

PRAWN PARK - TAUPO, NEW ZEALAND

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New Zealand's only freshwater prawn farm was established in 1987 to take advantage of geothermal waste heat from the Wairakei power generating field on North Island. Since approximately 2000 tonnes (2200 tons) per year of prawns are imported annually into New Zealand, the motivation was to try and capture some of this market with a domestic product.

Giant Malaysian Freshwater Prawns (*Macrobrachium Rosenbergii*) were imported from Malaysia in 1988. Half of these were lost in transit due to delays in lifting import restrictions. A second import of 25 breeding males and females had to be quarantined for 15 months to assure that they were disease free. Also, officials required that if prawns escaped into the adjacent Waikato River, they would not

survive and reproduce. It turns out that the prawns will die in 14°C (57°F) water, and since the river water is at 10°C (50°F), there was no chance of survival. Thus, a license was issued in 1989 for the firm to start commercial production.

The original farm consisted of five outside pools totaling one hectare (2.5 acres), and a small hatchery and nursery. Shortly, another four ponds were added to bring the total area to 2.5 ha (6.2 acres).

In 1993, the New Zealand Enterprise Board joined New Zealand Prawns Ltd., in partnership, and another 10 ponds were developed bring the total pond surface area to 5.8 ha (14.3 acres), with the entire facility occupying 10.2 ha (25.2 acres)(Figure1).



Figure 1. Prawn Park with Wairakei Power plant and Waikato River.

The present 19 ponds vary in size from 0.2 to 0.35 ha (0.5 to 9.9 acres) and have a depth of 1.0 to 1.2 m (3.3 to 3.9 ft), providing a slope for ease of harvest. The length to width ratio of the pond surface is approximately 20:1. The sides are sloped for stability and the bottom material is composed of an impermeable volcanic ash that also stores nutrients for the prawns (Figure 2).



Figure 2. Detail of outdoor pond.

Ideally, the ponds should be kept at a temperature of 28°C (82°F); but, presently, they are at 24°C (75°F) with a temperature variation from one end of the pond to the other of 1°C (2°F). A temperature probe controls the flow of water into the ponds and an aerator is used to obtain vertical mixing of the pond water. Without the vertical mixing, the pond becomes temperature stratified, reducing the production of prawns.

Water for the ponds comes from two sources, the plate heat exchanger at 55°C (131°F) and river water at 10°C (50°F). Water is circulated throughout the system from a storage and settling pond that is kept at 21°C (70°F). Approximately 90% of the water is recirculated, with the 10% makeup water coming from the river. Water is circulated through the plate heat exchanger at a rate of 250 tonnes per hour (1100 gpm) (Figure 3) in summer and 400 tonnes per hour (1760 gpm) in winter. The primary side of the plate heat exchanger takes waste water from the Wairakei power plant just before



Figure 3. Hot water intake and plate heat exchanger.

it flows in to the Waikato River. Approximately 4000 tonnes per hour (17,600 gpm) of over 90°C (194°F) waste water is discharged from the plant and flow across the pumps supplying the plate heat exchanger. The geothermal water cannot be used directly in the ponds due to the presence of detrimental sulphur, lithium and arsenic. However, there is an experimental project nearby funded by ECNZ (Electricity Corporation of New Zealand), that is attempting to extract these elements for commercial use.

The Prawn Farm pays a royalty to ECNZ for the heat source; however, the Prawn Farm is still the third largest annual electricity consumer in the Taupo District. The farm would not be economically viable if electricity were used for heating, instead of the Waikato River water, and this is reviewed on an annual basis.

Presently, the farm is capable of producing up to 30 tonnes (33 tons) of prawns per annum of prawns (Figure 4); however, presently only 16-17 tonnes are produced. The life of the prawn starts in salt water inside in breeding tanks and end in the freshwater ponds outside where they are harvested after nine months averaging 30 to 40 per kg (14 to 18 per lb) or about 30 g (1 oz) each. They are sold at \$NZ 25/ kg wholesale and \$NZ 40/kg retail (\$US 17 to \$US 27 per lb).



Figure 4. Harvested prawns.

The life cycle and stocking rates of the prawns start with the breeding tanks. These hold between 100 to 150 breeding stock at a ratio of one male to five or six females. The males last about 18 months at which time they are replaced. A female prawn spawn five times a year in brackish water (1/3 saltwater and 2/3 freshwater), and produce between 20,000 to 80,000 larvae per spawning. A total of one million larvae are produced per cycle giving total production of post larvae per year of nine million.

After spawning, the larvae are attracted by light where they are siphoned off into a catching bucket and placed in the larval tanks. The larvae undergo eleven different moults to metamorphose into a post larvae in 30 days. They are fed three times a day with a mixture of crushed mussels and scrambled eggs (Figure 5).

The larvae are then moved to nursery ponds holding up to 200,000 animals each and kept at 28°C (82°F) (Figure 6). Here they grow from 0.01g to 4 - 6 (0.004 to 0.14 - 0.21 oz) in four months. They are fed a diet of pellets containing fishbone, minerals, etc., still at three times a day.



Figure 5. Larval tank.



Figure 6. Nursery ponds.

After four months in the nursery, the prawns are transferred to the outdoor growout ponds for their final growth of a further five months. The prawns are moved manually using a net with mesh openings that catches only the largest ones.

They are again fed pellets, with zooplankton growing in the ponds providing additional food. Prawns are voracious eaters and will turn cannibalistic if undernourished. Two kilograms (4.4 lb) of food produces one kilogram (2.2 lb) of prawns.

At the end of the five months, the ponds are drained and the prawns picked up manually from the bottom by four to six harvesters. The prawns are then transferred to the hatchery for washing before they are taken fresh to the restaurant (Bar and Grill) or snap frozen for future use (Figure 7).

The stocking rate in the outdoor growout ponds are approximately 30 per square meter (3 per square foot) or 20 to 30,000 prawns per pond, depending upon the size. At harvest time, 400 to 500 kg (880 to 1100 lbs) are produced from the smaller ponds, and 800 to 1000 kg (1770 to 2200 lbs) produced from the larger ponds.



Figure 7. Bar and Grill Restaurant.

Ninety percent of the harvested prawns are sold to the Bar and Grill next door, with the rest going to gourmet restaurants in Queenstown, Wellington and Whakatane. Over a recent three year period, the restaurant has served more than 30 tonnes (33 tons) of prawns to more than 45,000 visitors (Figure 8). This is 10 percent of the prawns consumed annually by Kiwis. The restaurant offers a plate of 16 prawns for NZ\$ 22 (US\$ 15) or a half plate of 8 prawns for NZ\$ 12.50 (US\$ 8). This past year, with a full-time marketing manager and half-hour hatchery tours operating five hours a day (at NZ\$ 4 - US\$ 2.7 per head), more than 25,000 tourists, 50 percent domestic and 50 percent overseas, have been attracted.

Figure 8. A satisfied customer.



Prawn farming is labor-intensive with high overheads. Six hectares (14.8 acres) cost NZ\$ 500,000 (US\$ 330,000) a year to operate—compared to farming dairy cattle yielding NZ\$ 2500 per hectare (US\$ 660 per acre). Prawns return NZ\$ 150,000 per hectare (US\$ 40,500 per acre).

Recent plans are to tap into an Wairakei injection well at 120°C (248°F) and 6 bar (87 psi) pressure, instead of using the waste water in the adjacent stream. 400 m³/hr (105,600 gph) will be used on the primary side with a peak capacity of 35 MWt which will supply 28°C (82°F) water to the ponds. Economics dictate that for economic operation a minimum of 20 ha (50 acres) are needed