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Red koura hold unique potential

AQUANOR SHOW AN EYE-OPENER

KIWIS HELP DANISH MUSSEL INDUSTRY

THE INDEPENDENT VOICE OF NEW ZEALAND AQUACULTURE

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Red koura could be a breakthrough

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Fishhooks dealt to SMALL FRY

BY KEITH INGRAM

The aquaculture reforms the Minister of Aquaculture, Phil Heatley, promised our industry after the last election have now become law. It remains to be seen how they will pan out. But the industry may have taken its eyes off another important component of the reform package while the law-making process consumed our attention.

On April 2009, the then minister announced the formation of a dedicated Aquaculture Unit within the Ministry of Fisheries. MFish's chief executive, Wayne McNee, described the role of the unit as, "to take the lead on aquaculture across central government in a 'one stop shop', working with the aquaculture industry, regional government and all other groups with an interest in New Zealand's coastal waters".

The aquaculture industry greeted the announcement enthusiastically, as they had long felt as though they were the poor cousins, as aquaculture development risked being neglected by a ministry primarily focused on fisheries matters. The long list of other government agencies with a finger in the aquaculture pie – the Ministry for the Environment, the Department of Conservation and the Ministry of Economic Development, to name three – also seemed to do little to advance the cause. It was a case of too many cooks in the galley.

Concerns had been expressed for some time that aquaculture lacked a "champion" inside the government machine; an agency which would proactively support the development of the industry and was unaffected by the competing demands of other stakeholders and priorities.

This concern was highlighted in the review of the regulatory regime for aquaculture in New Zealand during late 2008 and early 2009, which revealed the lack of clarity in the government's responsibilities for aquaculture. The 2007 government strategy on aquaculture was endorsed by six different ministers, with five government departments having direct input.

The report recommended establishing a new, independent aquaculture division or sub-agency within an existing government agency (ie, the Ministry of Fisheries) to "direct policy development for aquaculture". The authors of this report must have envisaged this agency would be something akin to Biosecurity New Zealand, an autonomous body with its own strategy, management and governance structure and funding. The same theme was picked up in one of nine core recommendations contained in the report of the Aquaculture Technical Advisory Group appointed by Heatley in July 2009.

This group, chaired by Hon Sir Doug Kidd, recommended there was a need to "strengthen the role of government by establishing an Aquaculture Agency within the Ministry of Fisheries to provide policy direction through an aquaculture strategy with national consistency and standards".

So an Aquaculture Unit was established. Dan Lees, a former aquaculture manager with MFish, was appointed as its director. He began employing staff with a range of skills and the unit has been going about its work ever since.

The only problem is that MFish has undergone the bureaucratic equivalent of a sex change after being merged into the Ministry for Agriculture and Forestry. Yet another restructure has accompanied the merger. The director-general of the new ministry pledged to save at least $10 million per year. The same hand that gives now takes it away.

What position does the Aquaculture Unit occupy within this new super-ministry? At this point it's not entirely clear. It certainly doesn't have the autonomy of other standalone units under the ministry's aegis, such as Biosecurity New Zealand and the Food Safety Authority. Its funding has been cut. The new ministry's organisational structure is shaking down into a series of "branches" headed by deputy directors-general, of whom none is the head of the Aquaculture Unit, meaning its status is debatable.

The extent to which the unit has been, or will be, hit by the need to make budget savings is also unclear. It has been suggested the unit was never fully staffed before budget cuts began trimming the number of staff it would be able to take on.

At the same time, a number of MFish employees from outside the unit engaged in developing and shepherding the recently enacted aquaculture legislation. Whispers around the traps hint that some employees who are concerned about how they might be affected by the reshuffle might have started talking up their aquaculture credentials in an effort to bolster their job security

It is a fact that the ministry's policy advice on aquaculture does not appear to be drawn solely – or even primarily – from within the unit, but from the policy division of the ministry, a potential conflict.

While there is no doubting the intent of sound principles and the role of the Aquaculture Unit, in reality it has limited autonomy, questionable status and only a small number of staff. It is by no means the government's principal advisor on aquaculture as first envisaged and what the ministry's own website describes it as. This is not to say the unit can't make a significant contribution to the development of the aquaculture sector. But it will struggle to be the panacea for resolving past government inaction and confusion that advocates hoped it would be.

SALMON DIET IS LOW ON ANIMAL PROTEIN

The New Zealand King Salmon Company says it has achieved exceptional results by feeding its fish a diet containing only eight percent fishmeal. It said the salmon produced 1.4 kilos of protein for every kilo of fish protein in the diet, and the fish equalled the best summer commercial performance, doubling in size from 800g to 1600g.

"We wanted the trial to show whether we could use Skretting diets formulated with the MicroBalance concept to have lower fishmeal levels in order to manage diet costs in the face of rising marine protein prices," said Mark Preece, general manager of aquaculture at the company.

The group ran the trial in experimental sea cages at its Ruakaka Seafarm in the Marlborough Sounds. The farm contains nine sea pens of 125 m^3, each capable of growing about 350 chinook salmon to harvest size.

Three diets were tested: a standard Skretting commercial diet comprising 30 percent fishmeal and two experimental diets of eight percent fishmeal each. They all included animal protein such as blood meal, but one of the two eight percent diets had lower protein than the commercial diet.

To understand the performance of reduced-fishmeal diets under challenging summer conditions, the trial ran for 80 days from early December 2010 to late February 2011. Growth and mortality were statistically equal in all three groups.

"While it is possible to make low-fishmeal diets that don't work well, the results from this trial demonstrate there is no performance hit when using low fishmeal in summer if the fishmeal is substituted appropriately," said Skretting's New Zealand technical account manager, Ben Wybourne.

Skretting's researchers identified certain micro-nutrients present in fishmeal that proved to be essential to the fish, which let them find alternative sources of them. "We can guarantee the digestible nutrient content of a diet, while varying the levels of raw materials over a much wider range, according to their availability and cost," Wybourne said.

The results will allow the company to lower fishmeal in all its production diets, Preece said, as the new method is substantially less costly.

TOP LEADER JOINS SALMON COMPANY BOARD

Sir Eion Edgar KNZM joined the board of Mt Cook Alpine Salmon Ltd on September 12. The chairman, the Rt Hon James Bolger, said Sir Eion would bring his extensive experience and commercial expertise to the company, as well as taking a private shareholding.

The company was experiencing over 100 percent growth per annum, and was in the middle of a $20 million capital expansion designed to see a significant increase in export production within the next five years, Sir James said.

Sir Eion is chairman of the sharebroking and investment banking company Forsyth Barr Group Ltd. He was previously chairman of the New Zealand Stock Exchange and a director of the Reserve Bank of New Zealand. "I believe now is a good time to be moving into this sector," he said.

In 2004 he was named NBR New Zealander of the Year and was also inducted into the Business Hall of Fame. Last year he was awarded the title of Senior New Zealander of the Year at the inaugural New Zealander of the Year Awards. Sir Eion was knighted in 2009.

FUND NOW INCLUDES AQUACULTURE

A New Zealand government fund supporting community-based growth and innovation in the rural sector now includes fish farming.

Farmers doing work related to the economic and environmental performance in the marine and land-based aquaculture industry can now apply for funding through the Ministry of Agriculture and Forestry's Sustainable Farming Fund.

The fund is open for applications and is accepting proposals for grants of more than $25,000 until September 26, and of less than $25,000 until February 2012.

"The SFF already invests up to $9 million a year in projects led by farmers, growers and foresters, often with technical support from industry groups and research organisations," Agriculture Minister David Carter said on August 19.

"The fund has assisted around 800 projects over the years, from avocados to wine, so it makes sense to include a growing aquaculture industry."

The aquaculture sector is currently worth over $350 million per annum but had not previously enjoyed access to funding for community-led projects, said Fisheries Minister Phil Heatley.

"Legislative changes just passed aim to see aquaculture grow to more than $1 billion by 2025. I'm sure the industry will welcome access to the SFF during what will be a critical growth period."

Aquaculture New Zealand said it welcomed the government's announcement. The chief executive, Mike Burrell, said the funds would offer aquaculture operators opportunities to invest in projects that will deliver economic and environmental profits to the wider industry.

The funds would allow New Zealand marine farmers to invest further in sustainable development, including innovative technology. "Environmental sustainability, market development, science and innovation are key pillars to the New Zealand Aquaculture Strategy," Burrell said.

AQUA DES ACHIEVES UK ACCREDITATION

The disinfectant Aqua Des has been accredited in the United Kingdom by the Department of Environment, Food and Rural Affairs for use by health professionals and fish farmers.

According to Neil Crawford of Aquatic Hygiene, Aqua Des can be diluted in seawater without loss of efficacy. "The oxidiser naturally breaks down into oxygen, water and carbon dioxide.

"Such independent verification of efficacy provides fish health professionals, regulators and auditors alike with their required level of assurance. The efficient application of Aqua Des promotes the maintenance of good health and welfare," says Crawford. "Environmental legislation and standards for disinfection is very demanding and our product has passed all the stringent test criteria."

The disinfectant had achieved excellent

NEW DIRECTOR HAS INTERNATIONAL EXPERIENCE

Aquaculture New Zealand has appointed Colin Johnston to fill the role of technical director.

Johnston has 18 years of scientific, planning and management experience across private enterprise and government in three countries. He will draw on his unique set of skills to lead the aquaculture industry's research and development strategy and manage Aquaculture NZ's innovation, environmental, regional technical and bio-security portfolios.

He was previously principal advisor on aquatic animal health at MAF, where he became well known in the industry for his work in diagnosing the oyster herpes virus that struck earlier this year.

Prior to his five-and-a-half year stint with MAF, Johnston worked for the South Australian government as general manager of aquatic resources, where he looked after the aquatic animal health, research and development, environment and aquaculture zone policy development portfolios.

Before moving to Australia, he looked after 50 farms, 40 million fish and a 35,000 tonne annual production as the veterinary services manager for Marine Harvest, in Scotland.

results throughout aquaculture farming operations, including difficult areas to clean, such as pipelines, Crawford said. It was also safe and cost-effective to transport to remote areas of farming activity.

See www.aquatic.no

VIRUS COULD HAVE CAUSED SALMON FISHERY SLUMP

A newly discovered virus could be the "smoking gun" behind the collapse of Canada's Fraser River sockeye salmon fishery in 2009, a federal fisheries biologist Kristi Miller said on August 26. She was appearing as an expert witness at the Cohen Commission, a public inquiry investigating the collapse of the 2009 sockeye run.

Miller, who works at the Department of Fisheries and Oceans at Nanaimo, British Columbia, said the parvovirus was similar to one that has been found in humans, dogs, sea lions, shrimp, ducks, geese and snakes. However, it was the first time a parvovirus has been found in a fish. She said the virus, discovered in late February, had potentially been matched to a genetic signature linked to the increased die-off of sockeye returning to the Fraser River.

The virus discovery furthers work published by Miller and her colleagues in the journal *Science* which showed evidence that many sockeye were entering the Fraser River in a compromised state, possibly because of viral infections.

"If we demonstrate that when fish are entering the ocean and they become stressed in the ocean (due to the environment), and they carry a high load of this virus, and that we see significantly enhanced mortality, there certainly is the potential that this virus could have a major impact on salmon declines," Miller told the inquiry.

She agreed with a comment from anti-fish-farming lawyer Gregory McDade that the virus "could be the smoking gun."

McDade pointed to work done two decades ago that suggested there might be a virus causing leukaemia in salmon, and asked Miller if it could be the same virus that was recently discovered. She said the leukaemia virus had not been ruled out, but noted it had never been isolated.

A fellow DFO scientist, Kyle Garver, called for a more cautious approach and said that without more research it was purely speculative to say the new parvovirus was a significant factor in the 2009 collapse.

"We don't have a link to mortality. We don't know how it is transmitted. We don't know if it causes disease," said Garver, who added he was uncomfortable with the speculation.

The DFO is investigating if the newly discovered virus is infectious and causes disease in Fraser River sockeye. The work began in late August and is expected to take at least several months, Garver told the inquiry.

CONFERENCE PROMOTES OPPORTUNITIES

Unlocking the potential of aquaculture through genomics, feed nutrition, selective breeding and innovations will be the theme of an address by Professor Neil Gemmell at the New Zealand Aquaculture Conference in November.

Professor Gemmell, who holds the AgResearch Chair in Reproduction and Genomics at the University of Otago, is the inaugural director of the Centre for Reproduction and Genomics, a collaborative venture between the university and AgResearch. It is working with NIWA, the Cawthron Institute and Sanford to help enhance aquaculture programmes spanning mussels, paua, salmon, and other finfish.

The conference will celebrate New Zealand's marine farming sector, which produces some of the world's best seafood and generates over $380 million in annual revenue.

It will bring together New Zealand's aquaculture companies and experts along with international specialists to discuss the issues and opportunities facing the sector, including new legislation, market development, sustainability, global trends, innovations and health. It will be held in Nelson on November 9-10 at the Rutherford Hotel.

Dr Rhys Hauler, marketing manager at Skretting Australia, will speak on the company's sustainable economic aquafeeds programme. Dr Hauler will describe how Skretting develops and produces products to deliver sustainability in feeds. Advances in fish nutrition, selection of raw materials and life cycle analysis of fish feeds will be described.

Other notable speakers are expected to include Dr Richard Smullen, technical manager at Ridley Aqua Feed, and Nick King, the cultured shellfish programme leader and senior aquaculture scientist at the Cawthron Institute. King's expertise is combining biology with industrial automation. His improvements range from high-density larval tank design through to entire hatchery monitoring and control systems.

Others who will present their views to the conference include:

- the chief executive officer of the Fonterra Co-operative Group, Andrew Ferrier
- the Minister of Fisheries and Aquaculture, Hon Phil Heatley
- the chief executive of the Aquaculture Stewardship Council, Chris Ninnes
- Maori trustee Jamie Tuuta, who has a keen interest in innovation and increasing the performance of our primary industries, in particular the Maori pastoral and fishing sectors, and
- cook, writer and broadcaster Peta Mathias.

NEW LAW SUPPORTS SUSTAINABLE AQUACULTURE

The successful passage of the Aquaculture Amendment Act set the legal framework needed to support growth in the aquaculture sector, says Fisheries and Aquaculture Minister Phil Heatley.

From October 1, changes will be made to the Aquaculture Reform (Repeals and Transitional Provisions) Act 2004, the Fisheries Act 1996, the Maori Commercial Aquaculture Claims Settlement Act 2004 and the Resource Management Act 1991. The act removes the need to establish aquaculture management areas.

"These changes will support the aquaculture industry to fulfil its potential while maintaining essential protections for the environment. It balances aquaculture development with other uses of the coastal space," Heatley said.

"Aquaculture needs only a small fraction of our coastal space and has the potential to be a $1 billion industry by 2025. This potential was fettered by the unintended consequences of former regulations that saw aquaculture applications held back by moratoria."

Aquaculture would now be on the same footing as other coastal activities and enable local councils to plan new aquaculture ventures in a similar way, with proposed developments going through consent processes under the Resource Management Act.

The legislation specifically assists aquaculture development in Tasman and Waikato by amending both regional coastal plans to enable applications to farm a wider range of species, including finfish, in areas where aquaculture is already established.

"Before the introduction of this legislation, these two plans contained the greatest barriers to developing aquaculture. The government recognised there was a great opportunity to stimulate investment and growth in these regions, within acceptable environmental limits," he said. The Waikato coastal plan has also been amended to establish the Coromandel Marine Farm Zone.

Heatley said the government was committed to ensuring the Crown continued to uphold the Maori Commercial Aquaculture Claims Settlement, and the new law included a delivery mechanism for the settlement.

See www.fish.govt.nz.

Advances in KOURA FARMING

BY PIETER WILHELMUS

In the early 1960s, the then Department of Fisheries did some trials on koura farming. As a result, they determined koura would not be viable, as they would take three years to reach a weight of 35g. Current trials have produced far different results from those early days, with fish averaging 55g in two years and broodstock males in excess of 200g.

I started farming in 1993, just after moving to Marlborough with a number of years of freshwater salmon farming under my belt and keen to have my own freshwater fish farm.

We found a suitable site up the Wairau Valley and began the paperwork war to establish a salmon farm. I didn't want to have all my eggs in one basket, so, enter the koura. I had caught these as a child, having fun and a good feed at the same time.

So I decided to set up an aquarium trial in our shed in the middle of town to see how they would breed. The tank was about half a cubic metre in size and had an artificial cover, plus natural weed for food and cover.

I collected three males and three females, put them in the tank and left them to it. I fed them worms and salmon food, and the natural weed was also available for them to eat. Twelve months later I had so many hatchlings it wasn't funny, so I had to end the experiment.

By March 1995 we had a small salmon farm built and fish in the water. At that time David Smythe, who had done our consent work for the farm, said if I wanted a partner to help get the koura farm going to give him a ring.

So it was that New Zealand Clearwater Crayfish (Koura) Ltd was set up to help grow and market the *Paranephrops planifrons* that Ormond Aquaculture Ltd had started.

The first trials were very basic, using some large plastic tanks, just to establish growth rates and survival in the first 12 months. These were only partially successful, as the growth rates were good but the survival rates were affected by cannibalism.

We determined that koura needed lots of room and a lot of cover. Two races were dug out in the natural gravel and compacted to stop most of the water loss to ground. Water was supplied by gravity, just like a flow-through salmon farm. The races were left for 12 months to become just like a natural stream, with lots of weed and grass cover, before being stocked.

Over the next few years we had to find the best way to grow koura. We started by leaving things natural and relied on natural recruitment and harvesting what was ready each year. The system worked okay, but we weren't getting enough fish of market size coming through, and it was taking a lot of time to select these fish from the others.

Juveniles

The system had to change, so we decided to have separate classes for each year. For this to happen we had to have a separate pond for broodstock. Over the next six years we did three different trials, ranging from using a hatchery to get juveniles to stock races with females in protected baskets to hatching out young directly into predator-free races. This gave us the chance to selectively breed for growth and colour.

We have now settled on a system of hatching out fish into dedicated rearing races until they are 12 months old. These are graded out to grow on for another two years or more in larger races. Our outdoor hatchery is still used to hatch out selectively bred crosses, and the tanks also double for mating selective crosses for colour and growth. Koura moult and grow fastest in their first year, and this gave us somewhere to start improving growth.

Koura start breeding in mid-March and hatchlings start appearing in mid-November onwards, depending on how cold the winter is. If we could get the hatchlings out in early September we could get three or four months of extra growth in the first year. A trial was started in an aquarium to artificially incubate koura eggs. It was a pretty simple set-up.

A tank was insulated and heated to a selected temperature. The koura eggs were acclimatised slowly to the higher temperature and kept in the dark, with regular water tests

Red koura

Market size

Packed for sale

Koura in berry

Intake fish trap

Hatchlings settling out

Incubator box

done to check on the water quality. To our surprise, the eggs hatched in two months, a full three months ahead of eggs kept in ambient water temperature.

A full-size hatchery had to be built in the following year, but in what? Unfortunately in 2008 we lost all our salmon due to stock pollution of our water supply, which had been an ongoing problem for some years. Thankfully the council did something, though they left it a bit late, and the pollution did not effect the koura. This left us nearly bankrupt but with a lot of surplus ponds and gear.

One of our salmon hatching troughs was fully insulated and installed in our disused processing shed. An insulated bulk fish bin was installed in the roof for a head tank, and a collection tank installed under the salmon trough with a submersible pump on a float switch to collect the water and recycle it back to the head tank.

I would like to thank Brent Pickering for his input into the technical details of recirculating systems. The whole system is gas-heated on a thermostat, which also adds fresh water several times a day. We now start the indoor hatchery at the beginning of July and have the hatchlings out in in the races at the beginning of September.

When the fry start leaving the females we collect them every four days and bulk weigh them on micro-scales to obtain the numbers by average weight. These are then stocked at 50 per m^2 in the one-year races. The survival rate is 97 percent to stocking out. We now also keep male and female broodstock separate in our disused salmon ponds.

A result of selectively breeding fish is the different colour variations that come through. As black or olive green is not a very good marketing point we decided to work on this.

About six years ago I got a real surprise one day while grading a yearling race to see five bright red fish about 50mm in length. I treated these like royalty but, as Murphy's Law would have it, I lost all five one way or another and thought, that was that.

Two years later, 32 more appeared again. I kept these separate until they reached breeding size. Last year I bred these back across each other and had one small female get in berry. She was kept aside to hatch out her eggs undisturbed.

As a result, last spring all her offspring were red. I still don't know which fish will produce red offspring from standard-coloured fish, but I know I have produced fish with a red gene.

Last year I had 60 red fish from standard-coloured fish and now I have 200 red fish and 16 large red females in the hatchery. I am hoping for all red offspring, but three percent of red juveniles revert back to brown.

As far as I know we have the only fully red freshwater crayfish in the world. These fish really turn heads in the marketing sector and could easily compete with scampi and the like. I guarantee the photographs published with this article are the real thing, the koura are not colour-fed and there have been no genetic experiments. The red colour is natural, like any other farmer would do to get a particular trait. We hope to have commercial numbers in a few years.

The farm is producing two tonnes/ha equivalent, with a gross return of $55,000 to $60,000 per tonne, plus freight and so on. Running costs vary, depending on how much artificial food is used. I developed a special diet and it is fed as a supplementary ration to boost their natural diet.

Predators were a big problem at the start, with numerous races of koura lost to eels. It took several prototypes before I came up with what you see in the photograph. This still allows us to use an up-stand to control water depth, but also incorporates a trap for fish and to draw stale water from the bottom of the race.

We use 3mm slots on the grow-out races and 1mm slots on the hatchling races to stop the hatchlings from migrating out. The screens seldom become blocked and the screened and horizontal sections can be removed to let frog weed flow out without lowering the water level. Work needs to be done on identifying the gene for fast growth and the production of single-sex specimens to speed up growth rates.

Just remember, all you would-be aquaculture folks out there. Don't believe what you hear until you try it.

When does a cod **HAVE TWO TALES?**

BY JOHN MOSIG

Ready for market! A sample of cod from Thurla Farms

Col Beasley proudly shows off some of the cod produced in Thurla Farms' floating raceway system

When does a cod have two tales? When it's part of an aquaculture development scheme.

Over recent years Fisheries Victoria, with the enthusiastic support of Col Beasley of Thurla Farms, a prominent farmer in Victoria's Sunraysia Irrigation District, has been driving a development programme for Murray cod (*Maccullochella peelii peelii*) with funding from the Australian Department of Primary Industry.

While some success has been achieved, the programme has stirred up considerable controversy.

Sunraysia is a major horticulture region and many farms have holding reservoirs of over 2ha. The idea was to use this water storage to grow the iconic Murray cod in floating raceways.

The floating fish farm module consisted of four 15m x 2m x 2m floating raceways complete with walkways, a fish treatment bay, anti-bird netting, automatic feeders and an aeration system. Col Beasley says under ideal conditions, each module can produce 40 tonnes of cod over 18 months, spanning two growing seasons.

Fisheries' have worked for several years doing on-site trials, developing a marketing plan under the Murray Gold brand. They are also seeking funding for veterinarian expertise and advice. Col predicts Murray cod has a promising future in the region. "The double use of water to produce a high-value crop such as Murray cod has a lot to commend it."

The fish are grown in two stages. During the hatchery/nursery stage, the cod are spawned and the larvae taken from fry to 100g fingerlings over their first winter in temperature-controlled re-circulation units.

Although Sunraysia, as the name implies, receives abundant sunshine and hot summers, it has a continental climate. During winter, overnight temperatures can fall below zero and water temperatures fall to 9° Celsius for 10 to 12 weeks.

The six-month growing season in the floating runs from October to March. Once the water temperatures reach 18° Celsius they stock the 100g fingerlings. The cod are graded regularly to remove shooters and prevent cannibalism and are graded again toward the end of their first season. At this stage most of the cod weigh around 500g, with extremes of 200g to 750g.

During the second growing season they are harvested as they reach the market size of 800g to 1.4 kilos.

The cod need constant monitoring for health issues. While this may seem labour-intensive, the cages are designed so it only takes two minutes to move the fish into the central treatment tank, says Col. "We don't have to handle the fish or remove them from the water."

However, not everyone who went into the programme is as enthusiastic as Col. Four years ago Barry Avery, a table and wine grape and avocado grower, was attracted to aquaculture after reading a DPI report on the viability of farming Murray cod in Sunraysia.

"I invested quite heavily in a floating module recommended by the DPI. I thought I'd followed up the markets but all the information I'd been given on marketing, the time required to manage the operation, feed conversion and stocking densities and mortalities seemed to be heavily influenced by the desired outcomes, rather than the harsh realities of commercial aquaculture. They turned out to be impractical in a real-life situation", Barry said.

"Lack of support was probably the single key item missing from the scheme. The DPI people were enthusiastic about the project at the field days, but when it came to practical support and training, there was nothing there.

"I should have heard the alarm bells from the final report when it concluded: "Key risks and opportunities include best practice guidelines, integration and coordination of the value chain, elite strains of finfish for aquaculture, water quality issues, industry education and training and export development".

However, this was prefaced by the statement that, "Open water farming of Murray cod in private irrigation storage dams in northwestern Victoria is now at a 'commercial-ready' stage and is potentially a new A$50 million industry for Victoria.

"In hindsight, you would be excused for thinking the risks were for the investors and the opportunities were for the DPI people running the project."

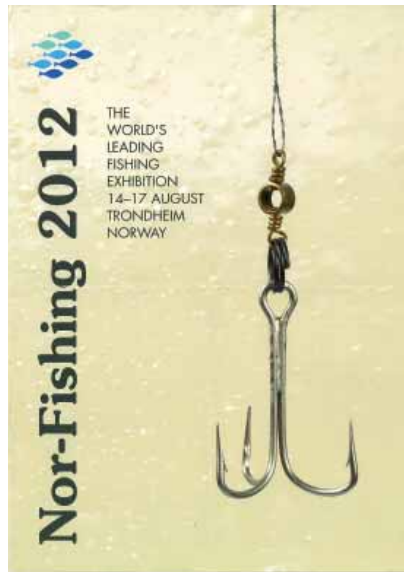
The jury is still out on the future of the programme. Murray cod grown in floating raceways is reaching the market from Sunraysia. However, at this point it's not clear if they are being sold for a profit.

Premiere aquaculture show COVERS THE FIELD

BY PHILIP JAMES

AquaNor is a forum for participants in the aquaculture industry from Norway and around the world to meet, exchange ideas and see the newest novelties, products, services, current research and development projects of relevance to the industry.

The meeting is held biannually and this year attracted 17,500 visitors from 61 nations to the Norwegian city of Trondheim. Some 460 exhibitors vied for the visitors' attention and for this reason AquaNor is recognised as being one of the largest and best-known aquaculture trade shows in the world.



The array of technology and information on show at AquaNor 2011 was sometimes breathtaking, with my favorite being the automated vaccination machine capable of vaccinating 20,000 fish per hour, or five per second!

On show were all the current developments in the fields of aquaculture technology, fish feed (surprisingly, the large feed companies did not actually have stands at the show but had numerous delegates present), fish health, quality assurance, training, funding, fish farmer networks, grading, equipment, storage, processing, packaging, environmental protection and distribution.

Given that Norway now produces more than one million tonnes of salmon per annum (by comparison, New Zealand produces 7500 tonnes of salmon per annum, less than one percent of Norwegian production) much of the technology and information on show at AquaNor was directed toward salmon farming.

This suited the two Kiwis I bumped into just fine, as one was from New Zealand's largest salmon production company and the other represented AQUI-S, a New Zealand-made marine anaesthetic used in fish farming.

Despite the focus on salmon production there were a huge variety of products on show, ranging from the quirky "happy fish" stand, which sold relatively simple but apparently effective wrasse condominiums (they apparently make wrasse "happy") to large-scale industrial products.

These included polar circle salmon cages which were 200m in circumference and constructed from 500mm diameter floating pipes, 2.7m wide net cleaners capable of vacuuming 1400sq m of net surface per hour, and sewing machines capable of producing dosing nets with a surface area of up to 5000sq m.

There were many biological-related exhibits, including the use of farmed cleaner wrasse to control sea lice populations in Norwegian salmon farms. This has proven so effective that farming Ballen wrasse has now become an industry in itself in Norway and a number of other European countries.

Not everything on show was huge. For example, the smallest PET electronic tags now available are a mere 8.4mm long and can be inserted directly into a fish or encased in a streamer tag for instant identification of a fish (or a range of other marine species) in a crowded cage. This makes scientific research on large groups of fish in sea cages significantly easier and more meaningful. There was something for everybody at AquaNor, and even the opening by King Harald V of Norway was a crowd-pleaser!

The only disappointment was the price of a beer in Trondheim of around NZ$17 for a 300ml glass. If you can handle that, next year (the alternate year to AquaNor) is the 2012 Nor-Fishing show, the world's leading fisheries exhibition, with all the latest and greatest gadgets and toys for large and small-scale fishing. See you there and BYO beer!

ADVERSE effects and arbitrated compensation

BY JUSTINE INNS

If the bulk of the recent reforms to aquaculture legislation were fairly uncontroversial, plenty of discussion has been generated by the new provisions for arbitrated compensation of quota owners impacted by undue adverse effects (UAEs) since they were unveiled by the Minister of Fisheries, Phil Heatley, in early August. In the first part of a two-part article, we look at what has and hasn't changed about the UAE regime.

There are now four distinct phases in the UAE process. A new option is for an applicant for a resource consent in respect of aquaculture activities to attempt to negotiate a "pre-request aquaculture agreement" with quota owners in respect of any fish stock potentially affected by the proposed activities.

Such an agreement can be concluded at any point up until the consent is granted and the relevant regional council asks the chief executive of the Ministry of Fisheries to undertake a UAE assessment in relation to it. A pre-request agreement must include the owners of at least 75 percent of any fish stock, though the aquaculture applicant will have to pay any compensation provided in it to all the quota owners. The effect of an agreement is to exclude the relevant fish stock or stocks from consideration in a UAE assessment.

The second stage, assuming no pre-request agreement has been reached, is the assessment of the effects of the proposed aquaculture activity on fishing by the chief executive of the Ministry of Fisheries. The requirements for this assessment have not changed significantly.

The ministry will now have only 20 working days (rather than six months) to undertake that assessment, excluding any period during which it is undertaking consultation. Consultation will no longer be mandatory, though it's difficult to imagine the ministry making a decision without opting to consult – if only to buy time!

The more significant change to the UAE test itself – removing effects on the sustainability of fisheries resources from the assessment, and limiting it to effects on fishing – actually occurred in the 2004 reforms, though it has not yet been implemented. A UAE decision by the chief executive can be challenged through a judicial review, but the alternative of appealing it to the High Court has been removed.

The consequences of the UAE decision have not changed. There are essentially three possible outcomes:

The chief executive determines the aquaculture activities will not have a UAE on fishing, in which case the aquaculture applicant can start their aquaculture activities in accordance with their resource consent.

The chief executive determines that the aquaculture activities will have a UAE on customary or recreational fishing, in which case the relevant resource consent is cancelled in its totality, or in respect of those areas specified by the chief executive.

The chief executive determines that the aquaculture activities (over the whole or a part of the area) will have a UAE on commercial fishing, in which case the resource consent (or the relevant part of it) can't be exercised unless the holder of it lodges an aquaculture agreement or a compensation declaration.

So, if a UAE is found to be likely, the third step – assuming the resource consent holder wants to proceed – is for them to attempt to reach an aquaculture agreement with affected quota owners. Again, this mechanism was introduced in the 2004 reforms but is yet to be tested.

It requires the consent holder to obtain the agreement of owners of at least 75 percent of the quota impacted by any UAE, and the consent of the High Court on behalf of any non-consenting quota owners.

The level of agreement required has been decreased from 90 percent under the 2004 rules, though, given the degree of concentration of ownership of several key inshore species, it remains to be seen how material this change might be in practice.

The consent holder has six months to attempt to negotiate an aquaculture agreement (or agreements), though this period can be extended by three months if the consent holder can satisfy the chief executive of MFish that they have taken reasonable steps to obtain the consent of all relevant quota owners, but require further time to obtain all the necessary consents.

If an agreement is lodged with MFish within the prescribed time, the consent holder is given the all-clear to exercise their resource consent.

If no agreement can be reached, the consent holder has the option of requesting an arbitrator determine what level of compensation they must pay quota owners before they can exercise their resource consent.

And that is where things get really interesting …

To be continued.

Justine Inns is a partner at Oceanlaw. She spent more than a decade as an advisor to various iwi (tribes), including several years with Ngai Tahu.

Under the JACARANDA TREE

BY DOROTHY-JEAN MCCOUBREY

I left the sunny shores of New Zealand just over six months ago to work in Africa. As I departed, the editor of this publication bravely said if I wrote stories he would keep publishing them. This is all very well, but I have learned such trust brings obligations. In return, I must come up with a new food safety or seafood story every two months. Believe me, when you are landlocked in some African country it is hard to feel a marine food safety story pulsing through the grey matter.

I have tried to stay abreast of New Zealand's major marine issues. I noted the public spat between Greenpeace and Sealord on sustainable tuna fishing methods and followed the exciting adventures of Happy Feet, who is possibly now in penguin heaven or at least forming part of the food chain.

So this month I pondered the question, "Can blue and green ever be seen together?" In other words, can the capture fishing industry ever prove its real interest in social responsibility to the environmentalists? Even if it could, would the environmentalists actually admit publicly that the fishing industry is on the right moral track?

I have struggled with this topic, carefully gathering up enough facts to ensure neither Greenpeace nor Sealords could start litigation proceedings to take away my hard-earned Zimbabwean dollars. Believe me, most dollars in Zimbabwe are earned the hard way.

There is up to 80 percent unemployment in many areas, and blue-collar workers lucky enough to have a job earn no more than US$150 per month. The land reforms mean the "bread basket of Africa" is no longer producing, because many of those who know how to farm are no longer in charge of the productive fields.

At least 1.8 million people live with the Aids virus, meaning life expectancy in Zimbabwe has now been reduced from 65 years to 38. There was an HIV prevalence rate of 43 percent on the farms, with the highest number aged between 15 to 23, the agricultural labour force. With such large numbers dying of Aids and no rural work, many families have fallen apart.

I live in the inner city of Harare, right behind the Mannenburg Jazz Club, which means six nights a week my apartment moves to the beat until the early hours and on the seventh night I cannot sleep because it is so quiet. It also means many homeless people line up to ask for help at my local grocery store.

Tenashi (middle) was arrested by the police today and roughed up. To get out of police custody cost US$20.00

I stayed staunch for many weeks, ignoring the queue and not knowing how to help what seemed like a bottomless pit. One day one of the young men, called Tenashi, said all he wanted from me was a smile. How can one resist such a black charmer?

At that point I decided the queue was at least due my respect and some words of daily recognition. Tenashi has been on the streets for many years as his parents both died of Aids in the 1990s. Like many displaced Zimbabweans he has no paperwork to provide him with a real identity. To get such paperwork requires not only payment, but also bribery money to receive it in a timely way.

Over the weeks Tenashi tried using his charm on me, asking for beer for his birthday party, cigarettes and meal money, but I decided the most practical way to help him was to arrange to get his national papers for him.

A few weeks after doing so I found him waiting for me at my apartment gate. He excitedly pointed to his national identification and showed me that September 9 was his birthday. I pointed out he had asked me in April for beer money for his birthday, to which he quickly responded, "But I did not know when my birthday was then! Now I know. I don't want your money this time, but I did want to thank you for giving me a real birthday."

It is very possible none of my multi-million dollar African United Nations projects will come to anything for political and bureaucratic reasons. However, the smile of pure joy on Tenashi's face in being given his birthright with a day to celebrate each year is enough for me to feel I have actually done something worthwhile while in Africa.

I have decided "social responsibility" does not only mean large corporate gestures, backed with significant and expensive scientific work. It could be something simple like Sealord and Greenpeace sitting down to find some common ground – they might be surprised how easy it is to find.

Freshwater aquaculture – UNTAPPED potential

BY JOHN MOSIG

G'day Kiwi, how's it going over on your side of the Ditch? After 14 years of below average rainfall, the East Coast over here has had some serious catch-up rainfall. It knocked us around a bit when it happened, but gee, it's great to see the country in full cry again.

I read Vince Scully's piece on koura and mullet (in *Aquaculture* issue 39) and I agree with him on both scores. Firstly, freshwater crayfish have a so far untapped potential to be a serious aquaculture product and secondly, polyculture with mullet has equal potential.

Let's examine the situation. The two bookends – a reliable supply of quality seedstock and a healthy market – must be in place for an aquaculture venture to be successful.

The cost of production must be such that it doesn't push the product up into the rarefied price bracket of the white tablecloth market. In other words, the fish must be cheap to feed and take as short a time as possible to reach market size.

Finally, and this is a must for investors, there must be enough potential technical up-side to add value to the balance sheet as well as the profit and loss account.

60g table yabbies

I can speak with some authority on freshwater crayfish, so we'll start with them. Pardon me if I concentrate on Aussie crayfish – yabbies in particular – but you'll be able to compare the comments with the trans-Tasman situation. There'll probably be some species-specific behavioural differences, but it's my guess they'll have more in common than otherwise.

When it comes to markets, yabbies, redclaw (*C. quadricarinatus*) and marron (*C. cainii* and *C. tenuimanis*) have an established mystique. The depth of that mystique has led many potential crayfish growers to base their marketing strategy, and consequently their downfall, on the assumption the world can't get enough of their product.

There is a market for freshwater crayfish, but when you talk to the hardheaded providores at the wholesale fish market, the glassy-eyed mystique that has blurred your marketing vision gets a quick polish. These lads know the depth of the market and pay accordingly.

So the question to be asked is, can the cost of production be reduced so the product can be presented inside the budget of the wider seafood-consuming community? (Look no further than mussels for proof of that, eh?)

The answer is simply yes, the cost of production can be reduced to levels that make the animal an attractive addition to the menu for those on a lower to middle-range budget.

As with all wild creatures, selection for a genotype that displays a predilection for farming can only be a plus. Although the animal tends to be labour-intensive, it can be fed relatively cheaply by generating a natural food web in the ponds. When coupled with farming friendly, faster-growing seedstock, this translates to higher yields over a shorter time, which in turn translates into lower production costs.

To cover the other bookend, seedstock supply, producing freshwater crayfish under controlled conditions in a hatchery tends to be labour-intensive, but the rewards pay for the outlay and effort.

Under controlled conditions, the seedstock cannot only be genetically improved, but also it can be produced to match the most advantageous time to stock the ponds.

In the wild, the female takes advantage of the warming spring to put condition into her eggs. In a hatchery, broodstock conditioning can be done in advance of the improving season so the newly hatched juveniles can be stocked as soon as conditions pick up.

As for genetic improvement by selection, for an animal that reaches reproductive maturity in three to six months, the potential for improvement in growth, conformation, food conversion and all-round vigour is appealing.

So what have we got? An animal with market appeal and acceptance, room for significant productivity improvements and its feed source is independent of the fish meal supply vortex faced by say, salmon producers. Where do I sign up, I can hear you asking?

Now let's look at mullet. I'm one of those people who think all fresh fish tastes good, and I have a particular liking for fresh mullet. There was a seafood café known as Jake's on the coast of New South Wales at Karuah.

It was on an estuary and you could bet your bottom dollar the mullet at Jake's was fresh. The only time I ever drove straight through Karuah was when Jake was on holiday or the sandwich board didn't feature mullet. Jake's was fresh because it was caught in the estuary or up one of its many tidal branches. So, if it was farmed you could make sure it reached the market fresh.

Then there's the added value option Vince suggested of smoking them. I've never tried smoked mullet but after sampling some of the marinades at Jan Dissel's Anatoki Salmon on Golden Bay, I can image it is mouthwatering.

Hatchery-reared seedstock can be produced and they are akin to vacuum cleaners in the ponds. They can be fed a natural diet the same as freshwater crayfish, or at least a low-value manufactured diet.

Crayfish can also be fed a supplementary diet if the economics of the day dictate, and the crayfish have a high turnover production cycle. Market-sized animals of 60-80g can be produced in a summer. This is looking better every time I read through it. Before you rush into it, get in touch with Vince and he'll explain why it ain't all beer and skittles.

Export windfall
FOR SEAWEED PEST

BY LINDSEY WHITE

Many seafood lovers may be unaware the green seaweed in their lunchtime sushi is the highly invasive and unwanted *Undaria pinnatifida*. To seaweed biologist Dr Lindsey White of AUT University, undaria is the nectar of the (sea) gods.

Dr White is currently leading a team of researchers exploring uses for undaria seaweed and new market opportunities for New Zealand's aquaculture sector, including its commercial use and health-related benefits.

"There are only a few places in the world where undaria seaweed is grown, so this could potentially be the next big thing for New Zealand's aquaculture industry," says White. "Undaria is a popular food source in Japan, Korea and China, and there's already a $400 million market for the seaweed. It is a multi-million dollar industry in Asia and it has the potential to be so here."

Undaria was introduced into our waters in the 1980s, where it spread rapidly. Until late 2010, government restrictions meant undaria couldn't be harvested or farmed in New Zealand, due to concerns about the spread of an introduced seaweed and its ecological impact on native plant and animal species. It is still classified as one of the top 100 global invasive species.

The previous moratorium on seaweed harvesting was an obstacle for developing seaweed-based industries in New Zealand, says White.

"Undaria is a resource whose time is finally coming. There is potentially tens of thousands of tonnes of undaria currently going to waste in New Zealand annually, most of it found growing on the lines of commercial mussel farms.

"There is also a potentially growing market in both New Zealand and Asia because of concerns about the radioactive fallout (from the earthquake and tsunami in Japan) and its impact on undaria seaweed farms in Japan."

White says there are increased demands for fresh seaweed in New Zealand because of our growing Asian population. "Asian people traditionally prefer to buy it fresh but currently this isn't possible, as all undaria here is imported frozen or dry-packed."

AUT, in partnership with the mussel export company Wakatu Corporation, is currently researching the commercial and neutraceutical applications of undaria.

The development manager at Wakatu, Mark Allsopp, says the research is part of the corporation's commitment to explore new market opportunities for the sector.

"Wakatu was one of the first to be granted a harvesting licence when the moratorium on undaria was lifted in 2010. A lot of undaria already grows on our lines, so we're interested in using it, rather than it being a pest."

Green-lipped mussels represent New Zealand's largest shellfish industry, with over $200 million per annum in exports. However, White says ongoing research is essential to increase the competitive edge of New Zealand's aquaculture sector on an international scale.

There are currently seven separate undaria research projects underway at AUT, ranging from the differences in nutritional chemistry between the New Zealand and Asian strands, to investigating undaria's potential anti-cancer properties.

Dr Lindsey White of AUT University

Harvesting undaria as a by-product of mussels

White says the compounds fucoidan and fucoxanthin, both found in undaria, have proven health benefits and there is some evidence they have an effect on cancer. However, he is keen to stress this line of research is only in its infancy.

New Zealand has a healthy local market for seaweed-based products, including fertilisers, stock food and produce for human consumption. It is also valued for traditional purposes among Maori.

Seaweed is rich in iodine, calcium, iron, magnesium and potassium, vitamins, amino acids, omega 3 and antioxidants. It may also boost immune systems, lower cholesterol and relieve joint pain.

"Undaria is such a valuable resource," says White. "My pick is that within the next few years we'll be farming it, not just harvesting it."

Contact Dr Lindsey White, AUT University, phone 09 921-9999 x 8065 or email lindsey.white@aut.ac.nz

This sensor mounted on a mussel line measures the water turbulence in the flow as it approaches the feeding mussels (Photo: Jens Larsen)

Exploring Danish SHELLFISH FARMS

BY CRAIG STEVENS, NIWA MARINE PHYSICS

This instrumentation raft in the centre of the farm houses a range of sensors (Photo: Craig Stevens)

New Zealand's involvement in an international project aimed at reviving the Danish mussel industry will help keep us at the forefront of world aquaculture development, say NIWA scientists Drs Craig Stevens and David Plew.

They recently returned from a high-profile collaborative field experiment in Limfjorden Jutland, where a three-year international project is underway to enhance mussel farming in Denmark.

While a wild fishery has existed there since the 1940s, Denmark's mussel aquaculture is a relatively new venture. Its expansion has been rapid in the last decade, when the Danish government began issuing farm licences for Limfjorden Jutland.

Total farmed production was nearly 3000 tonnes by 2009 and while that is only about 10 percent of New Zealand's output, Denmark is now the fourth-largest mussel producer in Europe and plays an important role in the local economy.

Blue mussels (*Mytilus edulis*) feeding (Photo: Jens Larsen)

The Danish industry grows blue mussels (*Mytilus edulis*), a species widely distributed in European waters from Russia to the Atlantic coast of southern France. Although blue mussels can live for up to 24 years, most cultured mussels are produced in less than two years.

Despite its success, Denmark's mussel aquaculture industry is currently facing significant issues which distinguish it from New Zealand's own aquaculture development. It's historically strong wild shellfishery is struggling because of economic and environmental pressures.

The centre of the industry - both wild and cultivated – is the largely landlocked Limfjorden, a complex series of basins connected to both the North Sea and the Kattegat, the strait between Denmark and Sweden.

Because the area is surrounded by agricultural farming and the basins are relatively low-flushing, the Limfjorden Jutland is typically quite eutrophic, with low water quality and frequent algal blooms, due to excessive nutrients.

To mitigate these effects, mussel farms are being used to soak up excess nutrients in the water. Being able to sell the mussels for feed or human consumption is a bonus.

To help boost the industry, an international team of scientists, funded by the Danish government's Strategic Research Fund, is part of the way through a three-year project to make mussel farming more efficient, while at the same time ensuring ecologically sustainable production that complies with environmental management requirements.

As a result of the project, sophisticated aquaculture approaches to harvesting mussel crops are evolving to complement and enhance the existing industry.

The project team includes biologists, oceanographers, economists and computer modellers from Canada, the United States and Germany, as well as Denmark and New Zealand. They are based at the Danish Shellfish Centre, a

Turbulence profiler about to be deployed next to a longline (Photo: Craig Stevens)

Sampling from an instrumented platfom next to a longline (Photo: Craig Stevens)

dedicated research station in central Jutland.

Mussels are passive, so they cannot adjust their position (well, not quickly) to improve their feeding. Locating the crop requires knowledge and forethought to maximise feeding rates and minimise the accumulation of waste deposits. This might seem simply a matter of locating them in the fastest-flowing water.

However, competing use of water space and the limited working depths mean the answer is not always that simple. The New Zealand team is providing expertise to the project team about how to observe and measure the currents moving through and around the farm.

The water stratification means flow can also move under and over the farm. With low flows and lots of stratification, the water around the mussels can be quickly stripped of food. The key to replenishment is knowing the degree of turbulent mixing that refreshes the water and food supply right near the mussels. Without this, models are just nice pictures.

How will the Danish project help New Zealand aquaculture development? Stevens says the most important lesson learnt from the Danish project is that we need to embrace complexity. The Limfjorden Jutland is a micro-tidal system, and so flushing is mainly driven by large storms which are hard to predict.

Measurements taken show the clear effects on the flow from farms surrounding the basin that is guiding the water flow in certain ways.

This farm-effect must be built into predictive models of the system to determine the best strategy to maximise feeding and minimise the accumulation of waste deposits.

Another key factor is the water is quite strongly stratified compared to New Zealand coastal waters. This makes the shallow Limfjorden effectively much deeper in terms of how nutrients are passed around and so more comparable to New Zealand waters. A number of strategies are possible to maximise feeding and growth, given this stratification, based around understanding the seasonal variations in stratification and how the crop can be varied with this both in season and spatially throughout a farm.

Working on the Danish project has been quite challenging, says Stevens. It's a very complex system and an ambitious research programme. but it brings substantial, high-level benefits to New Zealand. The Danish wind energy industry is a relevant example and has proven the benefits of building a knowledge-based sector around an industry and so corner the market internationally in terms of ideas and staying at the leading edge.

If we can build on this with mussels at a national level, New Zealand stands to keep a hand on the tiller in terms of leading mussel aquaculture. We are world leaders in understanding how suspended culture effects and is affected by flow variability. This will become more and more important as aquaculture space is limited.

So while we are exporting our skills and knowledge it's a two-way street. By working with top-level scientists in complementary science areas we bring home a range of ideas about how to improve our own approaches to understanding environmental influences on production, impacts and how to turn ideas into benefits for society.

Also, using mussels to soak up excess nutrients is highly relevant to ideas about how to mitigate fish farm effects.

Stevens says New Zealand's involvement in this international project is part of a broad initiative to have a much more knowledge-based approach to working with, and using, our oceans and coastal waters.

The basic tools for quantifying transport and mixing seawater and the nutrients carried with it can be applied to a wide range of sectors, including energy supply, biosecurity, future climate forecasting and food production.

The challenge is connecting the improvements in understanding how the ocean works to the particular needs of each sector.

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