Fishnote

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Redclaw Crayfish Aquaculture

(Cherax quadricarinatus)

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INTRODUCTION

Redclaw is a species of freshwater crayfish native to the westerly and northerly flowing rivers of Queensland's Gulf of Carpentaria, the easterly and northerly flowing rivers of the Northern Territory and also the southerly flowing rivers of Papua New Guinea. Redclaw is very similar to the marron (*C. tenuimanus*), and the yabby (*C. destructor* spp.) and all three have attracted significant commercial interest within Australia and internationally.

The majority of yabbies sold within Australia come from managed farm dam fisheries in Western Australia, South Australia and Victoria. Marron and redclaw however, are cultured in specifically constructed semi-intensive aquaculture ponds. Total freshwater crayfish production for Australia in 2000/01 was around 400 tonnes, while global production was around 70,000 tonnes. Clearly there is scope for export marketing.

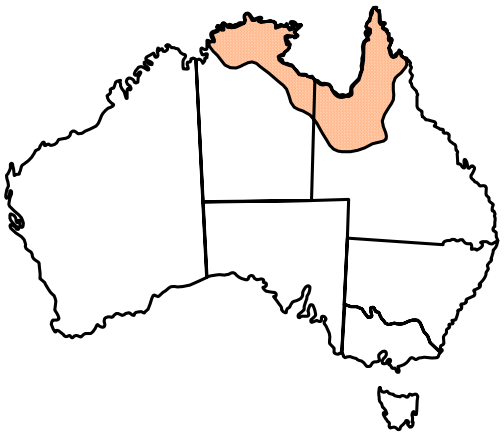

Figure 1. Natural range of redclaw within Australia

The Northern regions of Australia show a distinct wet/dry seasonality, and as such the water bodies that redclaw inhabit vary with season, from fast flowing rivers in the wet, to billabongs throughout the dry periods. These billabongs are frequently highly eutrophic, having poor water quality, and progressively diminish in size as the water evaporates. Crowding leads to a greater competition for food and shelter. Redclaw has evolved to tolerate a relatively high population density and poor water quality conditions, making it a highly attractive aquaculture prospect.

INDUSTRY DEVELOPMENT

Since the early 1980s there has been very broad interest in redclaw crayfish aquaculture. Industry pioneers were quick to learn of the species' positive aquacultural attributes, such as fast growth rates, ease of reproduction, lack of any free-living larval stages, gregariousness, and the ability to tolerate poor water quality conditions. That interest stimulated research which led to the development of optimum husbandry and best practice techniques. Even so, the redclaw farming industry in Queensland has not lived up to early expectations and predictions, and production has remained relatively low. There are very few licensed redclaw growers in the Territory.

Since its inception, the redclaw farming industry has slowly emerged to its current level of 86.3 tonnes of official production in the 2000/01 fiscal year. This is despite the report of Treadwell et al. (1991) showing redclaw as a species with great commercial potential at the time, and the economic analysis by Hinton and Jones (1997) which showed an internal rate of return of 29.09% and a discounted payback

period of only four years. The economic model of Hinton and Jones had a set up cost of $329,000 which may be prohibitive to some investors. The cost of setting up a stand-alone 5 ha redclaw aquaculture business in the Territory is as yet unknown.

There were in excess of 220 redclaw aquaculture licences in Queensland in 2000/01, covering 150 ha of ponds. The majority of licensees are hobby farmers and their poor yields contribute significantly to the industry average. In reality there are fewer than 20 farms producing in excess of 1,000 kg of product annually, and of these the average yield is 1,600 kg/ha. The best of these farmers are producing between 3,000 and 5,000 kg/ha.

WHY REDCLAW?

The harsh climatic and geographical conditions that redclaw crayfish has evolved in, have facilitated the development of broad tolerances to physical extremes. The prevailing conditions of billabongs in the Territory can be very extreme with wide variations through the day. Typically, these billabongs will have quite poor water quality with low levels of dissolved oxygen and low alkalinity, wide daily pH and temperature swings, and high nutrient loads. To make matters worse the billabong will diminish in size as the water evaporates in the dry season, leading to further crowding, higher nutrient loads and reduced food and shelter resources. These factors have combined to mould a crayfish that is tolerant to poor water quality conditions and relatively high population densities. This species is therefore relatively non-aggressive, and it is also able to utilise a wide range of food resources efficiently.

Figure 2. Redclaw (*Cherax quadricarinatus*)

Queensland strains of redclaw grow well over a broad temperature range. Optimal growth occurs between 26 and 29°C with lethal limits estimated to be around 9-10°C and 34-35°C. This broad range of optimal growth is probably typical for redclaw over its natural distribution, although the strains from around the Darwin region may be more tolerant to higher temperatures. Little research has been conducted on the Territory strains of redclaw. A wide tolerance for temperature variation also indicates that the species may be farmed over a wide section of the Territory.

Tolerance to salinities as high as 12 ppt for extended periods has also been established for this species. This is advantageous for two reasons. Firstly, aquaculture in mildly brackish water may be possible, and secondly, a final purging in salt water prior to marketing can be performed if markets request it. Generally freshwater crayfish is marketed as a premium seafood product with a delicate flavour for a refined palate.

Redclaw is able to survive under conditions of very low dissolved oxygen (1 part per million (ppm)) which can result in poorly managed aquaculture ponds. If dissolved oxygen in the pond water drops below 1 ppm, redclaw will move to the edge of the pond where oxygen levels are generally higher, and in extreme cases will migrate from the pond over land.

It is comforting to know that redclaw will survive under conditions that would otherwise kill other species, but for maximum growth, and good economic returns, it is important that ponds are managed in accordance with best practice protocols including good water quality management.

REPRODUCTION AND LIFE CYCLE

Redclaw has a very simple life cycle, and as such the technology needed to manage the life cycle is also simple. Broodstock are readily available from existing pond stocks, which also facilitates the selection of broodstock with advantageous characteristics such as a fast growth rate or high fecundity. Genetic selection and domestication of farm stocks can increase growth rates and yields by as much as 10% per generation.

Mating, fertilisation and spawning occur naturally in the ponds, and there are no free-swimming larval stages. The male deposits a spermatophore on the underside of the female who then spawns and fertilises eggs within 24 hours. The eggs are held under the female's tail until they are ready to hatch – usually six to eight weeks. The larvae develop within the eggs, which subsequently change colour from green, to brown to orange. Finally the eggs hatch and the 12 mm long juveniles remain attached to the female for one to two days prior to moving away as completely independent miniature forms of the adults.

Figure 3. Eggs one day post spawning

Figure 4. Eggs six weeks post spawning – ready for release

One disadvantage is the relatively low fecundity of freshwater crayfish, between 300-1,000 per spawn; however, because of the ease with which broodstock can be obtained, it is a minor concern, especially as the female can be marketed after release of the juveniles.

Under optimal pond conditions redclaw can grow from hatching to the smallest marketable size (~30 g) within four months. Queensland redclaw usually mature at around six months of age, or 45-50 g, but it may be possible to select for later maturing animals when selecting for faster growers. Female redclaw will stop growing at maturity when the ovaries develop and enlarge. Larger females are therefore less likely to have spawned, and providing it is a heritable trait, selecting the largest females may affect selection for late maturing individuals.

When best practice techniques are used, the majority of males will reach 100 g, and females 70 g, within 12 months of growout. The best of these should then be selected as broodstock for the next generation.

FARMING TECHNOLOGY

In the late 1980s very little was known of the biology or farming techniques of this species. However, in the 1990s excellent biological data and appropriate farming techniques became available from the Queensland Department of Primary Industries Freshwater Fisheries and Aquaculture Centre in north Queensland. Researchers there were able to make recommendations which incorporate cost effective, very low levels of technology, and which produce high yields.

For commercial production, the most important factors to pay attention to are stock management, water quality, feeding and the provision of shelter. Stock management is important in order to keep track of animals so that selection of the fastest growers can occur with confidence. There is no point choosing large animals if you have no record of their age. Also it is important to have like-sized animals in your pond at stocking. The greater the variability in size at stocking, the more pronounced cannibalism is likely to be.

Although redclaw will tolerate a range of water quality conditions, including what is generally referred to as poor water quality, optimum growth and commercial viability will only be achieved if water quality is managed and maintained within optimal ranges. Careful record keeping, a little knowledge of water chemistry or sound advice, and some experience are all that is required.

Redclaw are highly adaptive with respect to nutrition and are often referred to as omnivores – which means they eat a variety of organic matter. Presently there are no farms feeding complete diets to redclaw as they do to marine prawns. This is in part due to the fact that no complete diets are available, and partly because commercial growth can be attained by supplemental feeding. Supplemental feeding relies on redclaw's ability to gain some nutrition from invertebrates found in ponds and on pond floors. Supplemental feeding involves the distribution of a low-protein, high carbohydrate pellet diet in combination with organic matter. The organic matter stimulates productivity of the detrital food chain. The supplemental pellets are either ingested directly by the redclaw or are broken down by bacterial, fungal or protozoan decomposers and are subsequently consumed by other invertebrates. These larger invertebrates make up a substantial proportion of the diet of redclaw in ponds.

Shelter must be provided in abundance. Redclaw, like all other crustaceans, moult or shed their shell as they grow. Immediately after moulting the redclaw are soft-shelled and are vulnerable to predation by their pond mates. The provision of shelter has been shown to improve survival substantially (from 15% with no shelter to 75% for the best shelter types). The best forms of shelter are mesh-type materials, such as onion bags or shadecloth, and short lengths of pipe. Discarded car tyres have also been used effectively, although these may attract a removal fee when the venture closes.

Harvesting is a remarkably simple process. A flow-trap has been used for a number of years. Redclaw respond strongly to a current in the water. This is probably the result of evolving in a billabong environment. As the water body evaporates and becomes shallower, any new inflow represents an upstream water body and the opportunity to move to better conditions. This has been exploited by farmers who slowly drain the ponds over 24 hours and introduce a flow of new water. Commonly an aluminium box is placed in the pond in the late afternoon when the pond is two-thirds empty. The box is located towards the deep end, with a ramp pointing down towards the pond outlet, or where the last volume of water will be when the pond drains. An inflow of new water is introduced via the harvest box that is sensed by the redclaw. The redclaw then walk upstream, up the ramp and fall into the harvest box. The box is also supplied with aeration to sustain the redclaw until morning. This flowtrap reduces stress on the animals, maintains them in clean fresh water and results in a healthy premium product at market. In excess of 95% of the animals will be caught in this way.

Figure 5. Redclaw flowtrap

Redclaw can be grown at different levels of intensity. Semi-intensive ponds with relatively high stocking densities (7-9 crayfish/m^2) will require daily management, whereas less intensive production (less than 5 crayfish/m^2) can be managed with lower levels of input. This form of farming may be suitable for indigenous communities where cultural events may preclude daily management. At lower densities redclaw will grow faster and larger and survival may be even better, although total yields will be less than in a higher density production.

HEALTH MANAGEMENT

Redclaw have been shown to be susceptible to many diseases and parasites, although none have been shown to be responsible for significant commercial mortality events. In this respect redclaw seems blessed. However, complacency within the industry, and on farms, with respect to controlling the movement of animals, equipment and water, could result in severe disease outbreaks.

In Europe and the Americas a devastating fungal disease 'crayfish plague' has caused mortality in both cultured and wild freshwater crayfish stocks. Transmission is through fungal spores which can remain viable away from a host animal for several days. Currently there is a total ban on the importation of live crustacea into Australia and this in combination with other standard quarantine protocols should keep Australia free from crayfish plague.

The best method for ensuring crayfish health is to reduce stress on the animal during all phases of the life cycle. This can be achieved by ensuring water quality is maintained at a high level, sufficient shelter of the right form is provided, and the crayfish are fed enough of an appropriate diet to minimise cannibalism.

SUMMARY

The potential of redclaw aquaculture has taken substantially longer than expected to translate into significant industry development. The largest farms in Queensland have less than 10 hectares under water although at least one successful existing farm has begun expanding and within two years will have in excess of 25 hectares of ponded area.

The husbandry and general production technology is now well known, and a line of domesticated and selectively bred redclaw is available. Serious redclaw farmers have been expanding and at the same time increasing average yields and production. While production has increased so has the average price. This is likely a result of the coordinated marketing approach and self imposed quality assurance standards. Redclaw is always well accepted in market promotion activities and is presently positioned

as a premium seafood product competing alongside scampi and bay lobsters. Redclaw can be harvested at any size and can therefore fulfil almost any market order.

The Northern Territory is in a prime position to take advantage of the hard work already completed by Queensland researchers and farmers. Territory farmers are able to learn from mistakes made in the early stages of the redclaw aquaculture industry and can develop in line with the best crayfish farmers in the country.

Appropriate land and water resources are probably restricted to the northern part of the Territory except for localised pockets in the central regions. A combination of the extra expense of transportation of products and farm consumables, and cooler winters, may make a redclaw aquaculture venture in more southern areas less profitable. Careful economic and business advice should be sought prior to any form of development.

A Northern Territory aquaculture licence from the Department of Primary Industry, Fisheries and Mines is required for all commercial aquaculture operations. The licence application can be complex and time consuming, depending on the scale of the proposed operation, and will include permits from a number of government departments. If you would like more information on redclaw crayfish aquaculture, or on obtaining an aquaculture licence please contact Ian Ruscoe at the Darwin Aquaculture Centre on (08) 8924 4265 or follow the links below.

http://www.sqcfa.org/ - South Queensland Crayfish Farmers Association

http://www.dpi.qld.gov.au/fishweb/3380.html and http://www.dpi.qld.gov.au/fishweb/2815.html and http://www.dpi.qld.gov.au/fishweb/2702.html - Redclaw Crayfish farming on the Queensland Department of Primary Industries Website.

Please visit us at our website:

www.nt.gov.au/dpifm

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