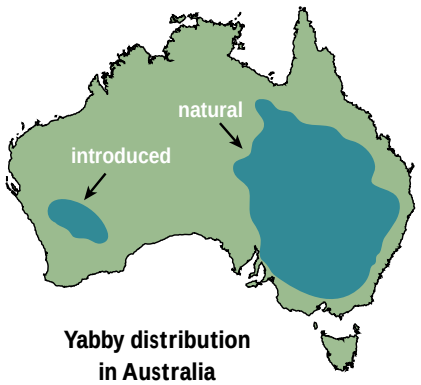
10.1071_ISSN0311–4546EC110p10

# Taming the yabby

**Wendy Pyper** meets an Australian icon with great export potential.




**Yabby distribution in Australia**

**Yabbies are indigenous to south-eastern Australia and occur in a diverse array of habitats: from the alpine regions of southern NSW and the billabongs, floodplains and rivers of the Murray-Darling Basin, to the hot mound springs of South Australia, and western Queensland. Yabbies in Western Australia were introduced from the eastern states. Most yabby farms supplying the Australian market are found in Western Australia, although legislation to allow yabby farming in dams in New South Wales and Victoria was recently passed.**

Growing up in rural New South Wales in the 1970s, one of my favourite past-times was 'yabbying' in the local creek, with a piece of meat on a string. Unfortunately, I spent more time marvelling at their ability to fleece me of bait than hauling in a catch.

Unskilled yabbiers such as I need not want for a plate full of tasty crustaceans, however, because more than 400 tonnes of yabby (*Cherax destructor*) is produced commercially in Australia each year.

Granted, the Australian yabby industry is small compared with many overseas freshwater crayfish industries. But our yabbies, are consistently bigger and of better quality than their Northern Hemisphere counterparts, and have excellent prospects for expansion into European and Asian markets. To achieve this, yabby farmers need to engage in selective breeding programs to ensure continuity of quality and supply.

Dr Dean Jerry from the CSIRO Livestock Industries Pastoral Research Station near Armidale in New South Wales, says yabby farming is based on wild animals that haven't been improved in any significant way.

'Genetic improvement of terrestrial livestock such as sheep and cattle has been practiced for thousands of years,' Jerry says. 'But the application of selective breeding technology to improve the productivity of crustaceans is rare.

'This is largely due to a lack of knowledge about the complex lifecycles of many crustacean species, and difficulties in culturing. Also, many crustacean aquaculture industries are still relatively immature and are not at a stage where they see genetic improvement as the next step forward in increasing productivity.'

Jerry says farmed yabbies are commonly only one to five generations removed from wild yabbies, making them susceptible to changing culture conditions. For example, if water quality declines, or their diet changes, fewer, smaller animals will be produced.

'Until yabbies are made more resilient to changes in the culture system through

domestication, farmers will always struggle to achieve consistent productivity increases,' Jerry says.

During the course of domestication, improvements in growth rate and meat production can also be made through further selective breeding. The success of such programs for other aquaculture species, such as Atlantic salmon, redclaw, prawns (see *Ecos* 107) and oysters – where an average increase in growth rate of about 10% per generation has been achieved – hints at the potential for the yabby industry.

To kick-start a domestication and improved production program for yabbies, Jerry and his CSIRO colleagues, Dr Ian Purvis and Dr Laurie Piper, evaluated five yabby populations for commercially important traits.

'Yabby populations are genetically different and each one might be equally likely to be suitable for aquaculture. But we wanted to identify ones that naturally had genes for faster growth rate, which is an important characteristic for commercial production, ' Jerry says.

'Information on the comparative performance of populations would then allow us to make an informed decision on the foundation stock for the program.'

The team collected 200 adult male and female yabbies from geographically and climatically discrete populations in the Warrego River near Cunnamulla, the Gwyder River near Armidale, the Mooki River near Gunnedah, the Tumut River at Tumut, and the Wimmera River at Horsham in Victoria. The animals were then placed in 108 similar glass aquaria.

Yabbies in each population were then mated and their offspring evaluated for three growth-related traits: weight at age, abdomen length and abdomen width.

'We found that the Warrego and Tumut River populations grew the fastest, Jerry says. 'In fact, they grew twice as fast as the slowest growing population, which was from the Wimmera River.'

'So there was certainly lots of variation in growth rate among the five populations. And we know this is due to genetics as we grew them under identical conditions'.

The team is now culturing the Warrego and Tumut River yabbies as foundation stock for their selective breeding program. The two populations will be crossed to look for 'hybrid vigor': where the performance of offspring is greater than that of the parents.

As well as selecting for increased growth rate, in 2002 the scientists will consider including tail size, as a larger tail means more meat. Preliminary studies indicate that yabbies from the Wimmera River 2–3% bigger tails than other populations.

'There's not much variation in tail size between populations, but within a population there is variation. So when we cross our Warrego and Tumut foundation stock, we'll pick offspring with longer tails for our breeding program,' Jerry says.

## Which yabby is that?

As comprehensive pedigree information will need to be recorded during the selective breeding program, Jerry has been looking at ways to improve the identification of yabby

**A female yabby may produce up to 500 offspring in a single spawning. The eggs are incubated under her tail for about 32 days, during which time the eggs will hatch and go through three developmental moults. After 32 days the hatchlings are released from the mother and function as independent juveniles.**

Dean Jerry.

# Aquaculture award

DR Dean Jerry has won an AFFA Science Award for young scientists for a proposal to study how aquaculture programs overseas conduct genetic improvement programs, and particularly, how they counteract inbreeding.

The award will allow him to travel to a number of countries to study selective breeding programs for Atlantic salmon, prawns, coho salmon, red swamp crawfish, channel catfish, oysters and tilapia.

'My award will allow me to visit various aquaculture facilities in the United States, Norway, the Philippines and Hawaii and look at the smart technology they're using. I'll then apply the information I collect to Australian native aquaculture species,' he says.

**Left: Australia has about 250 species of crayfish, many of which are wrongly called 'yabbies'. There is only one true 'yabby', *Cherax destructor*, which occurs in many temporary and permanent habitats in south-east Australia.**

**Below left: At two months, juvenile yabbies are grown out in ponds until they are eight months old. They are then transferred to tanks for breeding. The bale of straw provides nutrients to stimulate the plankton cycle in the pond.**

families and individuals. In the past, yabbies were identified by coloured dots of paint applied to their exoskeleton. But as yabbies moult as they grow, this system was unreliable.

'A major impediment to selective breeding programs for crayfish is that identification of individuals or families is difficult because external tags are lost through "ecdysis" or moulting of the exoskeleton,' Jerry says.

'This means that to preserve the identity of individuals and / or families, breeding programs usually require large numbers of aquaria and tank facilities. This increases the potential for growth differences among families to be confounded with environmental variation among tanks.

'A good tagging system would allow individuals from different families to be grown in the same tank, eliminating tank effects and improving the efficiency of the program.'

For a 10-week period, Jerry evaluated two internal tags, used successfully to identify fishes and amphibians. The first tag, a 'visual implant elastomer' or VIE, is a two-part chemical compound which, when mixed, becomes a soft rubbery polymer. It comes in eight colours and when injected into the abdominal muscle under the exoskeleton, fluoresces under UV and blue light. The second tag, a visual alphanumeric tag or 'VIalpha' also fluoresces under UV light.

Jerry found that his juvenile yabbies, which moulted on average three times over the 10-week trial, retained both tags. He will now incorporate the tags into his selective breeding program.

## Synchronised spawning

Jerry has also been looking at ways to synchronise spawning of his yabbies in order to generate families of a similar age. This will improve the efficiency of the selection program because size differences between animals will primarily be due to genetic, rather than age effects.

Researchers and aquaculturists stimulate spawning by manipulating environmental cues such as day length and water temperature. But synchronous spawning is still not reliably achieved.

By applying an electrical stimulus near the region of the fifth walking leg of male and 'intersex' (having male and female reproductive structures) yabbies, Jerry has been able to obtain sperm packages or 'spermatophores' in 76% of cases. It is hoped that these spermatophores could be stored and used to artificially inseminate females in a selection program.

Spermatophores from one species of crayfish could also be used to fertilise the eggs of another closely related species. Most inter-species matings are prevented by behavioural differences such as courtship routines.

'The selective breeding program will be easier if we can artificially inseminate females,' Jerry says. 'The next major challenge will be to induce females to spawn without mating with a male. This will allow us to obtain unfertilised eggs, which we can then fertilise with the sperm from one or more fathers.'

## All-male review

To protect the Australian yabby industry once selectively bred yabbies have been developed, Jerry and his colleagues are considering trying to make them sterile. As the yabby market is a live market, it would be relatively easy for importers of Australian yabbies to use the animals in

their own breeding programs. Sterile yabbies would prevent this as well as provide some protection against escapees in a foreign environment and help farmers control densities in their ponds.

Preliminary work by a group in Western Australia has shown that crossing yabbies with a closely related species can produce all-male hybrids. While such a hybrid cross has enormous potential for the industry, the performance of the hybrid has not been fully evaluated under commercial conditions. Because the cross is created using a smaller relative of the yabby, it is possible that the hybrid may not grow as fast or as big as the improved strain of yabby being developed at CSIRO.

**Abstract:** The Australian yabby industry has the potential to expand into Asian and European markets if farmers engage in domestication and selective breeding programs to ensure continuity of quality and supply. To identify suitable foundation stock, five yabby populations have been evaluated for commercially important genetic traits.Two populations from the Warrigo and Tumut rivers showed superior growth-related traits and are under further investigation. Other factors being evaluated include the use of internal fluorescent tags to identify individual yabbies and techniques for synchronised spawning and artificial insemination. Strategies to protect Australian intellectual property on the live yabby market are also being considered.

**Keywords:** yabbies, crustaceans, yabby farming, aquaculture, selective breeding programs, synchronous spawning.

As a consequence, Jerry is looking into other ways to create sterile yabbies using the selectively bred strain. One option is to use 'smarter' genetic technologies including the induction of 'triploidy'. This results in a fertilised egg with three sets of chromosomes instead of two. Because the chromosomes in a triploid yabby cannot pair up during meiosis, viable sperm and egg cells cannot be produced, rendering the animal sterile.

For the next few years, however, the team will concentrate on developing the selection program so that farmers can apply the techniques in their own hatcheries.

'It will be like a stud ram industry, where farmers selling yabby juveniles carry on their own selection,' he says.

'If we can breed a yabby that grows two or three times faster than those now farmed, the industry will become more efficient and will have a brighter future.'

## More about yabby farming

*More about farming yabbies can be found on the web at http://www.csiro.au/index.asp?type=faq&id=Yabby%20Farming.*

**Above: Dr Dean Jerry tends yabbies involved in the selective breeding trial. Female yabbies are mated and remain in the tanks until the juveniles are released from beneath their tail. The juveniles remain in the tanks for another four to five weeks before being transferred to the grow-out pond.**

**Top: Yabbies from the original populations collected for the study, are kept in larger tanks as backup in case disease or disaster strikes the selectively bred animals.**