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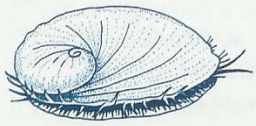
Abalone aqu



-the secret's out

By Barry Wiseman

As we sleep in our beds at night, hundreds of thousands of salt-water creepy crawlies are sharpening their tiny teeth and chomping away through green meadows. It's all in the name of science, aquaculture and Australia's long-term goal to produce a "super ab", as Barry Wiseman reports.

THEY'RE more active during the hours of darkness. Tiny juveniles, much smaller than a pin head, grazing on huge paddocks of greenery. To something this small, at least, a larvae-covered plastic plate measuring about 60 centimetres by 30cm must seem enormous. Endless pastures of tucker.

But it doesn't take long for a few million baby *Haliotis laevigata*, or greenlip abalone, to get through a batch of fresh algae.

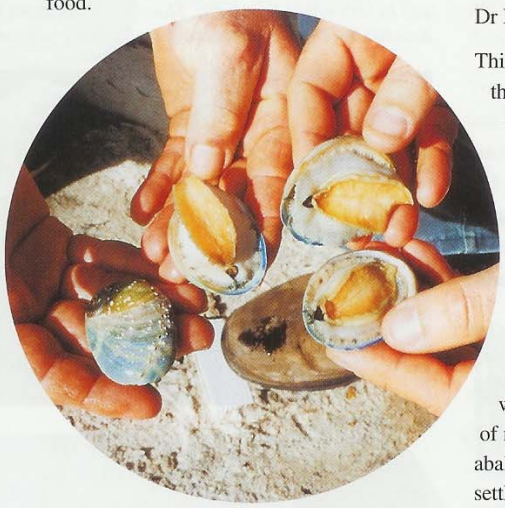
Western Australia's abalone aquaculture industry is still very much in its infancy compared to overseas countries such as South Africa and Japan, but due to much trial and error by farmers and researchers our greenlip abalone hatcheries have "turned the corner".

Much of that success is due to the efforts of German-born Dr Sabine Daume and her team of researchers from the Department of Fisheries' research division.

They have been able to improve the number of abalone larvae settling on feeding grounds in nurseries from five per cent to 60 per cent. Not that great, you might say, but in terms of aquaculture, researchers say you probably won't get much better than that. In the wild, the settlement rate of young abalone is much less. Survival after settlement has also been improved to about 60 per cent.

The secret to the researchers' success has been the large-scale culture of a green algae called *Ulvella lens*, which occurs naturally right along the southern Australian coast and in the tropics.

In the wild, after hatching, the abalone larvae swim in ocean currents until they find places to settle and explore the reefs for the right location before moving on to the next stage of their development, growing a juvenile shell and turning into young abalone as we know them. The right location, of course, has to include a source of the correct food.



It will be another 12 to 18 months before these juvenile abalone reach the ideal commercially viable size of 100mm.

Aquaculture farmers and researchers have been able to imitate this process in the nursery situation.

Dr. Daume is quick to point out that *Ulvella lens* is nothing new, but the algae had never been isolated and trialled in Australia for use as a settlement agent to attract larvae. Experiments in laboratories and at hatcheries at Queenscliff, Albany and Bremer Bay on the south coast paid off.

And there is a bonus. Dr. Daume says the green algae are easy to culture in a nursery situation.

Although the spores are minuscule, millions of these spores create the patches, covering experimental settlement plates, that induce the abalone larvae to settle and grow.

"There must be a chemical response. Something must be released from the algae that the abalone respond to because there is a definite cue. The moment you release the larvae into a tank with plates covered by *Ulvella lens*, larvae just go for it," said Dr Daume.

This development is seen as a major break-through in abalone aquaculture because, in the past, it had been a major problem to induce the larvae to settle.

Historically, abalone nursery systems in Australia incorporated settlement tanks, or ponds, where seawater was pumped through and whatever algae film grew on the plates was used to attract and induce the larvae to settle. Tanks had to be set up one to four weeks prior to spawning so that a biofilm of microalgae had developed before the abalone were introduced, and hopefully settle. It was very much hit and miss.

"Because of the seasonal changes between the farm locations in Australia, results varied enormously. Even in the tanks, one plate could be really good and another bad. And when I say good, it might achieve about a ten per cent settlement rate," Dr Daume explains.

"Now, with *Ulvella lens*, we get so much better response. It's much more reliable."

Dr Daume started working on developing the *Ulvella lens* connection while in Victoria after completing her PhD in Marine Science, on a program funded by

uaculture

the Fisheries Research and Development Corporation (FRDC). She took up a position with the WA Department of Fisheries and now, along with another Victorian, Stephen Ryan, conducts much of her research work at the Great Southern Marine Hatcheries (GSMH), near Albany.

The hatchery is located on the pristine shores of Frenchman Bay and is operated by partners Steve Parsons and Rick Lambert. A similar nursery and "grow-out" establishment further east at Bremer Bay is close to reaching commercial production. The Albany operation has previously sold juveniles to the Bremer Bay farm.

GSMH now has abalone that will reach the optimum marketing size of 100 millimetres in 12 to 18 months time, although a trial shipment of canned "gourmet" sized abalone has already been sent to China - with favourable reports coming in.

While *Ulvella lens* is highly successful in inducing abalone larvae to settle, it is not such a good food source for post larvae animals. They much prefer another food known as diatoms, which provide greater nutrition until the abalone grow to about 4mm to 5mm in shell length, when they can successfully graze on *Ulvella* and achieve a very fast growth rate.

So, the Department of Fisheries team started to isolate certain species of diatoms which grow on the substratum and which juvenile abalone like to feed on. There was more success when the researchers identified a species of the diatom *Navicula*, which also stuck well to the vertical settlement plates in the nursery.

Current methods used to culture diatoms were developed for plankton species that are found in the water column - these were grown in suspension in plastic bags. But the *Navicula* species the WA researchers wanted as a food source for the juvenile abalone were those that grow on the substratum, or hard surface, and not in the water column.

"Collecting wild animals and bringing them to spawn in the laboratory straight away is a big breakthrough."

Steve Parsons, from GSMH (left), and Department of Fisheries researcher Stephen Ryan remove the covers from the grow-out tanks holding hundreds of thousands of green lip abalone.

However after experimentation the researchers found that by lying the large commercial algal culture bags on a flat surface, *Navicula* was able to settle on the bottom and grow under artificial light. Harvesting was just a matter of rubbing the walls of the bags to achieve suspension, draining the fluid and then the nutritious algae were 'inoculated' into the nursery tanks for the abalone to feed on.

The development of a major abalone aquaculture industry depends on the continuous supply of the product and that comes down to reliable breeding methods. The success of using *Ulvella lens* and *Navicula* to settle and start abalone feeding was a major breakthrough.

"In relation to diatom culture, there is still a lot to be learned. However we're very happy with the *Ulvella* because it has made settlement much more predictable and allows us to grow larger juveniles," Dr Daume said.

"If we can improve the juvenile growth rate during the earlier stages of life, we might be able to reduce the mortality rate when they are moved into the grow-out facility and fed with formulated food."

Dr Greg Maguire, supervising scientist with the Department's Aquaculture Development and Fisheries Environment group, says researchers are also trying to reduce food limitations, so that when selecting animals that grow faster it's for genetic, not environmental, reasons.

"Some animals may be larger because they get a terrific head start in the nursery, based on their tank location. If Sabine and her team can reduce variation in the size of juveniles coming out of the nursery, then we are in a much better position to genuinely pick genetically superior animals," he said.

The achievements of the Fisheries research team is doubly important because GSMH is one of half a dozen similar sites around Australia taking part in the federally-funded program of selective breeding to produce a fast-

"We are looking for someone who is committed to the long-term objectives of the company, and who believes that these objectives offer real gains for them, the company and the community we live in."

growing, pedigreed greenlip abalone of superior quality.

GSMH partner Rick Lambert says while it will be some years before a genetically superior abalone is available, they have "rounded the corner", growing abalone.

The Albany farm is holding nearly one million abalone and, like the Bremer Bay operation, the farmers have proven they can successfully breed the prized green lip abalone.

The pristine environmental conditions along the south coast of WA, plus the influence of cooler water temperatures in summer and warmer water from the Leeuwin Current in winter, create ideal conditions for farming this delicacy, which is much sought after in Asia.

Working under sterile conditions, hatchery staff and the researchers laboured for more than a year to get wild brood stocks to spawn. It was a big challenge, but the work has paid off.

"The quality of the brood stock is very important and sometimes we may miss the spawning by 24 hours. We talk to the commercial abalone divers and offer to train them to tell when the wild abalone are getting ready to spawn so we can collect them at the right time," says Steve Parsons.

"We are now working to overcome that difficulty. We've developed an environment in our laboratories so we can get the adult abalone to spawn when we want them to. A normal legal sized female will lay up to four million eggs at a time. If we can imitate the ocean conditions here in the nursery, we can control the spawning process to produce eggs when we need them.

"In the wild, of course, most fertilised eggs will be eaten by predators, but here in the lab we can achieve a higher success rate. Ideally, we can hold 15 million larvae in our tanks at any one time and we would aim to have a success rate of 80 per cent or more. At the moment, we are averaging a 50 to 60 per cent success rate, but we need to get it to the stage where it is so reliable that we know exactly when they are going to spawn, how many we are going to grow and what we will have to harvest in three years time."

Steve Parsons and Rick Lambert are modest about their achievements, but the work they are doing is considered significant.

"Collecting wild animals and bringing them to spawn in the laboratory straight away is a big breakthrough," Mr Lambert said. Progress has also been made on getting a year round supply of fertilised eggs from captive broodstock maintained in a system developed by GSMH and the Department of Fisheries. More work is being done to ensure that these captive stock continue to produce eggs with the right nutritional reserves, so that high quality larvae are then available.

GSMH collects the brood stock from the ocean at locations between Augusta and Hopetoun. The females' eggs are collected and mixed with the male sperm for fertilisation. This process guarantees a regular supply of larvae and eventually the juvenile abalone are moved to the grow-out tanks until they reach harvest size. The whole process takes about three years.

The hatchery will be able to supply juvenile abalone to grow-out farms in WA as the industry grows, plus market its own adult product. A trial shipment of canned abalone has been sent to China and Steve Parsons says favourable reports are coming back on the product. Plans are also well underway to retail the abalone flesh in clear plastic vacuum packs so people can see what they are buying.

Australia's selective breeding program, which is part funded by the FRDC, is aimed at developing an appealing, fast growing, disease resistant abalone that will present as a gourmet delicacy.

"Australia-wide there will be about 50 family lines growing and eventually, probably within 10 to 15 years, we'll have a 'super ab' which is fast-growing and producing high net yields. Here, at this hatchery, up to 10 family lines are being developed," Mr Lambert said.

"It is very much like the breeding programs for cattle, sheep and racehorses."

Abalone fetches a high price on the export market and, while there has always been a lot of interest in commercial farming, getting financial commitment to establish hatcheries and farms is another matter.

Large plastic algal culture bags are used to grow the Navicula *diatom under artificial lighting.*

Like many other primary industries, the returns are good, but they are long-term.

GSMH has been operating for about four-and-a-half years. Because it is a fledgling industry with much trial and error in development, some original investors pulled their money out of the venture in search of quicker returns. Others can see the long-term benefits of producing a high quality product which is in great demand, especially in Asia.

One such company is Lakevista Enterprises, a wholly owned subsidiary of Augusta Marine Resources, which is developing an abalone farm at Augusta. Lakevista has a major holding in GSMH and, over the past two years, has injected substantial funding into the work being carried out at Albany.

Lakevista recognises the potential of the industry and is aiming to become a multi-site abalone aquaculture company,

developing the Augusta farm site plus the hatchery and grow-out facility at Albany. The company has just completed a program of raising funds to continue the hatchery process and will soon be looking to raise funds to enable construction of the Augusta complex.

It says the research and development work being done now will make a real contribution to Lakevista Enterprises and WA's aquaculture industry at large.

Peter Berry, a director of project managers Focus Fisheries, says the Augusta and Albany operations are aiming to produce a combined total of 250 tonnes of abalone a year, which would make it the biggest abalone farming project in Australia.

Mr Berry says the Augusta site, located on Leeuwin Road between the town and the Cape Leeuwin lighthouse, is being developed both for abalone aquaculture and as an eco-tourism resort, including a restaurant.

Steve Parsons says the abalone farming industry in Australia is in need of more investment capital.

"We are looking for someone who is committed to the long-term objectives of the company, and who believes that these objectives offer real gains for them, the company and the community we live in.

"To develop a farm these days which can produce 100 tonnes of abalone a year would cost more than $5 million. To build the whole thing from scratch without waiting for a return you would need to invest between $8 and $10 million. But to do it gradually over four or five years, as we have done, and increase the grow-out area as stock is sold, you're looking at between $4 to $6 million initial investment.

"About $2 million has been put into this venture so far and we would not have gone into it unless we were confident of the end results, but it does take time and money. We have another land-based site nearby which we hope to develop within the next few years, but it needs people who are committed to the long-term goals of the company."

The Executive Director of the Aquaculture Council of WA (ACWA), Simon Bennison, says Federal and State governments have put a lot of money into research aimed at reducing the time frame of producing farmed abalone, as well as the costs involved.

"I think once people can see what is being demonstrated the flow of venture capital will improve. Despite the fact that it takes up to four years to produce abalone, research being done will reduce that time by 12 months in the near future," Mr Bennison said.

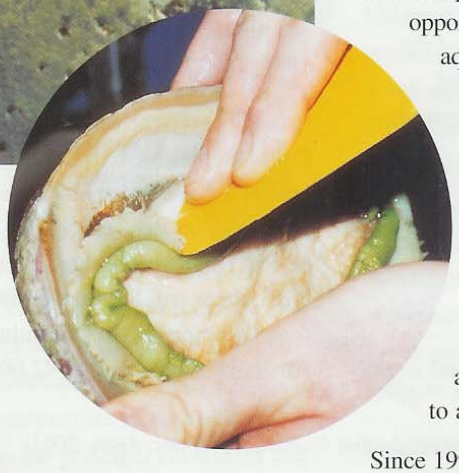
"You've got a good profit margin on abalone and independent economic analysis of the industry shows excellent returns on investment. We now have to work hard on getting that information into the investment arena so people can appreciate just what opportunities exist in abalone aquaculture."

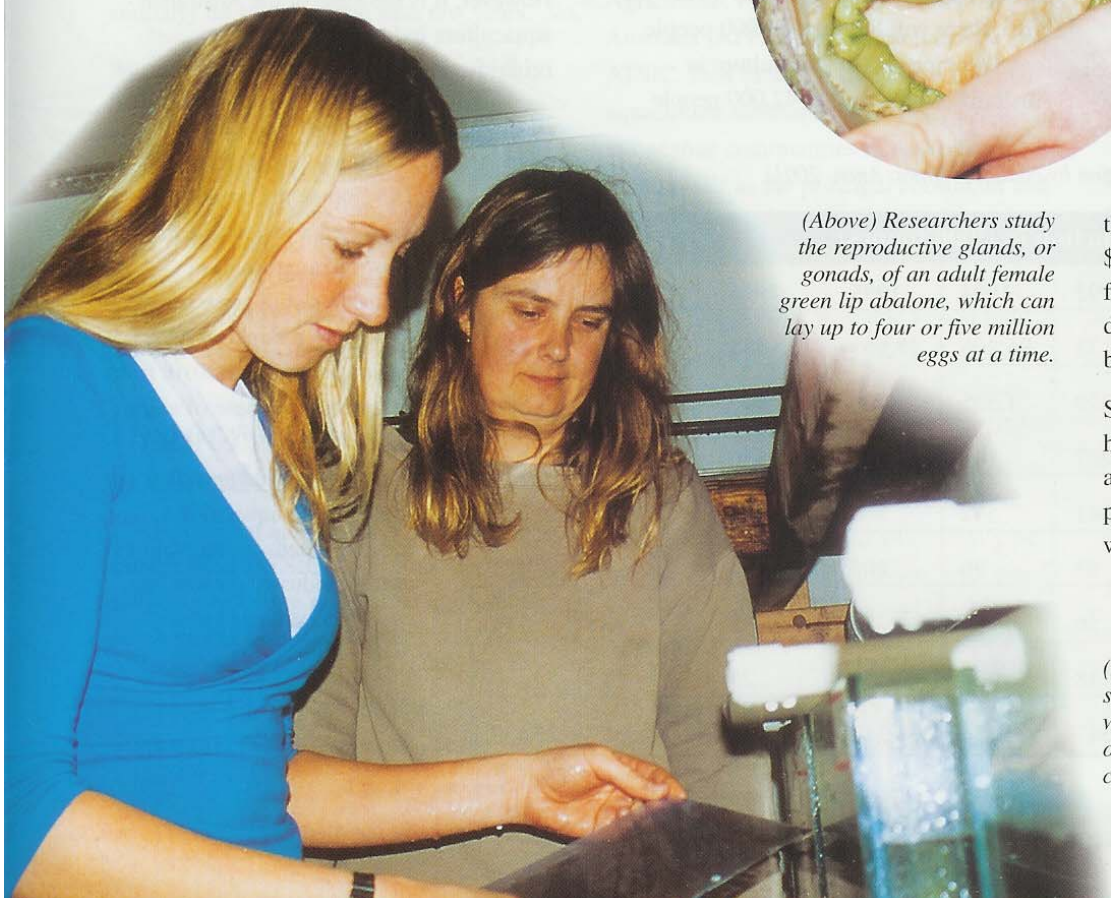
Through the WA Government's Aquaculture Development Fund, the Minister for Fisheries, Kim Chance, has provided funding to ACWA, who has contracted a company to compile an investment strategy which will be used as a guide to attract venture capital to aquaculture, including abalone.

Since 1993, the Federal Government, through the FRDC, has spent nearly $4million on abalone aquaculture, ranging from settlement and survival rate research, developing artificial feeds, and selective breeding to enhance growth rates.

Simon Bennison says the south coast has some ideal aquaculture sites and, as farmers and researchers overcome the production "glitches", Australia will be a world leader in abalone production.

Newly hatched juvenile abalone graze on green algae which is grown on settlement plates suspended in these concrete troughs.





(Above) Researchers study the reproductive glands, or gonads, of an adult female green lip abalone, which can lay up to four or five million eggs at a time.

(Left) Department of Fisheries research scientist Dr Sabine Daume (on right) is working with honours student Dianne Watson on refining algal techniques for the nursery culture of abalone.