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Aquaculture in New Zealand

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Abstract — *Aquaculture is a relatively new activity in New Zealand. The indigenous rock oyster (**Saccostrea glomerata**) was the first target for aquaculture in the 1930's although it was not intensively cultured until the 1960's. The faster growing Pacific oyster (**Crassostrea gigas**) appeared in 1969/70 and now comprises virtually all the farmed oysters in New Zealand.*

*New Zealand's most valuable aquaculture industry is the culture of green-shelled mussels (**Perna canaliculus**) which are grown by suspended culture from longlines, earning NZ $ 30 to $ 35 million in export and local sales.*

*Natural stocks of New Zealand scallops (**Pectin novaezelandiae**) are dredged to their maximum limit but a joint New Zealand/japanese enhancement program over the past 5 years has successfully shown scallop farming to be a viable proposition in New Zealand and production could increase by 500 percent in the next 10 years.*

*Three years ago, salmon farming was also at a very early stage of development but sea cage and pond rearing of salmon is now well established (mostly quinnat **Onchorynchus tshawytscha** and a small quantity of sockeye **O.nerka**).*

Other species being cultured include a native abalone, the New Zealand freshwater crayfish or koura, Australian marron, grass carp and giant freshwater prawns. Species being cultured on an experimental basis include seaweeds, the New Zealand rock lobster, native flat oysters, channel catfish, silver carp and scampi.

Control of marine and freshwater farming is vested in several different government agencies many of which are operating under outdated legislation so obtaining aquaculture permits can be expensive and time consuming. This, combined with the limited availability of venture capital has slowed the development of aquaculture in New Zealand in past years.

New Zealand's economy has traditionally been based on meat and dairy products — not surprising in a land of only 3.5 million people but 60 million sheep ! But we also have a fishing tradition which goes back a very long way. New Zealand comprises 3 main islands — the North Island, the South Island and a smaller one to the south, Stewart Island. The Maori in New Zealand, who, it is believed, originally came from the island of Huahine here in Tahiti, have a legend about a god called Maui who went fishing. He was so intent on catching a big one, that he punched himself on the nose and smeared the blood on his hook, and in so doing, he caught the biggest fish of all — the North Island.

Unfortunately, this early acknowledgement of the sea and its resources has only very recently been translated into economic prosperity for New Zealand. We have established a large Exclusive Economic Zone extending 200 miles out to sea and as a result seafood has now become one of New Zealand's leading cash crops. But, as with all world fisheries, production is rapidly approaching its maximal projected level, and attention is turning increasingly to aquaculture to fulfil market demands for seafood.

New Zealand's location and geography lead themselves well to aquaculture. We are an island nation consisting of 3 main islands and several smaller ones. We are approximately the same size as Japan or the British Isles (268,000 km^2) and within that area we have approx. 13,000 km of coastline and approx. 3000 km^2 of lakes and rivers. So there is no shortage of clean, sheltered water.

During the ice age, many coastal valleys were formed in New Zealand and since then, the sea level has risen and turned them into extensive estuaries. (That is the geologists' view point but the real reason is that Maui's fish fought and thrashed about so much when he caught it, that the edges were damaged !).

In the north, where the climate is sub-tropical, the estuaries support dense groves of low mangroves and a rich fauna including our native rock oysters (*Saccostrea glomerata*). Further south, the climate becomes temperate and there are extensive rush and sedge wetlands which provide habitats and spawning grounds for species such as whitebait (*Galaxias* spp.), freshwater crayfish (*Paranephrops* spp.) and eels (*Anguilla* spp.).

What are New Zealand's aquaculture industries ?

* Green shelled mussels.
* Salmon.
* Rock oysters.
* Scallops.

Paua (New Zealand abalone).

Prawns :	— *Penaeus orientalis*
	— *Macrobrachium* sp.
	— *Metanephrops* sp.
Crayfish	— New Zealand Koura
	— Australian marron
Carps	— Grass
	— Silver
Flat oysters	
Seaweeds	— *Porphyra* spp.
	— *Gracillaria* spp.

Rock lobsters.

This appears to be a wide variety of species for such a small country just getting established in aquaculture, but only those marked with * are large established industries. The rest are either very small (eg. 1 or 2 operators) or are still in experimental or development phases. I will concentrate my talk on the established industries.

The indigenous rock oyster (*Saccostrea glomerata*) was the first target

for aquaculture in New Zealand. Hard substrata were placed in appropriate foreshore areas in order to increase settlement surfaces for oysters during the 1930's. Methods for collecting spat and rearing oysters on intertidal racks were not developed until the 1960's, and there are now approx. 300 hectares of fully developed farms. Wild spat is caught on bundles of sticks, although we can supply hatchery-reared spat if necessary. As the oysters grow, the sticks are separated and laid out on intertidal racks to grow to maturity. Culchless oysters are also grown by some farmers, and some deepwater farming is also carried out, mostly to gain condition and to delay spawning. Growth is regulated so crops are sold from 12 months to 2 years after settlement.

The faster growing Pacific oyster (*Crassostrea gigas*) appeared in the 1970's and now comprises virtually all the farmed oysters in New Zealand. The industry is quite small by world standards, producing approx. 4000 tonnes/yr (whole shell weight), 50 % of which are exported, mostly to Australia, Asia and the Pacific Islands.

The industry is very lucky in that it does not seem to suffer from many of the oyster pests found elsewhere eg. MSX, QX, winter or summer mortality, paralytic shellfish poisoning, predation nor major industrial or domestic pollution. We have a good shellfish sanitation programme which allows us to export to such particular markets as the U.S.A.. The only problem that the oyster industry seems to suffer from is *Polydora* sp. mudworm infestation.

Culture of the green-shelled mussel *Perna canaliculus* began after the collapse of the dredge fisheries for mussels. Developing technology and increased numbers of farm licences have resulted in an exponential increase in production of mussels since 1978. Mussels are now our 6th most valuable export « fishery » in New Zealand and certainly the largest aquaculture industry earning approx. N.Z. $ 35 million in 1988.

The mussels are grown by suspended culture from long-lines using technology based on Japanese techniques. The major growing area is the Marlborough Sounds which is at the northern end of the South Island. The industry has 2 sources of spat. Either it is caught within the Marlborough Sounds growing area by hanging « hairy » catching ropes in the water during summer and autumn. Or it is obtained by gathering spat-covered drift seaweed which is washed ashore on to beaches in the far north. The weed is wrapped around the culture rope and held in place by a cotton stocking. Within a few days, the mussels attach themselves to the culture rope, and within 1-2 weeks, the seaweed and stocking have rotted away.

When the mussels have grown to 10-20 mm, they are stripped off the ropes and reseeded back on to culture ropes at a much thinner density to allow room for rapid and uniform growth. The mussels are harvested mechanically approx. 18 months after settlement.

Like the rock oyster industry, the mussel industry suffers no apparent disease problems, and the water in the growing areas is clean and very productive. The industry does have some problems though -namely predation by fish which eat thousands of dollars worth of mussels each year, and an unreliable spat supply.

Three years ago, salmon fishing was at a very early stage of development in New Zealand but sea cage and pond rearing of salmon is

now well established and growing very rapidly. Three species, Chinook, Sockeye and Atlantic, were introduced into New Zealand around the turn of the century. The Chinook established self-sustaining sea-run populations in our rivers, but the sockeye and Atlantic did not and have become voluntary lake-limited, completing their entire life cycle in freshwater. Chinook has proved the most suitable for aquaculture in New Zealand and present production is almost all Chinook.

We have in the order of 12 fish hatcheries in New Zealand producing salmon and/or other freshwater species. Juvenile Chinook from the hatcheries are transferred to sea cages for on-growing to market size. We are world leaders in the technology of large scale cage culture of salmon with cages capable of holding 35,000 adult salmon and able to withstand gale force winds and 10 foot breaking seas.

Peak harvesting occurs in the summer (Dec.-March). This is done by herding the fish into special plastic-lined pens where they are stunned with carbon dioxide and bled immediately. They are then packed in an ice-slurry and taken to shore for dressing and packing. We can have them in Los Angeles restaurants 48 hours after harvest.

At present we are the world's largest producer of Chinook, over 90 % of the production coming from 11 sea cage farms. We also have 11 freshwater pond farms rearing salmon -mostly up to a pan size of about 600 g for the domestic restaurant and hotel trade.

Ocean ranching is also being tried using both upriver and coastal release and recapture sites. Flesh quality of fish returning to upriver sites tends to be poor however so these hatcheries are really just enhancing the recreational fishery and generating broodstock for other farms. Four coastal release sites have now been developed but to date, fish returns have not been substantial enough to make them economic.

So, at least in the short term, our salmon future seems to be in large-scale, sea cage culture of Chinook which is not farmed on a large scale anywhere else and which is readily acceptable on world markets. As little as 6 % of the world farmed salmon is Chinook. Our southern hemisphere location also provides a « window » into northern hemisphere markets as we provide fresh salmon at a time when northern producers can only supply frozen product.

In New Zealand, we have a delicious scallop, *Pecten novaezealandiae*, but unfortunately natural stocks are dredged to their maximum limit, as with most scallop fisheries around the world, are subject to large fluctuations in landings. So 5 years ago, New Zealand embarked on a joint programme with the Japanese Overseas Fisheries Co-operation Foundation to attempt to enhance the fishery by seeding.

We have found that there is no need to hatchery-rear scallops as we have plenty of natural larvae in our waters. What they lack are suitable settlement surfaces for the early juvenile stage when they need to be attached to something. The lack of settlement surfaces is partly due to the method of dredging used at harvest which destroys benthic epifauna and distributes a layer of silt. The method we have developed is to sink to 2-3 metres from the bottom a whole long-line of the « hairy » mussel ropes I talked about earlier. The ropes are left for approx. 1 month during which

time the scallop larvae settle, grow to 5-10 mm and then detach themselves. In some areas the ropes will have a good by-catch of mussels remaining after the scallops have dropped off which are sold to the mussel industry.

If we wish to seed an area that does not normally contain scallop larvae, we use the same submerged longline technique, but instead of mussel rope, we use lengths of plastic mesh stuffed inside finer mesh bags. The inner mesh provides the settlement sites for the scallop larvae. The finer outer mesh prevents the juveniles from escaping when they grow to 5-10 mm and are ready to detach and move on. The technique also gives a boost to their survival stakes because they are relatively protected from predators on the sea floor.

Approx. 3 months from settlement, the juvenile scallops are emptied out of the bags and seeded out into the new growing areas, simply by tipping them over the side of a boat. Two years later they become part of the natural scallop harvest. Last year was the first year of commercial harvest from the reseeding programme and it was very successful. If it continues in this vein, then we will be able to increase our production by 500 % in the next 10 years and we will have a $ 24 million industry.

I would like to briefly mention abalone before I finish, because we at the Fisheries Research Centre have been largely responsible for establishing aquaculture of the species. We have 3 species- *Haliotis iris, H. australis* and *H. virginica* and have an established fishery for both the meat and the shell of *H. iris*. But the natural fishery is fully developed and even over-fished in some areas. We have successfully developed techniques for rearing *H. iris* in our hatchery for 8 months of the year. There are now two farms established on-growing seed stock obtained from our hatchery but as yet they have not had their first harvest.

We have also done some successful research into reseeding the wild fishery and the first commercial trials of that are about to begin. We will use hatchery-reared juveniles to outplant into appropriate rocky habitats for these trials, but we are also experimenting with out-planting larvae directly into the fishery.

This has been just a small taste of some of the aquaculture industries in New Zealand. It is an exciting time to be involved as it is starting to establish and grow. But there are still some impediments to that development. The current economic climate in New Zealand means that investment capital for aquaculture is difficult to obtain and research funding is short.

We also have some problems with our legislation relating to aquaculture which is very out-of-date and limited. It does not have the flexibility to cope with the range of species now being considered for aquaculture. Because many of the regulations have been designed to conserve the wild fisheries, they actually impede the development of aquaculture, e.g. by making it illegal to possess small abalone or rock lobster, even in a hatchery. So we are currently reviewing our legislation as rapidly as possible in an effort to assist people into aquaculture rather than to deter them as at present.