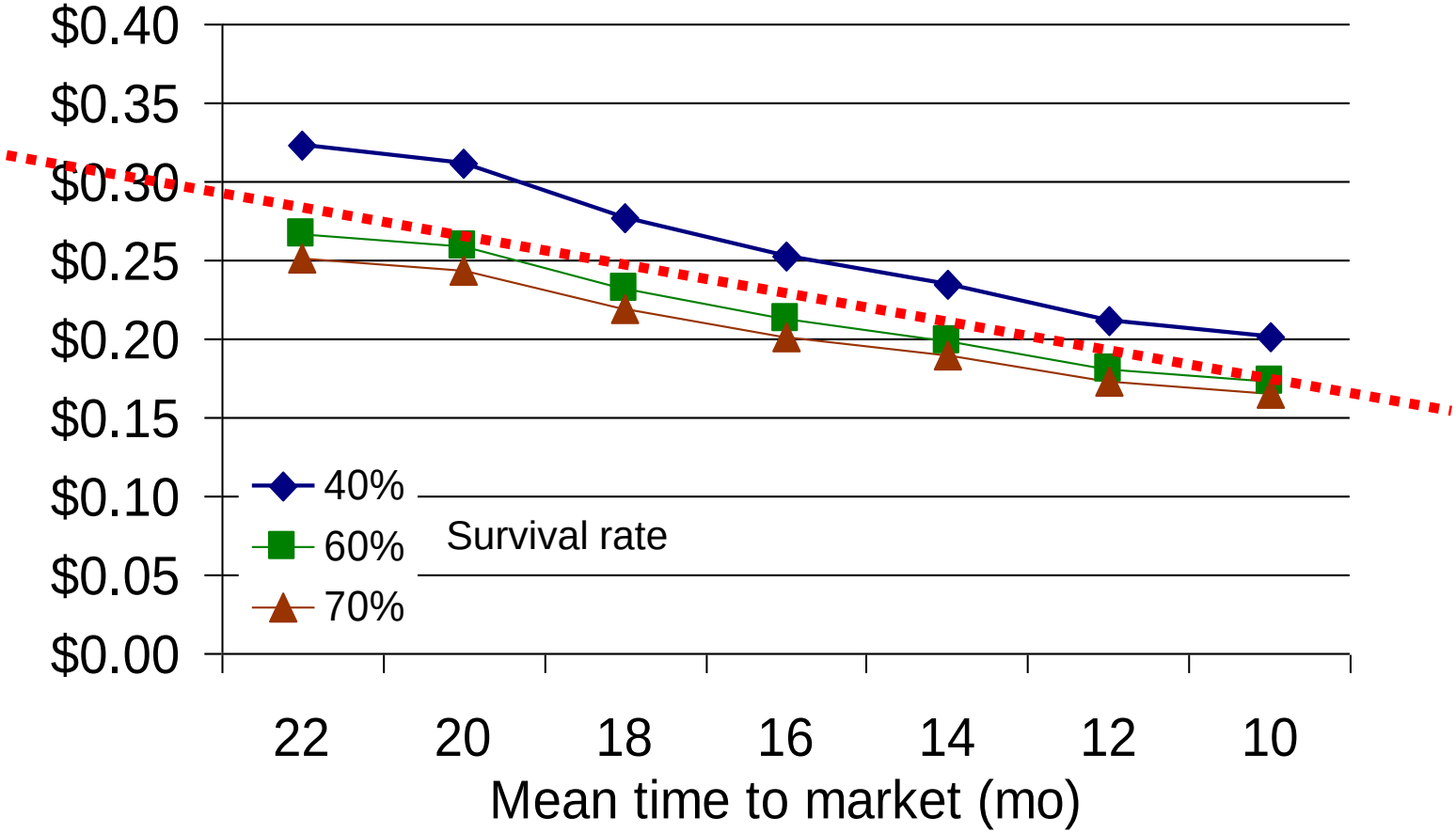
PROJECT DIRECTOR: STEPHENSON, S. K.

Funded by USDA

Affect of survival rate on production cost/ oyster



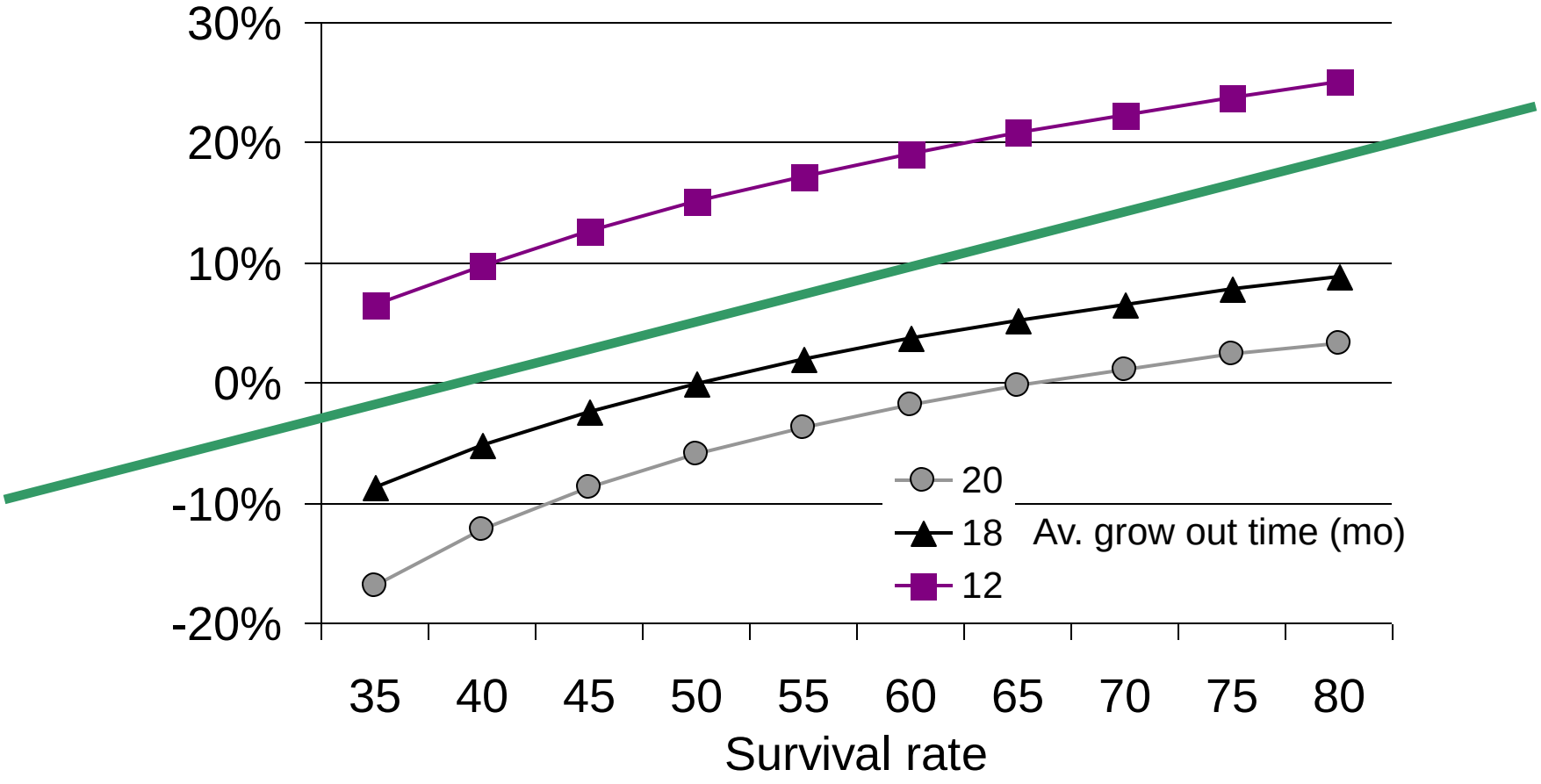
Affect of growth rate on production cost/ oyster



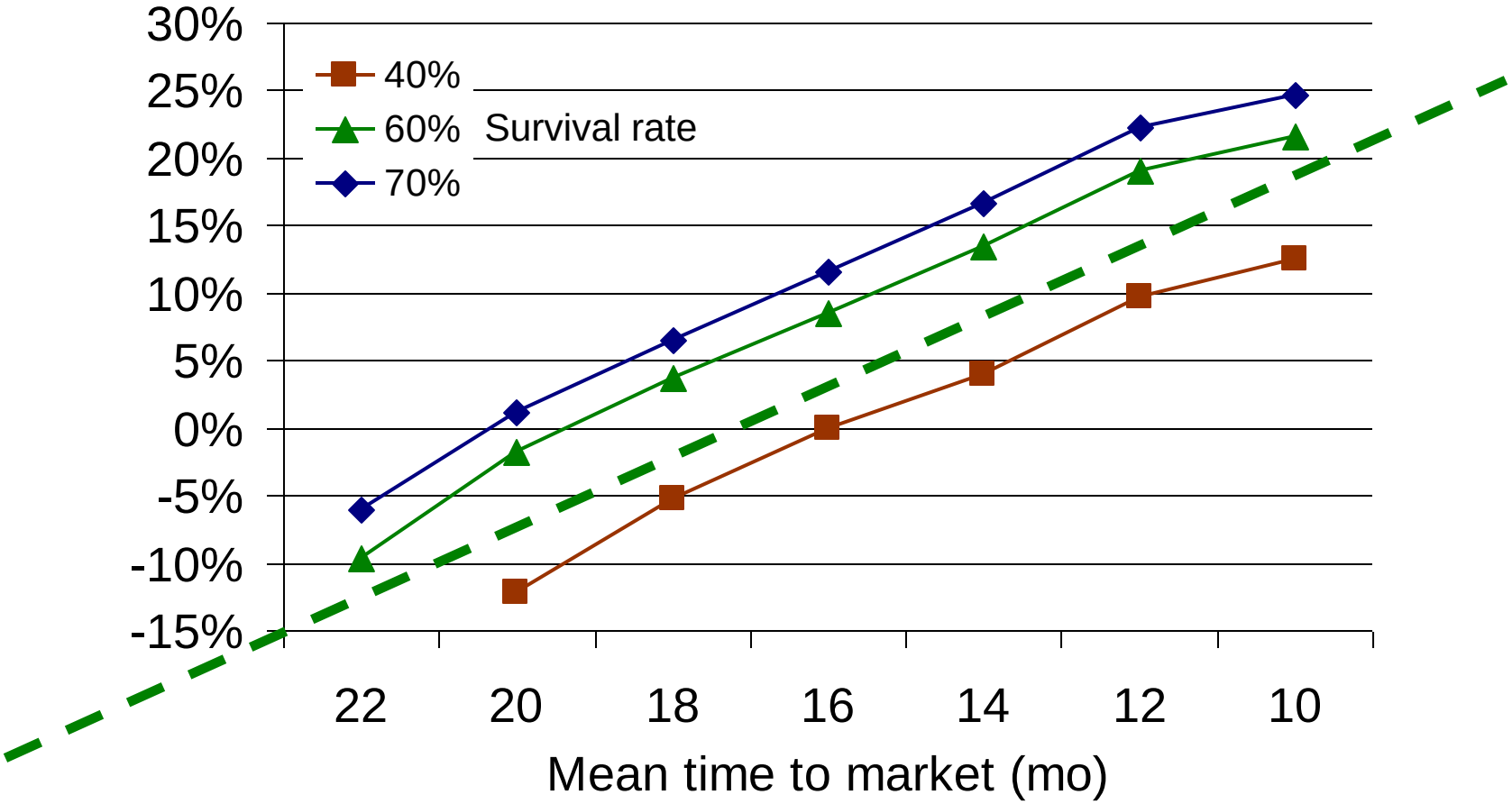
Affect of survival rate on production cost/ oyster

Affect of growth rate on production cost/ oyster

Affect of survival rate on 10 yr IRR



Affect of growth rate on 10 yr IRR



Affect of survival rate on 10 yr IRR

Affect of growth rate on 10 yr IRR

Annual operations costs (4M seed)