Growth potential and constraints in the New Zealand mussel farming industry

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ABSTRACT

Rapid expansion of the mussel farming industry in New Zealand, from an annual production of 300 t in 1977 to about 12,000 t at present resulted from the introduction of the longline system. This simple, efficient, low cost and aesthetically acceptable system allowed the new industry to exploit the rapid growth rate and available supplies of spat of the green-lipped mussel (*Perna canaliculus*). Spat supplies, food availability and market expansion are possible constraints on the continued growth of the mussel industry. The economics of growing, harvesting, processing and marketing hold the key to the industry's future potential.

Keywords Mussel farming; *Perna canaliculus*; longline; marketing.

INTRODUCTION

It is a well known fact that this country has over 20 sheep for every man, woman and child in the population. What is not so well known is that we also have over 200 farmed mussels for each and every New Zealander. Despite marked differences in the size of the 2 industries and of their end products, sheep farming and mussel farming are essentially similar primary production enterprises. Each is a 3 phase operation: an initial stocking phase — lambing on the land and spat catching in the water; followed by a growth and fattening period, with each industry using a natural raw material — grass or phytoplankton; and culminating in a marketing phase, in which the farmed product must be presented in an acceptable form to an ever more demanding consumer.

Sheep farming in New Zealand today is the result of almost 150 years of practical, technical and research experience. Our mussel farming has only a 20-year history, but in those 2 decades the technology has developed to such a degree that production can readily outstrip demand. Is the current production of farmed mussels sustainable and what constraints are there on further growth of the industy?

PAST AND PRESENT

Mussel farming began in New Zealand in the late 1960s. Large rafts, each capable of carrying 600 to 1000 mussel ropes, were modelled on those used in the well-established Spanish mussel industry (Waugh, 1972). These proved both economically and aesthetically unsuitable, and it was not until the floating longline system was introduced to New Zealand in 1974 that our industry started to grow. Each 110 metre longline consists of up to 50 large plastic floats, connected by a pair of horizontal headlines which support up to 440 vertical culture ropes (Fig. 1) (Hickman, 1980). A fully developed farm, typically 3 hectares in size, comprises 8 to 10 longlines.

Within 5 years of the first significant crop of farmed mussels — 300 t in 1977 — the annual harvest had increased 20-fold (Table 1). Since 1982 production has doubled to reach the current level of about 12,000 t/yr, although not all the crop has been harvested in recent years. A variety of factors were responsible for this rapid expansion of a new industry, one of which was the particular species being farmed. The green-lipped mussel (*Perna canaliculus*) grows rapidly to a large size, reaching the commercial size of about 100 mm length in 15 to 18 months (Hickman, 1979).

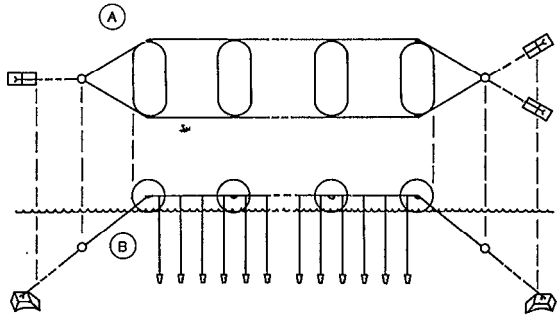

FIG. 1 Surface (A) and side (B) views of a longline, showing 2 alternative mooring systems. The typical longline is 100 m in length, with 50 floats, up to 440 of the 5 m long vertical culture ropes at 0.5 m spacings, and mooring lines 3 times the depth (generally 5 to 30 m).

TABLE 1 Growth of mussel farming in the Marlborough Sounds, 1977 to 1985.

	Year								
	1977	1978	1979	1980	1981	1982	1983	1984	1985
Annual harvest (*t*)	300	800	1100	3000	5000	6000	7000	9400	10760
Export value ($million)	0	0	0.3	4.1[1]	2.6	2.5	4.2	10.4	10.3
No. of longlines		40[2]	153	223	640	802	1051	1082	1184

[1] Inflated by high value mussel extract powder
[2] Estimate

The longline system is efficient in terms of both its bouyancy to crop-weight ratio, and the high stocking density that can be achieved. The system is simple in design, of low capital cost, and aesthetically acceptable, which together make it possible for a rapid increase in the number of longlines in the water (Table 1).

Mussel farming exploits the high levels of natural primary production found in the surface layers of sheltered coastal waters, such as those of the Marlborough Sounds. Mussel spat to stock the farms in the Sounds were locally available, but have been augmented, and in some years even replaced, by the mussel seed attached to seaweed which is irregularly found stranded on Northland beaches (Hickman, 1976).

Major efforts by individuals, companies and groups within the industry have sought out and established significant export markets for the new farmed product (Martin, 1981; Penlington, 1983).

FUTURE

Three major factors will determine whether the growth of the mussel industry can continue at its present rate. There will need to be firstly, sufficient mussel spat to regularly and reliably stock the increasing number of farms; secondly, sufficient nutrients and food in the water to maintain mussel growth and condition; and thirdly, sufficient markets for the increasing quantities of mussel product.

Recent studies by Fisheries Research Division suggest that spat of the green-lipped mussel may be more readily and reliably available in the Marlborough Sounds if spat catching is undertaken at greater depths (15 to 20 m) than the 2 to 5 m depth generally used for commercial spat catching (Hayden, 1986). A number of sources of spat, both within the Sounds and elsewhere, in combination with the potential for artificial hatchery rearing of spat (if this can be achieved economically) should ensure that seed supply is not a constraint on the expansion of the industry.

During the early 1980s there were expressions of concern within the industry that some mussel farming areas were already overstocked. However, studies on food availability and feeding within mussel farms have indicated only localised food depletion at the present density of farm units (Hickman, 1983; Waite, 1984). Few farms are presently fully developed, however, and if all 300 licences in the Marlborough Sounds were to come into full production the annual harvest could quadruple to 48,000 t.

Much variation has been apparent in the condition or fatness of mussels from different farming areas and in different years (Hickman, 1983). This probably reflects the high degree of natural variability in mussel food supplies. Food availability could be affected by the changes to the nitrogen cycle within the farms, that would result from a major increase in mussel numbers. Direct loss of nitrogen from the cycle as a result of harvesting large quantities of mussels, together with an increase in the denitrification which has been shown to occur within the farms (Kaspar *et al.*, 1985), could lead to a reduction in primary production and possible food limitation. However, it is likely that the balance between mussel numbers and available food, which is necessary for sustainable growth and fattening at any individual farm, will only be determined by commercial trial and error.

The most significant constraint on the future growth of New Zealand's mussel industry is, and is likely to remain, the availability of markets for the end product. Continued increase in the annual harvest must be export oriented, and the whole industry needs to be market rather than production driven.

The New Zealand growing system is highly efficient, producing up to 18 t/ha/yr of mussel meat, as compared to 2 t/ha/yr from seabed cultivation of mussels in Holland (Davis, 1970) and less than 0.2 t/ha/yr for sheep meat and wool combined on an average farm in New Zealand (New Zealand Meat and Wool Boards' Economic Service, 1986). The quality of the green-lipped mussel is generally considered to be high, but in order to find a ready market it must also reach the consumer at a price he is prepared to pay. At the same time the farmer, whether an individual or company, must be provided with a satisfactory financial return from the mussel growing operation.

ECONOMICS

Economic analysis of mussel farming is complicated by the unique characteristics of individual farms,

which significantly affect establishment costs and crop yields, as well as by variation in the first sale price ($1.60 to $2.10/kg meat) that the grower can receive for his mussels. A 1984 analysis identified marked differences in the profitability of farms in different regions of the Marlborough Sounds (Morris, 1984). The typical fully developed farm in Port Underwood — a highly productive area — was estimated to show a 20% return on total investment (about $100,000) at $1.80/kg for the crop, whereas even at $2.00/kg, a low productivity, outer Pelorus Sound farm would show a return of less than 10%. This 1984 analysis used a figure of $5240 for the cost of a single longline. The most recent cost analysis uses a much higher figure for this establishment cost (Table 2) and also provides a summation of annual expenditure per longline for an *average* situation in the Marlborough Sounds (Jenkins, 1985). Productivity, in terms of tonnage (largely determined by growth rate) and yield (determined by meat condition), has a major influence on profitability (Table 3). For example, after adding the variable costs involved in harvesting ($2.00/sack plus levies of about $100) to the fixed costs shown in Table 2 (plus 50% since the crop is normally harvested after about 18 months), farms from a low tonnage, low yield area and from a high tonnage, high yield area would show a loss of $1900 and a profit of $7800 per longline, respectively.

TABLE 2 Mussel farming costs (derived from Jenkins, 1985).

Operation		Costs $/longline/yr
Establishment	($8100 over 6 years)	$1350
Operating	(casual labour, etc.)	$1500
Vessel	(depreciation, running, etc.)	$1550
Spat collection		$ 200
Total		$4600

TABLE 3 Value of mussel crop per longline at low, medium and high tonnages and meat yields, based on $2.10/kg meat (sack = 25 kg live weight).

Crop yield		Crop value ($)		
(sacks)	(t)	At 20% meat yield	At 26% meat yield	At 32% meat yield
600	15	6300	8190	10080
800	20	8400	10920	13440
1000	25	10500	13650	16800

CONCLUSION

The economics of growing, harvesting, processing and marketing hold the key to the growth potential of the farmed mussel industry. Only time will tell whether 1985, the first year in which the value of mussel exports showed a slight decline, represents the top of the curve or simply a pause in the steady upward progression of an expanding export industry.

REFERENCES

Davies G. 1970. Mussels as a world food resource. *Symposium Series of the Marine Biological Association of India* **3:** 873-884.

Hayden B.H. 1986. Mussel spat settlement and survival. *New Zealand Marine Farming Association newsletter 1 (2):* 4-13.

Hickman R.W. 1976. Potential for the use of stranded seed mussels in mussel farming. *Aquaculture* **9:** 287-293.

Hickman R.W. 1979. Allometry and growth of the green-lipped mussel *Perna canaliculus* in New Zealand. *Marine biology* **51:** 311-327.

Hickman R.W. 1980. Management problems in mussel farming. *New Zealand veterinary journal* **28:** 226-230.

Hickman R.W. 1983. Mussel research in the Sounds. *Catch '83* **10** (11): 13-14.

Jenkins R.J. 1985. *Mussel cultivation in the Marlborough Sounds (New Zealand).* New Zealand Fishing Industry Board. 2nd Edition. pp. 77.

Kaspar H.F.; Gillespie P.A.; Boyer I.C.; MacKenzie A.L. 1985. Effects of mussel aquaculture on the nitrogen cycle and benthic communities in Kenepuru Sound, Marlborough Sounds, New Zealand. *Marine biology* **85:** 127-136.

Martin L.S. 1981. *Mussel farming in the Marlborough Sounds.* Development Finance Corporation, Wellington. pp. 22.

Morris C. 1984. *An analysis of mussel farming viability in the Marlborough Sounds.* Economics Division, New Zealand Fishing Industry Board. No. EM 57. pp. 26.

New Zealand Meat and Wool Boards' Economic Service 1986. In *The New Zealand Sheep and Beef farm survey 1984-85.* New Zealand Meat and Wool Boards' Economic Service. Publication No. 1957. pp. 70.

Penlington J.M. 1983. *Marketing update on the mussel industry.* Development Finance Corporation, Wellington. pp. 10.

Waite R.P. 1984. Farmed mussels feeding study. *Shellfisheries newsletter No. 22:* 16-17.

Waugh G.D. 1972. Prospects for mussel cultivation in New Zealand and observations on the Spanish mussel cultivation industry. In *Report on mussel cultivation seminar, October 1971.* New Zealand Fishing Industry Board, Wellington. p. 1-3.