ABC Stakeholders Meeting 2010

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

• To apprise industry of progress on ABCs breeding program

• To obtain input on selection goals

• To review and discuss some current events
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’s trial aquaculture enterprise zones
To be [wild], or not to be [wild]

DIPLOID

Rappahanock
Wicomico
Mobjack
Lynnhaven
NST = Maine

Kinsale
York River
growth
survival

Disease pressure
Wild oyster survival in York (disease) 30 mos.

Survival (%)

Lyn  Mob  Me  Rap  Wic  ABC  ABC

0  10  20  30  40  50  60  70  80  90  100

Wild oyster survival in York (disease) 30 mos.
Wild oyster meat weight in Kinsale (low disease) 30 mos.

Meat weight (g)

Lyn Mob Rap Wic ABC ABC elite families
To be [wild], or not to be [wild] (and triploid)

<table>
<thead>
<tr>
<th></th>
<th>wild (WW)</th>
<th>select (SS)</th>
</tr>
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<tbody>
<tr>
<td>wild (W)</td>
<td>WW + W</td>
<td>SS + W</td>
</tr>
<tr>
<td>select (S)</td>
<td>WW + S</td>
<td>SS + S</td>
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</table>

Tetraploid ( )
TRIPLOID

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

Disease pressure

Kinsale

York River

growth

survival

4n ABC x 2n ABC

4n ABC x 2n ++

X X

M M R

growth

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

Kinsale survival curves

18 mos.
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

Mean No. Alive

Rap_3N
Mob_3Ni
ABC_3Ni
Mob_3Nii
ABC_3Nii

18 mos.
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.
STAKEHOLDERS 2010

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Hybrid vigor in Pacific oysters

Dennis Hedgecock, USC

Testing hybrids on the Davis farm

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

Selection

“Breeding Value”

Inbreeding

Crossbreeding

“Hybrid Vigor”
Our approach to “hybrid vigor”

<table>
<thead>
<tr>
<th></th>
<th>XB</th>
<th>DBY</th>
<th>hANA</th>
<th>Lola</th>
<th>Rapp</th>
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<tr>
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<td>LGT</td>
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<td>DB</td>
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- **diploids**
- **tetraploids**

- good for low salinity
- good for high salinity
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• SLOT – Super Lines On Test
• Selection ’08 superlines
  • News and views 3: East Coast Breeding Center
• Breeding and economics in Virginia aquaculture
<table>
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<th>LINE</th>
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<tr>
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<td>L,D</td>
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<tr>
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<td>-</td>
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Creation of “super” lines

- DBY 2008
- XB 2008
- LA 2008

2009
Deployment for selection

- Kinsale
- XB
- Lola
- DBY
- DBY
- XB
- Hana
- DBY
- XB
- Hana
Deployment for SLOT

All sites have all lines, targeted and non-targeted
SLOT – how we keep track of the lines

LENGTH in Kinsale

Shell Length (mm)

<table>
<thead>
<tr>
<th>Industry spawn</th>
<th>Rapp control</th>
<th>DB</th>
<th>XB</th>
<th>LA</th>
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<td></td>
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Target Selection Site

KINSALE  YORK  LYNN.
SLOT – how we keep track of the lines

LENGTH in the York

Shell Length (mm)

TARGET SELECTION SITE

mkt size

Industry spawn  Rapp control  DB  XB  LA

KINSALE

DB  XB  LA

YORK

DB  XB  LA

LYNN.
SLOT – how we keep track of the lines

LENGTH in Lynnhaven

Shell Length (mm)

Industry spawn
Rapp control

DB       XB       LA

KINSALE

DB       XB       LA

YORK

DB       XB       LA

LYNN.

TARGET SELECTION SITE
SLOT – how we keep track of the lines

MEAT WEIGHT in Kinsale

Target selection site:

- Kinsale
- York
- Lynnn.
SLOT – how we keep track of the lines

MEAT WEIGHT in the York

TARGET SELECTION SITE

<table>
<thead>
<tr>
<th>Industry spawn</th>
<th>Rapp control</th>
<th>KINSALE</th>
<th>YORK</th>
<th>LYNN.</th>
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Meat Weight (g)
SLOT – how we keep track of the lines

**MEAT WEIGHT in Lynnhaven**

![Graph showing meat weight for different sites and categories.](image-url)
SLOT – how we keep track of the lines

SURVIVAL in Kinsale

Percentage survival

Industry spawn  Rapp control

KINSALE  YORK  LYNN.

TARGET SELECTION SITE

site average
SLOT – how we keep track of the lines

SURVIVAL in the York

Percentage Survival

site
average

TARGET SELECTION SITE
SLOT – how we keep track of the lines

SURVIVAL in Lynnhaven

Percentage Survival

TARGET SELECTION SITE

site average

Industry spawn Rapp control

DB XB LA DB XB LA DB XB LA

KINSALE YORK LYNN.
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DBY in York River

body weight (g)
DBY in York River

![Graph showing DBY in York River]

- Body weight (g)
- Population

Selected

S = 20.4
Quantitative genetics 101

\[ R = S \times h^2 \]

- \( R \) = Response to selection
- \( h^2 \) = heritability = 0.37±0.08

0.37±0.08 ??

Where does that come from?  families
Is that good?  yes
DBY in York River

\[ S = 20.4 \]

\[ R = S \times h^2 \]
\[ 20.4 \times 0.37 = 7.5g \]
hANA in York River

body weight (g)
hANA in York River

\[ S = 20.1 \]

\[ R = S \times h^2 \]

\[ 20.1 \times 0.37 = 7.4g \]
Body weight (g)
\[ S = 20.4 \]
\[ R = S \times h^2 \quad 20.4 \times 0.37 = 7.5g \]
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Northeast hub
Quantitative genetics
Molecular physiology
Mid-Atlantic hub
Molecular genetics -- RU
Bioinformatics -- UMD
Agronomy -- UMD

University of Maine
University of Rhode Island
Rutgers University
University of Maryland
University of N. Carolina

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

Regional Challenges to Selective Breeding

Confoundining conditions for shellfish aquaculture

Molecular orientation
Field orientation
STAKEHOLDERS 2010

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Effects of traits on economics of oyster culture

“Cage oyster aquaculture enterprise budget”

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

![Graph showing the relationship between survival rate and production cost for different average grow out times (mo). The graph includes lines for survival rates of 20, 18, and 12, with cost decreasing as survival rate increases.]
Affect of growth rate on production cost/ oyster

Mean time to market (mo)

Survival rate

40%
60%
70%
Affect of **survival rate** on production cost/ oyster

Affect of **growth rate** on production cost/ oyster
Affect of survival rate on 10 yr IRR

![Graph showing the affect of survival rate on 10 yr IRR]

- Survival rate
- 20 yr IRR
- 18 yr IRR
- 12 yr IRR
- Av. grow out time (mo)
Affect of growth rate on 10 yr IRR

Mean time to market (mo)

Survival rate

40%
60%
70%
Affect of survival rate on 10 yr IRR

Affect of growth rate on 10 yr IRR
Annual operations costs (4M seed)

- Labor (38%)
- Seed (15%)
- Package, shipping (22%)
- Admin, permitting (13%)
- Triploid licensing (3%)
- Utilities (3%)
- Triploid licensing (3%)
- Office, etc (1%)
- ABC licensing (1%)
- Seed (15%)