Farming yabbies

Spawning

The sex of yabbies can be determined externally. Females have oviducts located at the base of the third or middle of the five pairs of legs, while male genital papillae are at the base of the fifth pair of walking legs, nearest the tail (Lawrence and Morrissy 2000a). A male deposits a spermatophore between the female's fourth and fifth pair of walking legs, and the female extrudes the eggs, mixes them with sperm and attaches them to the swimmerets located under her tail.

Yabbies typically produce from 30 to 450 eggs per brood, although an average spawning is 350 eggs (Merrick & Lambert 1991) larger females generally produce more juveniles. The eggs hatch on the female and the juveniles are carried until they reach an advanced stage of development and detach themselves. Eggs are incubated under the tail of the female yabby and take between 19 and 40 days to hatch, depending on water temperature. (Morrissy *et al.* 1990). After the young leave the female, she is capable of spawning again immediately if environmental conditions are suitable (Mills 1983).

In cold parts of their eastern Australian native range, yabbies spawn annually during the summer months (Morrissy & Cassells 1992). The cue for development of eggs inside the female is longer day lengths and for spawning, higher water temperatures. When water temperature is above 15^{o}C, yabbies spawn from early spring to mid summer. However, if the water temperature remains between 18^{o} and 20^{o}C with a long artificial day length of 14 hours, they are capable of spawning repeatedly up to five times through a year (Mills 1983, Merrick & Lambert 1991).

Female yabbies are sexually mature at a very small size and early age; at 20 g and less than one year old. In the South-West of WA, young may be released in December and again in February (Morrissy *et al.* 1990). Unfortunately, this prolific breeding has major disadvantages for aquaculture because it results in over-crowding and stunting of growth in farm dam populations (Lawrence and Morrissy 2000a). Clearly, there is no need to have a hatchery for yabbies. A hybrid between two yabby species has been discovered from which all progeny are males (Lawrence et al 2000b). This simple technique can be used to prevent reproduction in carefully stocked ponds (Lawrence & Morrissy 2000a). Because male yabbies grow faster than female yabbies, the hybrid-cross also results in larger and therefore more valuable animals (Lawrence 2004). It is also possible to produce sterile yabbies by hybridising a number of yabby species and these may also have potential for controlling reproduction in ponds and dams (Lawrence *et al.* 2000b).

Culture environment

Yabbies are adapted to a higher temperature range than marron and thrive in the warmer, drier inland regions. Yabbies do not grow at winter water temperatures below 15^{o}C and grow best at 28^{o}C. Growth ceases over 34^{o}C (Merrick & Lambert 1991, Mills 1983, Morrissy et al. 1990) and mortalities start to occur at 36^{o}C (Mills 1983, Morrissy & Cassells 1992).

Growth of yabbies ceases at salinities above eight parts per thousand (ppt), equal to about one quarter seawater. Although yabbies tolerate higher salinities, they become stressed at salinities over one-third seawater, with mortalities occurring at levels above about half seawater. Yabbies are hardier under stagnant water conditions than marron and can tolerate dissolved oxygen levels lower than one part per million (ppm) and can survive for a short time at zero oxygen (Mills 1983, Morrissy & Cassells 1992). However, feeding activity and hence good growth are dependent upon healthy, well-oxygenated water conditions. Excessive run-off of sheep manure should be avoided as it leads to depressed oxygen levels. This can be achieved by constructing contour banks leading to sediment traps at the mouth of the dam.

Farm dams do not have a piped water supply and are necessarily deep (four metres) to retain some water over summer. Most of the light and heat of sunlight are absorbed close to the surface in these muddy dams, so that water below about one metre is colder and heavier than surface water; this is called a layering or stratification effect. This cold, deeper water becomes deoxygenated, resulting in the yabbies being forced to crowd in the shallows close to the banks, making them more vulnerable to predators.

Extensive pond or dam production of yabbies can yield 400-690 kg per hectare of water area (kg/ha). However, many of these yabbies are below market size due to uncontrolled breeding (Lawrence & Morrissy 2000a). Farm dams cannot be readily drained for (i) efficient harvesting during winter; (ii) stock control against excessive breeding; or (iii) cleaning out of the bottom mud when the sediments become over-enriched. Harvesting yabbies from dams by actively hauling a seine net is damaging to the animals physically and may result in bacterial infection from mud stirred up from the bottom. However, better feeding practices and monosex stocking of male and female yabbies are leading to much better yields, larger yabbies and better prices (Lawrence *et al.* 2000a, Lawrence and Morrissy 2000b). Fortunately, *Cherax albidus* has been shown to be relatively non-destructive in farm dams as it constructs fairly shallow burrows in comparison to the aptly named central Australian yabby species *Cherax destructor* (Lawrence *et al.* 2002c).

The use of purpose-built adjacent ponds at a site favourable for more intensive crayfish farming, has a number of advantages over widely spread and isolated farm dams. Unfortunately, at current market prices the level of investment that is required to build and manage commercial ponds is rarely economic for yabbies, unlike for their larger relative marron (*Cherax tenuimanus* and *Cherax cainii*), which have a much higher market price.

When harvested from farm dams, trapped yabbies need to be gill-washed in clean water immediately on the dam bank and subsequently kept cool in a moist atmosphere (Lawrence and Morrissy 2000a). For marketing, a processor must purge, or depurate, the yabbies in clean water to empty food from the digestive tract in the tail (the dark ‘vein’), to improve the flavour of the flesh and to prevent stress during transport due to faecal wastes in the carton.

Diet

Yabbies, like most crayfish, are detritus feeders. Consequently, while supplementary feeding is essential for higher than natural crayfish production, crayfish make up for the deficiencies of essential micronutrients in the artificial feed by also eating natural food in the pond.

A variety of low cost feeds and feed rates have been evaluated with the most promising results coming from cheap freshwater crayfish pellets fed at the rate of 5-10 g/m2/week (Lawrence et al. 1998, Lawrence and Morrissy 2000a). Nutrient leachates, from the artificial feed, enhance the amount of natural food in a dam. While some farmers feed yabbies lupins, commercial marron pellets give much better results (Lawrence *et al* 2000a). The major, and very widespread, problem in yabby ponds has been underfeeding. Improving feed quality and increasing feed rates can improve yabby growth by 85 per cent (Lawrence and Morrissy 2000a)

Growth

Yabbies can reach a maximum size of 320 g and these large yabbies are males. Females are greatly suppressed in growth by the diversion of food energy into spawning. As size increases, yabby claws increase relatively more in size than the rest of the body and they are massive in large males over 100 g. Although individual growth, as in other crayfish, is always highly variable in yabbies (Mills 1983), the minimum market size of 30 g can be produced in less than six months.

As in marron, growth of yabbies is temperature and density dependent (Mills 1983). Consequently, the uncontrolled breeding of yabbies in farm dams not only produces many undersize animals, but also affects the subsequent growth and survival of the parent stock.

Regular trapping of dams is vital to control density so that optimum growth can be achieved. But, farmers must be careful that they do not harvest all the fastest growing yabbies from their
dam and leave the slower growing animals to become the broodstock for future generations, otherwise stunting will occur (Lawrence *et al* 2006a).

At the onset of their early maturity and first spawning, growth of female yabbies declines markedly and is zero while they spawn over spring and summer (Morrissy and Cassells 1992, Geddes and Smallridge 1993). Monosex culture, by separating male and female yabbies, gives better growth for both sexes and results in a 70 per cent increase in gross income (Lawrence and Morrissy 2000a).

The tail meat recovered from headed and shelled yabbies is 15 - 20 per cent of the total body weight (the basis for sale of crayfish), and is lower than the 31 per cent obtained from marron (Morrissy *et al.* 1990). They also fetch a much lower price than marron but can be produced with very inexpensive technology.

Yabby health issues

For the protection of Western Australian native crayfish stock (gilgies, koonacs and marron), live crayfish may not be brought into this State from other Australian

states and territories. To preserve the disease status of existing yabby stocks in WA, further unregulated introductions of yabbies into this State are not permitted.

The microsporidian parasite *Thelohania* affects yabby and other freshwater crayfish populations in eastern states and has unfortunately become established in WA (Lawrence and Morrissy 2000a, Jones and Lawrence 2001)

Yabbies and all other Australian crayfish are extremely susceptible to the 'crayfish plague' of the northern hemisphere (a fungal disease *Aphanomyces astaci*, found on American crayfish), which has devastated Europe's native crayfish populations. To guard against plague, the importation into Australia of any species of live foreign crayfish, for whatever purpose, is not permitted.

Surface fouling on yabbies by ectocommensals, such as the protozoan *Epistylis* and the platyhelminth (flat worm) *Temnocephala*, although rarely harmful to the animals unless in extremely high densities, lowers the market appearance of affected individuals (Lawrence and Morrissy 2000a). These so-called epibionts are symptomatic of waters which are over-enriched with nutrients. A virus that affects a small percentage of yabbies has also been discovered but, as with these other diseases or ectocommensals, it poses no threat to humans.

Economics of production

The establishment costs for farm dam production of yabbies is very low. As most farmers already have their dams for watering stock, the only equipment required are traps to catch the yabbies and containers for gill flushing and transportation. Alternatively, farmers may elect to have commercial harvesters trap their yabbies and receive a percentage of the crop value. Commercial semi-intensive pond production is much more expensive with set up and operating costs similar to those of a marron farm.

A case study of the economics of harvesting yabbies from a farmer's dams was conducted (Roe 1996), and in that year the farmer produced marketable yabbies which grossed $19,000. The study demonstrated that the farmer, who had 46 dams on the property, incurred the costs shown below. After removing working costs from the $19,000 gross income for 1996 the farmer received $13,504 for the year. The farmer spent 360 hours, or approximately 7 hours per week on harvesting and feeding the yabby dams, which provided an equivalent return of $37.51/hour of labour.

Initial establishment costs

Item	Cost ($)
Yabby mover (inc. trays)	2,200
75 yabby traps	2,475
Buckets to gill wash yabbies	50
Grading tray	47
Total	**4,772**

Annual operating costs

Item	Annual cost ($)
Feed	2,053
Fuel, vehicle cost	2,900
Bait	243
Ice	300
Total	**5,496**

Income

Yabbies sold	Income ($)
Sales	19,000
Total	**19,000**

Aquaculture potential in WA

In the eastern wheatbelt and Great Southern regions of WA, yabbies are harvested commercially from inland farm dams by trapping. This level of farming has been very successful, although it is low yielding and dependent upon a very large number of small dams for the annual State production. Low capital and operating costs contributes to its profitability. However, exporters who buy yabbies from farmers or harvesters add significantly to the value of the yabbies by costly processing to supply a premium, live product to gourmet markets.

The yabby industry was one of the first aquaculture industries in WA to develop their own code of practice (see references and recommended reading at the end of this page). This code educates farmers, maintains product quality and facilitates industry expansion. While farming yabbies in more intensive purpose-built ponds has yet to be proven commercially viable anywhere in Australia, with all-male stock and improved feeding practices, it may still prove successful.

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Further information

Contact the WA Yabby Producers Growers Association.
W: www.aquaculturecouncilwa.com

Further information is also available from the Department of Fisheries Pearling and Aquaculture Branch. The Department has an extensive library, telephone (08) 9203 0120 for more details. Loans can be arranged through your local library.