GENETIC VARIATION IN PACIFIC OYSTERS FOR RESISTANCE TO *Ostreid herpesvirus*-1

Peter Kube
Mike Dove, Matt Cunningham, Peter Kirkland, Wayne O’Connor, Nick Elliott
The Spread of Oyster Herpes Virus

*Ostreid herpesvirus 1*

- Affects only Pacific oysters
- New micro-variant with high virulence

Outbreaks:
- France 2007-08
- New Zealand Mar 2010
- Australia Nov 2010
The Spread of Oyster Herpes Virus

SPREAD IN AUSTRALIA:
• Georges River Nov 2010
• Sydney Harbour 2011
• Hawkesbury River Jan 2013
The Spread of Oyster Herpes Virus

- DAY 1 10 AM: First sighting (30% mortality on one lease)
- DAY 1 5 PM: Mass mortality on that lease
- DAY 3: 10 million dead oysters ($3M loss)
- DAY 8: Entire system affected
**Aims**

**Breed for resistance to OsHV-1**

**The science challenge:**
- Is there resistance in our population?
- Genetic parameters of resistance?
- How can we measure resistance?
- How long before economically useful resistance?
Data analysis and summary

- Australian breeding population (up to 9 generations)
- Six field challenges and two laboratory challenges
- Two ages (4 to 6 months and 12 months)
- Analysed using ASReml;
  Sire model with pedigree structure (binary data)

<table>
<thead>
<tr>
<th>Number year classes challenged</th>
<th>3</th>
<th>2011, 2012, 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of families</td>
<td>175</td>
<td></td>
</tr>
<tr>
<td>Total number of parents</td>
<td>345</td>
<td></td>
</tr>
<tr>
<td>Number animals challenged</td>
<td>56,658</td>
<td></td>
</tr>
</tbody>
</table>
FIELD CHALLENGE NOV 2012
ADULTS (AGE 12 MONTHS)
SURVIVAL = 0%
Survival of one year old Pacific oyster families after exposure to OsHV-1 in a field challenge
Unselected families

2011 year class families

SURVIVAL (%) vs. FAMILY NUMBER
Selected families

2013 year class families

SURVIVAL (%) vs. FAMILY NUMBER

0% 10% 20% 30% 40% 50% 60% 70%
Difficult to get a good field challenge

<table>
<thead>
<tr>
<th>TRIAL</th>
<th>Description</th>
<th>$h^2$</th>
<th>Test day survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2011 YC spat</td>
<td>0.38</td>
<td>47%</td>
</tr>
<tr>
<td>2</td>
<td>2011 YC adults</td>
<td>0.18</td>
<td>20%</td>
</tr>
<tr>
<td>3</td>
<td>2012 YC spat</td>
<td>0.53</td>
<td>91%</td>
</tr>
<tr>
<td>4</td>
<td>2012 YC adults</td>
<td>0.60</td>
<td>29%</td>
</tr>
<tr>
<td>5</td>
<td>2013 YC spat (a)</td>
<td>-</td>
<td>No mortality</td>
</tr>
<tr>
<td>6</td>
<td>2013 YC spat (b)</td>
<td>-</td>
<td>No mortality</td>
</tr>
<tr>
<td>7</td>
<td>2013 YC adults</td>
<td>0.46</td>
<td>18%</td>
</tr>
</tbody>
</table>
Laboratory Disease Challenge

Done in a biosecure laboratory
(NSW Department of Primary Production)

Uses stock virus solution
(cryo-preserved) stock

Immersion of relaxed oysters
Disease progression in a lab challenge

High dose of OsHV-1 in a laboratory challenge with one year old oysters (10^{-3} dilution)

- Population average
- Susceptible
- Moderate
- Resistant
Disease progression in a lab challenge (low dose)

LOW dose of OsHV-1 in a laboratory challenge with one year old oysters (10^-4 dilution)

- Population average
- Susceptible (low)
- Moderate (low)
- Resistant (low)
## Genetic parameters – heritabilities

<table>
<thead>
<tr>
<th>TRAIT</th>
<th>$h^2$ (se) observed</th>
<th>$h^2$ underlying</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field survival (spat)</td>
<td>0.39 (0.09)</td>
<td>0.61</td>
</tr>
<tr>
<td>Field survival (adults)</td>
<td>0.27 (0.04)</td>
<td>0.55</td>
</tr>
<tr>
<td>Laboratory survival (spat)</td>
<td>0.18 (0.11)</td>
<td>0.28</td>
</tr>
</tbody>
</table>
### Genetic parameters – genetic correlations

<table>
<thead>
<tr>
<th>TRAIT</th>
<th>$h^2$ (observed)</th>
<th>$h^2$ (underlying)</th>
<th>Genetic correlations $r_g (se)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field survival (spat)</td>
<td>0.39</td>
<td>0.61</td>
<td></td>
</tr>
<tr>
<td>Field survival (adults)</td>
<td>0.27</td>
<td>0.55</td>
<td>0.85 (0.08)</td>
</tr>
<tr>
<td>Laboratory survival (spat)</td>
<td>0.18</td>
<td>0.28</td>
<td>0.71 (0.30) 0.61 (0.24)</td>
</tr>
</tbody>
</table>
### Genetic correlations – test days

<table>
<thead>
<tr>
<th>Field challenge survival ($r_g$)</th>
<th>Day 7</th>
<th>Day 14</th>
<th>Day 21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 14</td>
<td>0.74</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day 21</td>
<td>0.02</td>
<td>0.77</td>
<td></td>
</tr>
<tr>
<td>Day 28</td>
<td>0.03</td>
<td>0.77</td>
<td>0.99</td>
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Genetic gains

Genetic trend OsHV-1 resistance

- OsHV-1 resistance (all families)
- OsHV-1 resistance (best 4 families)
Conclusions

• There is genetic variation for OsHV-1 resistance in our population

• Field challenges presents logistic difficulties for applied breeding, and a reliable laboratory challenge is needed

• Selective breeding is providing a means to mitigate the impact and risk of this disease
**Peter Kube**  
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### ACKNOWLEDGMENTS

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