Improving Post-Spawn Conditioning of Pacific Oysters in Nutrient-Reduced Waters Through Genetic Gain and Farming Innovation

Paul Evans, 2025 Scholar

South Australia

July 2026

Nuffield Australia project number 2510

Supported by

Improving Post-Spawn Conditioning of Pacific Oysters in Nutrient-Reduced Waters Through Genetic Gain and Farming Innovation

© 2026 Nuffield Australia.

All rights reserved.

This publication has been prepared in good faith on the basis of information available at the date of publication without any independent verification. Nuffield Australia does not guarantee or warrant the accuracy, reliability, completeness or currency of the information in this publication nor its usefulness in achieving any purpose.

Readers are responsible for assessing the relevance and accuracy of the content of this publication. Nuffield Australia will not be liable for any loss, damage, cost or expense incurred or arising by reason of any person using or relying on the information in this publication.

Products may be identified by proprietary or trade names to help readers identify particular types of products but this is not, and is not intended to be, an endorsement or recommendation of any product or manufacturer referred to. Other products may perform as well or better than those specifically referred to.

This publication is copyright. However, Nuffield Australia encourages wide dissemination of its research, providing the organisation is clearly acknowledged. For any enquiries concerning reproduction or acknowledgement contact the Publications Manager 0402 453 299.

Scholar contact details

Name: Paul Evans

Organisation: Evans Oysters Pty Ltd

Address: Streaky Bay, South Australia

Phone: 0415 325 908

Email: evansoysters@internode.on.net

Website: https://www.evansoysters.com.au

Instagram: evansoysters

In submitting this report, the Scholar has agreed to Nuffield Australia publishing this material in its edited form.

NUFFIELD AUSTRALIA Contact Details

Nuffield Australia
Telephone: 0456 916 506

Email: enquiries@nuffield.com.au

Address: PO Box 450, Bendigo, VIC 3550

Executive Summary

This report presents the findings of a Nuffield Australia Farming Scholarship undertaken by Paul Evans, a Pacific oyster farmer based at Streaky Bay on the South Australian (SA) Eyre Peninsula. The scholarship was driven by a practical commercial problem that he faces every year: after spawning in summer, oysters can take anywhere from two weeks to several months to return to a condition good enough to sell. In good years the business runs smoothly. In bad years, the cash flow and farm program can be thrown into serious disruption. As a result, Paul set out to find whether genetics, specifically selective breeding or the more advanced technique of genomic selection, could give farmers an oyster that returns to condition more efficiently, on less available food.

“You farm oysters in something compared to the desert in South Australia” — Patrick Hone, (Retired) CEO, Fisheries

Research and Development Corporation (FRDC)

Over two years of research across Tasmania, New Zealand, Taiwan, Chile, Japan, Canada and the United States, visiting farms, interviewing scientists, geneticists, farmers, hatchery managers, wholesalers and industry leaders, the author came to understand that the problem he faces in South Australia is almost unique among the places he travelled. Not because other industries have solved it, but because most of them simply do not experience it to his level. Their waters are so rich in food that oysters recover from spawning quickly and naturally, or they farm with 100% triploid technology that South Australian farmers used when they had the ability to purchase stock from Tasmania prior to the borders being closed for Pacific Oyster Mortality Syndrome (POMS) quarantine reasons.

The same nutrient-reduced water that creates the conditioning challenge is also the farmers' greatest competitive asset, with South Australian oysters being safe to consume straight from the ocean without any treatment. Many of the world’s oyster-producing regions must depurate their oysters for days before sale to purge any accumulated contamination. In South Australia, the ability to grow oysters in exceptionally clean waters means this clean water story is not only genuine but an increasingly rare and valuable advantage that should be advertised and understood by consumers moving forward.

The final results of an on-farm conditioning trial on Paul’s property in Streaky Bay, with independent scientific analysis conducted by the Center for Aquaculture Technologies (CAT) in San Diego, USA, have produced the most encouraging scientific evidence encountered during the entire scholarship. CAT found a clear genetic signal in the trial data, and the final measurement in May 2026 produced the strongest result of the whole trial, confirming and strengthening everything the earlier results pointed toward.

The scholarship also identified an important historical context. Prior to 2016, South Australian farmers could access triploid oysters from Tasmanian hatcheries. A disease outbreak in February 2016 forced a quarantine ban on Tasmanian spat into South Australia, a ban that remains in place today. Restoring reliable triploid access through

SA hatcheries, combined with breeding diploid oysters that condition faster in low-food environments, offers the most complete solution to the conditioning problem.

Finally, the scholarship identified that major oyster-producing nations in Asia are beginning to adopt Australian and New Zealand single-seed farming technology at scale. This is a genuine success story for Australian and New Zealand equipment manufacturers. It also signals that the South Australian industry must continue to invest in what no high-volume competitor can easily replicate: the provenance, food safety, genetic quality and brand of an oyster grown in some of the cleanest water globally.

Keywords: Post-spawn conditioning, Pacific oyster, selective breeding, nutrient-reduced waters, South Australia

Table of Contents

Improving Post-Spawn Conditioning of Pacific Oysters in Nutrient- 1
Reduced Waters Through Genetic Gain and Farming Innovation

..... 1
Executive Summary 3
Foreword 7
Acknowledgements 9
Abbreviations 11
Section 1: Understanding the problem — The conditioning gap in South Australia 15
What conditioning actually is 15
Why our waters are different 15
The Triple Whammy — when everything hits at once 16
The commercial reality 17
The financial reality — what the conditioning gap actually costs 17
Section 2: What the world is doing — Global farm visits and key observations 18
New Zealand — the most productive leg of the scholarship 18
Moana New Zealand — scale, integration and FlipFarm 18
FlipFarm Systems Ltd — what the system actually delivers 18
Cawthron Institute — talking to the scientists 19
James Parsons — lessons from sheep and dairy genetics 19
Taiwan — traditional methods and changing tastes 19
Chile — clean water farming on the shorelines 20
Japan — tradition, innovation and the technology transition 20
Yuwa Fishery, Kasaoka Islands 20
Farm Suzuki, Hiroshima 21
Canada and United States — Taylor Shellfish 21
Fanny Bay, British Columbia — the G3 system 21
Washington State — Bill Taylor 21
Section 3: The genetics pathway — What I learned from scientists and breeders 23
How the current Australian breeding program works 23
The limitation of the current approach — and how genomics can change it 23
The big question — can we select for conditioning? 24
A critical question — will it work when food is plentiful too? 24

Section 4: The on-farm trial — What CAT's analysis found 26
Why we ran this trial 26
What CAT found — in plain terms 27
Why this matters & what happens next 28
Section 5: A South Australian hatchery perspective — Sea Ready Shellfish ... 29
Section 6: Technology and better farm data 31
Why data matters for the conditioning problem 31
Connecting farm data with environmental data 31
Artificial intelligence and the future 31
Section 7: The bigger picture — Where the global industry is heading 33
Where South Australia genuinely leads the world 33
Where we face a genuine gap 33
The global technology adoption story 33
Why solving the conditioning gap matters beyond the farm gate 34
Conclusions 36
Recommendations 37
For individual oyster farmers in South Australia 37
For the ASI breeding program and industry bodies 37
For the broader South Australian oyster industry 37
References 39
Appendices 41
Appendix A: Key contacts 41
Appendix B: Simple glossary of terms used in this report 41
Appendix C: About the Center for Aquaculture Technologies 42
Appendix D: Streaky Bay Conditioning Trial — Trial Layout Diagram 42

Foreword

I, Paul Evans, am a Streaky Bay oyster farmer on the South Australian Eyre Peninsula who has been farming Pacific oysters for 14 years on a family farm that has been operating for 32 years. Like most farmers in our region, I deal with a problem that comes back every year without fail: the post-spawn conditioning gap.

Every summer my oysters spawn, meaning they use up all their stored energy, the fat, white, plump meat that makes them worth selling, to reproduce. After spawning they are watery, translucent and completely unsuitable for sale. To return to market condition, they need to consume enough food from the water to rebuild that stored energy. In nutrient-rich waters around the world, this happens quickly. In South Australia, however,, where the water is pristine but also at times relatively low in food, this can take a long time. In some years, like 2025, the oysters regain condition within two weeks of spawning; in other years it has taken numerous months. That difference of two weeks versus numerous months is the difference between a business running smoothly and a business potentially being under real financial pressure.

I applied for a Nuffield Scholarship to try to find an answer to my original question: Can we breed an oyster that regains condition more efficiently, on less available food? I had watched numerous batches of oysters on my farm, all kept in the same water, on the same lines, and in the same conditions, and seen some genetic family lines open fat and white while others were thin and watery. If the environment is identical, the difference in oyster condition must be in the genetics, and if it is in the genetics, surely we can select for it.

Two years of travel across seven countries taught me that this question is more complex than I initially thought, yet potentially more solvable than the existing research suggests. I visited farms in Tasmania, New Zealand, Taiwan, Chile, Japan, Canada and the United States, during which I spoke with oyster farmers, scientists, geneticists, breeding program managers, wholesalers and technology developers. I opened oysters in each country and paid close attention to what I saw, which fundamentally changed how I understand both our industry’s challenge and our industry’s opportunity.

The biggest single insight of the scholarship was that the periodically nutrient-reduced water that makes conditioning so difficult at times across South Australia is the same water that makes our oysters so extraordinarily clean. Unlike South Australian oysters, which can be consumed directly from the water, many of the world’s oyster producers must hold their oysters in treated salt water for days before they can legally sell them. This advantage is genuinely rare in the global market, and it is ours.

The challenge, and the opportunity, is to combine that provenance advantage with an oyster that is in condition and available for sale more consistently throughout the year. That is what this scholarship aimed to find a path toward.

Table 1: Travel itinerary and key contacts – Nuffield Australia Scholarship 2024-2026

Date	Location	Visit / Contact
7 Sep 2024	Coles Bay, Tasmania	Giles Fisher — Freycinet Marine Farm
17 Feb 2025	New Zealand	Dr Mark Camara, Research Scientist — NIWA
16 Mar 2025	Whangarei, New Zealand	James Parsons — Nuffield Scholar, Dairy and Sheep Genetics
18 Mar 2025	New Zealand	Joe Donaldson — Moana New Zealand
19 Mar 2025	Nelson, New Zealand	Emmanuel Malpot — Moana New Zealand; Julian Vignier & Megan Scholtens — Cawthron Institute
20 Mar 2025	Marlborough Sounds, NZ	Matthew Pigou, Sales Manager — FlipFarm Systems Ltd
24 May 2025	Beimen Lagoon, Tainan, Taiwan	Luzhugou — Traditional bamboo pole and wild-spat farming systems
22 Jun 2025	Isla Chiduapi, Calbuco, Chile	Ostra Mar — Intertidal rock shoreline farming systems
24 Mar 2026	Streaky Bay, SA	Bryce Porker, Field Scientist — ASI Breeding Program
27 Mar 2026	South Australia	Will Turner — Fresh Eyre Oyster Co (written interview)
3 Apr 2026	Australia	Ken Rowe — Blue Farm Intelligence Pty Ltd / miShell (written interview)
7 Apr 2026	Kasaoka Islands, Japan	Kazuhira 'Peace' Fujii & Yuto 'Braveman' Fujii — Yuwa Fishery
10 Apr 2026	Hiroshima, Japan	Takashi Suzuki — Farm Suzuki; Takehiro Yoshimoto — Seapa
17 Apr 2026	Fanny Bay, BC, Canada	Alex Munro — Taylor Shellfish Canada
23 Apr 2026	Washington State, USA	Bill Taylor — Taylor Shellfish Farms
27 Apr 2026	Australia	Ernest Chuku — University of Tasmania (written interview)
2026	South Australia	Adam Butterworth — Owner, Sea Ready Shellfish (written interview responses)
May 2026	San Diego / Streaky Bay	Center for Aquaculture Technologies — FINAL Conditioning Trial Report received

Acknowledgements

I would like to sincerely thank Nuffield Australia for the opportunity to undertake this scholarship. The chance to step outside the day-to-day demands of running an oyster farm to investigate a South Australian industry-wide issue, by visiting global farmers and some of the best minds in aquaculture science, has been one of the most valuable experiences of my personal and professional life.

I am deeply grateful to everyone who gave their time during my travels and research: Giles Fisher (Freycinet Marine Farm, Tasmania); Dr Mark Camara (NIWA, New Zealand); Emmanuel Malpot and Joe Donaldson (Moana, New Zealand); Julian Vignier and Megan Scholtens (Cawthron Institute, New Zealand); James Parsons (Nuffield Scholar, New Zealand); Matthew Pigou and Aaron Pannell (FlipFarm Systems Ltd, New Zealand); Boyd Way (FlipFarm Systems Ltd, Japan); Henry Hewish and Bryce Porker (Australian Seafood Industries (ASI) Breeding Program); Will Turner (Fresh Eyre Oyster Co); Ken Rowe (Blue Farm Intelligence Pty Ltd); Kazuhira 'Peace' Fujii and Yuto 'Braveman' Fujii (Yuwa Fishery, Japan); Takashi Suzuki (Farm Suzuki, Japan); Takehiro Yoshimoto (Seapa, North Asia); Alex Munro (Taylor Shellfish, Canada); Benoit Eudeline (Taylor Shellfish Farms, USA); Bill Taylor (Taylor Shellfish Farms, USA); Ernest Chuku (University of Tasmania); and Adam Butterworth (Sea Ready Shellfish, South Australia).

The on-farm conditioning trial at Streaky Bay that sits at the heart of this report would simply not have happened without the support and commitment of the Australian Seafood Industries (ASI) breeding program. Henry Hewish, General Manager of ASI, approved and backed the trial from the outset — without that endorsement, the project would never have got off the ground. Bryce Porker (ASI) then brought it to life on the ground, designing the trial layout in collaboration with Henry and Klara Verbyla of the Center for Aquaculture Technologies, placing the families, managing the sampling across six measurement dates, and maintaining the scientific rigour that makes the results credible. The fact that this scholarship has produced genuine, evidence-based scientific findings — rather than remaining a set of observations from farm visits — is directly attributable to Henry's willingness to back the idea and Bryce's skill and dedication in executing it. I am deeply grateful to them both.

Special thanks to Patrick Hone, Chief Executive of the Fisheries Research and Development Corporation (FRDC), whose description of South Australian oyster farming as 'farming in a desert' proved to be a defining observation of the scholarship.

A special mention must also be made of Taylor Shellfish company owner Bill Taylor, who was exceptionally generous with his time, insights and hospitality, welcoming me warmly and going above and beyond to support my scholarship journey.

The final genetic analysis of the Streaky Bay conditioning trial was conducted by the Center for Aquaculture Technologies (CAT), San Diego, California, USA, and designed by Klara Verbyla, CAT. All scientific findings from the trial are entirely the work of CAT and are presented in this report with their full credit and attribution.

This scholarship was proudly sponsored by the Fisheries Research and Development Corporation, Australia’s national fisheries and aquaculture research and development

body, and a co-funded partnership between the Australian Government and the fishing and aquaculture sectors. I am deeply grateful for the FRDC's support.

I also thank my wife Danielle and two daughters for encouraging me to undertake this scholarship and my farming team at Evans Oysters, Streaky Bay (Riley, Baily, Jimi and Zane), who did an amazing job keeping things running in my absence. A final thank-you to my father Tom, with many years of oyster farming experience, who was always available if required.

This report was prepared with the assistance of generative AI tools which were used to help organise and draft material from the author's own notes and research.

Abbreviations

AI	Artificial Intelligence
ASI	(Australian Seafood Industries) The South Australian Pacific oyster selective breeding program
BST	BST Oyster Supplies (Australian oyster equipment manufacturer)
CAT	Center for Aquaculture Technologies, San Diego, California, USA
Cawthron	Cawthron Institute, Nelson, New Zealand
EBV	Estimated Breeding Value
FAO	Food and Agriculture Organisation of the United Nations
Food	Phytoplankton, microalgae, bacteria and other fine particulate organic matter
FlipFarm	The floating basket oyster farming system developed by FlipFarm Systems Ltd, New Zealand
FRDC	Fisheries Research and Development Corporation (Nuffield Australia scholarship sponsor)
GWAS	Genome-Wide Association Study
h^2	Heritability
miShell	Farm management software platform developed by Blue Farm Intelligence Pty Ltd
NIWA	National Institute of Water and Atmospheric Research, New Zealand
POMS	Pacific Oyster Mortality Syndrome
SA	South Australia
SARDI	South Australian Research and Development Institute
SAOGA	South Australia Oyster Growers Association
UTAS	University of Tasmania

Objectives

This scholarship was undertaken with the following objectives:

- To investigate whether genetic improvement, through selective breeding or genomic selection, can shorten the post-spawn conditioning time of Pacific oysters in periodically reduced-nutrient farming environments found across South Australia.
- To understand how oyster farming industries worldwide manage post-spawn conditioning and the practical lessons South Australian producers can draw from international approaches.
- To assess the role of farming techniques, systems and technologies in improving oyster conditioning outcomes and supply consistency in reduced-food environments.
- To evaluate the global competitive landscape for premium single-seed oysters and understand the implications for the South Australian industry.
- To develop practical, evidence-based recommendations on improving post-spawn conditioning performance and long-term competitiveness for South Australian oyster farmers, the ASI breeding program, and the broader industry.

Introduction

The South Australian Pacific oyster industry

South Australia is Australia's largest producer of Pacific oysters. Farming is concentrated particularly around Coffin Bay, Smoky Bay, Streaky Bay, Cowell, Denial Bay, Kangaroo Island and Stansbury — and uses Pacific oysters (Crassostrea gigas) grown predominantly on intertidal leases, with some farmers moving to or trialling one of many floating-style systems.

Australian oysters have an excellent international reputation for presentation quality, food safety and provenance. Australia has a small industry by global standards, producing approximately 15,000 metric tonnes of oysters annually. By comparison, South Korea produces close to 300,000 tonnes and Japan approximately 150,000 tonnes annually (FAO, 2020; Botta et al., 2020). Although small on a global scale, we produce a genuinely premium product.

The post-spawn conditioning problem

Pacific oysters spawn every year during the warmer summer months. The energy used for the spawning process is sourced directly from their stored fat, the plump, white, glycogen-rich meat that makes them worth selling. After spawning, that meat is gone and the oyster is left watery, translucent and impossible to sell.

Getting an oyster back to market condition after spawning requires it to eat by filtering enough food from the water around it to rebuild its energy reserves. In most major oyster-farming regions of the world, food is abundant and oysters recover quickly. However, during different seasons in South Australia, food in the water is scarce, increasing the oyster’s recovery time.

As FRDC Chief Executive Patrick Hone put it to me directly, ‘South Australian oyster farmers are essentially farming in a desert compared to the rest of the world’.

“We farm in something compared to the desert in South Australia”

Patrick Hone, CEO, FRDC

South Australian oyster farmers rely entirely on nutrients brought into our farming area by seasonal upwelling from the deep water of the Great Australian Bight, driven by winds, tides and ocean conditions. When those conditions deliver food, oysters thrive. When they do not, our oysters struggle to condition after spawning.

How POMS made the problem much worse

Prior to 2016, South Australian oyster farmers had a practical solution to the post-spawn conditioning gap: 100% bred triploid oysters sourced from Tasmanian hatcheries. Triploids are sterile, meaning they do not spawn, maintaining condition year-round, and enabling continuous sales through the summer period when diploid oysters are recovering.

In February 2016, Pacific Oyster Mortality Syndrome (POMS) was detected in Tasmania, wiping out more than five million dozen oysters and devastating an industry that represented 37% of Australia's total Pacific oyster production (FRDC, 2016). The response was immediate: a quarantine ban on the movement of live Pacific oyster spat from Tasmania into South Australia that remains in force today.

To establish a local and sustainable source of triploid oysters following the quarantine ban, South Australian hatcheries have spent the past several years developing tetraploid-based triploid breeding programs. While commercial-scale production has not yet been widely available to farmers, significant progress is being made, and industry reports suggest important milestones have recently been achieved.

The dual solution

Through my research I have come to believe that the best solution involves two factors working together.

The first is restoring access to quality triploid spat through South Australian hatcheries. 100% triploids for the summer spawning period would provide farmers with a year-round selling option while their diploid stock recovers condition. This is a near-term fix that the South Australian hatcheries are working on and are reported by SAOGA to be close to achieving.

The second is breeding a diploid oyster that conditions more efficiently and thus returns to market condition faster on the limited food available in our waters during different periods. This is a long-term genetic improvement goal, but the evidence gathered during this scholarship suggests it is achievable. Importantly, if the genetic gains can be delivered, they have the potential not only to provide improved post-spawn recovery but also to produce oysters with greater meat condition during favourable growing periods. If both tools are working together, SA farmers could potentially supply premium oysters for most months of the year: triploids through summer and fast-conditioning diploids for the remainder of the year.

But beyond just solving our supply consistency problem, there is a bigger prize. An oyster that conditions consistently to a high standard in the clean, nutrient-reduced water of coastal South Australia would be a product unlike anything else available globally — combining world-class food safety and provenance with the kind of plump, consistent condition that currently only farmers in nutrient-rich waters can reliably produce. That is an unbeatable product in any premium market.

Section 1: Understanding the problem — The conditioning gap in South Australia

What conditioning actually is

When an oyster is 'in condition' it means its meat is fat, white and plump, filling the shell and market ready. That condition comes from glycogen, the stored energy that the oyster builds up by filtering and consuming food from the water. Upon spawning, the oyster utilises its stored energy for reproduction, resulting in a substantial loss of meat condition. Getting the condition back requires the oyster to eat enough to rebuild reserves. In low-food or poor-quality food environments, reconditioning takes significantly longer after spawning compared to high food environments.



Figure 1: A well-conditioned oyster showing a strong adductor muscle and the nice white, plump glycogen cover with the meat filling the shell. (Source: Author)

Bryce Porker, the lead scientist on the ASI Breeding Program conditioning trial, highlighted the significance of the conditioning gap when stating, ‘if oysters can recover condition significantly faster after spawning, they could be market-ready within four weeks rather than four months, increasing revenue and reliable market supply' (Porker, B., pers. comm., 2026).

Why our waters are different

Most of the major oyster-farming regions of the world operate in sheltered bays, estuaries or enclosed coastal environments rich in nutrients. The result is a constantly replenished food supply supporting oysters to condition, even after spawning.

Across much of the Eyre Peninsula, including Streaky Bay, the farming areas are open coastal with no significant river or estuary feeding nutrients into the waters. Instead, the ocean brings food through the upwelling of deep water from the Great Australian Bight. Under the right seasonal conditions, the deep, cold, nutrient-rich waters rise to

the surface, supporting oyster growth and condition. However, when conditions do not align, food availability is scarce, causing oyster growth and conditioning to be restricted.

This dependence on deep-sea upwelling is why our conditioning gap varies so dramatically from year to year. In 2025, conditions were good and my oysters were back in condition within two weeks of spawning. In difficult years it has taken many months. There is no reliable way to predict which kind of year it will be, making business planning extremely difficult.

What I came to understand during my travels was that the very same thing that makes our water low in nutrients is what makes it so extraordinarily clean. There is no agricultural runoff, no urban pollution, and no estuarine biological loading. Most of the world's oyster producers must depurate their product prior to sale. This means their oysters are held in cleaned salt water for anywhere between twenty-four hours and seven days to flush out any accumulated contamination. Additionally, in some countries oysters must also be cooked before consumption for safety. In comparison, our oysters come straight out of the water and onto the plate, a rare and valuable thing in the global market.

Our biggest advantage and our biggest challenge come from exactly the same source — the purity of the water we farm in.

The Triple Whammy — when everything hits at once

Dr Mark Camara, the geneticist I interviewed at NIWA in New Zealand, described a concept that stopped me in my tracks. He called it 'The Triple Whammy', and it perfectly captures why South Australian farmers can face a more extreme version of the conditioning problem than almost anywhere else in the world.

The Triple Whammy works like this: If the correct environmental conditions combine, three damaging things can occur simultaneously to our oysters. First, they spawn, depleting their energy reserves entirely. Second, food availability to rebuild those reserves is at its lowest, when needed most, due to unpredictable summer upwelling conditions. Third, summer brings heat. Intertidal oysters across South Australia can be exposed to air temperatures exceeding 40 degrees Celsius at low tide. The combined physiological stress of spawning, minimal nutrients and heat occurring simultaneously is vastly harder to recover from than any one of those factors alone (Camara, M., pers. comm., 2025).

This is not a theoretical concern. The 2025-26 summer season at Streaky Bay provided the starkest possible demonstration of The Triple Whammy during the year this scholarship was being concluded. Official monitoring reports from the South Australian Research and Development Institute (SARDI) documented persistent moderate marine heatwave conditions in the waters near Streaky Bay and Smoky Bay during the summer spawning period, with sea surface temperatures recording up to 1.5 degrees Celsius above the long-term average for the region (SARDI, 2026a; SARDI, 2026b). My oysters spawned during these abnormally warm, food-poor conditions, and by June 2026, six months after the summer peak, they had still not

fully recovered to market condition. This resulted in six months of severely reduced sales, with no reliable end date in sight.

I want to be clear that I am a farmer, not a scientist, and I am not making a formal scientific claim about the precise mechanisms involved. What I can say however is that the SARDI data shows a marine heatwave at my location, my oysters were spawning during that period, food availability in our waters after February was limited compared to other times of the year and for an unusually long period, and what we saw was the worst and most prolonged conditioning gap I have experienced. That is The Triple Whammy, not as a concept from a textbook but as a lived reality on my farm during the concluding year of this scholarship.

There is also a longer-term dimension to this environmental issue that the industry needs to confront. Marine heatwave events off southern Australia are projected to become more frequent and more intense under future climate scenarios. This gives the genetic improvement program described in this report an urgency that goes beyond current conditions. We are not only trying to solve today's problem, we are trying to build an oyster that can condition efficiently in a more difficult climate future.

The commercial reality

Will Turner, Managing Director of Fresh Eyre Oyster Co, described the commercial impact of the conditioning gap directly from his perspective as a wholesaler. In the 2026 season he noted that post-spawn condition had significantly limited his ability to meet demand. When asked whether faster growth or more consistent condition and supply was more important to his business, his answer was clear: 'for our business, more consistent condition and supply would be far more valuable' (Turner, W., pers. comm., 2026). This confirmed that the conditioning problem is not just an issue experienced by my farm, but a statewide challenge limiting what the SA industry can collectively supply to the market.

The financial reality — what the conditioning gap actually costs

The commercial impact of the conditioning gap is straightforward to calculate, even if the experience of living through it is anything but. If an oyster farm is capable of selling product twelve months of the year, each month of lost sales represents one-twelfth of the farm's potential annual income. Lose one month and approximately 8 percent of annual revenue is lost. Lose four months, which is not unusual during a difficult conditioning year, and one third of the business's potential annual income is lost. In the 2025-26 season, with The Triple Whammy of spawning, marine heatwave conditions and reduced food availability combining to extend the conditioning gap well into the middle of the year, the financial impact has been severe.

This is not a small or manageable inconvenience. For most oyster farming businesses, fixed costs of leases, equipment, labour and loan repayments continue regardless of whether there is saleable product in the water. A four-month conditioning gap does not reduce the business's costs by one third, it reduces its income by a third while costs remain largely unchanged. That is the financial reality that makes solving the Pacific oyster conditioning problem so important. Every month of saleable product recovered

through better-conditioning genetics or triploid supply is not just additional revenue, it is the difference between a viable business and a business potentially under serious financial pressure.

Section 2: What the world is doing — Global farm visits and key observations

New Zealand — the most productive leg of the scholarship

New Zealand was where I gathered the richest combination of scientific, farming and commercial insights. The country's oyster industry operates in significantly more productive waters than South Australia and the post-spawn conditioning problem is rarely as chronic for NZ farmers. That context was itself an important finding.

Moana New Zealand — scale, integration and FlipFarm

My visit to Moana New Zealand, hosted by Joe Donaldson, gave me exposure to one of New Zealand's largest and most integrated oyster operations. Moana runs its own hatchery combined with significant FlipFarm operations. The site I visited showed me both the strengths of the system and the importance of site selection, areas with good water movement were highly productive while lower-energy areas at the back of the site presented challenges.

I also spoke with Emmanuel Malpot, Technical and Project Manager at Moana New Zealand, about their approach to breeding and genetics. The conversation reinforced the importance of combining genetic improvement with strong hatchery capability, something larger vertically integrated operations like Moana are better positioned to pursue than smaller operations.

FlipFarm Systems Ltd — what the system actually delivers

My visit to FlipFarm Systems Ltd in the Marlborough Sounds, with Sales Manager Matthew Pigou, was one of the most practically useful visits of the scholarship. Aaron Pannell, FlipFarm’s founder, is the farmer who developed the system to solve his own staffing and equipment failure problems. On his previous bag-based system, Aaron ran 15 to 20 staff across two shifts a week. With FlipFarm he was able to quadruple production and run the entire farm with four staff, improving staff retention dramatically (Pigou, M., pers. comm., 2025).

In terms of conditioning, Pigou detailed that regular flipping improves the quality of the oyster's condition by giving it regular air-dry periods which directs the oyster's energy toward building meat rather than simply filtering water. He also confirmed that one of FlipFarm's South Australian customers uses the system specifically as a finishing tool in the final weeks before sale, and that this SA site is one of the highest-energy FlipFarm sites operating globally.

Cawthron Institute — talking to the scientists

On 19 March 2025 I spent time at the Cawthron Institute in Nelson with Julian Vignier, a Senior Scientist, and Megan Scholtens, a Geneticist researching shellfish genetics. These conversations were among the most technically informative of my travels.

On my specific question, whether we can breed oysters that condition faster on less food, Julian was honest and measured. He explained that conditioning is heavily influenced by food availability and thus there may not be a strong genetic signal for it. However, he added that if a rigorous trial under controlled conditions were to show a genetic signal, it would be worth pursuing (Vignier, J., pers. comm., 2025).

Megan Scholtens engaged with the idea of running a genome-wide study to identify any genes consistently linked to improved conditioning. She described a genome-wide association study (GWAS) as the right tool to find genes influencing complex traits like conditioning. She also emphasised that trial design is critical, with all oysters to be placed in the same environment, measured the same way and at the right time. (Scholtens, M., pers. comm., 2025), which is exactly how the Streaky Bay trial was designed.

James Parsons — lessons from sheep and dairy genetics

James Parsons is a New Zealand Nuffield Scholar with deep experience in sheep and dairy genetics. Visiting him at his farm near Whangarei gave me a cross-industry perspective that no oyster scientist could provide.

James immediately understood my conditioning problem in livestock terms: 'That is basically feed efficiency, getting an animal to put on weight faster on the same amount of food. That is a trait the sheep and beef industries have chased hard' (Parsons, J., pers. comm., 2025). His most important warning was to never chase one trait without keeping an eye on everything else. Instead, set a minimum standard that your oysters must meet on shape, growth, survival and disease resistance, and then select for conditioning on top of that.

Taiwan — traditional methods and changing tastes

My visit to Luzhugou, an oyster farming operation in the Beimen Lagoon area of Tainan on 24 May 2025, was one of the most striking contrasts of the scholarship. The scale of farming in Beimen Lagoon was extraordinary with vast arrays of bamboo poles and traditional raft structures stretching across the lagoon as far as the eye could see, producing oysters at a volume that dwarfs anything I have seen. Unlike in Australia, these oysters are grown for meat quantity, not presentation quality. Given the Taiwanese water quality and production conditions, the oysters are unsuitable for raw consumption. Instead, they are produced as ingredients for soups, sauces and traditional Taiwanese dishes, rather than for a premium half-shell plate.

This was a vivid illustration of the market divide that defines the global oyster industry. While Taiwan is producing enormous volumes of low-cost, cooked-use product, South Australia produces small volumes of premium, eat-it-raw, half-shell oysters that can be

consumed directly from the water without further treatment. This underlines why our clean-water provenance story has genuine commercial value in any premium market.

An interesting observation during discussions was a generational shift beginning to emerge among younger Taiwanese consumers with a growing interest in the western-style experience of individual, premium half-shell oysters.

Chile — clean water farming on the shorelines

My visit to Ostra Mar on Isla Chiduapi, near Calbuco in the Los Lagos region of Chilean Patagonia, on 22 June 2025 exposed me to a farming method radically different from anything I had seen previously. Chilean operators employed divers to collect oysters from the seabed; once collected, they spread them along solid rock shorelines and covered them with nets to protect against birds. The tidal range was extraordinary, extending up to 6.5 m, providing natural water exchange and air-dry cycles on a scale impossible to engineer artificially.

With excellent water quality and cleanliness, the oysters could be consumed straight from the water, much like in South Australia. Chile is beginning to trial Pacific oysters alongside its native species, an investigation worth monitoring.

Japan — tradition, innovation and the technology transition

Japan was one of the most eye-opening stops of the scholarship, with the country producing approximately 146,000 metric tonnes of oysters per year, roughly ten times Australia's total output. With abundant nutrient availability the oysters were in outstanding condition, and the conditioning challenge is essentially non-existent. This was a direct and vivid confirmation of Patrick Hone’s SA oyster farming comparison to farming in a desert.

Yuwa Fishery, Kasaoka Islands

On 7 April 2026 I visited Yuwa Fishery on the Kasaoka Islands, a fourth-generation family oyster farming business run by Kazuhira 'Peace' Fujii and his son Yuto 'Braveman' Fujii. The Fujii family is in the process of transitioning from traditional raft farming to FlipFarm with significant government support. Specifically, they are investing in 90 lines of FlipFarm with approximately 30,000 baskets and triploid spat to produce a premium year-round product for the half-shell market, with an annual target of 300 tonnes.

Japan currently produces only 2% of its oysters as a single-seed half-shell product. Takehiro Yoshimoto from Seapa explained there is potential for this figure to grow substantially as Japan progresses to the single-seed farming method. He also highlighted that South Korea produces roughly double Japan's volume and is watching the same trends closely (Yoshimoto, T., pers. comm., 2026).

Farm Suzuki, Hiroshima

On 10 April 2026, I visited Takashi Suzuki at Farm Suzuki in Nakaku, Hiroshima, one of the most technologically controlled oyster farms I saw during the scholarship. Suzuki operates a system called the Seaducer, a programmable timed lifting system that can raise and lower oyster baskets in and out of the water up to 50 times a day. Following three years of operation, Suzuki found that providing oysters with more dry time than naturally received accelerated growth. This programmable system has enabled Farm Suzuki to increase workflow efficiency, employing only five to seven people to produce high-quality products at an accelerated rate.

Canada and United States — Taylor Shellfish

The North American leg of the scholarship centred on Taylor Shellfish, one of the world's largest and most respected shellfish farming companies, and its owner Bill Taylor.

Fanny Bay, British Columbia — the G3 system

On 17 April 2026, I visited Taylor Shellfish's Fanny Bay operation in British Columbia with Alex Munro, Director of Farming and Processing. Taylor Shellfish has developed its own proprietary floating basket system, the G3, which keeps oysters continuously submerged. The G3 system is enormous in scale, with individual baskets holding up to 400 sale-size oysters, and the system including a fully mechanised harvesting vessel. Taylor Shellfish combines the G3 with their traditional intertidal beach farming by currently growing their own hatchery produced oysters in the floating system until they reach 40 mm, where they are then transferred to traditional beach leases to finish. This hybrid approach combining new and old technology drastically increased survival.

Washington State — Bill Taylor

My two days with Bill Taylor, including the interview on 23 April 2026, were one of the most commercially informative periods of the scholarship. On genetics, his opinion was unequivocal: 'You can have the most efficient machine in the world, but if you do not have the oysters [with the desired genetics] to put in it, it is pointless' (Taylor, B., pers. comm., 2026). On market positioning he advised against becoming a commodity at all costs. Taylor Shellfish markets a brand, not just a product, and uses a wide range of markets, species and processing methods to protect itself from any single market shifting.

'You can have the most efficient machine in the world, but if you do not have the oysters [with the desired genetics] to put in it, it is pointless' (Taylor, B., pers. comm., 2026).

Section 3: The genetics pathway — What I learned from scientists and breeders

How the current Australian breeding program works

Australia has been running a formal Pacific oyster selective breeding program through the industry-owned ASI program for approximately twenty-five years. The program maintains around 80 different genetic family lines spread across multiple farm sites in South Australia. Each year the scientists measure the performance of all the families to identify the top performers. The best families are then used as parents for the next generation, and the top performing families are made available to commercial hatcheries.

The Australian program is considered one of the most advanced of its kind for a shellfish species globally. Its biggest achievement to date has been improving oyster survival and disease resistance (Porker, B., pers. comm., 2026).

The limitation of the current approach — and how genomics can change it

The existing breeding program is effective; however, it has one important limitation that Dr Mark Camara, a geneticist at NIWA in New Zealand, highlighted. When selecting by family, every oyster in the same family is treated as genetically identical for selection purposes. However, even within the same family, individual oysters can have significant genetic variability. The current program is incapable of identifying which sibling carries the optimal genes.



Figure 2: This shows the real impact genomic selection will potentially have on the oyster industry. This one tray is a single family. These oysters are treated as genetically identical for selection purposes. It is clear to see there are two standout individuals that are well conditioned, with the other three being of poor quality. Genomic selection may potentially give the ability to identify the individuals with the superior genes. (Source: Author)

Addressing this key limitation of the current program may be achieved with genomic selection. Through this process, a small DNA sample from each individual oyster is taken and thousands of genetic markers are analysed, enabling scientists to estimate the genetic potential of each individual animal, not just the family average. Dr Camara explained that this will approximately double the speed of genetic improvement, making it a significant and welcome development (Camara, M., pers. comm., 2025). Ernest Chuku from the University of Tasmania confirmed that ASI is already beginning to implement genomic selection in partnership with UTAS (Chuku, E., pers. comm., 2026).

The big question — can we select for conditioning?

The central question I brought to every scientist and geneticist was ‘can we find and breed for a genetic trait that allows an oyster to condition faster on less available food?’

Based on what I’ve observed on my own farm, I believe conditioning efficiency and growth rate are different traits. I have watched family lines that have excellent growth, great shape and impressive size, open up with mediocre condition, and other slower growing families open with outstanding fat and glycogen. These oysters were grown in the same water, on the same farm, under the same management, leaving genetics as the only explanation for the difference in conditioning (Camara, M., pers. comm., 2025).

James Parsons described what I was looking for as a feed efficiency trait, the ability to increase growth with reduced food (Parsons, J., pers. comm., 2025). Parsons drew a comparison to the broiler chicken industry which has utilised sustained genetic selection to reduce the time from hatching to market weight from 70 days to fewer than 30. This comparison was similarly made by Bill Taylor during my visit to Taylor Shellfish, USA (Taylor, B., pers. comm., 2026).

Julian Vignier from Cawthron and Megan Scholtens described the challenge of identifying the specific genes involved in conditioning due to the process likely being controlled by many genes working together (Vignier, J. and Scholtens, M., pers. comm., 2025). Despite this, they confirmed that if a trait showed a meaningful genetic signal in a well-designed trial, the study would be worth pursuing.

A critical question — will it work when food is plentiful too?

One of the most important questions I raised during the scholarship, and one any sceptic would rightly ask, was ‘if we breed an oyster that conditions more efficiently in a low-food environment, will that advantage carry through when food is plentiful?’

This question was prompted by my experience during the scholarship where I spoke to beef, sheep and chicken producers regarding how essential the feed conversion ratio is to genetic selection in their industries. I wanted to understand whether what we were pursuing in our Streaky Bay oyster trial was essentially the same concept, so I put this question directly to Klara Verbyla, the CAT scientist who co-designed and analysed the trial. Her answer was one of the most important scientific confirmations of the scholarship. She explained that the trial is essentially getting closer to selecting feed conversion ratio in oysters. The biological theory is that it is all about energy

partitioning, what the oyster does with the energy it has available at any given time. An oyster that is genetically wired to direct its available energy into building condition should, in theory, do so at least as well or better when food is abundant as it does when food is scarce. The trait is about efficiency of conversion, not just performance under stress (Verbyla, K., pers. comm., 2026).

Klara did add an important scientific caveat that this should be verified by checking whether the top-performing families in the low-food trial also rank well for conditions at a different time of year when food availability is higher. She suggested that, for example, placing the best-performing families from this trial into a higher-food environment and checking whether their superior ranking holds would give strong evidence that the trait is real and transferable (Verbyla, K., pers. comm., 2026).

This confirmation from the scientist who helped design the trial gives the central ambition of this scholarship its strongest scientific grounding yet. We are not just trying to breed an oyster that copes better in a desert. We are trying to breed an oyster that converts food into condition more efficiently than its competitors, and if we succeed, that efficiency advantage will show up year-round, in successful and challenging seasons alike.

Section 4: The on-farm trial — What CAT's analysis found

Why we ran this trial

The conditioning trial running on my farm in Streaky Bay is the most direct and tangible outcome of this scholarship. The idea was straightforward: take a range of genetic family lines used commercially by South Australian hatcheries and put them on the same farm under identical conditions, to measure which family line conditions fastest post spawning.

The trial was designed by Klara Verbyla (CAT), Henry Hewish (ASI), and Bryce Porker (ASI), a Field Scientist with the ASI Breeding Program who also ran the field trial. Bryce placed oysters from 20 different family lines across three different year groups into randomised baskets, at a consistent stocking density, on the farm's lines. The oysters' condition was measured at six points through the December 2025 to May 2026 period using the standard industry condition index, which compares the weight of the oyster's meat to the weight of its shell and whole body.

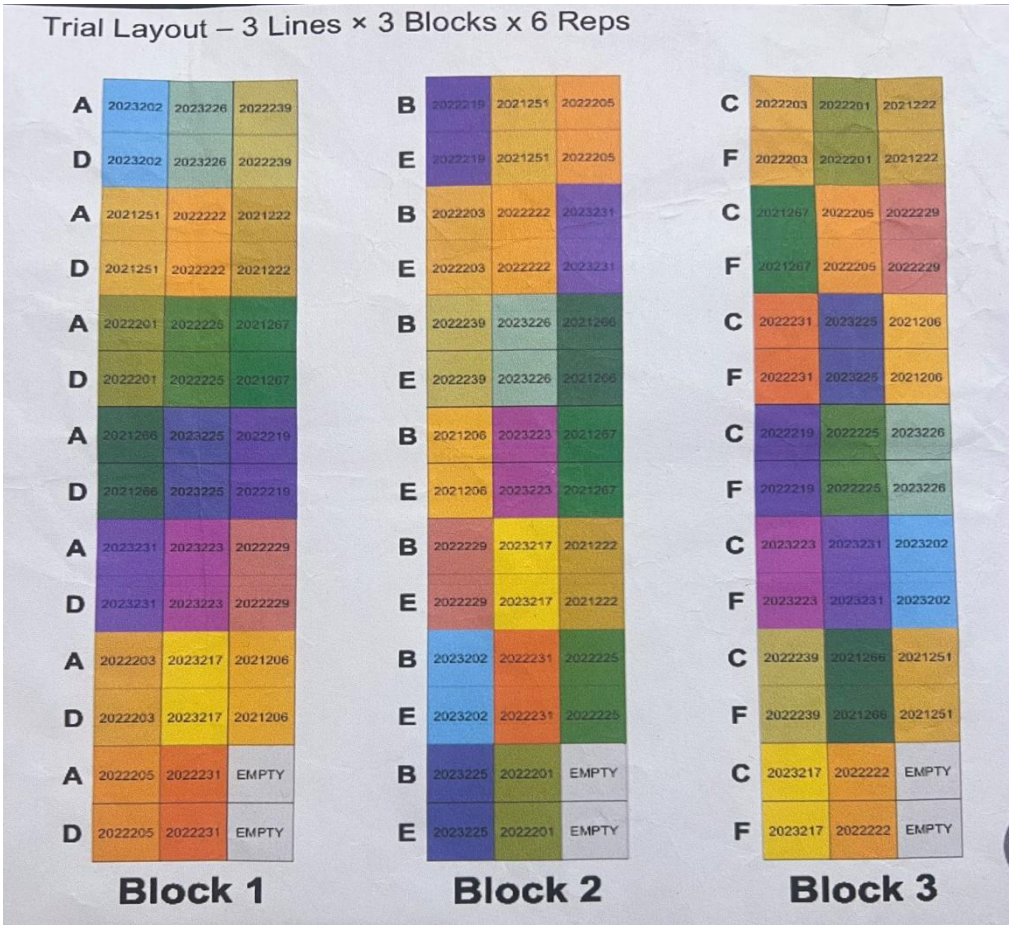


Figure 3: Trial layout for the Streaky Bay conditioning trial — 3 Lines × 3 Blocks × 6 Replicates. Each family line (identified by colour) is randomised across positions within each block to remove any environmental bias from position on the line. Trial design by Klara Verbyla, Center

for Aquaculture *Technologies* (CAT). Analysis conducted by CAT (Source: Center for Aquaculture Technologies, 2026).

The final genetic analysis of the trial's data was conducted by the Center for Aquaculture Technologies (CAT) in San Diego, California, USA, an international aquaculture science organisation with no connection to the Australian industry and no stake in the outcome. All trial analysis findings and conclusions belong entirely to CAT and are presented here with their full credit and attribution.

What CAT found — in plain terms

The results that CAT returned were more encouraging than I had dared hope, and stronger than some of the previous scientific literature had suggested possible.

The headline finding is this: genetics plays a meaningful role in how fast an oyster conditions in a low-food environment. Some family lines are genuinely, consistently better conditioners than others in our environment. CAT has now scientifically confirmed what I have suspected for years based on what I've observed on my own farm.

Prior to expanding on CAT's findings, it is worth addressing a question that any informed reader might ask: if there is a genetic signal for conditioning, why did previous research not find it? The honest answer comes down to when and how the measurement was taken. Previous research used data from the existing ASI program, which measures oyster condition at a single point in the year, typically well after the post-spawn recovery period has occurred. This is like trying to understand how a drought affected a crop by only looking at the paddock at harvest. By the time you look, the story has already played out. This trial was specifically designed to measure at multiple points through the post-spawn recovery window, starting from the beginning of the spawning process.

Table 2: Summary of CAT's FINAL genetic analysis findings across six measurement dates. (Source: Center for Aquaculture Technologies, 2026).

Measurement Date	Heritability Estimate	What this means in plain terms
12 December 2025	0.60 — High	Strong genetic signal — the difference between oysters is genetic
17 December 2025	0.66 — High	Strongest early result — genetics clearly driving conditioning differences
22 January 2026	0.37 — Moderate	Genetic signal still present but environment becoming more influential
05 February 2026	0.32 — Moderate	Families still separated but gap narrowing as season progresses

06 March 2026	0.30 — Moderate	Genetics still meaningful — some families consistently ahead throughout
07 May 2026	**0.82 — Very High**	**FINAL RESULT: Strongest genetic signal of the entire trial — families clearly separated again over the longer recovery window**

As depicted in Table 2, the genetic signal was strongest in December 2025 at h^2=0.66, and gradually reduced through January, February and March 2026 as the spawn-out season progressed. CAT interprets this as the environment becoming more influential over time as its conditions change through the season.

Unexpectedly, the genetic signal had a stronger recording at the final measurement in May 2026 (h^2=0.82) than recorded at the trial's beginning (h^2=0.60), with May's recording being the strongest result of the whole study. CAT's analysis explains that over the longer March-to-May window, oyster condition had clearly separated the families from each other again, meaning genetics matters at two points in the oyster cycle: immediately at the beginning of spawning, and again over the longer recovery period that follows. Both windows offer real opportunities to select better-conditioning families.

Why this matters & what happens next

Given the trial families are already in the commercial hatchery system, the most exciting aspect of the trial's findings is how quickly they can be translated from research to practical industry benefit. Looking ahead five years, Bryce Porker envisions oyster farmers in every South Australian bay selling for 11 months of the year if they choose (Porker, B., pers. comm., 2026). Recent trial results suggest this is achievable; however, it is dependent on trial continuation. ASI is currently considering the future of the research, with the trial potentially being scaled back to best utilise available time and resources while still collecting key data. Ultimately, trial continuation will be dependent on funding availability.

Section 5: A South Australian hatchery perspective — Sea Ready Shellfish

To ground the recommendations of this report in commercial hatchery reality, I put a series of written questions to Adam Butterworth, owner of Sea Ready Shellfish, a South Australian oyster hatchery with direct experience supplying the industry with spat from ASI-program family lines. His responses provided a very frank, technically informed and commercially grounded perspective.

On the question of whether post-spawn conditioning is a concern at the hatchery level, Adam's answer was informative. In a controlled hatchery environment, the conditioning picture looks very different to what happens at sea. Under optimised hatchery conditions where broodstock is fattened and conditioned specifically for spawning runs, the time from spawning to full condition can be as little as eight weeks, compared to the typical 12-month cycle at sea. This means that variation between family lines in conditioning speed can appear in days rather than months in the hatchery. However, Adam noted that recovery after spawning in the grow-out environment is the dimension he is particularly interested in, with a specific curiosity in the sequence of spawning between different family lines: which families spawn first, which spawn later in the season, and whether selecting lines that spawn later in the season and those that condition quickly could extend the commercial selling window (Butterworth, A., pers. comm., 2026).

On the commercial value of faster post-spawn conditioning, Adam was direct: 'It would certainly be an advantage to identify lines that reach condition quicker post-spawn. I think it would also be an advantage to select lines that spawn later. Providing glycogen-rich oysters in late summer and early autumn to the market would be the greatest benefit. In my view, faster recovery would certainly improve profitability with more oysters being sold during high demand periods and well before winter when demand slows. I also think growers could sell at a slightly higher price during periods of peak demand' (Butterworth, A., pers. comm., 2026).

This perspective from a commercial hatchery is significant. It confirms that the financial benefits of breeding oysters for faster post-spawn conditioning are clearly recognised across the hatchery sector. It also adds an important dimension that the trial data could potentially capture, the value of selecting not just for faster conditioning after spawning, but for family lines that spawn later in the season to provide farmers a longer window of saleable product before the conditioning gap begins.

Adam also made an important observation about the relationship between conditioning and other traits. He noted that oysters that devote energy toward fattening rather than shell growth are likely to be more resilient in general, which makes conditioning efficiency a positive selection trait beyond just the commercial benefits. His biggest concern, however, is that oysters that fatten quickly post-spawn may also be the ones that spawn earliest in the season, meaning that while they recover well, they may also create an earlier conditioning gap. This is the kind of nuanced trade-off that a multi-trait breeding program needs to account for (Butterworth, A., pers. comm., 2026).

On the pathway from the CAT trial results to hatchery adoption, Adam confirmed that given the evidence from the Streaky Bay trial, faster post-spawn conditioning can be

integrated into hatchery breeding programs at the between-family level relatively easily. He noted that within-family selection for this trait is more difficult and would require marker-assisted selection, the genomic approach that ASI is currently beginning to implement in partnership with the University of Tasmania (UTAS). Adam also made a practical suggestion that closely mirrors Klara Verbyla's cross-environment validation recommendation: running side-by-side trials of the best and worst conditioning families identified by CAT, in real grow-out conditions to provide growers with visible and undeniable evidence of the trait's commercial relevance (Butterworth, A., pers. comm., 2026).

Adam's view on the next five to ten years of oyster breeding was equally interesting. He believes the focus will increasingly move toward combining multiple desirable traits into a single cross, producing an oyster that grows fast, conditions well, and survives adverse environmental conditions. He sees this as achievable but notes that the challenge will be maintaining a large enough breeding pool to achieve it. His final observation was perhaps the most practically important of all: 'To ensure this research has real industry impact; it is simply a matter of showing growers the stock in real time in each bay. If growers can see fat stock at the same time they are having trouble moving other oysters into the market, they will support the research — there is no grey area' (Butterworth, A., pers. comm., 2026).

This last point deserves emphasis. The most powerful argument for the conditioning genetics program is not a scientific paper or a heritability estimate. It is a farmer opening a basket of oysters from a top-performing CAT / ASI family line at the same time as their other skinny and watery stock and seeing the difference for themselves. That is the demonstration that will build industry support for this work.

Section 6: Technology and better farm data

Why data matters for the conditioning problem

One aspect that stood out to me during the scholarship was how little systematic data most oyster farmers, including myself, have historically kept on conditioning performance. As farmers, we talk about conditioning performance constantly and know which years are favourable and unfavourable; however, most of this knowledge is carried in our heads, meaning it is gone when someone leaves or a season is forgotten.

This was specifically highlighted through my conversation with Ken Rowe, the owner of Blue Farm Intelligence and the miShell farm management platform, who made the point clearly: 'Post-spawn recovery has always been discussed between farmers but has never had a reliable, consistent measure. Without recorded data farmers cannot identify what caused a good or bad year, cannot compare the performance of different genetic lines, and cannot measure whether changes made are beneficial' (Rowe, K., pers. comm., 2026).

Farm management software like miShell has changed this and enabled farmers to systematically record batch history, grading results, stocking densities, line heights, stock movements and condition measurements over the full life of every batch of oysters. Over time, this builds a data set that can reveal patterns in which lines perform better in which locations, how stocking density affects conditioning, and whether certain management practices correlate with better recovery times.

Connecting farm data with environmental data

The more powerful application would be combining farm production data with environmental data like water temperatures, tidal patterns, wind direction, and food availability indicators. This combination of data would enable farmers to ask and answer questions with no current answers, such as: does this year's poor conditioning correlate with specific upwelling patterns?

Ken Rowe described this missing link as the connection between hatchery genetics data and the downstream farmer. Currently, even if a hatchery knows which family line they provided you, that information is not systematically tracked through to your farm's performance records. Closing that loop so farmers can identify which genetic family lines condition best on their farm is one of the most valuable developments the industry could pursue (Rowe, K., pers. comm., 2026).

Artificial intelligence and the future

Looking further ahead, the combination of quality farm data and emerging AI tools creates new possibilities that would have seemed far-fetched even a few years ago. The University of Tasmania is already exploring AI-based image analysis as a tool for assessing oyster condition more consistently and efficiently than current manual methods. Ken Rowe was direct about the stakes stating that for many businesses,

adopting these tools will not be optional, they will be the difference between staying competitive and falling behind (Rowe, K., pers. comm., 2026).

Section 7: The bigger picture — Where the global industry is heading

Where South Australia genuinely leads the world

After visiting oyster farms across seven countries, I came back with a clearer and more honest view of where South Australian oysters stand in the global market. There are areas where we are industry leading, and areas where we face a real gap.

What South Australia does better than almost anywhere is our food safety story due to water quality. The vast majority of the world's oyster-producing regions must depurate their product before sale, meaning their oysters are held in filtered clean saltwater systems from one to seven days to purge accumulated contamination. Some countries also require their oysters to be cooked prior to consumption for safety. In contrast, South Australia's pristine waters allow our oysters to be enjoyed fresh and untreated. It is rare, it is real and it is ours.

Australia also leads the world in farming technology and industry organisation. As Takehiro Yoshimoto from Seapa Japan explained, farmers across Asia look to Australia as the benchmark for how oysters should be farmed. Our selective breeding program is among the most advanced of its kind for any oyster industry globally, and our equipment manufacturers are exporting their products and expertise around the world.

Where we face a genuine gap

The condition, the actual meat fill and plumpness, of oysters I saw in nutrient-rich environments during my travels was often exceptional. The abundance of food in waters I visited produced an oyster that is consistently, reliably plump in a way that is genuinely difficult to match year-round in our more inconsistent farming environment, especially after spawning.

South Australian oysters can be outstanding at certain times of the year. When conditions are right, our oysters are as premium as any I’ve seen or tasted globally. The challenge is that favourable conditions are not consistent or predictable enough to build a reliable premium business around. That is the gap this scholarship is trying to close. Not by changing what our oysters are, but by extending the period during which their natural excellence is reliably available.

The global technology adoption story

One of the most significant things I observed across my travels is the speed at which Australian and New Zealand single-seed farming technology is being adopted internationally. In Japan, South Korea and the United States of America, farmers are actively moving toward the modern floating systems that New Zealand and Australian companies pioneered. This is happening with active government support in countries

like Japan, where rural community development policy is driving investment in farming modernisation.

This is a genuine success story for the Australian and New Zealand oyster equipment manufacturing industry. Companies including FlipFarm Systems Ltd, Seapa, BST and several other manufacturers are seeing growing international demand for their equipment, systems and expertise as international markets develop.

Why solving the conditioning gap matters beyond the farmgate

Everything in this report has been focused on the conditioning gap as a farm-level and industry-level problem with months of lost sales, limited wholesaler commitments, and an inability to supply reliably through the summer and early autumn. All of that is real, but there is a broader strategic dimension that became clearer to me the more I travelled, and which I think the industry needs to be aware of.

The premium live oyster market, the fresh, half-shell experience that SA oysters primarily serve, is currently well protected. Geographic isolation, food safety credentials and provenance are genuine advantages. The frozen half-shell category is different, and it is where the strategic risk sits. Australia does have a frozen oyster sector, though fresh is overwhelmingly the primary focus today. The concern is not so much disruption to the existing frozen business; it is the potential loss of a future growth opportunity before Australian producers are positioned to take it.

Once oysters are individually quick frozen and distributed through cold-chain logistics, most of the geographic and freshness advantages that protect our live market disappear. Quality, consistency and price become the deciding factors, not proximity to market.

Takehiro Yoshimoto of Seapa told me that Japan has a stated ambition to grow single-seed half-shell production from approximately 2% of total output toward 20%. South Korea, which Yoshimoto noted produces roughly double Japan's volume, is also actively modernising its industry. The Korean Ministry of Fisheries plans to transition 30% of the country's total oyster production to single oysters by 2030, currently accounting for just 1% (We Are Aquaculture, 2025). If even a fraction of that expanded production finds its way into frozen export channels, the volumes involved would be significant (Yoshimoto, T., pers. comm., 2026).

Here is the direct connection back to this scholarship's central purpose. The only way Australian producers can compete credibly in premium frozen half-shell, or serve premium live markets consistently year-round, is with high-quality product available every month of the year. This is exactly what the post-spawn conditioning gap prevents us from delivering.

Solving the conditioning problem through faster-conditioning genetics, reliable triploid access, and improved farming systems is therefore not just about fixing farm cash flow. It is the prerequisite for consistently being able to compete in the premium global oyster trade. A South Australian oyster that conditions consistently year-round, grown in some of the cleanest water in the world, with no depuration required, would be genuinely competitive in both live and frozen premium channels.

The appropriate response for the South Australian industry is not alarm; it is investment. Investment in genetics, so our oysters condition more consistently and maintain a quality edge. Investment in brand and provenance, so consumers understand what makes SA oysters unique. Investment in traceability, so the clean-water story can be verified and communicated all the way to the consumer.

We need to produce quality oysters all year round, with our consumers educated in the uniqueness of the waters they are grown in

Conclusions

I set out on this scholarship as an oyster farmer looking for practical answers to a practical problem. Two years later, several possible answers have surfaced: not a single silver bullet, but a clear set of interconnected solutions that I believe can genuinely transform the commercial performance of SA oyster farming in inconsistent food environments.

The post-spawn conditioning problem in South Australia is real, commercially serious and directly linked to the inconsistent nutrient availability in our open coastal farming waters. It was made significantly worse when the POMS outbreak in Tasmania in 2016 forced a quarantine ban on Tasmanian spat, cutting off our access to quality triploid oysters that had previously filled the summer conditioning gap. The 2025-26 season, in which SARDI-documented marine heatwave conditions near Streaky Bay and Smoky Bay coincided with summer spawning and reduced food availability, resulted in my oysters still not having fully returned to saleable condition by June 2026. This is The Triple Whammy that Dr Camara described playing out on my farm, in the concluding year of this scholarship.

- Genetics does play a meaningful role in how fast an oyster conditions in a low-food environment. The final analysis conducted by CAT on the Streaky Bay trial data found a clear and significant genetic signal. The final measurement in May 2026 ($h^2 = 0.82$) was the strongest result of the entire trial, showing that genetics matters both immediately at the beginning of spawning and again over the longer recovery period.
- Improved conditioning will depend on the combined use of selective breeding and genomic selection. The ASI program's transition toward genomics, in partnership with UTAS, should now include conditioning efficiency as a selection target alongside survival and disease resistance.
- Restoring reliable access to quality triploid spat through SA hatcheries is the most immediate practical solution available. Combined with fast-conditioning diploids through genetic improvement, the industry could have a more consistent year-round supply, with triploids available through summer and well-conditioned diploids supplying the market for the remainder of the year.
- The perspective from Sea Ready Shellfish confirms the commercial hatchery sector's readiness to act on the CAT trial findings. The most powerful demonstration will be showing growers the difference in conditioning between top and bottom family lines in their own bays.
- Data-driven farm management is not optional; it is the foundation on which all other improvements will be built, measured and validated.
- South Australia's greatest competitive asset, the pristine clean water in which our oysters grow, is also the source of our greatest production challenge. An oyster that consistently achieves excellent condition in these waters will be genuinely unbeatable in premium markets.
- Solving the conditioning gap problem is not just a farm-level priority; it should be a strategic prerequisite to assist the SA industry to compete in premium frozen and live channels year-round before the opportunity becomes more contested.

Recommendations

For individual oyster farmers in South Australia

- Implement farm management software such as miShell to start building a reliable record of conditioning performance across seasons, genetic lines and management approaches.
- Advocate strongly for SA hatcheries to continue the development of tetraploid-based triploid programs. Recent reports indicate significant progress is being made, and it is important that this momentum continues.
- Support the ASI breeding program, and advocate to relevant industry and government bodies for continued funding of these projects, with the conditioning trait prioritised alongside disease resistance and survival in future genomic and selective breeding runs.

For the ASI breeding program and industry bodies

- Formally add post-spawn conditioning efficiency as a selection trait in the ASI breeding program, based on the now-confirmed final CAT trial findings.
- Design measurement protocols that specifically capture conditioning through the post-spawn recovery period, including the longer recovery window through to May, which the results show can carry an even stronger genetic signal than the early post-spawn period.
- Accelerate the adoption of genomic selection and include conditioning efficiency as a priority trait alongside survival and disease resistance. The partnership with UTAS is the right foundation.
- Run side-by-side demonstration trials of the top and bottom conditioning families identified by CAT across multiple South Australian farming bays. Making the difference visible to farmers in their own environment is the most powerful way to build industry-wide support for the conditioning genetics program.
- Establish cross-farm genetic linkages across different SA bays to confirm that superior conditioning families perform consistently well across multiple locations with varying food availability.

For the broader South Australian oyster industry

- Invest in building and communicating the provenance, food safety and clean-water story of South Australian oysters as a deliberate strategic priority.
- Work toward full life cycle traceability from hatchery genetics to consumer, so that the quality and provenance of South Australian oysters can be verified and communicated at every point in the supply chain.
- Never stop innovating. The countries adopting Australian farming technology today will develop their own capabilities over time. Australia's position at the

front of the global oyster industry is earned, not given, and it must be continuously renewed.

References

Published references

Botta, R., Asche, F., Borsum, J.S. and Camp, E.V. (2020) ‘A review of global oyster aquaculture production and consumption’, *Marine Policy*, 117, p. 103952. doi: 10.1016/j.marpol.2020.103952.

Center for Aquaculture Technologies (2026) *ASI condition trial analysis: Streaky Bay 2025–2026*. Final report (unpublished). San Diego, CA: Center for Aquaculture Technologies.

FAO (2020) *The state of world fisheries and aquaculture 2020: sustainability in action*. Rome: Food and Agriculture Organization of the United Nations. doi: 10.4060/ca9229en.

FRDC (2016) ‘National impact from Tasmanian POMS outbreak’, *FISH*, 24(2), June. Canberra: Fisheries Research and Development Corporation. Available at: https://www.frdc.com.au/node/8474

PIRSA (2020) *Pacific Oyster Mortality Syndrome (POMS)*. Adelaide: Department of Primary Industries and Regions South Australia. Available at: https://pir.sa.gov.au/poms (Accessed: 30 October 2026).

SARDI (2026a) *South Australian algal bloom situation update: 27 January 2026*. Adelaide: South Australian Research and Development Institute, Department of Primary Industries and Regions. Data sourced from the Bureau of Meteorology and Australia’s Integrated Marine Observing System (IMOS).

SARDI (2026b) *South Australian algal bloom situation update: 24 February 2026*. Adelaide: South Australian Research and Development Institute, Department of Primary Industries and Regions. Data sourced from the Bureau of Meteorology and Australia’s Integrated Marine Observing System (IMOS).

Waycott, B. (2016) ‘Oysters and farming methods make inroads into Japan’, *The Fish Site*, 2 February. Available at: https://thefishsite.com/articles/oysters-and-farming-methods-make-inroads-into-japan

We Are Aquaculture (2025) ‘South Korea announces “vision of becoming the world’s No. 1 oyster-exporting country”’, *We Are Aquaculture*, 9 January. Available at: https://weareaquaculture.com/news/aquaculture/south-korea-announces-vision-of-becoming-the-worlds-no-1-oyster-exporting-country

Personal communications

Butterworth, A. (2026) Owner, Sea Ready Shellfish, South Australia. Written interview responses, 2026.

Camara, M. (2025) Research Scientist, National Institute of Water and Atmospheric Research (NIWA), New Zealand. Personal interview, 17 February 2025.

Chuku, E. (2026) Researcher and Geneticist, University of Tasmania. Written interview responses, 27 April 2026.

Donaldson, J. (2025) Moana New Zealand. Personal visit, 18 March 2025.

Fisher, G. (2024) Owner, Freycinet Marine Farm, Coles Bay, Tasmania. Personal visit, 7 September 2024.

Fujii, K. and Fujii, Y. (2026) CEO and Oyster Blender / 4th Generation, Yuwa Fishery, Kasaoka Islands, Japan. Personal visit, 7 April 2026.

Hewish, H. (2026) General Manager, Australian Seafood Industries (ASI). Personal communication, 2026.

Hone, P. (2025) Chief Executive, Fisheries Research and Development Corporation (FRDC). Personal communication, ABARES Outlook Conference, Canberra, 2025.

Malpot, E. (2025) Technical and Project Manager, Moana New Zealand, Nelson, New Zealand. Personal interview, 19 March 2025.

Munro, A. (2026) Director of Farming and Processing, Taylor Shellfish, Fanny Bay, British Columbia, Canada. Personal visit, 17 April 2026.

Parsons, J. (2025) Nuffield Scholar, Dairy and Sheep Genetics, Whangarei, New Zealand. Personal interview, 16 March 2025.

Pigou, M. (2025) Sales Manager, FlipFarm Systems Ltd, Marlborough Sounds, New Zealand. Personal interview, 20 March 2025.

Porker, B. (2026) Field Scientist, ASI Breeding Program, South Australia. Personal interview, 24 March 2026.

Rowe, K. (2026) Managing Director, Blue Farm Intelligence Pty Ltd (miShell). Written interview responses, 3 April 2026.

Scholtens, M. (2025) Geneticist, Cawthron Institute, Nelson, New Zealand. Personal interview, 19 March 2025.

Suzuki, T. (2026) Owner, Farm Suzuki, Nakaku, Hiroshima, Japan. Personal visit, 10 April 2026.

Taylor, B. (2026) Owner, Taylor Shellfish Farms, Washington State, USA. Personal interview, 23 April 2026.

Turner, W. (2026) Managing Director, Fresh Eyre Oyster Co. Written interview responses, 27 March 2026.

Verbyla, K. (2026) Center for Aquaculture Technologies, San Diego, USA. Personal communication regarding trial design, feed conversion ratio and energy partitioning, 2026.

Vignier, J. (2025) Senior Scientist, Cawthron Institute, Nelson, New Zealand. Personal interview, 19 March 2025.

Yoshimoto, T. (2026) Regional Director North Asia, Seapa, Hiroshima, Japan. Personal meeting, 10 April 2026.

Appendices

Appendix A: Key contacts

A full list of key contacts and organisations visited during this scholarship is contained in Table 1 of the Foreword section of this report.

Appendix B: Simple glossary of terms used in this report

- Condition / conditioning — the process of an oyster building up stored fat (glycogen) after spawning to return to a plump, market-ready state.
- Diploid — a normal oyster with two sets of chromosomes. Diploid oysters spawn seasonally, creating the post-spawn conditioning gap.
- Triploid — a sterile oyster with three sets of chromosomes that does not spawn and stays in condition year-round.
- Tetraploid — an oyster with four sets of chromosomes, used as the male parent in producing triploid oysters.
- Glycogen — the stored energy in an oyster's meat, which gives it the plump white appearance that indicates market readiness.
- Selective breeding — identifying oysters with desirable traits and using them as parents for the next generation, gradually improving the overall performance of the population over many generations.
- Genomic selection — using DNA analysis of individual oysters to identify their genetic potential, allowing more precise selection within and between family lines and approximately doubling the speed of genetic improvement compared to family-based selection alone.
- Heritability — a measure of how much of the variation between individual oysters in a particular trait is due to genetics versus environment.
- Family line — a group of oysters produced from the same parents, used in selective breeding programs to compare the performance of different genetic backgrounds.
- Food (Diet): The microscopic particles consumed by oysters through filter feeding. These primarily include phytoplankton (microalgae), along with bacteria, protozoa, detritus (organic matter), and other suspended particulate organic matter present in the water column. The quantity and quality of these food sources strongly influence oyster growth, condition, and survival.
- Feed efficiency — the ability of an animal to convert available food into productive output. The equivalent trait in oysters — conditioning efficiency under limited food — is the central genetic target of this scholarship.

- POMS — Pacific Oyster Mortality Syndrome, the disease that devastated the Tasmanian oyster industry in 2016 and led to the quarantine ban on Tasmanian spat entering South Australia.
- Depuration — the process of holding oysters in clean flowing water for one to seven days before sale to purge any accumulated pathogens or contamination. Required in most oyster-producing countries but not needed for South Australian oysters due to the quality of our farming water.
- Upwelling — the process by which deep, cold, nutrient-rich ocean water rises to the surface. In SA, upwelling from the Great Australian Bight is the primary source of nutrients for oyster farming areas.
- Marine heatwave — a period of unusually warm sea surface temperatures above the seasonal average. SARDI documented persistent moderate marine heatwave conditions near Streaky Bay and Smoky Bay during the 2025-26 summer spawning period.

Appendix C: About the Center for Aquaculture Technologies

The Center for Aquaculture Technologies (CAT) is an independent aquaculture science organisation based in San Diego, California, USA (www.aquatechcenter.com). CAT conducted all genetic analysis of the Streaky Bay conditioning trial data reported in Section 4 of this report, including the trial design contribution of Klara Verbyla. All findings, statistical methods, results and conclusions from that analysis are entirely the work of CAT. The complete CAT final report (received May 2026) is available separately and should be cited as: Center for Aquaculture Technologies (2026).

Appendix D: Streaky Bay Conditioning Trial — Trial Layout Diagram

Figure 3 in Section 4 of this report shows the physical layout of the conditioning trial as it was set up on the author's farm at Streaky Bay. The trial layout — 3 Lines x 3 Blocks x 6 Replicates — was designed by Klara Verbyla of the Center for Aquaculture Technologies (CAT) specifically to ensure that no family line had an environmental advantage from its position on the farm line. Each of the 20 family lines is distributed across multiple positions within each of the three blocks, with every position replicated twice (A/D pairings in Block 1, B/E pairings in Block 2, C/F pairings in Block 3).

This randomised, replicated design is what makes the results scientifically credible. By ensuring that every family experienced the same range of positions across the trial, CAT's analysis can be confident that differences in conditioning performance between families reflect genuine genetic differences. All statistical analysis of the trial data was conducted by CAT.