
Assessment of the Potential for Mussel Aquaculture in Northland

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Executive Summary

Mussel farming is the largest aquaculture industry in New Zealand with production exceeding 140,000 tonnes valued at over \$200M in 2002. The majority of this production is exported to more than 60 countries around the world. Most of the mussel production in New Zealand takes place in the waters of the Marlborough Sounds and Coromandel. There are also small pockets of mussel farming elsewhere around the country including Northland, which has around 26.6 hectares of space allocated to mussel farming with around 20 hectares fully developed. This area produces about 500 tonnes of mussels per annum. Northland also plays a critical role in supplying the majority of mussel spat used by the mussel industry elsewhere in the country. Over 200 tonnes of wild mussel spat material is harvested from 90 Mile Beach each year and supplied to mussel on-growing operations.

There are a number of opportunities for developing mussel aquaculture activities in Northland. Existing mussel growing areas have the potential to be expanded, and new growing locations could be explored and developed, including offshore coastal areas that are currently being investigated elsewhere in the country. Expansion of mussel farming production from its current limited base would bring exponential socio-economic benefits, as it would attract the development of local mussel processing capacity with its associated employment and income.

One small operation in Whangape Harbour is working to capture wild mussel spat using “hairy” ropes. There is the potential for other operations in Northland to develop a supply of wild mussel spat caught on ropes. There is also the potential to develop hatchery production of mussel spat in Northland as an alternative and more reliable source of spat than wild mussel spat sources. Northland also has the opportunity to increase the value from the existing wild mussel spat product it currently sells as a raw unprocessed product to the rest of the mussel farming industry. Spat that is free of attached seaweed and advanced mussel seed products could be developed from wild spat sources to increase the value of wild spat currently harvested in Northland.

Mussel aquaculture is a well-proven industry in New Zealand that has high labour involvement, relatively little environmental impact and good economic returns. Mussel farming in Northland has been proven to be effective on a small scale. The development of mussel farming capacity in Northland would help to spread the geographical production from the two existing main growing regions in New Zealand, and hence lower the risks to continuity of supply to global markets. Together, these considerations give mussel farming considerable potential for development in Northland. While there are numerous areas that are likely to be suitable for mussel farming in Northland, there is likely to be considerable public concern over new areas being proposed for this purpose. These public concerns appear to relate to impact on visual amenity and the possible environmental impact of farms. These concerns have not prevented the controlled development and subsequent social and economic benefits of mussel farming being realised in other parts of New Zealand. Some simple estimates suggest that the development of spat catching and processing, as well

as some limited mussel farming in Northland could result in a \$20M per annum increase in regional income and provide direct employment for around 200 people within 10 years. This would also provide a platform for the potential for strong future economic growth from these and other aquaculture activities.

Introduction

Mussel farming is the mainstay of the New Zealand aquaculture industry. The industry began in the 1960's with the initial attempts at commercial scale mussel cultivation based on floating raft methods which have been used in Europe for more than 700 years. These methods were suitable for small-scale production of mussels, but up scaling the commercial production of mussels became difficult. Shortly afterwards the adaptation of a Japanese longline farming system for the New Zealand green-lipped mussel proved highly successful and also opened the way for large scale mechanised handling of mussels on farms. These farming developments combined with the international recognition of the Greenshell mussel as a premium seafood product, resulted in a phenomenal growth of the mussel farming industry in New Zealand. From 1980 to 2002 the total mussel production from New Zealand increased by around 50 times. The New Zealand mussel industry produced over \$200M worth of mussels in 2002 with \$185M exported. The industry is estimated to provide direct full-time employment to more than 1,500 people. An average annual yield for a mussel farm is over 27 tonnes per hectare and there are currently over 3000 hectares of mussel farms allocated in New Zealand, mostly in the Marlborough Sounds, Coromandel Peninsula, Golden Bay, Stewart Island, Banks Peninsula and Northland.

Northland has around 26.6 hectares of space allocated to mussel farming with around 20 hectares fully developed in Houhora Bay just outside the entrance to the Houhora Harbour in the Far North. This area produces about 500 tonnes of mussels per annum with a value of over \$1M. Currently, most of these mussels are harvested and trucked to Auckland for processing.

Northland also plays a critical role in supplying the majority of mussel spat used by the mussel industry elsewhere in the country. Over 200 tonnes of wild mussel spat material is harvested from 90 Mile Beach each year and supplied to mussel on-growing operations. The spat arrives on the beach periodically attached to large quantities of drift seaweed. The spat and seaweed is gathered off the beach, chilled and freighted to mussel farming areas. The spat-covered seaweed is packed into a biodegradable stocking along with a growing rope, which is hung out in the sea from large floating buoys. The spat attach to the growing rope once the stocking and seaweed has disintegrated. The mussel-covered ropes are usually harvested and re-seeded at lower densities onto cultivation ropes using the stocking method again. The mussels are seeded onto the ropes at between 200 and 300 per metre of rope. The mussels are then

usually ongrown to about 80mm in shell length in about 13 months, at which time they are harvested. About 80% of the spat requirements for the mussel industry come from 90 Mile Beach, with the remainder coming from “spat catching” efforts, whereby fibrous ropes are hung in the water column to catch settling mussel spat. These spat catching activities are mostly conducted close to the growing areas, however, there is one small spat catching operation that has recently been established in the Whangape Harbour. Experimental work on the northwestern coast of Northland indicates that mussel spat may settle out all year round in commercially viable quantities.

Sites for farming Greenshell mussels using the longline culture system usually require reasonable shelter from waves and wind, high water quality, adequate tidal flow and depths of at least 5 m. In recent years there has been interest in developing methods for farming mussels in locations well offshore of the coast. Proposals have been put forward for large farm developments in the Bay of Plenty, Hawke Bay, and off the east coast of the South Island. Methods have been developed for offshore shellfish farming overseas, but these have been largely untried in New Zealand. If these methods prove successful in New Zealand waters, it may well be feasible for offshore mussel farms to be established off the east coast of Northland.

In summary, the following opportunities are available for developing mussel aquaculture enterprises in Northland

- 1) Expanding inshore mussel growing areas
- 2) Expanding offshore mussel growing areas
- 3) Developing wild spat catching enterprises
- 4) Developing artificial spat production
- 5) Developing seed mussel production.

Expanding inshore mussel growing areas

The rapid growth and good financial returns from mussel farms in other parts of the country encouraged attempts at mussel farming in Northland from the early 1980's. Despite several attempts, mussel farming has not become well established in Northland as it has in other parts of the country. For example, attempts at commercial scale farming of mussels in the Hokianga Harbour encountered problems with labour, currents, siltation, algal blooms, pollution and theft. The most active mussel farming area in Northland currently consists of over 20 hectares of farms at Houhora Bay. These farms started from a single farm in 1984 and have gradually expanded to their present size. Currently around 55 mussel lines are established with room for 17 more. The current farms produce around 500 tonnes a year, most of which is transported to Auckland for processing. The farms employ at least four people full-time and two part-time, and provide gross returns of around \$1M per annum. This area seems well suited to mussel farming operations with only severe northeasterly storms causing problems for farming operations. The Houhora Wharf is about to be upgraded and this will assist in improving mussel farm support activities.

Since the early 1990's there have been further proposals for mussel farms in the Parengarenga, Whangaroa and Whangaruru Harbours and Karikari Bay, however, these proposals all failed due to concerns over issues such as navigational safety, conservation, as well as public recreation and iwi concerns. The proposal for Karikari Bay also included the farming of scallops and crayfish. This area seems well suited to mussel farming operations with only severe northeasterly storms causing problems for farming operations. The Houhora Wharf is about to be upgraded and this will assist in improving mussel farm support activities.

Green-lipped mussels can tolerate a wide range of water quality, but grow best in sheltered waters, up to 40 metres depth, with low turbidity, gentle currents, low wave and wind action, and ample phytoplankton food supply. For these reasons mussel farming has concentrated and prospered in areas such as the Marlborough Sounds and Coromandel. As a particularly active filter feeding shellfish, green-lipped mussels require water of high public health quality.

Green lipped mussels are a relatively low value aquaculture product with the economic returns being generated through the efficient production of large quantities of mussels at relatively low cost. This is made possible through high density farming of mussels often over relatively large areas, with relatively little maintenance of stock

required between seeding and harvesting, and the use of large scale handling equipment and mechanisation to achieve economies of scale. This is an important consideration for developing new mussel farming activity in an area such as Northland. Ideally it would be best to concentrate mussel farming activities in areas where there is ready access to good wharf facilities capable of servicing larger scale mussel farm handling vessels.

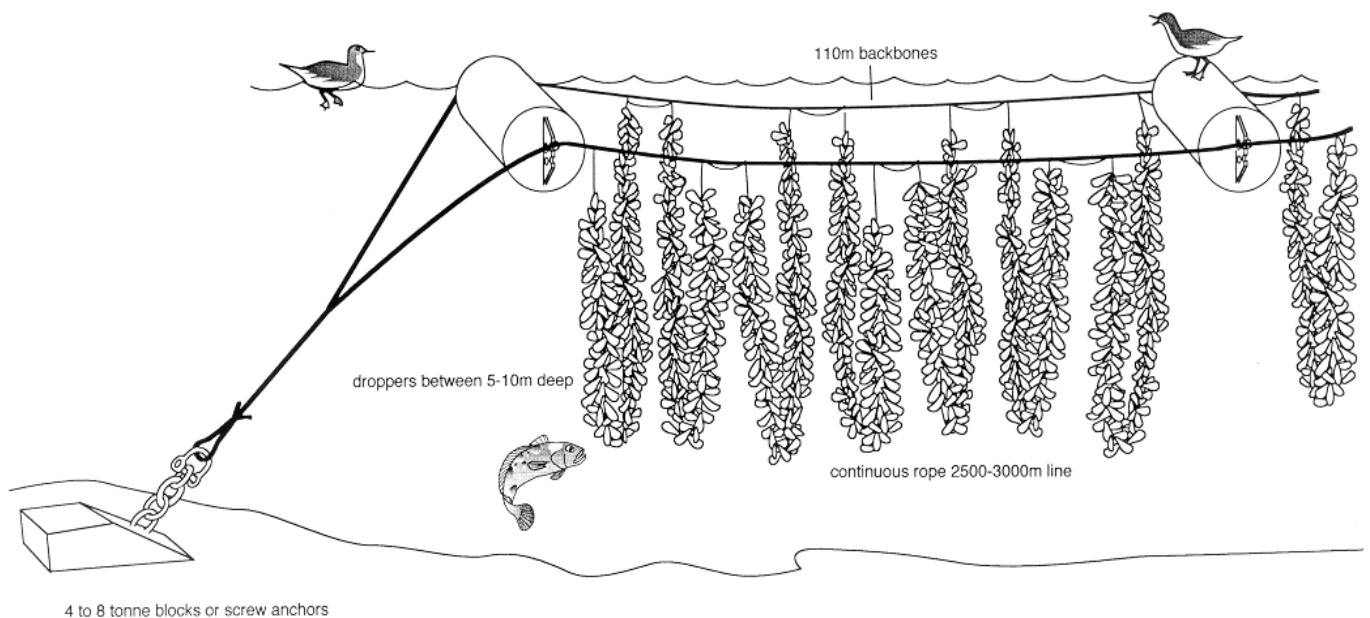


Figure 1: The layout of a typical longline culture system now widely used for the aquaculture production of Greenshell mussels in New Zealand.

For Northland to gain the full advantage of a local mussel farming industry it would need to have the locally farmed mussels processed in Northland, preferably close to the site of landing on shore. A mussel processing plant would greatly lift the employment and economic benefits from the aquaculture activity for the region. For a mussel processing plant to be economically viable it would require around 6000 tonnes of mussels to be processed a year. A clear commitment to provide growing space for 6000 tonnes of mussels would probably entice a seafood company to invest in a processing plant at smaller volumes. Using current farming methods around 200 hectares of growing space is required to produce 6000 tonnes of mussels, around 12

times the current mussel production of Northland, and around 10 times the current farmed mussel space. Development of 200 hectares (an area enclosed by 1km × 2km) of mussel farm space and local processing capacity could be expected to generate about \$12M to the Northland economy and provide direct employment for around 150 people. Indications are that the aquaculture industry would be prepared to make the capital investment to rapidly develop a large coastal mussel farming space in Northland if it were to be made available. On this basis it is very likely that the outlined economic benefits would be realised easily within a decade of proceeding.

Areas of Northland with suitable biological conditions and infrastructure for siting 200 hectares of inshore mussel farms are Houhora – Rangaunu Bay, Whangaroa Bay, Doubtless Bay, Bay of Islands, Bream Bay, and possibly Whangaruru.

Given the public response to previous efforts to establish mussel farm and fish farms in some of these areas it is likely that any proposal to establish 200 hectares of mussel farms outright would meet with strong public resistance. However, if the Northland Regional Council is serious about promoting economic development for the region it needs to consider making aquaculture management areas on such scale so that they can attract investors and actually meet economic development goals, while balancing the environmental sustainability, Treaty obligations, and community concerns. Much of the public concern over mussel farm development is related to the impact on visual amenity, recreational use and the environment. Previous research on mussel farms indicates that they have a very localised impact on the marine environment. There is an impact on visual amenity that declines as mussel farms are moved further offshore and out of sight of coastal residents. Assigning a value to the loss of visual amenity due to the siting of mussel farms has been a difficulty that many regional councils have struggled with in assessing mussel farm applications. Likewise, assessing the impact of mussel farms on recreational activities has also been difficult, as in some instances mussel farms apparently enhance some recreational opportunities, such as recreational snapper fishing.

Expanding offshore mussel growing areas

In New Zealand and overseas there has been interest in moving aquaculture activities offshore where there is less conflict with coastal residents and users. For farming shellfish such as green-lipped mussels, moving offshore creates a number of potential difficulties. The economics of offshore farming are markedly different to inshore farming operations. In the offshore situation heavier farming equipment needs to be used to deal with the more extreme wave climate and weather. Working this gear requires heavier hauling equipment and more seaworthy vessels that are also required to travel further to and from the offshore farms.

Around 20 years ago some research work was conducted on semi-exposed mussel farming in the Eastern Bay of Plenty. The mussels grew well in the conditions, however, the research work was only conducted on a small scale. Indications from some mussel farming sites in the Firth of Thames and Marlborough that occasionally experience storm events is that tangling of the growing lines can be a major problem in exposed locations and that mussels can be shaken from the lines with very strong wave movement.

Fully exposed offshore mussel farming has not been undertaken in New Zealand, but some initial offshore mussel farm development has occurred in North America and Japan. Some of these farm designs are completely submerged to reduce wave exposure and potential conflict with shipping activities.

Submerged culture systems have been proposed for some large offshore mussel farm developments that are being considered for Hawke Bay and the Eastern Bay of Plenty. The Eastern Bay of Plenty proposal is for farm sites 6.2 km and 11.9 km offshore. The technology for these offshore farming systems will need to be developed, as will the methods for growing green-lipped mussels under these conditions. An important consideration is that the offshore growing waters are likely to produce less phytoplankton food for the mussels than would be available to mussels at inshore growing sites. This may result in protracted periods to reach harvestable size, which may also impact on the economics of this activity. Examination of satellite images of phytoplankton production off Northland indicate that offshore areas along much of the northeastern coast of Northland have reasonably high annual average phytoplankton abundance. However, suitable shore facilities for vessels capable of servicing a large offshore mussel farm are really only available at Whangarei, and perhaps the Bay of Islands and Whangaroa Harbour.

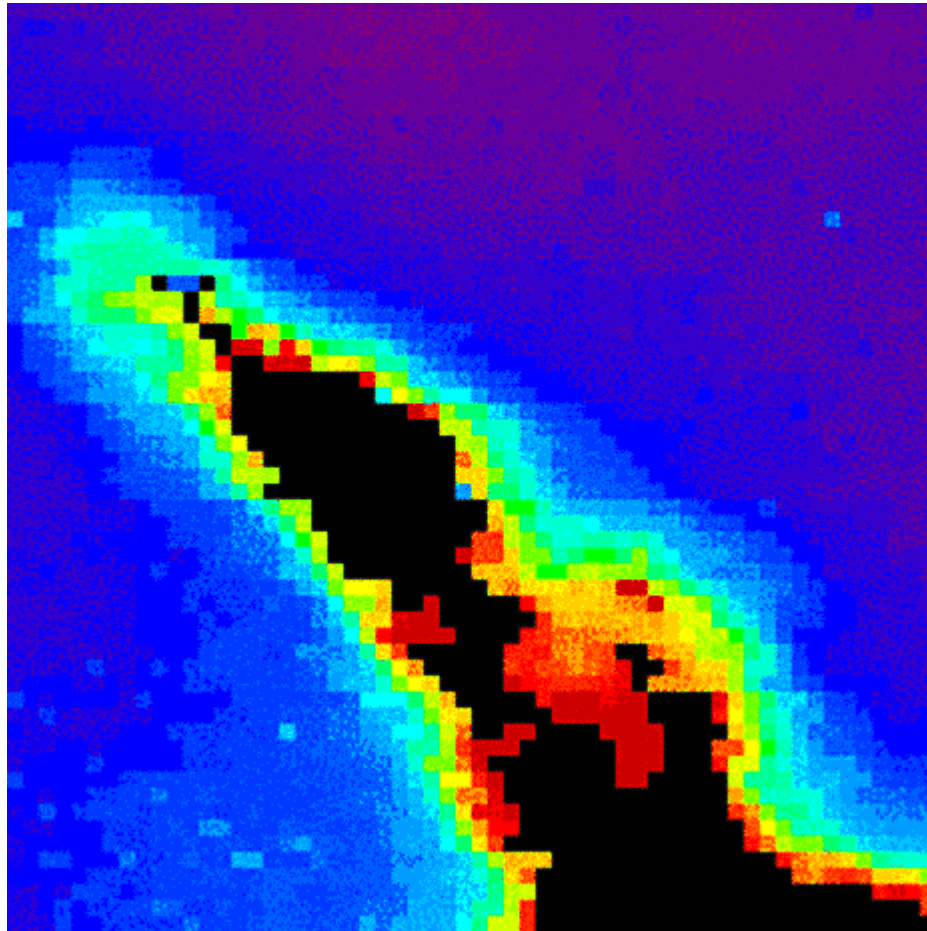


Figure 2: SeaWiFS satellite image of phytoplankton production around the Northland coastline in 16 km² resolution averaged over all readings over the past 5 years. Low average phytoplankton production is dark blue and areas of high production are dark red. The data needs to be interpreted with some caution as land run off in near coastal areas can cause erroneous readings.

Developing wild spat catching enterprises

The mussel spat gathering industry in Northland currently employs around 25 people in the Far North and generates \$1.2 - \$1.4M in sales per annum and this figure has been steadily increasing with the growth of the mussel industry. The Ministry of

Fisheries is currently looking at rearranging the management of this mussel spat gathering fishery, which is currently permitted through Special Permit arrangements under the Fisheries Act. The leading proposal is to place mussel spat gathering into the Quota Management System, creating an individually owned catching right for set amounts of beach cast mussel spat. This Individual Transferable Quota (catch right) will attract a substantial capital value, as it has for other fisheries. This new capital value is likely to result in the exclusion of the current owner-operators, in much the same manner that many small commercial fishers were forced out of Northland waters with the introduction of the QMS for many finfish species. Furthermore, servicing the capital cost of the mussel spat is likely to increase the cost-structure for supplying beach cast mussel spat, making alternative sources of spat, such as hatchery raised and wild-caught spat on “hairy” ropes more economical. Hence, the change in management regime for mussel spat gathering in the Far North may also result in major changes to this small but important activity in Northland.

There is increasing interest in developing offshore mussel spat collection using spat catching materials, such as “hairy” ropes. A small pilot operation has been established just inside the entrance to the Whangape Harbour, and there is strong interest in other areas such as the Hokianga Harbour, Kaipara Harbour and offshore from Ahipara. Studies by NIWA and Auckland University offshore from Reef Point near Ahipara have shown that excellent levels of mussel spat can be caught on “hairy” spat catching ropes throughout much of the year. This area and a number of others in Northland have the potential to be developed as important mussel spat catching areas. To achieve this will require the identification of specific areas where spat are available for capture in good numbers and their designation as aquaculture management areas by the Northland Regional Council. The technology for spat catching has the potential to be greatly developed to make wild spat catching far more efficient. Currently deploying large quantities of “hairy” ropes to catch spat is relatively costly and inefficient because it requires the handling and transport of large quantities of heavy spat catching/holding material. There is the potential to develop spat catching systems that attract more mussel spat, and make them available for harvesting in a more convenient arrangement, such as individual mussel spat that are free of attached seaweed. If the demand for green-lipped mussel spat continues to grow with the New Zealand mussel farming industry, and regulatory changes place a quota value of harvesting beach cast spat, then there is likely to be excellent potential in developing commercial mussel spat catching operations in Northland. The small spat catching operation in the Whangape Harbour currently employs two people part time. However, a large scale spat catching operation in Northland could conceivably employ up to 25 people and be worth more than \$3M per annum within 10 years.

Developing artificial spat production

Mussel spat can be produced artificially through breeding mussels and raising their offspring in a shellfish hatchery, such as the one operated by NIWA at Bream Bay. A number of hatcheries in New Zealand have produced green-lipped mussel spat on a small scale so that the technology for doing so is readily available. However, producing hatchery mussel spat economically on a commercial scale is more problematic. Currently wild mussel spat can be gathered from 90 Mile Beach for only a few dollars for a million mussel spat, whereas artificially produced spat is considerably more expensive. There is the potential to develop the technology for large scale hatchery rearing of mussel spat that greatly reduces the cost of the spat production. Also, the value of the hatchery mussel spat can be raised by producing a more valuable product. This could be achieved through selective breeding which is only possible with hatchery production of spat. For example, Sanford Ltd has recently selectively bred a “golden” Pacific oyster which attracts a higher value in the marketplace because of its attractive flesh colour. With the hatchery production of mussel spat it may also be possible to selectively breed mussels with more valuable traits, such as a golden shell colour, faster growth, or more nutritious meat. The Cawthron Institute in Nelson is currently attempting to develop selective breeding methods for New Zealand’s green-lipped mussels and is claiming some promising initial results.

Another area where hatchery spat excels over wild caught spat is that it can be very reliable. There have been several periods of up to a year when wild mussel spat has not been available from 90 Mile Beach, which has created major difficulties maintaining continuity in production for mussel farmers. A mussel spat hatchery has the potential to supply spat during these periods and attract a commercial premium due to the unavailability of wild spat alternatives.

The commercial prospects for operating a commercial mussel spat hatchery warrant closer examination. Indications are that to be financially viable a mussel spat hatchery would need to improve current production technology to greatly reduce per unit cost, or increase the value of the product they produce. A commercial scale mussel spat hatchery in Northland could be expected to employ up to 15 people and generate up to \$2M per annum.

Developing seed mussel production

A great deal of the mussel spat seeded out by mussel farmers is lost due to predation and migration. In many instances this is 80 - 90% of the spat seeded out onto a farm. Mussel spat are highly mobile and are capable of “walking” along hard surfaces and “rafting” – riding water currents by releasing a long mucous string that helps to keep them buoyant. The reasons for this behaviour are unclear, however, it appears that this behaviour becomes less prevalent with increasing size of the rapidly growing spat.

Currently mussel spat gatherers on 90 Mile Beach collect and freight to mussel growing areas more than 200 tonnes a year of wet seaweed containing mussel spat with very little processing other than chilling. The freight costs of this activity are substantial as a large portion of the material shipped is seaweed.

There is the potential for Northland to gain greater value from its mussel spat resource through further processing and development of this wild spat resource. Techniques for separating spat from seaweed are available which could help to reduce freight costs. Likewise, land-based and sea-based aquaculture methods are available for artificially feeding young shellfish which may work effectively on mussel spat so that they could be ongrown to a larger size where they would be of greater value and less prone to loss after seeding onto a mussel farm. It may also be possible to develop a specific treatment for spat that prevents their subsequent migration after seeding onto a mussel farm. A mussel seed product from Northland with greatly increased retention on mussel farms would increase the value of the spat and extend the effectiveness of the current wild spat supply from 90 Mile Beach.

The development of seed mussel production techniques in Northland has the potential to more than double the value from the existing spat catching industry to \$2M.