

86/62.

AN ASSESSMENT OF THE POTENTIAL FOR COMMERCIAL FARMING

OF YABBIES

Andrew Staniford *

1. Introduction

The yabbie, Cherax destructor has been identified as an Australian freshwater crayfish species having a very high potential for aquaculture. Research into biological aspects of the yabbie (Carroll 1981, Mills 1983) has demonstrated that commercial farming of yabbies is technically feasible. However, there is little information available on the profitability of investing in, and developing, commercial yabbie farms.

In 1986, a research project was initiated by the South Australian Department of Fisheries to assess the potential for commercial yabbie farming operations. The project was supported by a grant from the Fishing Industry Research Trust Fund Account. Some key results from the research are summarised in this article. Prospective investors requiring further information can obtain a copy of the complete report (Staniford, Kuznecovs and Mills, 1987) from the Department.

2. Yabbie Production in Australia

Yabbie production in Australia (tonnes of live weight) from 1974/75 to 1984/85 (the most recent year for which data are available) is provided in Table 1. Annual production is small (less than 160 tonnes) and variable, ranging from 28 tonnes in 1977/78 to 157 tonnes in 1981/82. Most of the commercial catch is obtained from harvesting wild stocks which occur in natural waterways or in farm dams. Aquaculture production of yabbies is minimal: only 1.3 tonnes in 1985/86 (FAO, unpublished data).

3. Markets for Yabbies

Opportunities exist to sell yabbies on either domestic or export markets.

3.1 Domestic Markets

Most yabbies sold on domestic markets are destined for table consumption. Information provided by producers and buyers indicates that these yabbies should:

- (a) weigh at least 50 grams; the market prefers a weight of between 70 and 85 grams;
- (b) be graded to provide a uniform size;
- (c) be of good appearance with no missing appendages (e.g. claws), and,

* Mr Staniford is an Economist with the South Australian Department of Fisheries, Adelaide.

(d) be in sound condition.

Yabbies are generally cooked prior to sale. Some producers also sell juvenile yabbies (up to 15 grams) for bait or stocking farm dams.

Table 1: Commercial Production of Yabbies by State and Australia (tonnes): 1974/75 to 1984/85

Year	New South Wales ^a	Victoria	South Australia	Total Australia
1974/75	16	2	127	145
1975/76	25	-	86	111
1976/77	26	5	44	75
1977/78	7	-	21	28
1978/79	16	19	3	38
1979/80	18	42	8	68
1980/81	7	61	4	72
1981/82	15	127	15	157
1982/83	2	61	7	70
1983/84	n.a.	9	10	n.a.
1984/85	n.a.	15	8	n.a.

^aThese figures have been adjusted to exclude catches of River Murray crayfish, which form part of the official figures for freshwater crayfish.

Source: Australian Bureau of Statistics, Fisheries, Australia, Catalogue No. 7603, various issues. Department Conservation Forests and Lands (1984), Fishermens News, 1(2), August.

The average Australian wholesale price of adult yabbies (for table consumption) has increased from \$1.01 in 1974/75 to \$3.15 per kilogram in 1982/83 (Table 2). In May 1987, the wholesale price of yabbies in Adelaide was \$6.00 per kilogram (Table 3). Current prices in Victoria vary between \$5.00 and \$8.00 per kilogram (Table 3).

The real price of yabbies, in 1986/87 dollars, has fluctuated between \$3.06 per kilogram in 1974/75 to \$4.89 per kilogram in 1976/77 (Table 2). There has been no clear trend in real price during this period. There is insufficient information to determine whether domestic demand for yabbies is seasonal.

The data presented in Table 2 are based on auction prices recorded at fish markets. However, only a small proportion of yabbie production is marketed at auctions. For example, records of yabbies sold at the Sydney and Adelaide fish markets are not maintained due to infrequent supplies (personal communication, 1986). Between 1978/79 and 1983/84 only 30% of Victoria's yabbie production was sold at the Melbourne Fish Market (Department of Conservation, Forests and Lands, 1984). Consequently, the prices provided in Table 2 may not be representative of prices actually paid for yabbies. Indeed, discussions with yabbie producers indicated that most sold a portion (and sometimes all of their production) to retail outlets (restaurants and hotels etc.) They indicated that the price obtained varied between \$8.00 to \$12.00 per kilogram (Table 3). Larger yabbies (greater than 100 grams) may attract a premium of between \$1.00 to \$2.00 per kilogram.

Discussions with producers and buyers of yabbies also indicated that there is potential to increase the quantity of yabbies marketed domestically with a minimal impact on price. However, the precise nature of the relationship between quantity marketed and price obtained (the price elasticity of demand) is not known. Consequently the impact of increased supplies of yabbies on the domestic price is uncertain.

3.2 Export Markets

Currently, yabbie production for sale on export markets is minimal. However, yabbies were exported from Australia to Sweden in 1976 (43 tonnes) and 1977 (24 tonnes) (Department of Trade and Resources, 1979). Exports ceased due to insufficient supplies.

Other potential export markets for freshwater crayfish exist in France, West Germany, Belgium, Holland and Spain, (Spicer 1984). Turkey has been the traditional supplier of crayfish to these markets. In 1982, exports totalled 2000 tonnes (Koksai 1983). However, in 1986, the Turkish fishery collapsed due to the crayfish fungus plague Aphanomyces astaci (Furst, personal communication). As a result, there may be opportunities to export Australian yabbies to these countries. The demand for freshwater crayfish in some markets (e.g. Sweden) is highly seasonal (Department of Trade and Resources 1979).

Table 2: Average Wholesale Price (\$/kg.) of Yabbies by State and Australia: 1974/75 to 1984/85

Year	New South Wales	Victoria	South Australia	Australia	Real Australian Price ^a (\$1986/87)
1974/75	3.30	0.50	0.12	1.01	3.06
1975/76	3.50	-	1.00	1.57	4.20
1976/77	3.50	1.00	1.36	2.08	4.89
1977/78	1.50	-	1.95	1.86	3.99
1978/79	1.50	1.80	2.00	1.68	3.34
1979/80	2.50	1.62	3.13	2.03	3.66
1980/81	4.00	1.97	3.25	2.24	3.69
1981/82	3.00	2.32	2.73	2.43	3.63
1982/83	3.00	4.00	3.11	3.15	4.21
1983/84	n.a.	3.33	3.90	n.a.	n.a.
1984/85	n.a.	3.47	4.00	n.a.	n.a.

^aDeflated by the CPI for Australia (all goods index) as recorded by the Australian Bureau of Statistics Catalogue No. 6401.0.

Source: Australian Bureau of Statistics, Fisheries Australia, Catalogue No. 7603.0, various issues; Department of Conservation, Forests and Lands (1984), Fishermens News 1(2) August.

Table 3: Current (1986/87) Wholesale and Retail Yabbie Prices

<u>State</u>	<u>Price (\$/kg)</u>	
	<u>Wholesale</u>	<u>Retail</u>
N.S.W.		10 to 12
Victoria	5 to 8	
S.A.	up to 6	8 to 11

Source: Personal discussions with producers.

Information supplied by the Department of Trade and communications with Swedish importers, indicate that the following conditions should be noted when considering exporting yabbies to Europe:

- (a) the total length of the yabbie be at least 9cm.
- (b) there is a preference for live fish in some markets (eg. France).
- (c) if cooking is to occur prior to shipment, it should be in accordance with the traditional recipe of the region. This may necessitate using imported ingredients.
- (d) yabbies should be of good appearance with no missing appendages and in sound condition.

The price obtained for yabbies on export markets may vary between A\$4.00 and A\$30.00 per kilogram (personal communication with Swedish importers). Koksai (1983) also noted that the export price for freshwater crayfish varied greatly, by origin and species. This, combined with the usual risks associated with export trade (e.g. failure to meet quality standards, currency realignments), indicates that the export price is highly uncertain.

4. A Yabbie Aquaculture System

To assess the profitability of investing in a yabbie farm, it is necessary to specify a farming system suitable for aquaculture of yabbies. Using available biological information, a system comprising five phases is specified:

1. a hatchery to produce juveniles:
2. a nursery for juvenile grow-out:
3. rearing ponds for adult grow-out:
4. harvest: and,
5. processing and marketing.

Alternate farming systems could have been specified. The optimal system is not known, and may vary with individual circumstances. (e.g. the availability of water, labour or capital). Further details on the rationale for this system are provided in the larger report.

A farm size providing 10 hectares of rearing ponds is assumed. One crop of yabbies is produced each year from every pond. Breeding stock (two females and one male) are placed in aquaria in an insulated hatchery. Spawning is induced through manipulation of temperature and photoperiod, and hatching occurs (Mills 1983). Each female is assumed to produce an average of 350 juveniles, three times each year of which 85 per cent survive.

Newly hatched animals are transferred from the hatchery to the juvenile grow-out ponds (above ground ponds) within one week of hatching. They are stocked at a rate of 200 animals per square metre. No feeding is required during this stage. The survival rate is assumed to be 50 per cent.

Yabbies are transferred from the juvenile grow-out ponds to the adult grow-out ponds (earthen ponds) when they reach a size of one to five grams. The stocking rate is assumed to be 10 animals per square metre. Feeding commences using pig starter ration at a rate of 3 grams per square meter, adjusted for water temperature (Mills 1983). Yabbies are progressively harvested using traps as they reach market size. The final harvest for the year is obtained by complete draining of the ponds. The minimum marketable size of yabbies is assumed to be 50 grams. It is further assumed that 60 per cent of the yabbies transferred to the adult grow-out ponds reach this size; the remaining 40 percent either die or are unsaleable. The average weight of individual yabbies harvested is assumed to be 55 grams.

A processing plant is installed to cook or freeze yabbies harvested from the adult grow-out ponds. They are then packaged in 2 kilogram cardboard cartons (with plastic liners) and delivered to retail outlets.

Pond water is assumed to be supplied from natural run-off. It is stored in the adult grow-out ponds and a water storage dam. Water can be recycled subject to water quality (salinity, level of pollutants etc.) being satisfactory for growth of yabbies (Staniford et al. 1987). Mains water is used in the hatchery. Water released from the farm is used for irrigation or can be disposed of without additional treatment.

It is assumed that 10 hectares of rearing pond are provided by 50, 0.2 hectare ponds. Given the assumptions outlined above, an annual hatchery output of 2,000,000 yabbies is required to stock the rearing ponds. Assuming the hatchery operates continuously throughout the year, monthly hatchery production is 170,000 yabbies.

While hatchery production can continue during the winter months, growth in the juvenile and adult grow-out ponds will be reduced (Mills 1983). It is assumed that there will be four months during which growth is minimal. During this period, juveniles produced in the hatchery will be stored in juvenile grow-out ponds. Ponds sufficient to store 1,000,000 juveniles are required.

Yabbies are harvested throughout the year. During the winter period, yabbies of marketable size are held over in adult grow-out ponds, and harvested as required.

5. Results

A budget detailing annual costs and returns for the yabble farm specified is provided in Table 4. Given the assumptions outlined above, annual production is estimated to be 33,000 kilograms (3,300 kilograms per hectare). This estimate is based on expected survival rates and growth rates of yabbies. However, it has not been established experimentally. Moreover, the production system outlined has not been evaluated on a commercial scale. The estimated yield of 3,300 kilograms per hectare is greater than that indicated by Mills 1983 (viz. 1,500 to 2,500 kilograms per hectare) but less than that estimated by Carroll 1981 (8,229 kilograms per hectare). Assuming a price of \$10.00 per kilogram, annual gross income is \$330,000.

Table 4: Annual Budget for a Hypothetical Yabbie Farm

Item	\$	% of total cost
Gross income @ 33000 kgs. \$10 per kg.	330000	
Costs		
Feed	31050	15.6%
Hatchery water	306	0.2%
Energy	10000	5.0%
Packaging	8250	4.2%
Repairs and maintenance		
Equipment	8080	4.1%
Buildings	275	0.1%
Labour	96000	48.3%
Insurance	4797	2.4%
Vehicle reg. and insurance	1000	0.5%
Rates and taxes	1500	0.8%
Accounting fees	500	0.3%
Depreciation	33612	16.9%
Office costs	1300	0.7%
Sundry expenses	2000	1.0%
Total costs	198670	
Operating return	131330	
Rate of operating return on capital invested (%)	27.4%	

Total annual cost is estimated to be \$198,670 (Table 4). The major cost item is labour, accounting for 48.3% of total cost. This includes payment for an owner-operator, a fish farm manager and a farm hand. The second most important cost is depreciation, representing 16.9% of total cost. Feed costs are the next most important cost (15.6% of total cost).

Other cost items listed in Table 4 are relatively small (each less than 5% of total cost). Annual operating profit is calculated to be \$131,330.

Total capital required to establish the farm is estimated to be \$479,660 (Table 5). Pond establishment costs are the largest individual cost item, representing 36.1 per cent of total establishment costs. This estimate may vary, depending on the topography of the land and its suitability for pond construction. Nursery costs are the second most important item, accounting for 13.5 per cent of establishment costs. Predator control costs are also large (11.1 per cent of establishment costs).

Table 5: Capital Costs of Establishing a Yabbie Farm

Item	\$	% of total capital invested
ESTABLISHMENT COSTS		
Land	47000	9.8
Pond establishment	173000	36.1
Water storage dam	40000	8.3
Hatchery and office	27535	5.7
Nursery	64625	13.5
Processing plant shed	19000	4.0
Storage shed and equip.	3500	0.7
Predator control	53200	11.1
Electricity connection	10000	2.1
Monitors and lab. equip.	4000	0.8
Pond transfer equip.	4000	0.8
Feeders	2000	0.4
Pumps	800	0.2
Harv. & process. equip.	8000	1.7
Transport equipment	23000	4.8
TOTAL CAPITAL	479660	100

Return on capital is estimated to be 27.4 per cent, indicating that yabbie farming may provide a favourable return to investors. However, the estimated rate of return depends critically on the assumptions made regarding survival rates and growth rates throughout the

production process. While these appear to be technically achievable, their appropriateness in a practical farming situation cannot be assessed until additional information becomes available on the performance of yabbie farms that have adopted the farming system proposed. In addition, on any given farm, there will be variation in the growth rates and survival rates recorded for yabbies (Mills and McCloud 1983). Thus the estimated return on capital is uncertain.

A limitation of return on capital as an indicator of investment performance is that it fails to take into account the timing of expenditure and earnings. For example, during the period in which a yabbie farm is being developed, costs will be incurred and revenue may be minimal. A cash flow budget was developed to examine these aspects. The budget was used to estimate the internal rate of return of the project which represents the maximum interest rate that an investor can afford to pay for borrowed funds, and break-even, at the end of the investment period (10 years), assuming no capital repayments are made. Costs and revenues were estimated in real terms, i.e. the effects of inflation were ignored. The pay-back period (number of years before total income generated exceeds cost) was also calculated. Results are provided in Table 6. The internal rate of return is 23.7 per cent. Payback occurs in year 5.

Table 6: Results of the Cash-Flow Analysis.

ITEM	VALUE
Internal Rate of Return	23.7
Pay-Back Period (years)	5

Given the assumptions incorporated in the analysis, these results imply that, provided the price of yabbies is at least \$10.00/kg and the interest rate is less than 23.7 per cent, investment in the yabbie farm is economically attractive.

However, profitability will depend on the price received for yabbies and the production level achieved. A 30 per cent reduction in the harvest rate (the number of yabbies reaching marketable size) or price, reduces the internal rate of return to zero and extends the pay-back period to 10 years. A 30 per cent increase in price or harvest rate causes the internal rate of return to increase to 43 per cent and the pay-back period to be reduced to 4 years.

These results indicate the profitability is extremely sensitive to variation in price and harvest rate. Price is uncertain and will vary depending on product quality and the market in which the yabbies are

sold (e.g. export or domestic markets). The potential impact of price on profitability indicates that prospective investors should carefully evaluate alternate marketing opportunities to ensure that the expected price is sufficient to provide an adequate return, and that the product marketed conforms to the requirements of consumers in those markets (e.g. size, method of processing). Harvest rate is also uncertain due to the potential variation of growth rates and survival rates of yabbies (Mills and McCloud 1983). In addition, unforeseen circumstances such as disease, production failure, mechanical breakdown or human error may seriously reduce production in one or more years and would alter the return on the investment. Indeed, the experience of aquaculture in Australia indicates that it would be unwise to ignore such possibilities. It is concluded that a high standard of farm management will be necessary to produce consistently high yields (high harvest rates).

6. Concluding Remarks

Currently, yabbie production in Australia is almost exclusively harvested from wild stocks. Due to environmental factors, catches are low and highly variable. There appears to be potential to develop a yabbie aquaculture industry, with opportunities to sell yabbies on both domestic and export markets.

Exploitation of these market opportunities requires the development of an efficient yabbie production and marketing system. One possible system was specified in this paper on the basis of biological information currently available. An evaluation of the profitability of investing in such a yabbie farm indicated that the investment may produce a reasonable return: assuming a price for yabbies of \$10.00 per kilogram, the internal rate of return was estimated to be 23.7 per cent and the rate of return on capital invested was 27.4 per cent. However, profitability was very sensitive to the harvest rate achieved and the price obtained for yabbies. These parameters are uncertain. Moreover, the production system analysed has not been evaluated in a practical farming situation. Thus, while favourable returns may be feasible, it is concluded that the development of a commercial yabbie farm is a risky investment.

To minimise the risk associated with the development of a specific yabbie farm, investors are advised to undertake private research and small-scale experimentation to determine values for key parameters affecting the profitability of the investment (eg. yield and price) before investing large amounts of money in the farm. The information obtained will assist to establish the profitability of the proposed project, and may also be useful in obtaining finance to fund the project.

REFERENCES

- Carroll, N.P., 1981, Aquaculturists' enthusiasm for yabbies highlights potential beyond the problems. Aust. Fish. 40(6) : 7-14.
- Department of Conservation, Forests and Lands, (1984), Fishermens News 1 (2), August.
- Department of Trade and Resources, 1979. Overseas Market Report No. 1079: Yabbies, Sweden.
- Koksal, G., (1983), Turkish crayfish - a success, Infofish Marketing Digest No. 6/83.
- Mills, B.J., 1983. Aquaculture of yabbies. Proceedings of the 1st Australian Freshwater Aquaculture Workshop, Narrandera.
- Mills, B.J. and McCloud, P.I., 1983. Effects of stocking and feeding rates on experimental pond production of the crayfish Cherax destructor Clark (Decapoda : Parastacidae). Aquaculture, 34 : 51-72.
- Spicer, H., 1984. "The Western European market for crawfish". Infofish Marketing Digest No. 4/84.
- Staniford, A.J., Kuznecovs, J., and Mills, B.J. 1987. Economics of Commercial Aquaculture of the Yabbie Cherax destructor, South Australian Department of Fisheries.