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ON THE COVER:
The Prime Minister, Helen Clark, is wooed with tasty treats at the launch of Aquaculture New Zealand.
PHOTO BY: Keith Ingram

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Aquaculture looks to new horizons

It would be fair to say that the New Zealand aquaculture industry has long been the poor sister of the New Zealand seafood industry. But times are a-changing, and with the realisation that our demands on current wild marine fish stocks are no longer sustainable comes the realisation that if we are going to continue to eat quality seafood products, we need to produce more and more.

Clearly the future of New Zealand's economy will lie in our food basket, a basket that, if we are half smart, the rest of the world will be wanting to share.

Agriculture, horticulture and aquaculture are well poised to capitalise on the world's demands for good quality food. We have the green environment and the pristine waters, and the sooner we forget about fart taxes, food mile taxes and carbon credits, and focus on developing what we need to sustain the nation, the better we will all be.

Unfortunately, we are bogged down by rules and regulations, many of them made by politicians and bureaucrats trying to justify their own existence, and who in many cases are now starving opportunities to grow and develop.

I am saddened to read about marine farmers throwing in the towel because they have run out of money trying to get past first base. One case took five years and cost \$3 million in the Environment Court, with nothing to show for it. Green or "nimby" activists can stonewall a process and yet not be accountable for their actions. They can make ludicrous claims based on no foundation of evidence, and the marine farmer, the applicant, has to disprove these at their own expense. It's no wonder we are hearing and now seeing the frustrations first hand, as we watch more and more of our Kiwi skills, investment and knowledge moving offshore.

The horror stories are countless and too many to recap here, but we have all heard them, and what have we done? Moaned, sulked, beaten up on the wife or just got pissed, as no one gives a shit.

But there is light. Yes, there are those who care, and these proactive leaders have united, and we have witnessed the birth

of Aquaculture New Zealand and its bold document, the New Zealand Aquaculture Strategy.

Yes, it is a sign of action, and the government has responded with its Our Blue Horizon strategy, which will be the foundation for taking us forward. The document is full of nice words and commitments from six different ministers to make it happen. Unfortunately, the Emperor wears no clothes and, as usual, the devil is in the detail. But it is at least a start, a promise from the government and the six ministers on behalf of Environment, Conservation, Maori Affairs, Fisheries, Local Government and Industry and Regional Development. It is pretty high powered, and the new umbrella of the aquaculture industry, Aquaculture New Zealand, is going to have its work cut out keeping this lot honest. They, in turn, will require the support of all the marine industry, Maori and the New Zealand public to ensure that our children and we can enjoy sustainable seafood on our tables.

We have the ability to produce the finest quality seafood, and add value. The world is looking for our products on a regular and sustainable basis. It's prepared to pay for regular supplies of quality seafood. It wants more than a taste, so if we are to become a serious supplier to the world, the most sought-after food basket, we must cut through the past years of bureaucratic claptrap.

Central and local governments must deliver a sound business environment, one that protects our coastal waters while allowing for development and investment.

We have the skills and the families prepared to invest their lives and their futures. Let's give them a fair go.

This issue of *Aquaculture New Zealand* also highlights the opening of the new aquaculture research unit at the Mahurangi Institute of Technology, which has made several breakthroughs in research, not least in successfully breeding New Zealand shortfinned eels.

Other features include Pacific oyster farming with single-seed hatchery spat, and the potential for establishing offshore marine farms around the New Zealand coast to raise yellowtail kingfish and other species.



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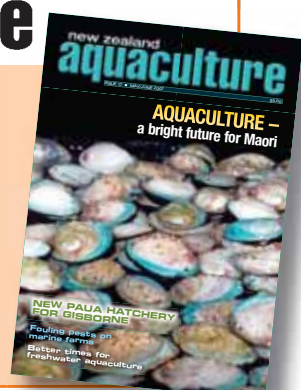
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FISHING SKILLS LEAVE POLICE UNIMPRESSED

Perry Kevin Anderson's fishing skills have earned him scant respect from the salmon, and even less from the police. The 20-year-old Cantabrian and nine friends climbed over fences into the Isaac Industrial Estate's salmon farm near Christchurch on January 8, went fishing in one of the ponds and caught more than 20 breeding salmon worth \$550. The group scarpiped when the site security guard arrived.

The Police prosecutor, Sergeant Dave Murray, agreed to drop the charge from burglary to being found unlawfully in an enclosed yard, because Anderson had not caught any fish. Anderson pleaded guilty in the Christchurch District Court, and Judge Michael Green fined him \$500.

"Fishing in a salmon farm and not catching anything is a bit like breaking into a brewery without a bottle opener," Murray told the Christchurch District Court. The group is paying for the fish it did catch.

SEA SQUIRT COMPOUND COULD RELIEVE GOUT

A group of New Zealand scientists may be just a few years away from releasing a new medication derived from sea squirts that could relieve gout. Crop and Food Research, the Malaghan Institute and the National Institute of Water and Atmospheric Research collaborated to produce synthetic copies of the sea squirt's anti-inflammatory properties.

The compound has been proven to reduce inflammation in mice with gouty arthritis, and the team hoped to begin

clinical trials on other animals shortly, says Vicky Webb, the NIWA biotechnologist leading the project. Unlike current gout drugs, the compound under development does not have unpleasant side effects. Webb says clinical trials are expected to take about five years.

ALGAE NOW PLENTIFUL

A continuous algal production system is now supplying micro-algae to a Greenshell mussel farm at Bream Bay. Nutrients and pasteurised seawater is constantly injected into 20 polyethylene bags, which each hold 1500 litres.

The bags are inoculated with various micro-algal species, which rapidly divide and multiply to a density of three to four million cells per millilitre. The harvested algae is supplied to the Sealord Shellfish farm, which is a client of the National Institute of Water and Atmospheric Research, where it is used to feed broodstock and the subsequent spat.

"We are able to confidently feed larger numbers of juveniles without the boom and bust cycles inherent in batch cultures," said Sealord's hatchery manager at Bream Bay, Jon Bilton.

RED TAPE FORCES OUT PIONEERS

Bureaucracy is crippling the aquaculture industry, say a trio of mussel farm pioneers in the Marlborough Sounds who are getting out for good.

John Pickering is one of the three mussel farmers to have sold up since March, saying "bureaucratic bullshit" had stifled the industry's potential, making growth "virtually impossible".

Pickering said he had no room to expand his business. "We spent mega-money to come up against brick walls every time. One case took five years and \$3 million in the Environment Court, and we didn't have one inch of water space more."

In March, Pickering and business partner Robbie Brownlee sold their shares in Pickering Brownlee and Talley's Mussels, which farmed 90ha in the sounds, to the third shareholder, Talley's. "We have got a great industry if it had potential to grow. But it hasn't got that potential now."

Companies in Scotland and Ireland had approached him to set up marine farming operations there. "Once I would never have thought about taking our technology out of the country," he said. But that was already happening.

"The invitation and the rewards are substantial. It's a shame for our industry that is sitting here, poised to do the business, but these other countries are going to overtake us."

After 30 years in the Marlborough mussel industry, Peter Large sold up in May. He said his son could have continued to run the business if it had been worth it. The high dollar had made an already bad situation untenable.

AQUACULTURE LEGISLATION TO BE AMENDED

The government is to introduce a bill to make technical amendments to aquaculture legislation. The intent of the 2005 aquaculture reforms was that applications would be lodged only within aquaculture management areas. AMAs are established through either council or privately initiated changes to regional coastal plans.

After the legislation was passed, the Environment Court indicated that aquaculture activities could be allowed outside these areas. The bill will restate the intent of the original legislation. Parties currently involved in aquaculture-related High Court proceedings will be able to consider their position in light of the proposed amendments.

"The current situation impacts seriously on major elements of legislation, such as the creation of AMAs, allocation of space to iwi, testing for effects on fisheries, tendering and private plan changes," the Minister of the Environment, David Benson-Pope, said on May 15.



NEW FREEZING PROCESS FOR SEAFOOD

An equipment specialist says it has developed a carbon dioxide system for freezing seafood products such as shrimps that could previously only be processed by using nitrogen.

Starfrost says it has developed two pilot systems that combine CO2 refrigerant with low temperature, high-velocity freezing techniques. Both operate at lower temperatures than traditional -32 degrees Celsius freezers.

Shellfish require extremely fast freezing, and cryogenic freezing with nitrogen had been the only answer, as a standard mechanical freezer could draw in moisture at very low temperatures, said a director of Starfrost, Dave Pearson.

"With our new CO2 systems, the desired temperature at product cores can be quickly achieved without extreme over-freezing at the edges."

Another advantage was the potential to recover waste heat and energy from the system as hot water suitable for cleaning, cooking or process heating. The system was also environmentally friendly, with low running costs.

EEL FARMING could be big



Minister of Fisheries, Jim Anderton congratulates Paul Decker on the new facility



Paul Decker explaining the life-cycle of eels to the minister

New Zealand could develop a self-sustaining eel farming industry if the Mahurangi Technical Institute can become the first in the world to produce commercial quantities of eels in captivity, the Minister of Fisheries, Jim Anderton, said at the opening of the institute's new E Block on May 25.

"If we can succeed in this, we will be able to develop a self-sustaining eel farming industry. We won't hammer the wild eel population."

He said the MTI was among the top three institutes in the world for research on breeding eels. "We can't develop eel aquaculture until we can breed eels in captivity. So this facility and the research it does is very important."

Eels were highly valued as a food delicacy, he said. "In Tokyo there is a restaurant where eel dishes are so highly prized that there are two separate entrances: one for ordinary Japanese cuisine and another exclusively for eel dishes."

The uncertain supply of juvenile glass eels meant this delicacy was under threat, creating an opportunity for New Zealand.

E Block had grown out of the various aquaculture activities conducted at the institute, and this was reflected in the wide range of species held there and the ideas being pursued, said special projects manager David Cooper.

The major driver had been the progress the MTI had made in breeding New Zealand short fin eels, *Anguilla australis*, with a view to commercially developing a process for glass eels to supply the international eel farming industry.



Eels hatching in captivity

"After succeeding at producing larval (but not yet glass) eels in quantity and to order, it became obvious that we could no longer proceed with the small and rather basic facilities we had previously used," said the institute's director, Paul Decker. "So we bit the bullet and decided to design and build E Block."

The block was the realisation of a dream that was first conceived out of an industry need to have access to qualified staff with experience in a real aquaculture working environment, to be able to acquire hatchling seed stock for grow-out purposes, to have access to a help line and have affordable help in developing new concepts, Decker said. He especially thanked Dr Tagried Kurwie, Adrian Paarman, David

Cooper, Kim Piece and Birgit Ruschin for their hard work and dedication.

The 740sq m facility is situated in a commercial building in Warkworth, about an hour's drive north of Auckland. It incorporates a broodstock room, a hatchery/laboratory, a workshop, a general fish room, offices and a classroom.

The classroom is used to teach the Certificate in Marine Technology to students keen to have a career in fishing or aquaculture. They gain practical experience through managing aquatic species held at the site, and by assisting on nearby marine farms and land-based fish farms.

The government, through the Foundation for Research, Science and Technology, contributed \$630,000 to the institute's eel research as part of the Technology for Business Growth programme.



AQUACULTURE NZ LAUNCH

BY KEITH INGRAM



Aquaculture New Zealand's head office



The mussel harvester Innovator

THE 10 POINTS OF THE AQUACULTURE STRATEGY INCLUDE:

1. Establish a national sector organisation. This will include all the sub-sectors – mussels, salmon, oysters, paua, koura and other finfish developments.
2. Strengthen the partnership with the government. Work with the Minister of Economic Development and the Minister of Fisheries to promote and develop aquaculture.
3. Strengthen other stakeholder partnerships. Improve relationships within the industry.
4. Secure and promote investment in aquaculture. The three components include the renewal of existing consents, the creation of new aquaculture management areas and security of resource consents as collateral for investments.
5. Improve public understanding and support for aquaculture.
6. Promote Maori success in aquaculture. The scale of potential iwi involvement is such that the sector will not reach its potential unless iwi prosper.
7. Develop markets for New Zealand aquaculture products. Significant future growth will come from new species and products.
8. Maximise opportunities for innovation. The key will be expanding the number and depth of industry and research partnerships.
9. Promote environmental sustainability and integrity of aquaculture. Aquaculture depends on pristine water, and the industry therefore has a stewardship role in helping to protect New Zealand's aquatic environments.
10. Invest in training, education and workforce promotion. The future of the sector depends on investment in training and education and the ability to attract and retain a skilled workforce.

Aquaculture New Zealand is a single voice for the industry, the Prime Minister, Helen Clark, said at the launch on June 7.

"Twenty years ago, aquaculture was a relatively small industry, turning over about a million dollars a week and employing 400 people. Today it employs 2500 people and turns over close to a million dollars a day," she said at the launch, which was held at the Boathouse on the Nelson waterfront.

Guests included representatives of the various sections of the aquaculture industry, local dignitaries, and politicians, including the Minister of Fisheries, Jim Anderton.

"Fishing and shellfish farming has become the fastest growing sector of New Zealand's seafood industry, and the government believes the sector's vision to become a billion-dollar industry by 2025 is achievable," Helen Clark said.

Farmed fish and shellfish production was now worth \$300 million. Aquaculture could make a significant contribution to the national economy that was both environmentally and socially sustainable.

"It's potential is being driven by the quality of our produce and a reputation for clean, sustainable production. That gives us an edge in global markets. Aquaculture NZ will enable the industry to implement its strategy and communicate and build relationships between the government, councils and other stakeholders," she said.

New Zealanders already enjoy the benefits of locally farmed seafood. Virtually all of the fresh and chilled mussels, salmon and Pacific oysters sold in retail outlets are farm-raised. "However, the future growth of the sector will depend on continued, sustainable growth and market development of its products, particularly offshore.

"Aquaculture is one of the most important economic sectors for future growth, with an ability to boost economic development in our regions and small coastal towns. It also offers enormous potential for Maori communities."

She said the opportunities for New Zealand fish farming were abundant, because the world was hungry for farmed products. "There is not enough fish in the sea to meet demand, so global aquaculture will increase. As a nation, we cannot let pass the opportunity to be part of that growth, and we do have those compelling competitive advantages. Conditions are ripe for expansion, with our uncrowded coasts, clean water, and a community of highly skilled scientists and researchers dedicated to developing new varieties, management techniques and innovations in processing."

She said that the industry had the government's full support, and she looked forward to seeing further development through regional coastal plans.

The chairman of Aquaculture New Zealand, Callum McCallum said the aquaculture industry had sought for some years to find a collective, over-arching representative body that had national recognition

Historically, the industry had developed in a somewhat ad hoc



The Prime Minister, Helen Clark, officially launches Aquaculture New Zealand



The Minister of Fisheries, Jim Anderton in serious debate with (from left) Alastair McFarlane, Mike Burrell, John Glaister and Eric Barratt

manner, but the size of the industry today made it prudent to move into a more structured organisation with its own identity that avoided past duplicated efforts and costs, McCallum said.

This new organisation has been formed through the amalgamation of the New Zealand Aquaculture Council and the species groups for mussels, salmon and oysters.

The government was committed to a partnership with the aquaculture industry, local government, Maori, and anyone else who could help the industry achieve its goal of earning \$1 billion per year by 2025, said the Minister of Fisheries, Jim Anderton.

Regional councils needed to balance new aquaculture development against competing ratepayer priorities. "So the government has set up a contestable fund of \$2 million over five years to help councils with these costs." Amendments to the aquaculture legislation would ensure that new law operated as intended.

"For all the positive work going on to promote good practice, it saddens me that public support for aquaculture is sometimes patchy," Anderton said. "There is sometimes reflexive 'nimby-ism', and we can't afford it.

"Better public support is our second objective, as it makes both the investment and the planning environment more straightforward. It is a matter of engaging with real concern and ensuring that we are true to our promise of high environmental standards."

New Zealand had to be at the forefront of technology and industry practice to achieve the best value from aquaculture development, he said.

Aquaculture NZ recently calculated that almost \$15 million was spent on aquaculture research and development annually in New Zealand. Over \$9 million of this was publicly funded, and \$5.5 million came from the industry.

More funding would come soon through the granting of tax credits for research and development, as announced in

OUR BLUE HORIZON

We congratulate the aquaculture industry on the launch of Aquaculture New Zealand.

The government looks forward to working in partnership with Aquaculture New Zealand to foster the growth of an environmentally sustainable industry.



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IN RESPONSE TO the launch of Aquaculture NZ and its New Zealand aquaculture strategy, the government released the publication *Our Blue Horizon*.

It includes a national positioning statement on aquaculture, and a five-point strategy to support its development:

- building the confidence to invest
- improving public support
- promoting Maori success
- capitalising on research and innovation, and
- increasing market revenues.

One way the government is assisting councils in their aquaculture planning and development is through a \$2 million contestable fund administered through the Ministry for the Environment. The recipients of the first round of this fund are the Auckland, Waikato, Bay of Plenty and Northland Regional Councils.



the Budget in May. "If you are investing in research and development you will be eligible for a tax credit of 15 percent," Anderton said.

The industry had spent about a year putting together the New Zealand Aquaculture Strategy, said McCallum. "In the last six months, we have established the organisation, and put in place new staff, new budgets and new directions."

The chief executive, Mike Burrell, said that it would be another six to 12 months before the organisation became fully operational. "But we've already started with a big rush. We are

focussing on each of the 10 points in the strategy, and we have ticked off the first three. We are now working on points four to 10 simultaneously.

"So what you are seeing is a focus on markets, new market developments, sustainability and a development programme with the government that focuses on Maori development more closely."

A new science strategy focussing on research, science and technology would be released at the end of the year. Education and training were other key issues it was working through with the Seafood Industry Training Organisation.

Aquaculture NZ had clearly stated its concerns to the government over the aquaculture management area process, and was working closely on two fronts.

"One is to look at the changes that can be made on the implementation side, in improving access to water space in future developments. The second is working at a policy level to identify opportunities for streamlining, tweaking or modifying parts of the legislation and parts of the regulatory environment."

When asked if this meant looking at the Resource Management Act, he said, "Nothing is off the table yet. But we want to be focussed, engaged and positive. We're not interested in just lobbying. What we would rather do is work alongside the government and engage by actually helping to develop philosophies that work."

Aquaculture NZ had to facilitate a process for new aquaculture management areas that was workable. This was vital to enable farmers to have secure tenure and thus achieve the goal of \$1 billion by 2025.

"We need to be able to introduce new species. Currently we have single species – mussels, oysters or salmon - for AMAs. Our marine farmers need greater flexibility to be able to move between species as markets and local conditions dictate."

Finfish was one of the first things on the horizon. "Kingfish, groper and some other species are all in the development stage, and are showing high potential. The first thing we have to do is look at coastal plans and the legislation to allow us to turn a mussel farm into a finfish farm."

Mike Burrell said the international scene showed two very interesting models. The scale of growth in China was staggering. "That's low-value, high-volume growth, and I think they will make it sustainable.

"But it's certainly not the kind of growth that New Zealand is interested in. The second model is what you see in Europe, North America, Australia and here in New Zealand. It's high-value, based on innovation, new technology and smart marketing. And that's the kind of game we're in.

"There's absolutely nothing to stop us from earning three or four billion dollars a year. We've got the basics right. We just have to tweak it. We've certainly got the know-how. So then it's just a matter of getting the environment right and getting that investment in. And if we have those then there's nothing to stop us."



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GOVERNMENT CONCEDES the need to amend legislation

In mid-May, the Minister for the Environment, David Benson-Pope, announced that the government intended to introduce a bill to make various “technical” amendments to the 2004 aquaculture reform legislation. This article looks at what form those amendments might take, and why they have been identified as necessary.

The need for amendments was highlighted by a 2006 decision of the Environment Court relating to the Tasman Resource Management Plan (the TRMP), *SMW Consortium Limited v Tasman District Council* (May 9, 2006).

Oceanlaw New Zealand acts for three iwi in the case, which is currently under appeal. The SMW case has also been joined with a second set of proceedings brought by Golden Bay Marine Farmers Ltd (the GBMF case), which focuses on the impact of the Maori Commercial Aquaculture Claims Settlement Act 2004 (the Settlement Act).

The TRMP, covering Tasman Bay and Golden Bay, is one of a small number of regional coastal plans that proposed managing aquaculture in designated aquaculture management areas before that approach was adopted globally through the 2004 reforms.

The plan has a long and convoluted history, but ultimately saw areas being identified as potentially suitable for new aquaculture development - subject to an assessment of effects on fisheries - through long-running Environment Court hearings. The Environment Court coined the term aquaculture management area, or AMA, to describe these zones well before that term became enshrined in the current legislation.

So, the TRMP is one of the few plans in the transitional category under the 2004 reforms. At the heart of the SMW and GBMF cases therefore are issues as to the inter-relationship between the old statutory regime, the transitional regime and the new regime. Most of the issues are specific to the circumstances of the TRMP.

One significant issue of more general application was thrown up by the 2006 Environment Court decision, however, and has been identified by the minister as a target for proposed amendments.

Central to the 2004 amendments to the 1991 Resource Management Act is s.12A, which provides that, “no person may occupy a coastal marine area for the purpose of an aquaculture activity...except in an aquaculture management area in a regional coastal plan...”

The Environment Court in the SMW case ruled that s.12A did not prohibit a person from applying for resource consent to occupy an area outside of an AMA for the purpose of aquaculture, and that such an application would have to be received and

processed by the relevant council in the normal way.

The Court went further, and proposed that there was nothing legally preventing such a resource consent from being granted, albeit that the area could not be physically occupied for aquaculture purposes unless and until it became an AMA.

The minister’s recent statement confirms that this was not what was intended by the 2004 reforms, and that the proposed amendments will “restate the intent of the original legislation”, which was that resource consent applications could only be made inside established AMAs.

The government has admitted that the proposed amendments will impact directly on the matters before the courts in the SMW and GBMF cases. For other areas not subject to the transitional regime, it is proposed to clarify that applications can only be made after AMAs are proposed, fisheries effects assessed, public consultation undertaken and appropriate space set aside for iwi under the Settlement Act.

The minister’s announcement raises an entirely new set of legal issues for the parties to those SMW and GBMF cases, however. Those cases were to have been heard in the High Court in the last week of May, but were adjourned, as the judge who was to hear them was required for another fixture.

The parties on both sides of the two cases are reluctant to incur further expense to clarify the current state of the law, when that law is in line for amendment.

On the other hand, a ministerial announcement of an intention to amend the law is not the same as an amendment: there are a number of hurdles to surmount first.

Firstly, the government has to introduce an actual bill containing the amendments. That bill, after it is introduced to parliament, will presumably be subject to Select Committee scrutiny and will ultimately have to be supported by the majority of MPs in parliament, something that can never be guaranteed in the current political environment. Until that happens, the law remains unchanged, but under a cloud.

The government is to be applauded for facing up to the reality that the drafting of the 2004 reforms was inadequate or unclear in some respects. But leaving it until the week before a High Court hearing to announce proposed amendments was frustrating for all the parties involved in the SMW and GBMF cases.

We can only hope that the amendment process will not be too drawn out or contentious and, more to the point, that they get it right this time.



BY
JUSTINE
INNS

Justine Inns joined Oceanlaw as a senior associate. She previously spent more than a decade as an advisor to various iwi (tribes), including several years with Ngai Tahu, responsible for implementing the iwi’s Treaty of Waitangi claim settlement.

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FROM ACROSS THE DITCH: Oz is ideal for mariculture

BY JOHN MOSIG



Barramundi are one of the most widely grown species in Australia



Tasmanian salmon being unloaded



Sydney rock (left) and Pacific oysters. Growers favour the Pacific for its faster growth and more even shape

I've been involved in commercial aquaculture since 1979. In that time I've set up warm-water finfish and freshwater crayfish farms and been a partner in a mussel farm. I have also written a couple of books on their production published by the Commonwealth Scientific and Industrial Research Organisation, and developed practical training courses. I've been writing on aquaculture since 1990.

I like to think I bring the aquaculturists' view to my writings. I hope there's some journalistic expertise there as well.

The first thing I noticed on a recent trip to New Zealand and spoke with seafood producers was the similar problems faced by growers in our two countries. The most vexing would have to be the attitude of the public and the authorities to the world's fastest growing, and arguably most important, food-producing industry.

Medical science has demonstrated time and again how important seafood is to our physical and mental well-being, yet time and again we find our industry's development lumbered with regulations and restrictions not imposed on other food producers, and especially not our competitors on the global seafood market.

In these times of climate instability, and in the face of unprecedented population growth, food security is fast becoming a major universal issue, the neglect of which, when it becomes time to do the counting, will be regarded as scandalous.

Now that I've established my credentials as a card-carrying member of the aquaculture fraternity, I'll tell you a bit about what's happening across the ditch. Unlike New Zealand, we are a federation of six states and two federal territories. Without going into the pros and cons of this system, it means that the goalposts are in a different position when you play interstate.

In many respects Australia is made up of seven countries ruled from an eighth. You've all heard of the Australian Capital Territory, Canberra.

The two main aquaculture-producing states are Tasmania and South Australia. It's no coincidence that these states can trace the growth of their respective aquaculture industries back to

the time they removed the control of the industry from the regulatory, resource management-driven fisheries departments, and wrote separate aquaculture acts that reflected the wealth creation nature of a farming sector, with its inherent capital and labour commitment and seasonal and marketing risks.

With a coastline of approximately 45,000km, you would imagine the "West Island" is ideally set up for mariculture. However, a good stretch of it is dominated by the Great Barrier Reef, which in turn is protected by an act of parliament and a protection authority with powers that would have made the Sheriff of Nottingham look like he had both hands tied behind his back.

The cost of complying with environmental requirements for a marine farm in Queensland, and that includes prawns, is astronomical. In spite of that, the state produced A\$80 million of seafood in 2004/05. Prawns made up \$46 million of that, followed by barramundi at \$12 million, native aquarium species \$6 million, crocodile skins \$5.5 million and crocodile meat \$1.2 million.

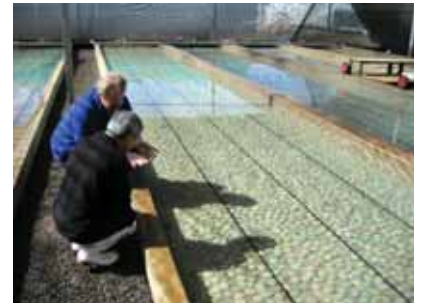
Further south, it is the "nimbys" who put the mockers on aquacultural development. New South Wales has an output of \$48 million. Nearly \$36 million of this is from oyster production established before the baby boomers sought their retirement dream homes along the coastal inlets.

Further south you turn the corner into Victoria, which has a predominantly Bass Strait coastline. To the west of Port Phillip Bay there's the shipwreck coast, and to the east there's the national park coast.

It will come as no surprise that Victoria's biggest sector is salmonid - mainly rainbow trout - aquaculture, based on water diversion from the main river, the Goulburn. This makes up \$10.5 million of the state's \$25 million aquaculture output.

Abalone has stalled due to a disease outbreak on two of the major farms, but in 2004/05 they produced \$4.5 million and were well on the way to equalling the salmonid production. Blue mussels and exotic fish production were around \$2.5 million each. You've probably got a dozen or so bays in New Zealand that do that much.

The Apple Isle is fast becoming the seafood isle. The



LEFT: The mussel fleet at Port Arlington, Victoria

ABOVE: Blue mussels are grown in five Australian states

ABOVE RIGHT: Abalone farming is one of Australia's fastest growing aquaculture sectors

pristine waters and progressive government of Tasmania have seen aquaculture output top \$138 million. According to the latest figures available, \$115 million of that was salmonid production, with Atlantic salmon weighing in at \$111 million. Pacific oysters were next at \$17 million. Then came abalone at \$4.5 million, followed by mussels at \$2.6 million (total \$250 million).

Now we move across to the desert states, where there's plenty of coastline but limited service facilities. This hasn't stopped the crowd eaters, as South Australians are affectionately known, from taking the cup for aquaculture production.

South Australia, following Tasmania's lead with an Aquaculture Act, has built a dynamic industry based on feed-lotting southern bluefin tuna that is going from strength to strength. Naturally, southern bluefin tuna leads the way with \$140 million worth of exports. Their Pacific oysters bring premium prices in Asia and earn the Desert State \$21 million. Yellowtail kingfish are a relatively newcomer to the scene but have already reached \$10 million in value, a good deal of it destined for the sushi market.

Abalone is next at \$5.5 million and mullet follow at \$4.4 million. They even produce over \$2 million worth of tropical barramundi in recirculation systems, and \$2.5 million of micro-algae.

Western Australia is surrounded by desert to the east and north. It faces the Indian Ocean and the Southern Ocean. Its capital, Perth, is closer to Jakarta than it is to Sydney.

The staple aquaculture product is pearls. It produced \$122 million of them in 2004/05. Everything else pales into insignificance, and freshwater crayfish was the only other product that topped seven figures. Marron made \$1.4 million and yabbies \$1.1 million.

Finally we have the Northern Territory, the Top End and the Dead Heart. As would be expected, the aquaculture industry is based at the Top End, where pearls, at \$17 million, again provide the mainstay. Barramundi, at \$6.4 million, is followed by crocodile products of just under \$4 million. The territory is still regarded as frontier land in the eyes of southerners, but the region has huge potential for tropical aquaculture production.

As you can see, each state has a mainstay that carries the production figures for the industry, but where a positive attitude, and we should say a scientific attitude to aquaculture prevails, the industry has prospered.

The federal government is pushing aquaculture, and the market prices for fresh seafood, in particular finfish, have never been more bullish. The future looks bright. Overseas product is putting pressure on the market, but only at the low-priced frozen end. As an example, white-fleshed, boneless, skinless basa catfish fillets from Vietnam are for sale, thawed for customers' convenience, for between \$10 and \$12/kg. Fresh, plate-sized gilled and gutted rainbow trout sit beside them at around the same price.

There's so much to talk about. Hopefully we can catch up again soon.



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PACIFIC OYSTER FARMING with single-seed hatchery spat

BY NAT UPCHURCH, WAIHEKE FRESH SEAFOODS



Iain Tyler clips 12mm Seapa baskets onto a long-line at Te Matuku Bay, Waiheke Island. Each basket contains 750 8mm spat

Seapa baskets with mature 80-100mm Pacific oysters hanging above the low tide. Note the uniformity of the crop



Waiheke Fresh Seafoods is a relatively small oyster company that started farming oysters in 2001. We now produce 80,000 dozen per year on 4ha of inter-tidal water in the Hauraki Gulf. Our product is mostly sold to Kia Ora Seafoods, an Auckland seafood company, where it is processed for the domestic and export markets. We also operate a small processing room at our depot to supply oysters in the half-shell to local Waiheke Island restaurants.

We used to grow oysters on sticks, like everybody else, but over the past five years we have been working to convert our farm from this traditional style to the Australian long-line system, growing single-seed oysters in a plastic basket suspended on a plastic long-line.

We completed the conversion over the summer, and we now farm 22,000 Seapa oyster grow-out baskets in 6mm, 12mm and 20mm mesh sizes.

We persevered with farming wild oyster spat in this new system for a while, but when we became aware of the single-seed spat from Cawthron we tested this, and soon convinced ourselves of the major advantages that come with it.

We now only use Cawthron spat, and are hoping to turn over 100,000 dozen per hectare next year, double the number we used to do five years ago with wild spat and stick culture.

For a start, sourcing the spat is easy. We just write an email message. The spat arrives in plastic bins, and is big enough to go into 6mm mesh baskets, so very little labour is required to stock the farm, and the hassles with smaller spat are avoided.

Of course that comes at a price, but we have done our calculations, and the labour savings and lower mortality rates offset the higher price for larger spat.

The spat is uniform and will stay uniform throughout the grow-out. That means it requires less grading and little extra effort goes into the slower growers. Carrying oysters over into the next season does not make for good farm economy, so we

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appreciate that a batch of spat goes through to the market as one batch, and the farm space is then free for the next batch.

Mortality has been minimal, and of course the oysters generally have a better shape than oysters grown on sticks. This is thanks to a combination of the selective breeding of Cawthron spat, and the effects of wave action rolling the oysters around inside their grow-out baskets.

Stick culture requires a lot of labour. In contrast, single-seed culture lends itself to mechanisation. Although we still do more manual work than necessary, we are thinking of ways to mechanise our processes.

Single seeding allows us to manipulate the crop to suit our needs and optimise the use of our farms. We can adjust the stocking density, move oysters between or within farms, and adjust the height of the bags in the tide. These stock management options allow us to grow a uniform crop with good overall efficiency, regardless of uncontrollable environmental conditions like food availability.

Single-seed farming also offers significant environmental benefits. Our farm is located in Te Matuku Bay on Waiheke Island, a place cherished by many for its beauty. The single-seed technology allows us to keep our farm clean and minimise its environmental impact.

With less material and fewer structures on the farm, the tidal water flow increases, noticeably reducing the silt build-up on the seafloor associated with past marine farming practices. And as the oysters are contained within the grow-out basket, shell drop-off due to oyster mortality is avoided, again helping to reduce any issue with silt formation. We also remove feral oysters from our farm that compete with our crop for precious food and can harbour oyster-specific parasites and diseases.

The Cawthron spat is produced from selectively bred broodstock. Achim Janke and his team are well aware of our needs in terms of meat yield, weight, shape, colour and growth rate. The spat we received last year has performed well in all these aspects and grew to harvest in 10 months.


The good performance of our single-seed spat is not only based on Cawthron's science but also on our husbandry. Single-seed spat requires a different farming method, and this means some capital investment and learning.


We have trialled several spat batches on our farms, and we now know what to do in order to have a certain effect on our crop. For example, we put oysters to the rear of the farm if



Roger Knecht packs Pacific oyster spat at Cawthron's nursery

we want shell growth, and bring them to the front for meat growth.

The regular and reliable availability of single-seed spat has allowed us to transform our operation into a business to be proud of. Our accountant tells us that we cannot afford to go back to stick culture and wild spat, and I am sure our staff  wouldn't want to.

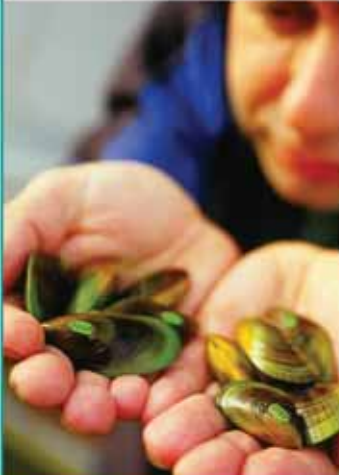


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HATCHERY PRODUCTION OF SEA CUCUMBERS: larval rearing and settlement

BY DR ANDREW MORGAN



Differences in growth and development can become very pronounced if the rearing environment is compromised (0.2 to 0.7mm)



Some variation exists even in a fairly robust rearing environment (0.5 to 0.8mm)



These larvae are typical of the late stage in growth and development (0.8mm to 1.1mm)



Species of phytoplankton used to rear larvae and jars set up to run nutrition experiments

Sea cucumbers, or *Stichopus mollis*, exist naturally on mussel farms and under fish farms, and feed on animal waste. This provides an ideal environment for enhancement by supplementing an existing farming operation and the fishery through the quota management system.

Quota has been allocated. Export markets exist but are not developed. The potential for value-added products and processing technology also exists.

Previous articles have discussed aspects of husbandry, spawning and embryo quality. This article discusses the logistics of larval rearing through to settlement are outlined, and equipment used and its effects on the rearing environment. The determination of larval quality is highlighted and how this can be assessed.

LOGISTICS

Sea cucumber larvae are very susceptible to system crashes due to proliferation of bacteria. Unless bacteria can be plated out using appropriate equipment, which can be costly, water exchanges are the best way to control this problem.

Furthermore, care is taken in rearing algal species to feed larvae, as it is a potential source of water quality problems. Adoption of robust protocols for working with larvae, and the use of chlorine or hydrochloric acid to clean equipment, will ensure optimum success in rearing larvae.

Less food more often is best when feeding

larvae so that water quality is maintained and a more constant feeding regime is adopted. Due to the way sea cucumber larvae feed, more algae does not result in increased feeding. Rather, the reverse happens and nutritional requirements are not met.

Ultimately, flow-through technology and continuous feeding would be ideal and this should be investigated further. The Cawthron Institute has had great success using this technology to raise shellfish larvae, and it could equally apply to sea cucumber larvae.

LARVAL QUALITY

The quality of larvae is difficult to assess in the first week of feeding. However, developmental differences become more obvious as growth progresses. Gut shape and length and width of larvae, the timing and growth of key developmental features, and the overall shape of larvae are used to assess quality.

A large variation in growth and development between larvae indicates problems within the batch. This could be due to nutrition in relation to stocking densities, the rearing environment and water quality, or it could even be traced to egg quality or a compromised hatch pre-rearing.

Competence to complete the larval cycle and settle can be assessed late in the larval phase. Features characteristic of change to the juvenile form are easily identifiable. When larvae are ready to change shape the process itself is relatively short.

However, if the post-rearing environment

is not ideal, larvae may stay in the transitional stage for too long, and their ability to complete settlement and achieve the juvenile stage could be compromised.

TRANSITIONAL PHASE AND SETTLEMENT

The end of the larval stage results in a drastic change as larvae adopt features necessary for benthic life. This includes a major contraction of shape into a "barrel-like" form, and reorganisation of the alimentary canal or gut.

In terms of logistics, encouraging settlement is much the same as for settling abalone larvae. Settlement tanks are used and contain a bio-film for larvae to settle on. Juveniles will not be visible for two months but grazing trails on the bio-film will be visible. At this stage water quality is important, and excessive bacteria and other micro-organisms in the bio-film will decrease survival drastically. Bio-film should be barely visible.

These are just some of the issues that need to be addressed when rearing sea cucumber larvae. In principle, rearing sea cucumber larvae is similar to rearing many other species. However, the interaction between the rearing environment and growth and development and how to assess this is more specific. These problems have been solved already, and simple procedures adopted to minimise complexity.

The next article will outline post-settlement procedures and growout technology for *S. mollis*. This area still requires some development to enable commercial hatchery production to be realised.

OFFSHORE marine farming sites

BY KEVIN HEASMAN, CAWTHRON INSTITUTE



Kevin Heasman checks mussel lines in blue water off the eastern coast of the North Island



Mussels and diver

Worldwide, the space that can be allocated for marine farming in sheltered coastal waters is reaching at least a temporary limit. The aquaculture industry is responding to this constraint by developing technology that will allow marine farming in exposed areas on the open ocean.

Offshore sites are subjected to the full force of oceanic conditions without the benefit of land to dissipate the forces. In New Zealand this may mean that equipment and workers have to withstand gale-force winds, waves exceeding 12m and strong water currents. This is not a place for the frail or fainthearted! Several offshore sites are either being tested in New Zealand, or are awaiting permits to start trials.

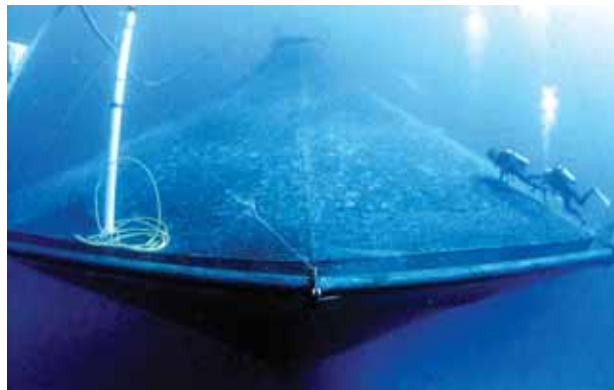
A good understanding of the specific conditions is required in order to consider offshore farming at a new site. The oceanic and weather patterns of the area, including 50 or 100-year extremes, are very important for the site's engineering, design and economic models. The number of days on which the weather permits work on the farm will also greatly affect the economics and logistics.

Trials need to determine the species that can be grown on the site and the potential effects of predators. In addition, there are all the questions that apply to sheltered sites, including the supply of juveniles and food, post-harvest operations, productivity, product quality and marketing.

Two major types of farming are being investigated on the offshore sites in New Zealand - shellfish farming (eg, mussels) and finfish farming (eg, yellowtail kingfish).

Shellfish structures consist of a submerged "backbone" from which the ropes holding the shellfish are suspended. Methods to date appear to hold promise, but a fair amount of work is still required to test the structural efficiency and biological parameters of selected species, and how these parameters all fit together economically.

Offshore cages for finfish are developing around the world, but it is difficult to build structures that meet all the site requirements and remain economical. As a result, many cage types have trade-offs which make them suitable for



A fully supported Sea Station cage by OceanSpar, Bainbridge Island, Washington, USA

one site but not necessarily another.

The simplest cage is a net "bag" hanging from a flexible floating frame. Its volume can range from 2000m³ to 40,000m³. Although it sounds simple, the engineering is a challenge, even for this cage type.

The next type of cage is similar to the bag, but has a net mesh stretched over the top which allows the cage to be submerged during bad weather. Submerging the cage adds complications. How do you feed the fish when you cannot see the cage or the fish? And if the fish are submerged to a depth of 15m and then brought to the surface too quickly, the swim bladders expand and can cause the fish to float on the surface and die, resulting in a short-lived and expensive operation.

The next advancement is a cage with some form of rigid supporting structure for the net. This structure is used where the net "bag" is deformed by water currents, reducing the volume and changing the shape of the bag. Of course, this frame adds expense and different maintenance needs.

The most sophisticated concept is a frame which fully supports the net so that water currents do not deform the bag at all. These are generally the most expensive structures but can tolerate demanding conditions.

Offshore aquaculture is certainly an exciting area of new developments for the industry. However, the environment poses some big challenges, and time will tell whether this type of marine farming will succeed in New Zealand.





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