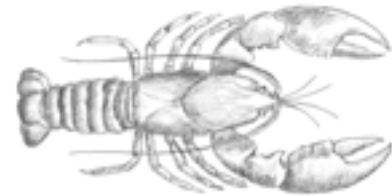




Yabbie farming in South Australia

The yabbie, *Cherax destructor*, is native to south-eastern Australia and is present in waterways throughout the state. Yabbie farming commenced during the early 1980^s in South Australia. There are now close to 300 registered growers and this figure is rising. However there are only a modest number of yabbie growers producing on a commercial scale with the majority of farmers producing yabbies for a sideline income.



Yabbies have many biological, economic and marketing attributes that make them a good candidate species for aquaculture. Some of these include their rapid growth, good feed conversion efficiency and their direct life cycle. Yabbie farms are also relatively inexpensive to construct compared to other forms of farming with some people utilising existing farm dams to produce yabbies. As yabbie farming is practised on privately-owned land, it is an industry that is readily accessible to the majority of South Australian primary producers.

Yabbie farming is practiced throughout the State with approximately 80% of production from the South-East. Other areas of yabbie production include Eyre Peninsula, Fleurieu Peninsula, Kangaroo Island and the Mid-North.

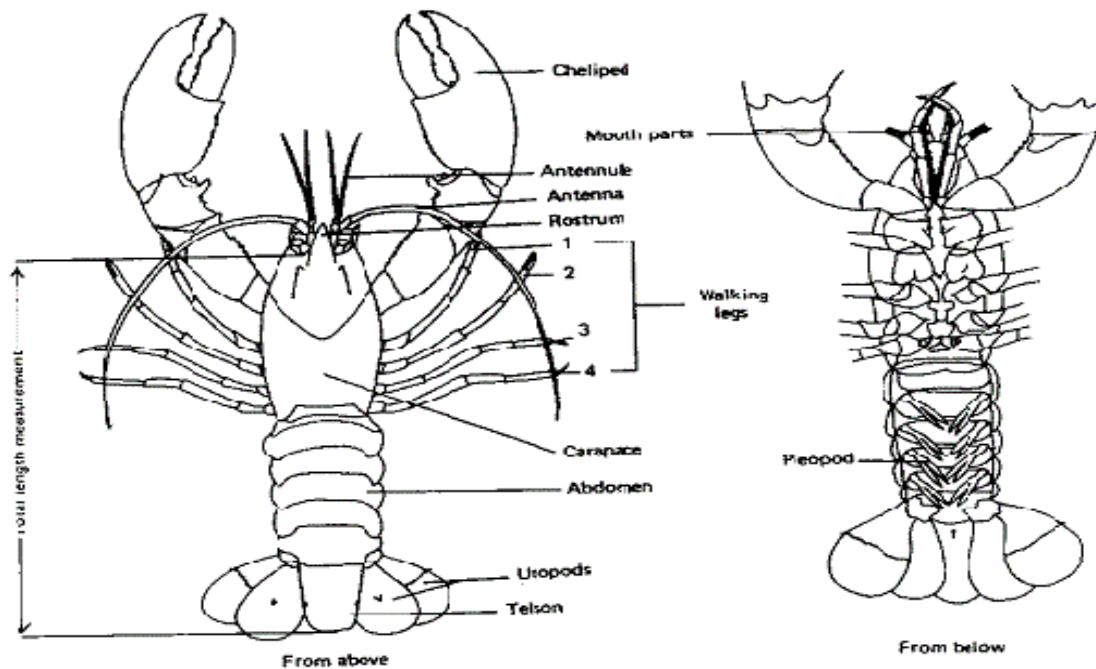
To be able to establish a successful yabbie aquaculture venture, a number of issues must be considered.

- Suitable land for pond construction must be available.
- An adequate supply of good quality water.
- Climate suitable for yabbie growth.
- Availability of transport to markets.
- A good level of commitment to management of the yabbie farm.

Before someone can venture into yabbie farming an aquaculture permit must be obtained through the Aquaculture SA within Primary Industries and Resources South Australia (PIRSA). This permit will record the applicant as a registered fish farmer and therefore enable them to stock ponds or dams with yabbies and sell their produce. Before a permit may be granted by the Aquaculture SA for a land-based applications it may be required that approval be sought by the Department of Environment and Heritage (DEH), the Environment Protection Authority (EPA) and local councils.

Anatomy and morphology

The figure below gives the morphology of the yabbie.



Water quality

Good water quality is essential to maintain optimum yabbie growth. To manage water quality, regular testing needs to be conducted. Relatively inexpensive testing kits are available through analytical supply stores. The following parameters should be monitored on a regular basis.

Water temperature

The optimum growth rates for yabbies is achieved between 25°C and 28°C however as oxygen levels start to decline with increasing temperatures, it is recommended that without suitable aeration, temperatures be maintained around 20°C to 25°C. Growth will decline and eventually cease when temperatures hit below 15°C or above 34°C. Mortalities will start to occur when temperatures reach 36°C.

Ponds can also undergo thermal stratification and occurs when the pond divides into two separate layers. This will depend on the amount of light that penetrates the water column and is mainly due water depth and the turbidity in the pond. Thermal stratification is caused by the upper surface layer being warmed by the sun and therefore will remain on the surface as it is less dense than the bottom cooler layers of water in the pond. Unless the stratification is broken down by some sort of mechanical aeration (ie wind action, airlift systems etc), its effect can be detrimental to pond life.

Thermal stratification will also cause oxygen stratification. This occurs when oxygen rich waters on the surface can not mix with the cooler bottom waters where oxygen is being continually consumed by plant, organic and animal matter. If the stratification persists, oxygen levels on the bottom will drop to levels that would be lethal to bottom dwelling yabbies.

Dissolved oxygen

Oxygen levels in pond systems depend on water temperatures, stocking rates, and the amount of aquatic vegetation growing in the pond. Oxygen levels experience day and night fluctuations where levels are high during the day and then drop at night. This is due to aquatic plants within the pond producing oxygen during the day via photosynthesis (which requires sunlight) and respiring (consume oxygen) at night.

It is recommended that oxygen levels within a pond be maintained above 4 ppm. However yabbies are extremely hardy and can withstand oxygen levels as low as 0.5 ppm although not for extended periods.

pH levels

pH is the measure of the concentration of Hydrogen ions (H^+) in the water. Water with a pH of above 7 is considered to be alkaline (low concentration of H^+) whereas a pH level of below 7 is acidic (high concentration of H^+). pH levels in freshwater ponds depend on factors such as nature of the catchment area (eg limestone areas would have a high pH) and the amount of respiration and photosynthesis occurring in the pond (*ie* the amount of carbon dioxide present – carbon dioxide dissolves in water to form carbonic acid).

Water with a pH between 7.5 and 8.5 are recommended however yabbies can tolerate a pH of 7.0 and 9.0. A pH of below 7.0 will increase the toxicity of dissolved metals within the water column and soften the exoskeleton of the yabbie. A pH of above 9.0 will greatly increase the toxicity of ammonia within the ponds.

Alkalinity and water hardness

Alkalinity refers to amount of carbonates and bicarbonates in the water and water hardness refers to the concentration of calcium and magnesium. As calcium and magnesium bond with carbonates and bicarbonates, alkalinity and water hardness are closely interrelated and produce similar measured levels.

It is recommended that alkalinity and hardness levels are maintained around 50 to 300 mg/l which provides a good buffering (stabilising) effect to pH swings that occur in ponds due to the respiration of aquatic flora and fauna. A lack of calcium in the water will also result in soft shelled yabbies as they rely on the intake of calcium from the water column to harden their shells after moulting.

Water alkalinity and hardness can be increased by liming ponds which involves adding a measured amount of lime to the pond.

Salinity

Salinity is a measure of the saltiness of the water. Yabbies can withstand salinities up to 25 ppt however their growth rates start decreasing when the salinity reaches 6ppt.

Turbidity

Water turbidity in freshwater ponds is caused by phytoplankton and zooplankton (microscopic plants and animals) and suspended solids, such as clay and silt particles in the water column. Water turbidity is important as it determines the amount of light penetration that occurs in the water column of a pond. This in turn will have an affect on the temperature of the water and the amount of vegetation and algae that will grow in the pond itself. For example a highly turbid pond will allow less light penetration therefore the temperature of the water will be lower. A combination of less sunlight and lower temperatures will result in a decreased amount of vegetation present with in the ponds which depend on sunlight and warmth to grow. A low turbid pond will of course have the opposite affect.

Quite often if a yabbie detects sunlight within a non turbid pond, they will burrow. This is their natural response to escape from predators and water loss from a drying pond. A turbid pond will therefore provide protection from predators, such as birds, and allow yabbies to feed during the day.

Turbidity is measured in centimetres using a Secchi disk which consists of a round plate divided into alternate black and white “pie” sections. This disk is attached to a graduated rope or a

metal handle divided into measuring units (usually at 2 cm intervals). The disk is lowered into the water until it can not be seen and then raised until it re-appears. Sechii depths between 20cm and 60cm are recommended for optimal management of yabbie ponds.

Ammonia

Ammonia in ponds is produced from the decomposition of organic wastes resulting in the breakdown of decaying organic matter such as algae, plants, animals and uneaten food. Ammonia is also produced by the yabbie as an excretory product.

Ammonia is present in two forms in water – as a gas NH_3 or as the ammonium ion (NH_4^+). Ammonia is toxic to crayfish in the gaseous form and can cause gill irritation and respiratory problems.

Ammonia levels will depend on the temperature of the pond's water and its pH. For example at a higher temperature and pH, a greater number of ammonium ions are converted into ammonia gas thus causes an increase in toxic ammonia levels within the yabbie pond.

Units of measurement		Conversions	
“g”	= grams	1 g/l	= 1000 mg/l
“kg”	= kilograms	1 ppt	= 1000 ppm
“m”	= metres	1 mg/l	= 1 ppm
“m ² ”	= square metres	1 g/l	= 1 ppt
“mg”	= milligrams	1 gpg	= 14 mg/l (or 14 ppm)
“l”	= litres		
“ppm”	= parts per million		
“ppt”	= parts per thousand		
“gpg”	= grains per gallon		

Pond management

Water supply

Before commencing any aquaculture venture, a suitable and plentiful water supply is required. Yabbie growers throughout South Australia obtain their water from a number of sources. These sources include soaks (where water seeps into a pond or channel from the water table), artesian bore water or run-off from the water catchment. It is however not recommended that ponds or dams are built directly into the water table and applications for yabbie farming permits using this method are usually rejected.

As South Australia is the driest state in the driest continent on earth, water is an extremely important resource in yabbie aquaculture and must be effectively managed. The majority of yabbie growers recycle their water into storage dams when draining their ponds to harvest or clean so that it can be used again in the same or a different pond. It is also advised that if a grower is to rely on run-off water from a catchment area, they should construct a number of dams to store water to ensure that yabbie ponds can be topped up during the summer months when water evaporation is at its peak.

Aeration

Artificial pond aeration is used to help maintain oxygen levels in the water throughout the day by aerating and circulating water within the pond. Aeration is usually required when ponds are stocked at higher densities and when supplementary feeding occurs. The majority of growers aerate only when oxygen demand within the ponds is high which is usually around dawn and midday.

Mechanical aeration can be achieved using a number of methods. The most popular method in South Australia is using an air-lift pump system which is effective and relatively cheap to construct. There are also a variety of other methods which can be used to effectively aerate ponds and include paddle wheels, aspirators or even an outboard motor on the back of a boat!

Pond design

Yabbie ponds are usually constructed on relatively flat or slightly sloping land which allows for water to be supplied or drained to or from the ponds by gravitation. Grow-out ponds are usually rectangular in shape and range anywhere between 500m² to 5,000m². Some growers have indicated that a pond size between 1,000m² and 2,000m² are easier and can be more effectively managed. Grow-out ponds are usually around 1 to 2 metres deep.

Other factors which aid in pond management include:

- A definite deep and shallow end to aid in water drainage.
- A sump (well defined low point) in the deep end to aid in pond drainage and crayfish collection during a harvest.
- A central channel down the middle of the pond to aid in water drainage and the collection of wastes.
- Sloping sides to allow for the gravitation of waste products toward the channel of the pond and to allow for the yabbies to locate themselves at an appropriate depth to suit water quality conditions during that time.
- Drainage and overflow systems.

It is advised that ponds are built in “blocks” which reduces building costs, area of used land and the costs of associated infrastructure such as water piping, aeration and netting. Ponds should be relatively close together for ease of management but far enough apart to allow for a vehicle to pass between them which aids in transport for feeding and harvesting.

Diet

Yabbies are described as opportunistic feeders which means that they will consume any food that is readily available within the pond system. This includes;

- *Plant material* – aquatic plants, flooded crops, lucerne, phytoplankton (tiny algae cells) and algae. As yabbies are unable to digest cellulose they are not able to obtain sufficient minerals and nutrients from eating these products. However many plants provide a medium for aquatic animals to colonise which in turn provides food for yabbies.
- *Animal material* – aquatic insects and zooplankton (tiny aquatic organisms). This includes free-swimming animals as well as animals (alive and dead) inhabiting the pond floor. Animal material provides a good source of protein in the yabbie’s diet. Zooplankton blooms are usually induced by generating a phytoplankton bloom which results after fertilising a pond with measured doses of fertiliser.
- *Detritus* – decomposing plant matter which is colonised by bacteria and fungi. Detritus is thought to be a major component of the yabbie’s diet and is a good source of protein.

As well as the natural food available in the grow-out pond, yabbie growers also provide supplementary feed. The most common type of feed used in the South Australian yabbie industry is lupins, a type of legume. Lupins provide a high source of protein and are relatively inexpensive. Some yabbie growers also use other feed or supplement lupins with other grains such as wheat and barley, lucerne, vegetable scraps, grass clippings and processed crayfish pellets manufactured by a feed company.

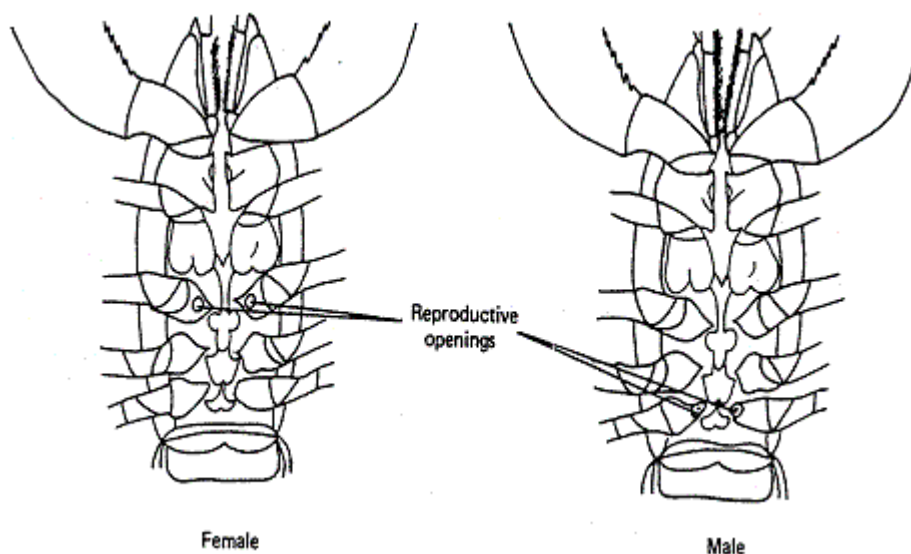
Yabbies are fed around twice per week during the summer months which tapers down to around once per fortnight during winter when the activity of the yabbie slows down. The amount of feed yabbies are given is around 3% of their body weight per day however most yabbie growers determine the amount of feed according to the proportion of previous feed which is left over. It is important not to overfeed as this can result in oxygen depletion problems within the ponds when uneaten food decomposes.

Little is known about the nutritional requirements of yabbies. The above information is based on previous observations but there is still a lot to discover. For example it is not completely known how important the natural pond flora and fauna is on the nutritional component of the yabbie's diet. The relative importance has been speculated by previous studies showing that crayfish fed the best processed pellet diet in tanks do not achieve the same growth rates as yabbies grown in earthen ponds. More research is required to investigate into the nutritional requirements of the yabbie and the role of plant and animal matter, detritus and processed pellets in providing those requirements.

Yabbie production

Breeding

The sex of yabbies can be determined very easily by examining the underside of the yabbie. Female yabbies have oviducts which are located at the base of the second pair (from the head) of walking legs and males have male genital papillae located on the base of the fourth pair of walking legs. Yabbies reach sexual maturity before one year of age and can be as small as 20g.



The position of female and male reproductive openings used in sex determination.

Yabbies are prolific breeders and females can produce eggs up to five times a year depending on climatic conditions. Mature females can produce anything from 30 to 450 eggs per brood depending on their size with larger females producing a greater number of eggs. The male deposits a spermatophore within the vicinity of the female's oviducts where her eggs are produced. The female then releases her eggs, mixes them with the male's sperm and attaches them to her swimmerets (pleopods) located underneath her tail.

The eggs are incubated underneath the tail of the female and hatch after a period of 19 to 40 days depending on the temperature of the water. After hatching, the juveniles pass through three distinct stages before they become completely independent from their mother. These stages can take up to another 25 days to complete and again depend on the temperature of the surrounding water.

Supply of juveniles

Stocking of juveniles in grow-out ponds can be achieved using a number of methods. These include

- Stocking the pond with a parent population of yabbies and allowing the natural population dynamics to occur. This method is very extensive and can result in overcrowding and decreased growth rates if the pond is not regularly trapped to remove the large individuals.
- Stocking the ponds with broodstock yabbies at a ratio of one male to three females, allowing them to breed and then trapping out the adults.
- Stocking the ponds with berried females however the handling of berried females can sometimes result in the loss of eggs from underneath her tail.
- Breeding the yabbies within a smaller pond or tank, harvesting the juveniles and then re-stocking them in a separate grow-out pond. This method can be very time consuming and can also result in a loss of juveniles due to handling stress.

Growth rates and survival

Yabbies grow via a series of moults which involves a period of no growth (known as the intermoult period) followed by rapid increase in size after moulting. Moulting occurs when the entire exoskeleton of the yabbie is shed to accommodate for a new larger exoskeleton underneath.

There are many factors that affect the growth rates and survival of yabbies. Some of these include:

- Water quality conditions.
- Stocking rates.
- Predation mainly due to cannibalism and birds.
- The availability of shelters or hides.
- Diet.
- Pollutants.

Stocking rates within a yabbie pond usually depend on the initial size of the yabbie and the extent of pond management (ie aeration, water quality, supplementary feeding, provision of shelter *etc*). Growth rates and survival depend heavily on the stocking density of yabbies although as a general rule, juveniles are usually stocked at a rate of 4 to 8/m². More research is required in this area to determine an optimum stocking rate for yabbies held under various degrees of pond management.

Yabbie stocking rates can be difficult to maintain due to their frequency of breeding which can result in an influx of a numerous number of juveniles every couple of months. Yabbies can attain a maximum size of 320g however this is not economically viable due to the costs and time associated in producing a yabbie of this size. A market size yabbie between 40g to 100g can usually be attained within a year.

Harvesting

Yabbies can be harvested using several methods;

- Trapping – baited traps are thrown into the pond during dusk and yabbies are collected in the morning from the traps.
- Drain down #1 – ponds are drained and yabbies are manually collected. One problem encountered with this method is that yabbies burrow in response to dropping water levels which can result in no yabbies being present once the pond is empty.

- Drain down #2 – ponds are again completely drained however a cage is placed around the outlet pipe which collects yabbies as they follow the water from the pond into the sump area and down through the outlet pipe.

After harvesting is completed, yabbies are graded into various size classes and then purged in cold water to remove the gut contents. Yabbies are then packed in styrene foam containers ready for transporting to the market.

Marketing

Presently yabbies are marketed anywhere between 40g and 100g. Yabbies are sold live to various markets both domestically and interstate (mainly Sydney and Melbourne). At this stage production of yabbies is not sufficient to support an international export market however there is an interest overseas for our yabbies once production increases. Currently yabbies are selling at a farm gate price of around \$10/kg.

Marketing can be accomplished either individually or through a marketing co-op. The advantages of marketing through a co-op are:

- Consistency of the quality of the product.
- Consistency of supply of product.
- Stability of the price of the product.
- Market advertising is done by the co-op.
- Allow even the smallest grower to supply yabbies to the market.

There are marketing co-ops in South Australia for yabbies to "co-ordinate the orderly marketing of yabbies grown aquaculturally by registered growers throughout South Australia". There are three distributions centres located throughout the state in Fleurieu Peninsula, the South East and Eyre Peninsula.

Yabbies have excellent marketing attributes due to their presentation on the table and good meat yield which is around 15 to 20% of the total body weight. The majority of yabbies are served whole however there is opportunity for value adding. One grower has had excellent success marketing yabbies as a pickled product (just the tail meat) and pate.

Health issues

To manage the introduction of potential diseases into South Australia, the PIRSA Aquaculture SA have protocols in place to control the importation of fish species, including yabbies, into our state. This allows the yabbie industry to operate in a relatively disease free environment.

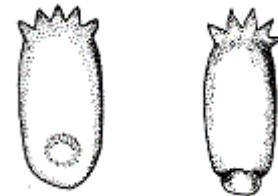
There are two main health issues that are present within the South Australian yabbie industry.

Thelohania

Thelohania is a microsporidian which affects the tail musculature of the yabbie. It is also known as "chalky tail" due to the thelohania organism causing the tail muscle to become white and chalky in appearance. *Thelohania* is mainly found in wild populations therefore stressing the importance of obtaining broodstock or juveniles from registered growers rather than from wild populations where there is a risk of introducing the parasite into an aquaculture pond.

Temnocephids

Temnocephids are an ectocommensal (external parasite) that reside on the exoskeleton of the yabbie. They are often associated with low salinity and nutrient rich waters. Eggs of temnocephalids are laid on the underside of the tail of the yabbie and sometimes in their gill cavity.



Temnocephalids

Temnocephalids are rarely harmful to yabbies unless they are present in extremely high densities. Presence of adult temnocephalids or their eggs within the gill chamber of the yabbie may cause respiratory problems. Their appearance may also reduce the market appearance of the yabbie. Adult temnocephalids can easily be removed by washing the yabbies in a salt bath for a couple of minutes. However the eggs of temnocephalids are extremely adherent and remain even after steaming and boiling.

The future of yabbie farming

There are programs in place to ensure the successful development of the yabbie farming industry.

Code of Practice

There is a Code of Practice for the Growing of Freshwater Crayfish (yabbies *Cherax destructor* and marron *Cherax tenuimanus*) in South Australia. The Code of Practice was produced by the Australian Freshwater Crayfish Growers Association South Australia (AFCGA-SA), the PIRSA Aquaculture SA and the Environment Protection Authority (EPA). It provides guidelines to yabbie growers on site selection, pond construction and waste water management to ensure that the industry develops in an environmentally sound manner.

The Code of Practice for the Growing of Freshwater Crayfish can be obtained from a AFCGA representative, the Aquaculture SA PIRSA and the EPA.

There will also be a Code of Practice for Post Harvesting Techniques of freshwater crayfish (yabbies and marron) developed to ensure that a premium quality product will be delivered to the market place.

Research pond project

In 1997 the South Australian branch of the Australian Freshwater Crayfish Growers Association (AFCGA-SA) was awarded grant funding through the Rural Industry Adjustment and Development Fund (RIADF) to establish four research trial ponds. The purpose of these ponds is to conduct research projects relevant to the industry that will aid in refining and establishing best practice procedures and therefore improve production and participation in freshwater crayfish aquaculture.

The four research ponds are situated on established freshwater crayfish farms located throughout the state on Kangaroo Island, Fleurieu Peninsula and the upper South East. Each pond is divided into 24 enclosures and equipped with an airlift aeration system. Research will incorporate both marron and yabbies.

Research undertaken within the ponds has investigated:

- Diet and feeding regimes.
- Stocking rates and regimes.
- Importance of habitats.

Research was coordinated and conducted by AFCGA-SA in conjunction with the Aquaculture Group in Primary Industries and Resources South Australia (PIRSA), South Australian Research and Development Institute (SARDI), the University of Adelaide and Flinders University. The research project is now being coordinated by the Australian Freshwater Crayfish Growers Association.

Production in the future

Yabbie farming has a promising future in South Australia. With larger commercial operators entering the industry combined with the establishment of improved management practices due to further research and development within the industry, production is expected to increase in the future.

Further Information

Please note that this fact sheet contains only guidelines to yabbie farming. It is strongly recommended that further information be attained from the following sources.

Contacts

The Australian Freshwater Crayfish Growers Association (SA)

- President: Keith Keen
Phone/Fax: (08) 8758 4000

Aquaculture SA of Primary Industries and Resources South Australia (PIRSA)

- GPO Box 1625
ADELAIDE SA 5001
Ph: (08) 8226 0314
www.pir.sa.gov.au/aquaculture

Yabbie Co-operatives

- Fleurieu Peninsula
Mrs Carol Schofield
PO Box 61
INMAN VALLEY SA 5211
Ph: (08) 8558 8215
- South East
Mr Kevin Hillier
PO Box 501
BORDERTOWN SA 5268
Ph; (08) 8754 2021
- Eyre Peninsula
Mrs Margaret Hurrell
Post Office
COFFIN BAY SA 5607
Ph: (08) 8685 4056

The South Australian Aquatic Science Centre Library SARDI (South Australian Research and Development Institute)

- The Librarian
PO Box 120
HENLEY BEACH SA 5022
Ph: (08) 8200 2423

Further reading

The SARDI Aquatic Centre Library (contact details above) contains an excellent range of books, articles and publications on aquaculture. Besides the information stated below, you will be able to source a significant amount of material regarding yabbie aquaculture from the library.

- Boyd, C. (1994). Water Quality in Ponds for Aquaculture. 500pp.
- Boyd, C. and Tucker, C. (1992). Water Quality and Pond Soil Analyses for Aquaculture. 200pp.
- Jones, C. (1990). Biology and Aquaculture of the Red Claw. 146pp.
- McCormack, R. (1996). Yabby Farmers Handbook. 250pp.

- Merrick, J.R. and Lambert, C.N. (1991). The Yabby, Marron and Redclaw Production and Marketing. (Macarthur Press, NSW) 180pp.
- Moloney, J. (1993). Feeding in Freshwater Crayfish. (Turtle Press Pty Ltd, Tas) 24pp.
- Mosig, J. (1995). Australian Yabby Farmer. 218pp.
- Mosig, J. and Fallu, R. (1995). Australian Fish Farmer. 263pp.

Walker, T. (1994). Pond Water Quality Management: A Farmers Handbook. (Turtle Press Pty Ltd, Tas) 68pp.

Last update: January, 2003

Agdex: 474/10

Author:

Aquaculture SA.

Disclaimer

Use of the information in this Fact Sheet is at your own risk. The Department of Primary Industries and Resources and its employees do not warrant or make any representation regarding the use, or results of the use, of the information contained herein in terms of its suitability, correctness, accuracy, reliability, currency or otherwise. The entire risk of the implementation of the information which has been provided to you is assumed by you. All liability or responsibility to any person using the information is expressly disclaimed by the Department of Primary Industries and Resources and its employees.