Applying genomic selection to improve Pacific oyster (*Crassostrea gigas*) resistance to the pathogen *Vibrio aestuarianus*

Department of Biological Sciences
University of Calgary

Presentation by Denman Moody

Co-supervisors: Dr. Sean Rogers (UofC) and Dr. Timothy Green (VIU)

My Background

Diploma, Fisheries & Aquaculture (VIU)

BSc, Biology (VIU)

MSc Student, Biological Sciences (UofC)

- Deep Bay Marine Field Station
- Centre for Shellfish Research

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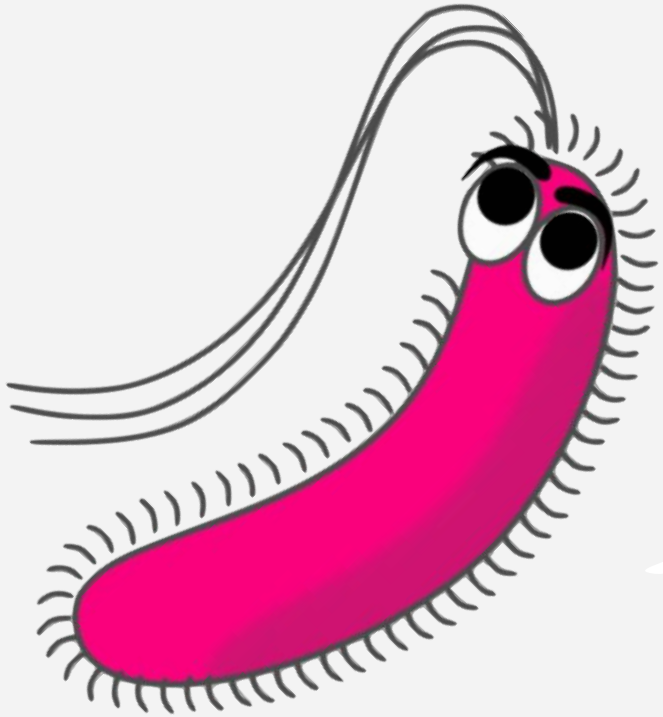
Vibrio aestuarianus (*Va*)



- Bacteria
- Pathogen of Pacific oysters
- Correlated with summer mortality events
- Losses of 20-100% of farmed oysters

(Cowan et al., 2024)

Selective breeding for disease resistance

- Agriculture:
  - Potatoes – Late blight (fungus-like microorganism)
  - Chickens – Marek's disease (virus)
- Aquaculture:
  - Rainbow trout – Bacterial cold-water disease (bacteria)
  - Shrimp – Early mortality syndrome (bacteria)
    - *Vibrio parahaemolyticus*

Selective breeding approaches

1. Family-based (pedigree) selection
2. Marker-assisted selection
3. Genomic selection
    - Ideal for traits controlled by many genes
    - Resistance to *Va*

(Ajithkumar et al., 2025; Surry et al., 2024)

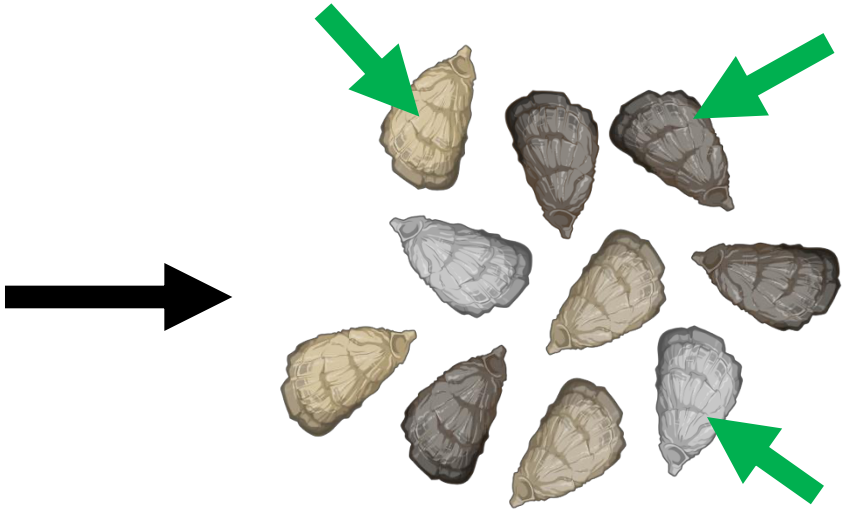
Problem

- Resistance to *Va* is trait we want to breed for
- How resistant is an oyster to a disease?
  - Need to do a disease challenge
  - Fast death = Low resistance
  - Long survival = High resistance
- “Destructive sampling”
  - Oysters we know have the trait of interest (resistance) are **dead**
  - **Can’t use as broodstock**

Solution

- Use genetic information of the oysters that went through disease challenge
- Compare to **siblings**

Disease-challenged oysters (dead)

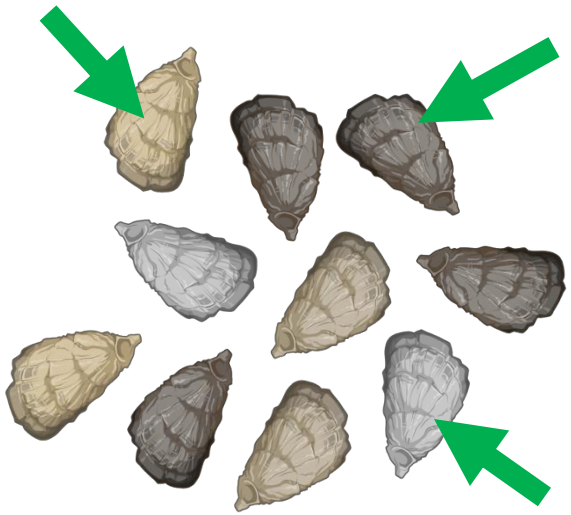


Siblings (alive!)

Can identify best individuals to produce desired trait

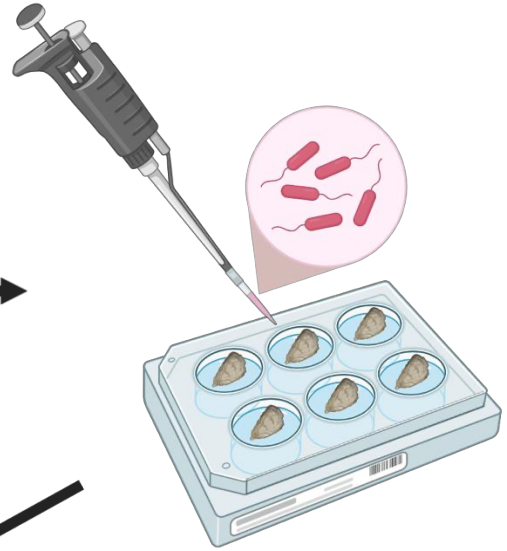
Solution

- Siblings becomes our **candidate broodstock** for the next generation

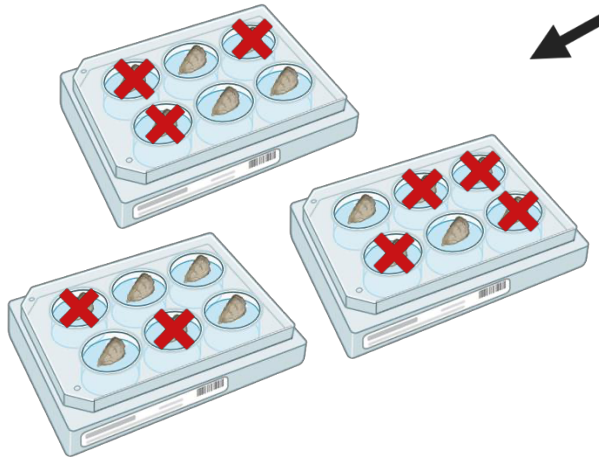


Siblings (alive!)

Cohort of oysters



Disease challenge (*Va*)



Monitor survival for 7 days

Longer survival

≈

Higher resistance to *Va*

Cohort of oysters (dead)

DNA sequencing

Results

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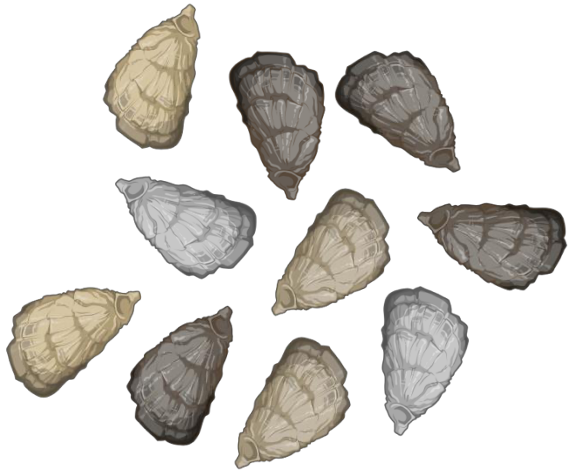
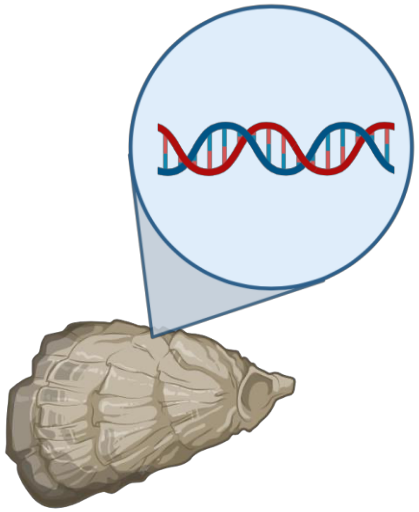
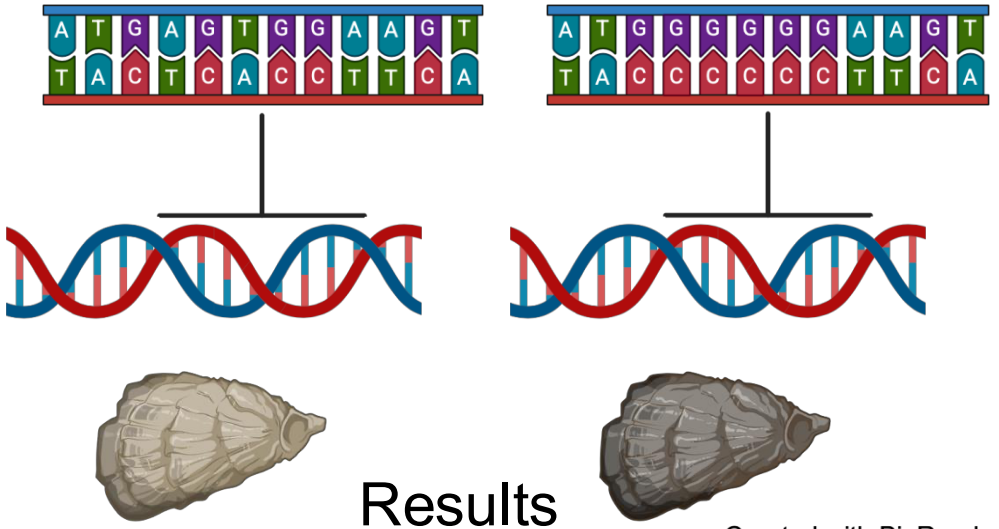


Candidate broodstock
(alive!)



DNA sequencing



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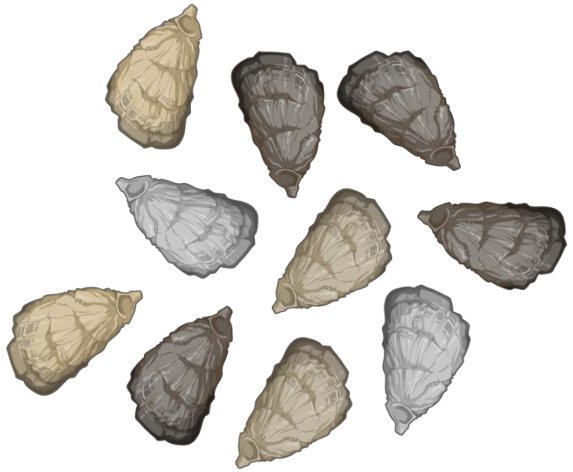


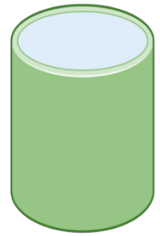
Candidate broodstock
(alive!)

Predicted highly
resistant broodstock

Predicted highly
susceptible broodstock

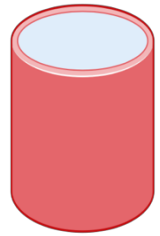
August 2025: Spawning resistant families

Predicted highly resistant broodstock

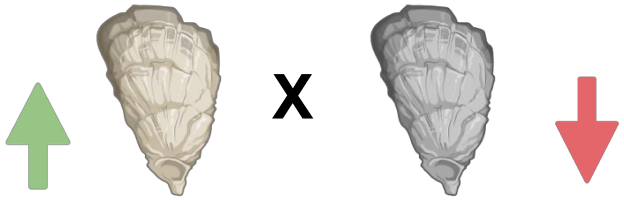


Offspring with high survival

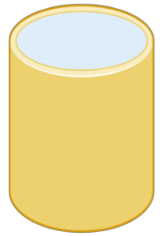
Predicted highly susceptible broodstock



Offspring with low survival

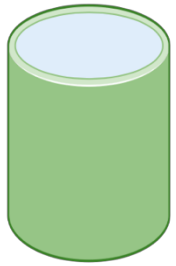


Control: One highly resistant,
and one susceptible broodstock

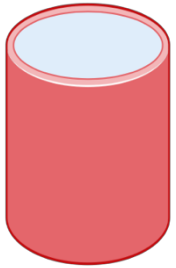


Offspring with moderate survival
(Control)

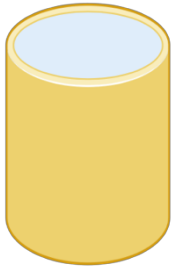
November 2025: Disease challenge with *Va*



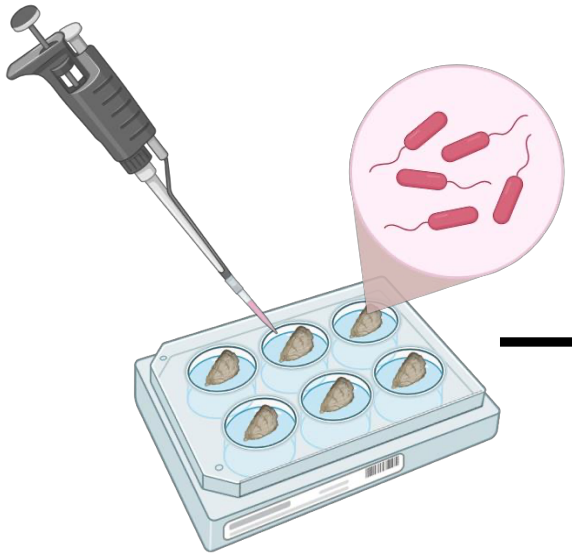
Offspring with high survival



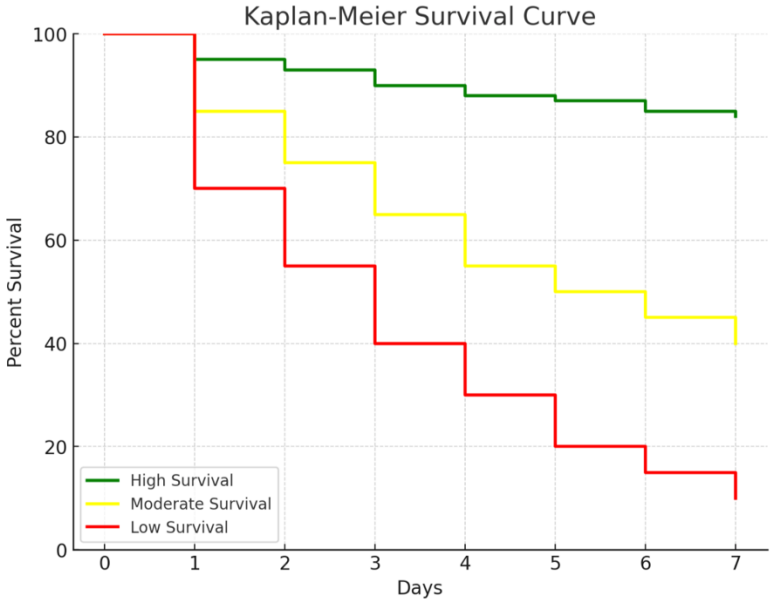
Offspring with low survival



Offspring with moderate survival (Control)

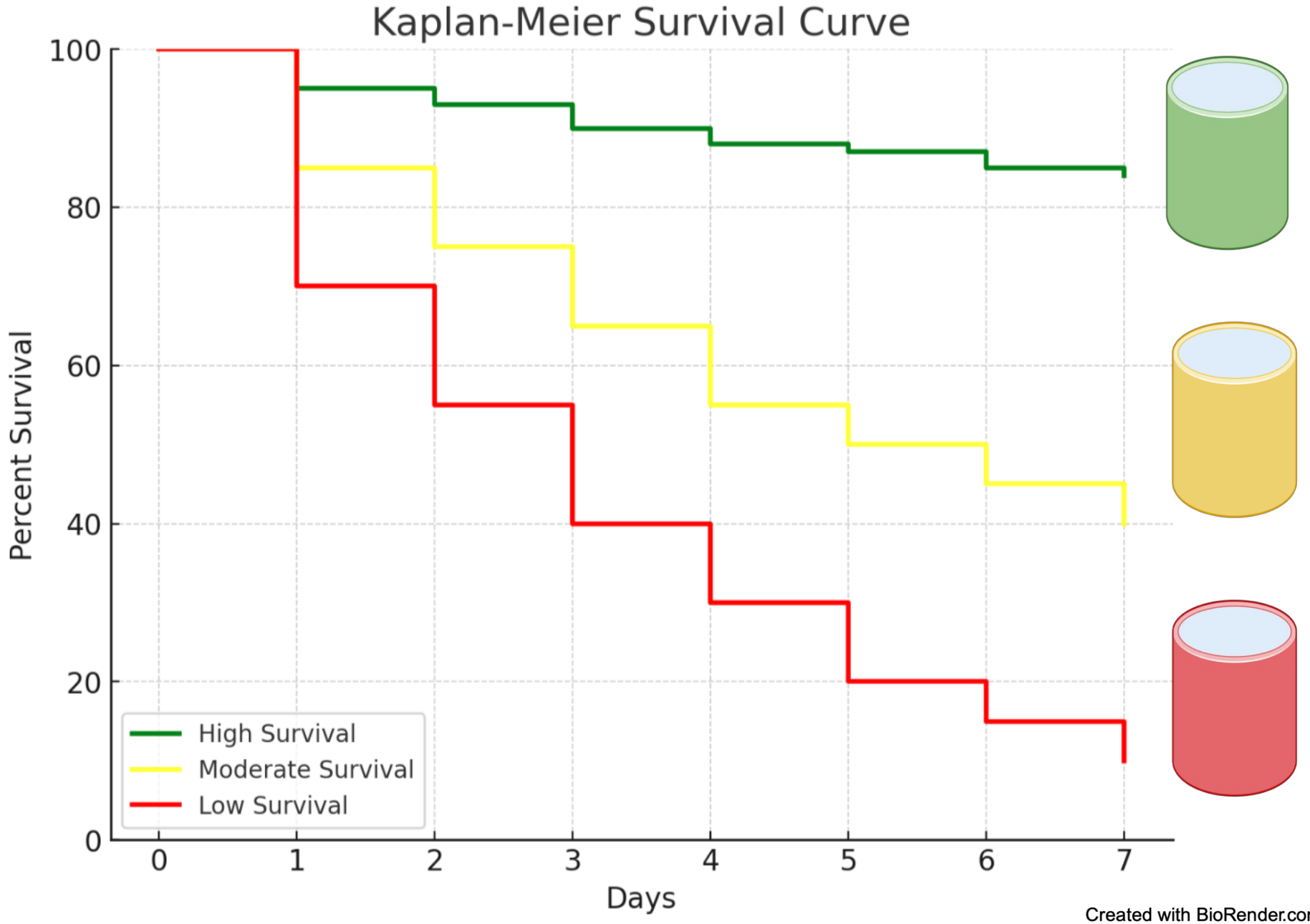


Predicted results:



Predicted Results:

- Evaluate success of crosses using survival as indicator



Big Picture

- Selective breeding for disease resistance
- Can we breed for resistance to *Va* in Pacific oysters?
- Genomic selection
- Increased survival during summer mortality events

Thank you ☺

Questions?

denman.moody@ucalgary.ca

References

Ajithkumar, M., D'Ambrosio, J., Travers, M.-A., Morvezen, R., & Degremont, L. (2025). Genomic selection for resistance to one pathogenic strain of *Vibrio splendidus* in blue mussel *Mytilus edulis*. *Frontiers in Genetics*, *15*. https://doi.org/10.3389/fgene.2024.1487807

Cowan, M. W., Pearce, C. M., Green, T. J., Finston, T., Meyer, G. R., McAmmond, B., Van Hamme, J. D., Bottos, E. M., Marshall, R., Evans, W., Sutherland, T. F., & de la Bastide, P. Y. (2024). Abundance of *Vibrio aestuarianus*, water temperature, and stocking density are associated with summer mortality of Pacific oysters in suspended culture. *Aquaculture International*, *32*(4), 5045–5066. https://doi.org/10.1007/s10499-024-01415-5

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