Performance and Productivity:
The Case for QMS Driven Productivity and Performance Gains in the New Zealand Seafood Sector

Eugene B Rees
University of Auckland, School of Geography and Environmental Science
e.rees@auckland.ac.nz

Abstract This paper examines the success of the seafood sector since the introduction of the Quota Management System (QMS) in 1986. It addresses the question of whether the QMS and Individual Transferable Quota (ITQ) have lead to an increase in industry performance and competitiveness. The theoretical arguments for the institution of quota management and individual transferable quota propose that re-regulation will lead to efficiency, and by implication, profitability gains for the seafood sector. After eighteen years of a quota regime one may expect there to be clear indications of improved performance and competitiveness. This paper employs three scales to examine this: analysis of the hoki and snapper fisheries; industry wide statistics, and a detailed examination of New Zealand's only publicly listed seafood company. My claim is that QMS is but one of several factors that has shaped improvements in both performance and productivity.

Introduction

There is a well established argument that a shift from input to output based management leads to greater profitability and gains in economic performance (Arnason 1991; Scott 1986). However, this paper challenges this thesis. In 1986 New Zealand introduced a quota management system (QMS), based on individual transferable quota (ITQ). The new management regime was expected to achieve resource conservation and sustainable utilisation of the resource, and it is timely to evaluate its overall performance.

The policy process behind QMS, including accounts of systems features and stakeholder roles is well documented (Bess and Harte 2000; Hughey *et al.* 2000), however the literature rarely focuses on outcomes, although Batstone and Sharp (1999); Hersoug (2000); Straker *et al.* (2002) are exceptions. QMS is expected to produce a number of positive outcomes for the industry, enterprises and the fish resource (Shallard 1996) and this paper explains the rationale for these expectations, measures its performance and deconstructs the success rhetoric of QMS as a regulatory regime. It contends that QMS is but one of several factors that have shaped improvements in performance and productivity in the seafood sector. Importantly, I focus analysis on the regime through the lenses of fish stocks, industry and enterprise. I interpret change at the fishery level: hoki (*Macruronus novaezelandiae*) and snapper (*Pagrus auratus*), I examine changes in the producer price index from pre quota to the present and examine responses to QMS and ITQ by New Zealand's only publicly listed seafood company.

The paper outlines the theoretical expectations of QMS. Relevant industry indicators and expectations of productivity and performance are discussed. The

scene is set by outlining the QMS regime in New Zealand. Industry wide performance data, company performance data, and changes in total allowable commercial catch for both hoki and snapper indicate an increase in performance and productivity, but QMS appears to be only partly responsible. Performance gains for the fishing industry are also attributable to an expanding aquaculture sector and more effective utilisation and marketing of New Zealand seafood products at a time when international markets for ground fish strengthened. These factors are all capitalised into New Zealand fisheries companies in such a way as to force a reappraisal of the role of the QMS regime in industry performance and productivity.

Neo-classical Theory and the Rationale Behind Quota Management Systems

The QMS is an evolving and dynamic regulatory framework (Hersoug 2002) that simultaneously addresses the 'tragedy of the commons' (Hardin 1968) and concomitant cycles of boom, overcapitalisation, resource depletion, collapse and rationalisation (Clapp 1998). ITQs and the QMS reflect a paradigm shift in approaches to fisheries management (Pauly 1996) and have become a conventional wisdom (Copes 2000). Indeed, many commentators now advocate QMS and property rights reform as the key to alleviating over-capitalisation and its commensurate problems, such as the race for fish and pressure for unsustainable catches (Fujita *et al*. 1998).

The rationale for QMS rests on neo-classical theory and a presumption of tragedy ensuing from ungoverned open access (Gordon 1954; Scott 1955). Most modern fisheries fail to meet this theoretical absolute and are what Grafton (1996:19) describes as 'limited user open access' in which the right to fish may be conditional and exclusive but there is no limitation on the amount of fish to be taken. In this situation rational profit maximising behaviour atomises fishing effort and promotes relentless competition, resulting in Hardin's (1968) tragedy of the commons

QMS and ITQ are elements of what Bridge and Jonas (2002) have described as the progressive codification of environmental protection and sustainable development and are often implemented under the auspices of sustainable resource management discourses. Quota facilitates the conservation of threatened stocks through the setting of total allowable catch (TAC) and encourages fishers to farm a resource rather than act as hunter/gatherers. Quota reduces the race to fish and wastage or by-catch associated with this (Shallard 1996).

The QMS facilitates economic and efficient behaviour through the reduction of costs for the fisher and allows fishers to adjust their individual roles within a fishery (Shallard 1996). By ascribing value to the fish stock through property rights, QMS encourages capital inflow from other sectors of the economy, compelling companies to recapitalise, acquire new assets (fishing rights) and to garner suitable returns in order to justify said recapitalisation. The newly formed asset becomes a means for raising capital to explore other under-utilised resources and develop more efficient or appropriate fishing methods. This leads to continual shifts in expectations and optimum performance resulting in a ratcheting up of effort and investment, which in turn shapes the actions of firms.

The QMS regulatory regime reduces the need for the state to set rules for participants and maintain a large and costly policing force (Shallard 1996).[1] The regime

invokes marketisation but it also redefines the state's role, making it a facilitator of market mechanisms to distribute resources. In the process, the regime also changes established relationships for distributing resources among economic actors, the state and civil society (Bridge and Jonas 2002). The result is a shift in responsibility from the state to companies. QMS should encourage industry self-policing to protect the newly acquired asset base.

Embedded in wider social and ecological goals of sustainable utilisation lies an expectation of productivity gains and profits for enterprises. The objective of optimal fishing regulation is, perforce, to limit annual harvest to a level that maximises the value of the resource. It is presumed that in most cases maximum value accrues when a resource can be harvested in perpetuity (see Clark 1973 for evidence to the contrary). The three widespread mechanisms of fishery legislation available to achieve these economic and ecological goals are input and effort controls, taxation through resource rents and the imposition of output controls – of which QMS is an example.

Input and output effort controls are used to bring enterprise effort into line with social, ecological and economic goals, and attempt to directly control fishers' behaviour. However, experience demonstrates that in many cases input controls are unsuccessful in limiting fishing effort (boats and/or technological innovation) because they do little to blunt the incentives for individuals pursuing short term profits to maximise their share of the fishery through increased capitalisation. Fishers often over capitalise, employ too many workers, and employ an inefficient mix of vessels: too many fishers chase too few fish. Input regulations are flawed because as long as free access to the fishery is permitted, returns in excess of costs encourage further investment (Tietenberg 2000).

In economic terms a tax on landings or resource rent shifts the industry cost curve upward. Thus fishers would have no incentive to fish above the socially constructed optimal catch level (Hannesson 1993). The purpose of resource rentals is to promote an 'equitable distribution of a surplus income that some consider in principle to belong to all members of the community' (FAO 2000). Irrespective of whether they deplete the stock or are the ones gaining a financial return from the resource, fishermen tend to be opposed to resource rents as they have to pay for something that was previously free (Talley 1999; Sanford Annual Report 1987). The problem, as Hannesson (1993) notes, is that for any tax to be efficient it has to cope with the vagaries of fish stock fluctuation. Whether the political decision is to maintain a stable catch or let it fluctuate from season to season, the tax rate would most likely have to be adjusted yearly to meet the precise level of effort and catch deemed socially appropriate.

The output focused approach demands quota rights that are secure, incontestable, transferable and durable over time. The quota rights have to be incontestable: if fishers other than quota holders harvest with impunity the quota becomes valueless. By their very nature transferable property rights theoretically allow efficient fishers to garner a larger share of the fishery and for inefficient fishers to sell or lease their quota and shift resources to more productive spheres of the economy. Transferability presupposes a matching of fishing capacity and the amount of fish available. In accordance with ITQ and the establishment of rights based fishing, the sustainable fish stock is determined through scientific stock assessment and annual

setting of TAC.[2] Provision for artisanal (traditional/indigenous) and/or recreational fishing can be made and the balance is allocated to individual commercial quota holders as ITQ. Quota holders are free to choose the method and time of the year that they harvest their catches. The 'race to fish' is obviated by property rights as quota can be fished any time during the year.[3] Transferable quota provides incentives for fishers to make the most of their quota and thus maximise returns from the fishery, ITQ therefore provide an incentive for constructing value-adding enterprises. They are efficient for the state too, as the state sets TAC, but the processing of information concerning the quota market is carried out by firms themselves.

The positive outcomes of ITQ and QMS are not certain. The solution to a problem may simply change the nature of the problem. Copes (2000) asserts that through a number of mechanisms ITQ regimes lead to sub-optimal performance with respect to biological conservation and in turn harvest productivity. Copes argues that QMS requires intensive management from fisheries scientists and managers, and structures their efforts to the exclusion of alternative science and management. Wallace (1998a) asserts that QMS has resulted in lopsided decision making and political dynamics that disempowers other users. QMS may also induce negative behavioural responses which may deplete stocks and reduce productivity.[4] Clapp (1998) contends that the repositioning of property rights will lead to a short term expansion in yield (related to performance and productivity) within the fishery and this may be unsustainable unless there is a further removal of fishers and/or some sort of technological innovation in catch effort. This new regime may contribute to catch intensification and resource collapse in a conventional resource cycle. Clapp posits that as the cycle continues we should also witness a rise in farming and aquaculture. Following Copes (2000) and Clapp (1998) we should expect short term gains to be followed by further pressure (both economic and environmental) on the resource as fishers experience poor harvest levels and a decline in industry performance and productivity. In response, industry may call for further reductions in those able to fish (such as recreational fishers) and for a re-codification of stakeholder positions.

New Zealand authorities opted for QMS and ITQ, instituting a new regime in fishing rights in 1986. They did so with high expectations. Despite the potential problems already outlined, government had legitimate reasons including the wide support of industry (Annala 1996) that was to be compensated by reform, a mandate from the electorate to seek efficiency gains within the economy, and a demonstrable mechanism for achieving conservation of stocks, economic and efficiency gains in the fisheries, and a diminished role for itself in fisheries management.

Economic Performance Indicators for Fisheries

To be effective, fisheries managers must develop economic indicators as part of the broader task of developing indicators of sustainability (Hundloe 2000). Most indicators are based on specific data sets that measure some component, process or trend of interest (Dahl 2000). Garcia and Staples (2000:385) define an indicator as 'an index related to a criterion. Its fluctuations reveal the variations in those key attributes of sustainability in the ecosystem, the fishery resource or the sector and social and economic well being.' Economic performance is discerned by assessing the

value of output against the real costs of inputs. Such an approach acknowledges the opportunity costs of labour and capital tied up in the venture. Economic indicators can be divided into two broad types: indicators of commercial sector activity, based on estimates of returns, stocks and so forth; and indicators of the values of recreational fishing and other non-market amenity values (Whitmarsh *et al.* 2000).

Several mechanisms can be identified for measuring economic performance (Rose *et al.* 2000), but Hundloe (2002:490) argues that '*the* indicator of economic performance is sustainable profit'. He proposes that prior to investing in any business, one would seek verifiable evidence of its profitability over a number of years and some indication of its future returns. In New Zealand, information on the economic performance of fisheries is problematic as little data has been assembled due to lack of interest and/or money or because of commercial sensitivity (Hersoug 2002). Hundloe (2000) proposes the use of proxies to address lacunae in the data. Indicators of economic performance include, but are not limited to, tracking the stability of prices for ITQ, the various costs of fishing, port prices for landed products, and the stability of catch.

New Zealand's Quota Management System

The QMS was designed to manage and conserve New Zealand's major commercial fish species and was a part of a wider restructuring of the state (Talley 1999; Le Heron and Pawson 1996). The government specifically intended to bring market forces to bear in the management of fisheries resources (amongst others). By 1982 the government was aware of declining catch per unit effort in the inshore fishery and signs of the same problems emerging in the deep water fishery. Industry and fisheries managers recognised the failure of input controls and it was recognised that something more radical would be required to preserve fish stocks (Sharp 1997).

Government acted strongly. Following a discussion paper in 1984 (Ministry of Agriculture and Fisheries 1984) and clear signals by the government of the day that change was to come, the Fisheries Amendment Act of 1986 created the New Zealand quota management system.[5] On its introduction, 1st October 1986, the QMS covered twenty-seven species (Sharp 1997).[6] Currently, forty-five species or groups of species are managed as 290 separate fish stocks under the QMS (Clement and Associates 2000) and may yet be extended to include other marine capture fisheries.

Sharp notes that it was not possible to socially engineer an optimal system *de novo* for the fishery (Sharp 1997:516). The New Zealand QMS system began with a fixed tonnage allocation based upon catch histories, but was switched to setting quota as a percentage of TAC.[7] It is a dynamic institution that has undergone many refinements, but the basic structure – setting TAC and leaving the market to determine the most profitable allocation of fishing effort – has remained unchanged.

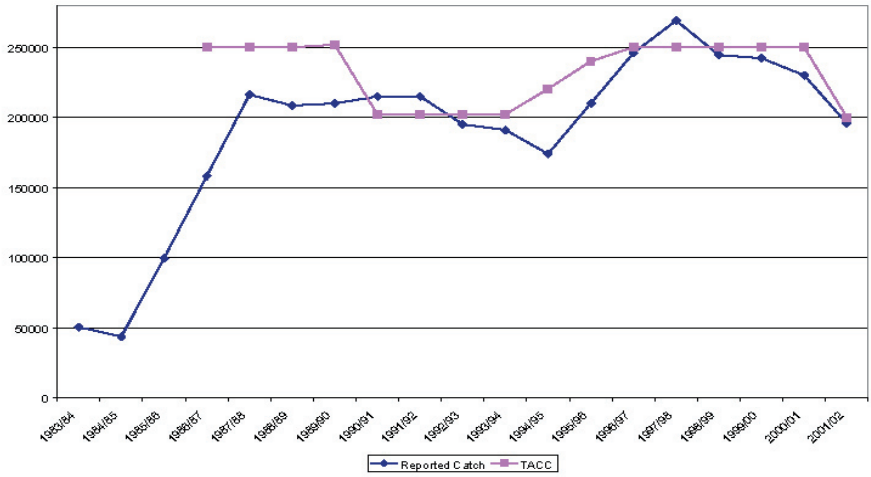
The state expected improved fisheries management, sustainable harvests and stability and efficiency gains in the industry. The seafood industry supported the QMS, in the belief that catch reductions would have long term benefits and that industry restructuring would provide sufficient returns from less catch (Straker *et al.* 2002:22). QMS was also a mechanism for 'New Zealandisation' of the fishery, allowing domestic industry to capture rents and build capacity in the offshore sector pre-

viously dominated by foreign and charter vessels (Connor 2001a). These potentially contradictory objectives implied a restructuring of the fleet to make use of limited resources and a simultaneous expansion of domestic effort as domestic enterprises replaced foreign fishers. Thus QMS initiated new investment in the fishery as industry moved to new levels of production. Together these expectations should be reflected in changes in industry structure, performance, value and volume. The rest of this paper examines the outcomes of the QMS regime through analysis of the available economic performance indicators.

Hoki, Snapper and the Biological Success of QMS

The state expected QMS to address both the biological health of fished species and ensure long term sustainability. By setting TAC and commercial catch (TACC), Shallard (1996) proposes that QMS instils attitudes of compliance that serve both the future interests of the industry and the biological well-being of the fishery. If he is correct then stocks should have stabilised following the introduction of QMS.

Figure 1. *Reported Catch and TACC for Hoki 1983/84-2001/02.*



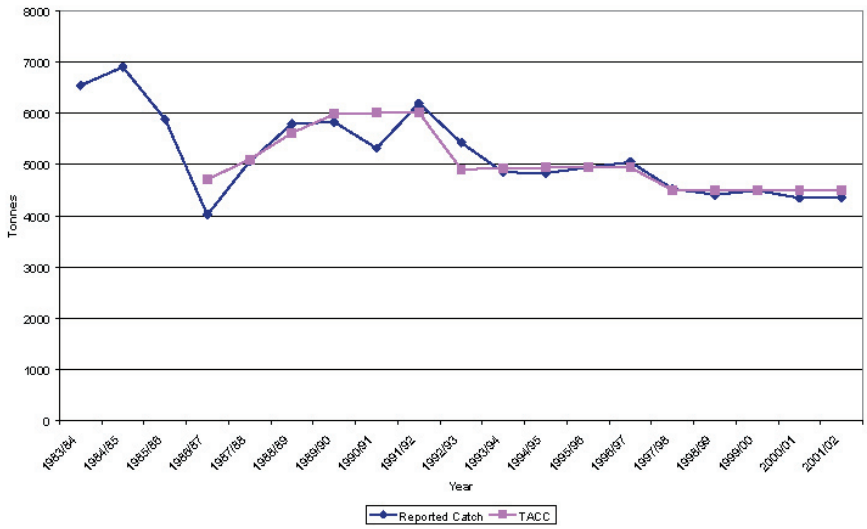
Source: Annala et al. 2002

The hoki fishery was not ostensibly under pressure prior to its introduction into the QMS (figure 1). The evidence for this is the increase in TACC. hoki catch has changed in both quantity, pattern and processing since the institution of QMS. Prior to QMS total catch was approximately 50 000 tonnes (figure 1). In 1986 TACC was set at 250 000 tonnes. Since then the annual catch ranged from 175 000 to 215 000 tonnes, but increased to 246 000 tonnes in 1996-97. The total catch peaked at 269 000 tonnes (1997-98), but has declined to less than 250 000 tonnes (figure 1). In 2001/02 TACC was reduced following ministerial concerns surrounding pressure on the eastern stock of the fishery. Prior to 1989 most fishing was done in the hoki spawning ground. However, Annala *et al.* (2002) note that there has been a steady reduction

in the proportion of catch from the spawning grounds and an increase in the catch from the year round fishery.

In the hoki fishery, QMS and ITQ are associated with a large volume of fish, and (despite recent reductions) hoki remains available in significant volumes. Companies have responded in various ways to these fluctuations in TACC. The way in which hoki is processed for export has changed. Between 1986-1990 surimi vessels took about thirty per cent of annual catch. Since 1991, hoki export composition has changed with a clear shift towards fillets and a fresher catch, which fetch higher export prices (Wallis 1997). Enterprises have invested to meet the challenges of this fishery. Sanford expanded its cool store operations in Timaru and invested in increased processing capacity. Sanford claims that a conservative approach to the hoki fishery has provided enhanced returns from improved catch rates, higher average fish size and enhanced market acceptance through the Marine Stewardship Council's approval of the fishery as a sustainable resource (Sanford 1999).

Figure 2. *Reported Catch for Snapper in SNA1 and TACC 1983/84-2001/02.*



Source: Annala et al. 2002

The high profile SNA1 snapper fishery, situated off the north east coast of the North Island, provides an opportunity to examine the success of the QMS on a stock that was under considerable pressure prior to QMS. Recreational, commercial, and customary fishers as well as recreational fishing tour boat operators are all significant stakeholders in the fishery (Maunder and Starr 2002). SNA1 presents a case of intense fishing interest in a stock and a QMS that limits access for one stakeholder group, but not others. Recreational fishers are currently restricted to bag limits, but not in their numbers or frequency of fishing trips.

The introduction of QMS resulted in a substantial reduction in catch as TACCs were set well below MSY to allow for stock rebuilding (Figure Two). Occasionally

levels have been exceeded, most notably in 1992/93 (500 tonnes), and while this was partly a carry over from the previous year, approximately 400 tonnes incurred penalties.[8] The catch closely follows TACC, however, after fifteen years the stocks have not recovered sufficiently to increase the TACC to pre-quota levels, although maximum sustainable biomass is expected to be achieved by 2020 (Annala *et al*. 2002).

Total exports of snapper in the year ending December 2000 were worth thirty-seven million New Zealand dollars and Japan takes around half of all snapper exports. New Zealand companies organised the commercial snapper catch around the Japanese market. Around eighty per cent of snapper exports are either whole chilled or live fish, with the remainder exported as frozen fillets. New Zealand companies have been pioneers in developing methods for air-freighting live fish. Catching and processing of snapper has changed with a shift away from trawling and purse seining to long lining in order to meet the expectations of Japanese consumers. Long lining and the exporting of live snapper are evidence of companies constructing value added not through adding to, or altering a product, but by emphasising the freshness and natural state of the product. This suggests that the QMS regime is facilitating the development of what Clapp (1998:140) refers to as 'value fishing', in which innovation or adaptation in a fishery may be reflected in a change in product prices. Long lining, and the emphasis on quality, support this claim and simultaneously illustrate a shift as New Zealand enterprises move from wild stock fishers to Anderson's (2002) extensive aquaculturalists harvesting a perpetual resource. Total collapse of the SNA1 fishery has been avoided, although the catch is not up to pre-QMS levels and the expectation of returning to pre-quota catch levels is long term.

The QMS has met the biological expectations of legislators for these two species. However, Wallace (1998b) argues that the QMS is flawed because it does little to engage with ecosystems or the environmental impacts of fishing. There is concern over damage to seamounts and fragile benthic communities. On previously unexploited seamounts it is not unusual for up to five tonnes of various underwater flora and fauna to be dragged into the trawl (Parliamentary Commissioner for the Environment 1999). Funnell (1999) argues that there needs to be recognition of the broader scale issues of environmental complexity. Thrush *et al.* provide evidence that there is a positive correlation between habitat structure and macro-benthic diversity (Thrush *et al*. 2001:261). By focusing research and fishing on just one species there is a danger of trophic cascade as other species are removed from the ecosystem as bycatch and wastage. The QMS supports this single species stock by stock management because, as Hersoug (2002), observes each group of quota owners has a financial interest in the status of 'their' stock, rather than the wider ecosystem.

The hoki fishery represents an example of a fishery that was perceived as not under pressure prior to QMS. It has seen reductions, but the volume of hoki is still significant. Enterprises are constructing value by processing hoki further and by enhancing market perception of hoki through eco-labelling. Catch data for both species show that companies are fishing at or below TACC in most years and thus complying with the regime. But as Wallace (1998b) notes this single species approach does little for ecosystems management or benthic diversity. Hundloe (2000:490) argues that catch data is merely 'an indicator of the trend in catch and nothing else.' Thus, the system is self-referential and may not in fact adequately assess the health of ecosystems. hoki TACC is declining (figure 1) and this suggests the TACC has been set

too high. It is uncertain whether the current level of catch is biologically sustainable. Nevertheless stock assessment and catch evidence appear to have given good signals to industry, whether firms choose to act on this information is a different issue. Accordingly, the key issues for industry are whether profitability and performance have improved.

The Case for Success at the Industry Level

Both the volume and value of New Zealand's seafood exports have increased since 1984 (Table 1), doubling over the period 1985-92. This expansion, which was primarily in the deep sea fishery, reflects fishing down of virgin stocks at the expense of foreign fishing vessels (Hersoug 2002) and was inherently profitable. This can be construed as 'growing' more product as opposed to manufacturing more value from the stock. The volume of exports peaked in 1998 at 350 000 tonnes and has since declined 8.5 per cent. From 1992-1998 export value remained stable despite fluctuations in tonnage caught. During this period few, if any, new species were added to QMS. New Zealand firms have benefited noticeably from an increase in catch volume of ninety-two per cent and nominal value of 181 per cent from 1985-2002. From this account it appears that QMS contributed to an expansion of the New Zealand seafood industry not just in terms of volume but overall value.

Table 1. *Volume and Value of New Zealand's Seafood Exports 1985-2002.*

Year	Quantity (000 tonnes)	Value (million NZ$)	Return per tonne	Value in 2002 NZ$	Return per tonne ($2002)
1985	145.0	543.0	3,744.8	1,065.3	7,347.2
1986	158.2	657.0	4,153.0	1,138.4	7,196.3
1987	155.9	676.0	4,336.1	1,011.2	6,486.2
1988	209.9	722.0	3,439.7	1,015.5	4,838.0
1989	257.4	818.0	3,177.9	1,088.3	4,228.1
1990	210.7	744.0	3,531.1	932.6	4,426.1
1991	261.2	961.0	3,679.2	1,174.7	4,497.2
1992	292.8	1,217.0	4,156.4	1,472.6	5,029.5
1993	305.8	1,199.0	3,920.9	1,431.7	4,681.7
1994	289.6	1,167.0	4,029.7	1,369.3	4,728.2
1995	322.2	1,238.0	3,842.3	1,401.0	4,348.2
1996	328.4	1,179.0	3,590.1	1,304.2	3,971.5
1997	338.0	1,125.0	3,328.4	1,229.4	3,637.4
1998	350.4	1,237.0	3,530.3	1,335.7	3,811.8
1999	322.2	1,340.0	4,158.9	1,448.3	4,495.1
2000	279.2	1,431.0	5,125.4	1,507.6	5,399.6
2001	273.4	1,494.0	5,464.5	1,533.7	5,609.6
2002	320.3	1,530.0	4,776.1	1,530.0	4,776.1

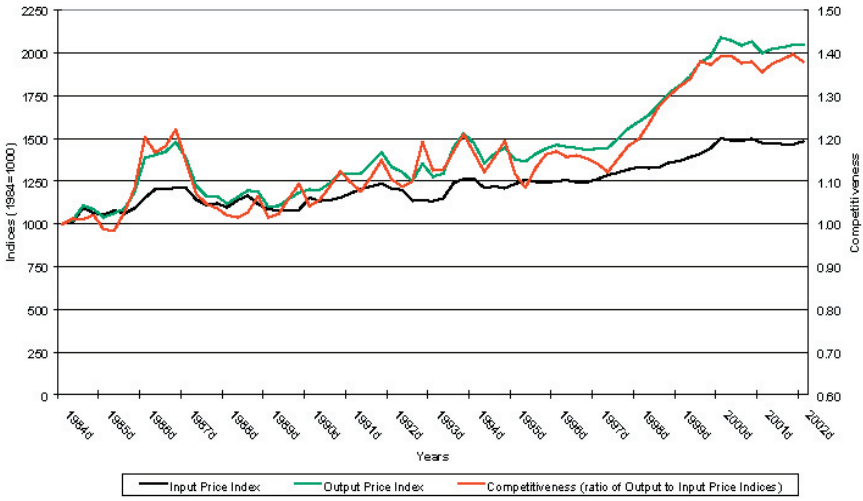
Source: Rees 2003: 112, derived from Hersoug 2002 and New Zealand Seafood Industry Council 2003.

Hersoug's (2002) data obfuscates the variability of returns, the nature of the fleet, the composition of exports and the role that currency fluctuations and aquaculture play in shaping export volume and value. By acknowledging the role of inflation it can be seen that in real 2002 dollar terms the increase from 1985-2002 is only fourty-three per cent, despite the volume of sales increasing by nearly two-hundred per cent. Thus in real terms the fishery has not improved as significantly as described by Hersoug.

Overall returns per tonne have increased by twenty-seven per cent since 1985. This however fails to acknowledge inflation and when doing so we see that in fact, returns per tonne have declined spectacularly from $7347 per tonne to $4776. There was a sharp decline in returns per tonne from 1985-1988, then a variable pattern between $3000 and $5000 thereafter Thus, while volume of exports has increased the value of these exports has not kept pace. The figures indicate a shift from more high value inshore species to deep-sea species with a lower value. While returns per tonne have been fairly stable since 1988, the figures do not support the contention that industry profitability has improved.

With the introduction of QMS commentators expect an increase in prices because security of access allows fishers to respond better to market conditions in terms of timing and product form, thus realising improved prices. Their costs should decrease as companies utilise the most efficient inputs and arrange their harvesting operations in a manner which minimises costs. These expectations should be reflected in an improvement in producer price indices (figure 3). The Producer Price Index – Outputs (PPO) is a measure of changes in the level of prices received for goods and services produced, the Producer Price Index – Inputs (PPI) measures price changes in the current costs of production within the industry.

Figure 3. *Input Prices, Output Prices and Competitiveness in the New Zealand Seafood Industry; 1984-2002.*



Source: Statistics New Zealand

A functional measure of change in industry is the competitiveness ratio. Competitiveness is expressed as the ratio of input to output price index (Wallis 1997). The index contrasts prices received for outputs from the sector with prices of factor

inputs. For every dollar invested in the industry (inputs) the industry receives a sum in return for this investment (outputs). As output prices increase relative to input prices the 'competitiveness' of the fishing industry improves, this improvement is relative to the performance of other sectors of the economy

The relatively small increase in input prices within the New Zealand seafood industry (figure 3) may be attributable to the effects of government policies other than ITQs. Conservative monetary policy and the Employment Contracts Act contributed to a low cost base for inputs (excluding interest costs) for the industry's operations (Wallis 1997). Thus competitiveness is shaped by the PPO. Generally, New Zealand's seafood industry has secured rising competitiveness. In September 1986, prior to QMS, the competitiveness ratio was 1.08. Thus for every $1.00 spent $1.08 was earned. In 2002 the ratio was 1.38, representing a twenty-seven per cent increase over 1986. This result corroborates Hersoug's (2002) findings.

During the period 1986 to 2002, however, three distinct periods can be identified (figure 3). First, a boom period followed initial allocation of quota. Despite an increase in inputs, outputs (returns) increased due to several factors. Government legislation meant that only New Zealand companies could own quota. Joint ventures were required to fish available quota, making inputs more expensive, but returns substantially higher. As expected many small enterprises sold their rights and the industry was restructured (Talley 1999). Larger operators not only purchased quota, but achieved higher levels of throughput as well as effective control over the flow of product through processing facilities and economies of scale.[10] While this was an outcome legislators and industry expected, the rate at which smaller quota holders sold out as opposed to leasing quota was not (Talley 1999). This period is characterised by short-lived increased profits at the expense of other enterprises in the seafood sector.

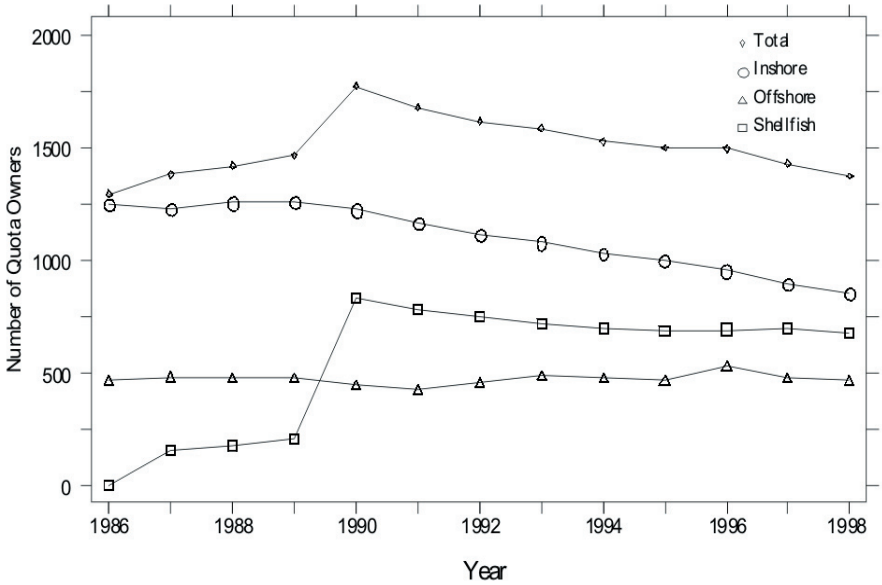
Following the 1987 peak, profitability and competitiveness fell, but not to the pre 1986 levels. The key feature of this period is the fluctuation in output prices and competitiveness. This second phase can be explained by remembering Hersoug's (2002) contention that the QMS was, and is not, a fixed system. This stage demonstrates the seasonality of fishing and the (re)regulation of the industry with associated uncertainties. For instance there was uncertainty over the role Maori were to play in the industry, the shift from fixed tonnage to quota, the shift from resource rentals to cost recovery and due to currency fluctuations.[11] This is a period in which legislators and enterprises were gaining more experience and insight concerning the management of quota.

A third period can be identified from 1997 to 2001, characterised by increased competitiveness and profitability. Both fisheries managers and industry had learnt how to manage and operate in a QMS regulatory system, regulatory uncertainty had reduced and Maori fishing interests had been subsumed into a commercial framework. Because the industry exports such a high volume of product the strengthening New Zealand dollar induced a decline in the price outputs and competitiveness in 2002.

In fisheries, subject to the buying and selling of quota or licences, the stability of ownership of these entitlements is an indicator of economic sustainability. Quota price can be equated to the perceived future returns from harvesting the stock.[12] Commentators expect a concentration of ownership as ITQ will be accumulated by

those who can generate the greatest economic return from its use. The ability of companies to buy and sell quota in a well-functioning market is a necessary prerequisite for achieving these efficiency gains. Newell *et al.* (2002) explore the quota market in some depth. Overall, the industry has undergone a consolidation and a reduction in operators. The total number of quota owners increased from 1300 in 1986 to 1800 in 1990 (figure 4) as new species (especially shell fish) were introduced to the QMS, but has subsequently declined by twenty-two per cent. The median number of owners in individual fisheries has fallen from fifty-one in 1986 to forty-two in 1998 (Newell *et al.* 2002:13).

Figure 4. *Trends in the Number of Quota Owners 1986-1998.*



Source: Newell et al. 2002:46

There has been a rationalisation of the inshore fishery. Newell *et al.* (2002:3) attribute this to the exit of approximately nineteen per cent of shellfish owners and thirty-two per cent of inshore owners. Hersoug (2002) identifies a clear shift in ownership, with the ten largest entities now owning forty-nine per cent of inshore fish quota (up from forty-four per cent) and twenty-six per cent of rock lobster quota (up from thirteen per cent). Interestingly, the number of offshore quota owners has remained relatively static and this may be evidence of maturity in the sector especially as some offshore stocks were included in a nascent quota system that limited entry prior to the establishment of a more comprehensive QMS. A word of caution is still required. Concentration pressures are background to any industry and the QMS cannot be responsible for all the signs of concentration in the industry. The data also understates the level of concentration of rights ownership due to the formation of shell and proxy companies to evade legislative restrictions on quota aggregation.

A major concern prior to QMS was the over-capitalisation of the fishing fleet with too many operators chasing too few fish. Expected outcomes of implementing

a QMS included a reduction in effort measured by a decline in the fleet, especially in the inshore fleet (less than twelve metres), a shift in fleet composition from chartered to domestic vessels and an increase in catch per unit effort as vessels operate over an extended area. The fishing fleet structure has undergone significant change from 1996 -2002 (table 2).[13] The greatest period of change was from 1997 to 1998 with some 346 vessels, comprising 13.4 per cent, removed from the fleet. Total fleet size has decreased by 596 (twenty-one per cent), and there have been significant reductions in vessels less than twelve metres (twenty-two per cent) and vessels over thirty metres (fifty-eight per cent). The decline in deep-sea vessels (those over thirty metres) may be evidence of capacity creep in terms of specialisation and technology with more efficient and effective fishing techniques. This is supported by the relative stability of the mid–range vessel numbers. The fifteen to thirty metres mid size vessels are able to fill a number of roles and can shift rapidly from fishing for mackerel in the Pacific to hoki in the Tasman. Connor presents evidence that while vessel numbers have declined, the gross registered tonnage, an indicator of vessel capacity, has actually increased leading him to conclude that total capacity grew by forty-three per cent between 1987 and 1998 (Connor 2001b:165). The decline in vessel numbers may also be an outcome of consolidation and the vertical integration of the larger firms, which now control ninety-two per cent of deepwater species quota (Hersoug 2002). Either way, the catch is being taken with fewer boats.

Table 2. *Numbers of Vessels Registered 1996-2002.*

Size	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
< 12m	1844	1706	1483	1409	1362	1438	1354
12-14.9m	327	318	301	295	289	293	304
15-17.9m	152	153	142	142	135	143	146
18-29.9m	159	153	143	142	147	157	160
30m+	250	254	169	142	100	105	111
Total	**2732**	**2584**	**2238**	**2130**	**2033**	**2136**	**2075**

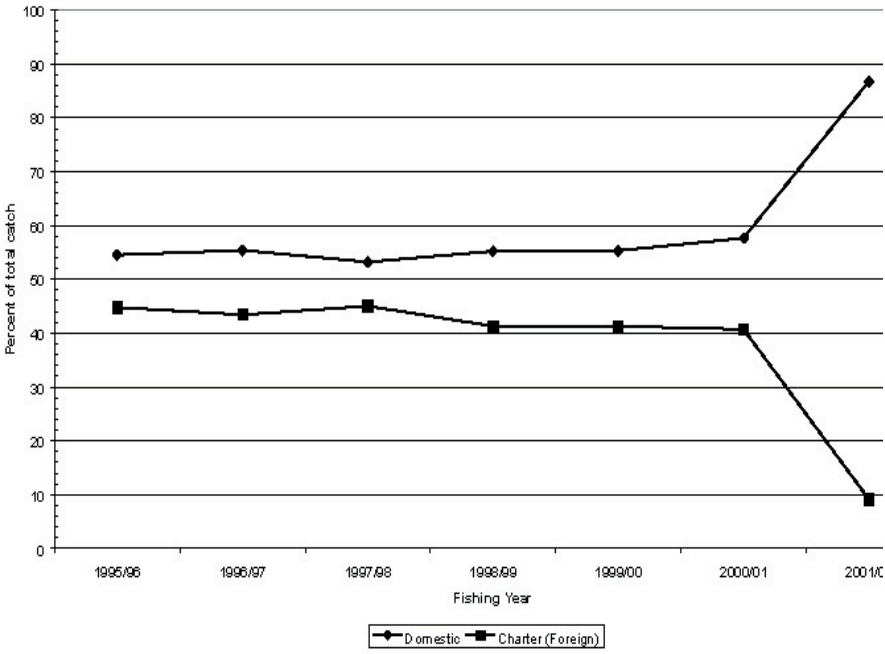
Source: New Zealand Seafood Industry Council (2003)

The 'New Zealandisation' of the fishing fleet was one of the expected outcomes of the QMS. Evidence concerning fleet composition suggests that competitiveness of the domestic fleet is improving. With the declaration of the EEZ in 1978 foreign licensed fishing declined rapidly and by 1990 was not significant. Wallis (1997) argues that

there was a marked change in fleet ownership: the domestic fleet grew, while foreign licensed vessels, and later charter vessels, disappeared from the fleet. Between 1978 and 1986 catch was shared evenly between domestic, charter and foreign vessels (Wallis 1997). A marked change occurred in 1986, with the displacement of foreign vessels and a commensurate expansion of charter and domestic fleets. Since 1990 domestic operations have been displacing joint ventures.

Charter operations still play a significant role in the fishing fleet (Figure Five). The importance of joint venture relationships lies in the increased flexibility and added efficiency firms gain. Firms can adjust fishing capacity without directly impinging on their fleet. In lean years joint ventures can be curtailed and in good years excess fish can be targeted by charter operations (Figure Five). For instance in the 2001/02 season total green weight catch fell by 6809.9 tonnes. Simultaneously, catch by the domestic fleet expanded to eighty-seven per cent of total green weight. On one level this may represent a New Zealandisation of effort but the result may also indicate New Zealand registration of previously chartered vessels. At first sight the decline in fleet size and increasing New Zealandisation of the fleet indicate that excess capacity has been removed. However, the impacts of technological advances and capacity creep need to be acknowledged. Hersoug (2002) contends that capacity creep is approximately three per cent per annum. While over-capitalisation may be a problem it is a problem for owners and not the state (Hersoug 2002).

Figure 5. *Percentage of New Zealand Catch by Vessel Registration.*



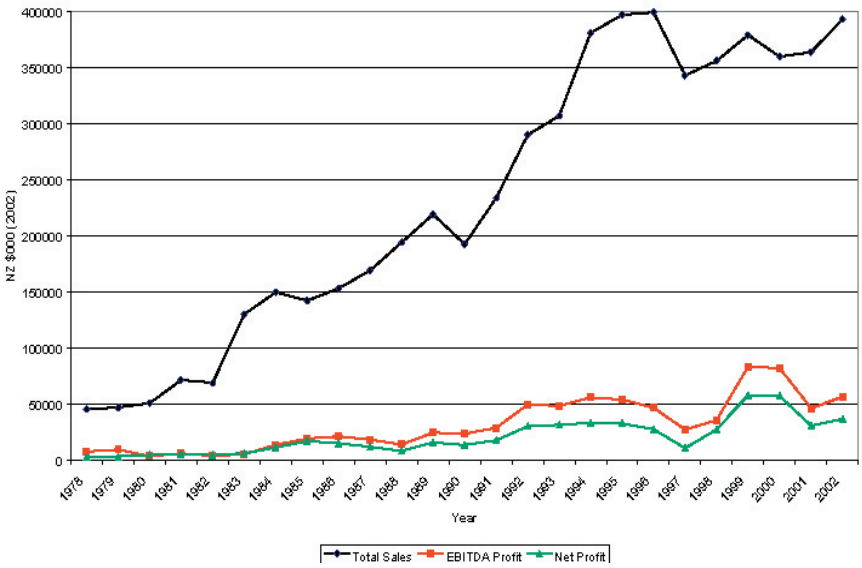
Source: New Zealand Seafood Industry Council 2003

The industry input and output measures, quota holdings and fleet numbers show an initial improvement in performance and competitiveness associated with a shake out of the smaller enterprises. Real profits from the sector have been variable, but have trended upwards. Industry has prospered in the new regulatory framework, Rationalisation of the fleet and increased vessel capacity has moved the industry towards concentration. In this context the rate of profits becomes important (Clapp 1998). Pressures mount for individual enterprises to find alternative means to generate profits, be it through marketing, adding value, farming, or diversifying product. Firms may also attempt to find ways to circumvent social and environmental goals expected by legislators. It is therefore important to identify how enterprises have responded to the challenges.

Sanford Limited and Evidence at the Scale of the Firm

Most companies in New Zealand are privately owned and jealously guard information concerning quota they own or control. Data from Sanford Ltd, New Zealand's only publicly listed seafood company, illustrates how the practices and approaches of one company have changed in recent years in response to the introduction of QMS.[15] Sanford began operations in 1881, a period of ungoverned resource exploitation (Titchener 1981). Prior to QMS it operated under a number of different regulatory regimes, including varying forms of government subsidy, input restrictions and import substitution. These days, Sanford publishes data on sales, gross profit, net profit and an annual report that gives insight into the growth strategies and expectations of the company.[16] Sanford's annual reports offer the opportunity to investigate whether QMS has lead to profitability and productivity gains at the level of the firm .

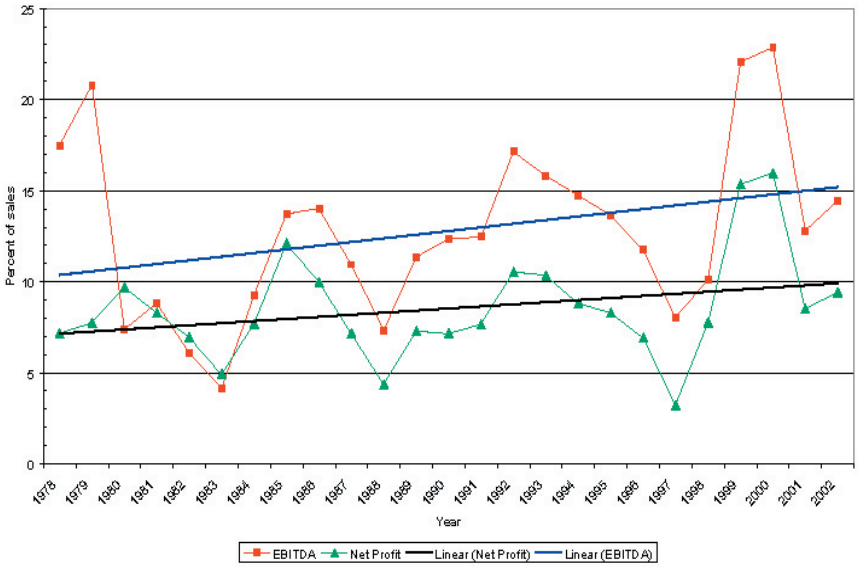
Figure 6. *Sanford Ltd Sales 1978-2002 (value in $2002).*



Source: Sanford Limited 1978-2002

Since the imposition of QMS Sanford's sales have increased nearly tenfold (figure 6). Hersoug (2002) contends that this increase by Sanford has not been accompanied by an increase in productivity. Profits have remained a stable percentage of sales. This paper challenges Hersoug's position. The relationship between profits and total sales for Sanford has improved (figure 7), although the annual profits have fluctuated. The trend line for gross profit has improved from just over ten per cent of sales to just over fifteen per cent and net profit has improved about three per cent over the period. Importantly, the general trend obscures the volatility of the industry – something that QMS was supposed to reduce.

Figure 7. *Earnings Before Interest, Tax, Depreciation and Amortisation and Net Profit as a Percentage of Total Sales for Sanford Limited 1978-2002.*



Source: Sanford Limited Annual Reports1978-2002.

Following the declaration of the EEZ in 1978 and subsequent decline of foreign vessels, gross profit increased with initial gains in output, but as capital was invested to fill the void of foreign effort both net and gross profit fell substantially (figure 7). By 1983 profits had slumped to less than five per cent reflecting stagnation in the industry. This was evident in declining catches in the inshore fishery, reduced export prices for snapper and tuna and attendant rising costs of fishing (fuel amounting to thirty-three per cent of operating costs). Freight rates continued to rise and in some cases represented fifty per cent of total selling price (Sanford Ltd 1982). At fifteen to twenty-five per cent, the cost of working capital was very high. The fishing industry is labour intensive, capital intensive, energy intensive and seasonal. It also utilises retained earnings for expansion. With the loss of earnings and the reluctance to borrow, both the industry and Sanford suffered. This loss of earnings could not be recouped by raising prices because, in a global economy, the local scarcity of fish or rising costs does not affect the world price. In effect companies such as Sanford

are price takers and have to compete and trade as such. The QMS presented Sanford with a challenge: it limited the amount of quota that any one company could hold in any one species in any one management area. By 1986 Sanford recognised that while quota guaranteed throughput for factories and processing, the shortage of fish brought about by quota demanded action from them.

Sanford followed several strategies. It began to change the types of products produced with more emphasis going into value added and ready-to-cook products and aquaculture (Sanford Ltd 1986). Sanford also looked to purchase other companies and quota. In 1991, Sanford made a substantial investment purchasing Wilson Neil/Skeggs Seafoods deep water quota and assets including its Nelson processing plant (Sanford Ltd 1991).

QMS should see the development of new species and products as companies have a secure asset worth investing in (Shallard 1996). It was hoped that the security of quota would provide an incentive for companies to develop new species commercially. Sanford has played a role in both the scampi fishery and the antarctic toothfish fishery – the latter may earn Sanford in excess of three million dollar in annual sales (Chapple 2003).

In addition, aquaculture has become a significant part of Sanford operations. Sanford has extended control to the biophysical environment in order to ensure throughput in factories thus securing sustainability when wild fish stocks fluctuate. Aquaculture and especially green lipped mussel (*Perna canaliculus*) production has increased significantly in New Zealand. In 1990 Sanford closed the Christchurch processing plant and opened an enlarged mussel processing plant in Havelock, Marlborough. In 1993 aquaculture (including salmon, oysters and mussels) comprised ten per cent of volume and the company hoped to raise this to twenty-two per cent by 2000 (Sanford Ltd 1993); however by 2002 it accounted for only eleven per cent of sales (Sanford 2002). The introduction of the government moratorium on further marine farm licenses in November 2001 may further limit expansion in aquaculture.

To gain further access to fish, Sanford hoped to expand overseas. Since 1986, a number of overseas ventures have been undertaken, some have proven successful and others less so. In 1986 the company invested in prawn farming in Australia. Although not a hugely profitable venture the small capital investment meant that this ran for some time and provided knowledge that could be applied in a New Zealand context. Exploratory fishing in Chile began in 1990 and in 1994 Sanford purchased forty-four per cent of a fishmeal interest and subsequently increased its shareholding to fifty per cent in 1995. In 1997, the company wrote off the total investment in Chile ($8.7 million) citing the volatility of the fishery and the nature of a regulatory environment that did little to protect fishing rights (Sanford Ltd 1997). Later Sanford sold its share of its venture in Namibia (Sanford 2000). Despite the losses on the balance sheet the investment into these countries produced knowledge that may prove useful in the long run. Sanford continues to develop foreign direct investment assets in Argentina, building on the knowledge developed in Chile and Namibia. There are synergies with the New Zealand hoki operation as the Argentine hoki is produced to the same specifications as the New Zealand product for international customers (Sanford 2002). Despite the 8.7 million dollar Chilean write-off it is important to note that there may still have been a net gain as the timing of the entry and exit are

important, and short term gains, as well as knowledge and relationships built in the country may out weigh the financial loss of the write-off. Investment overseas may also be a response to the economic climate in New Zealand, as periodically the returns overseas may be greater than in New Zealand.

Sanford also developed international relationships and investments at the other end of the supply chain. Sanford has maintained direct investment in the Canadian companies Fisheries Products International (FPI: 14.9 per cent share holding) and High Liner Foods Incorporated (High Liner: 9.4 per cent share holding). The investment into FPI is a means of accessing an extensive foodservice distribution business in such a way as to benefit both parties (Sanford 2002). High Liner is oriented towards servicing the retail sector in North America. These investments are designed to assist the consolidation of supply chain by Sanford in the North American markets (Sanford 2002a). In the future Sanford hopes to develop growth strategies that focus on the security and preferential access to foodservice and retail distribution systems (Sanford 2002a).

Other firms in the seafood industry have undertaken different growth and investment strategies in response to the regulatory environment. Talley's Fisheries Ltd has made use of its proximity to a horticulture region and freezer technology to expand firstly into vegetables and more recently ice cream. The company has sought to diversify its holdings beyond the seafood industry and most recently has looked to expand its holdings in meat company Affco and open a meat processing plant in Invercargill. Another global player, Sealord, has added value by shifting its focus toward packaged meals and branded products. By emphasising the Sealord brand, products become simulacra that are no longer solely New Zealand products. The overseas expansion forward integration and diversification strategies of New Zealand seafood companies are very similar to the actions of Canadian seafood companies in the late 1980's and early 1990's (see Kimber 1989; National Sea Products Limited 1991).

To summarise, Sanford investments overseas into fisheries and along the supply chain, as well as the investment in aquaculture, lend support to the idea that QMS has not resulted in the performance gains that many predicted. QMS may not be as profitable and productive as first envisaged. Sanford adopted growth and investment strategies through FDI, indirect investment, new species and aquaculture. Sanford seeks to mitigate risks associated with the uncertainty (including the seasonality) of fishing, the uncertainty of operating in a global market (including fluctuating currency exchange rates), and the uncertainty of new regulation that saw the fishing industry in court challenging the TAC setting mechanism on at least one occasion (Sanford 1997; Batstone and Sharp 1997).

Sanford's strategies resonate with Anderson's (2002:149) ideas concerning property rights and control. As property rights strengthened, Sanford invested in new technologies (including aquaculture), became more forward looking, and gained more control of the production and marketing systems through such overseas ventures in Chile and Namibia and investment in FPI and High Liner. Whether overseas fishing is indicative of increased productivity and performance remains unclear. However, Sanford is making better use of wild stocks and expanding its aquaculture interests. By expanding through the commodity chain, developing forward linkages, emphasising rapid fresh delivery to markets, taking maximum advantage of

the freshness premium and accessing extensive foodservice distribution networks, Sanford has tried to break with Clapp's (1998) inexorable resource cycle scenario. Sanford used the security of quota under QMS and its bankability to explore other options for securing growth.

In conclusion, Sanford has increased sales dramatically but profits have not kept pace. Profits have trended upwards since the institution of QMS, but the trend line obscures the variability of these profits from year to year. ITQ and QMS have, it seems, been sending the right signals to companies and they have behaved accordingly. Companies such as Sanford have adopted growth strategies that are in part driven by QMS which blocks them from expanding fishing effort. They have expanded into new fisheries (not necessarily successfully), looked for development opportunities outside QMS (although the current moratorium on marine farming has stymied development in this area) and promoted overseas investment beyond New Zealand jurisdiction as a means of securing profit.

Conclusion

The New Zealand QMS is dynamic and evolving. What can we conclude about it so far? Since we cannot examine a counterfactual of what would have happened without QMS it is difficult to be too dogmatic about the outcomes. This paper has surveyed a range of indicators of change, growth and performance in the New Zealand fishing industry. It examined whether the intended outcomes of ITQ and QMS have been borne out by actual experience in the seafood sector. The QMS was simultaneously driven by crisis in inshore fisheries and impending crisis in the deep sea fishery, the opportunity to capture rents and profits in the deep sea fishery and a wider restructuring of state, industry and civil society relations. Advocates of QMS and ITQ often point to positive outcomes from the adoption of the regulatory regime. This is framed within a rhetoric of sustainable utilisation and expected outcomes include sustainable management of fish stocks, rationalisation of fishing effort, better returns to capital and a subsequent increase in productivity and performance for commercial users.

At first glance, the QMS resulted in an increase in performance and productivity. It has successfully controlled the exploitation of the hoki fishery and maintained fishing of high volume. The QMS appears to have constrained the race to fish and the hoki fishery has not suffered the same fate as other deep sea species (such as Orange Roughy). It has preserved the fragile inshore species and appears to have avoided Clapp's (1998) resource cycle and Hardin's (1968) tragedy for at least one deep sea and one inshore fish stock respectively.

Since the introduction of QMS the value and volume of seafood exports has risen enormously. Value increased three-fold and volume has doubled. From 1984 to 2002 the competitiveness of the industry increased as a function of producer outputs. Quota owners have declined from a high of 1800 in 1990 to approximately 1500 in 1998, but these figures do little to shed light on lease arrangements, shell companies and proxy owners created to evade quota aggregation restrictions. There was a rationalisation of fishing effort and the expected reduction in fishing vessels. Vessel numbers have declined thirty per cent, with significant reductions in both

inshore and deep sea fleets. Despite overall fleet reductions the mid-range fleet has remained relatively static. These vessels have the capacity to fish a wide range of species and can operate both inshore and offshore. The QMS has allowed the domestic fleet to capture the rents and build capacity in the offshore sector. Fishing effort has been 'New Zealandised' through the removal of foreign vessels and a decline in the percentage of catch taken by chartered vessels.

It was expected that the introduction of the QMS would encourage efficiency and innovation. Firms were expected to become more profitable and perform better than before. Sanford has expanded its sales tenfold since the introduction of QMS. Both profits and earnings before tax increased significantly and Sanford has developed different ways of processing both hoki and snapper to maximise value. The QMS promoted the development of new species and products such as scampi and toothfish, as companies like Sanford now had an asset worth investing in. In addition Sanford has expanded its aquaculture interests.

Further investigation has shown that the results of QMS are mixed. There are increasing concerns surrounding the biological success of a single species/stock approach to managing fisheries. By focussing on a single species (or stock) there is little incentive for fishers (or managers) to be concerned about wider ecosystems until collapse impinges directly on commercial species. The value and volume of seafood exports in real (2002 New Zealand dollar) figures makes sobering reading. Growth has occurred, but not to the extent described by some commentators. Data indicates a shift away from high value inshore species to lower value deep sea high volume species. In addition, performance may be lower still once the significance and role of aquaculture in volume and sales is discounted.

It is clear that New Zealand companies are 'growing' more product, as well as gaining more value from what they export, and this has come at the expense of smaller quota owners and foreign fishing enterprises. Productivity and profitability have not increased steadily as there have been periods of uncertainty and fluctuating fortunes as competitiveness varies. There was an initial period of increased profitability as the industry underwent restructuring and many smaller quota holders sold out of the industry, this was further increased by the removal of foreign vessels and the establishment of charter operations. Profitability and competitiveness proved to be unsustainable and was followed by a period of fluctuation that was accentuated by uncertainty surrounding the role Maori were to play in the industry, regulatory tinkering and currency fluctuations from 1987 to 1997. The 1997-2002 period illustrates a return to increased outputs and profitability. This can be partly attributed to the decline in the New Zealand dollar relative to the United States dollar and an increased understanding by stakeholders of the practicalities of QMS.

The QMS has failed to address the volatility of the sector in part because the global market has little to do with the security of local supply. Firms have responded to QMS in a number of ways. Despite mixed fortunes companies have persevered with these efforts. Sanford developed business relationships establishing indirect investment into FPI and High Liner, and firms such as Talley's, Sealord and Sanford have developed extensive aquaculture interests. The strategies of firms have been about securing control: control of markets; control of supply; and control of resources. Firms have responded to QMS by finding ways of operating beyond its purview.

The QMS has provided a secure bankable and tradeable asset. Although not a

property right, but a right to harvest, quota has provided an asset that supports the expansion beyond QMS. But the key factors behind productivity and improvements in the seafood industry are not the direct result of ITQ and QMS. Quota in and of itself is not enough to guarantee productivity and performance. The 'success' of the QMS regime must acknowledge the role of aquaculture and the expansion of companies overseas.

This paper has demonstrated that QMS has achieved positive resource outcomes including the preservation of commercial species. It has sent signals to firms concerning the status of species. These signals are such that companies appear to be acting responsibly and fishing within the TACC. QMS has resulted in companies fishing beyond New Zealand's waters or investing beyond the quota system. These moves may have reduced pressure on over extended wild stocks but they also place more of the seafood industry beyond the domain of QMS and into other regulatory frameworks. The challenge for fisheries management and the seafood industry in the future will be to unite the demands of multiple stakeholders and maintain stocks and sustain performance and productivity gains.

Acknowledgments

I am grateful to Gordon Winder, Richard Le Heron and Edwin Massey for their helpful comments and suggestions. The input and helpful advice of two anonymous referees has greatly strengthened this paper. All remaining errors of fact or interpretation are the authors. The paper draws on research supported through a University of Auckland Doctoral Scholarship and builds on a paper presented at the 2003 New Zealand Geographical Society conference. I would like to thank those who attended the session for the useful feedback.

Notes

[1] An important consideration for New Zealand – a nation with the fifth largest Exclusive Economic Zone (EEZ) (Hersoug 2002).

[2] Total Allowable Catch (TAC) comprises two elements Total Allowable Commercial Catch (TACC) and Total Allowable Non Commercial Catch (TANC) which might be allocated to scientific, recreational and indigenous fishers for traditional use.

[3] The harvester only allocation gives fishers the flexibility to reduce the daily harvest and extend the season, thus lowering marginal and average variable costs. Matulich *et al.* (1996:125) note that such an allocation does little for a processing sector that is initially capitalised to meet an overcapitalised open access fishery.

[4] Copes (2000) refers to these negative behaviours as being systems induced. For example quota busting is the out right fishing beyond allocated quota, high grading is the discarding of fish of lesser value due to size or quality, price dumping is the dumping of catch if port prices are perceived as too low so that it will not count against quota and the ratcheting of quotas occurs when fishers pressure for increased catch and resist reductions resulting in quotas drifting up in good seasons but remaining at high levels in poor seasons.

[5] For a further history and institutional detail there are a number of descriptive assessments including Hersoug 2002; Straker *et al.* 2002; Batstone and Sharp 1999; Sharpe 1997 and Annala 1996.

[6] There had also been, for a limited range of species, a quota management scheme in existence in New Zealand since 1 April 1982. These species were limited to relatively unexploited deep-water stocks that came within New Zealand's management purview as the result of the declaration of a 200-mile Exclusive

Economic Zone by New Zealand in 1978, and had limited seasonal transferability.
[7] See Hersoug (2002) for a description of the shortcomings of the fixed tonnage system.
[8] Carry over is the right to carry over up to ten per cent of ITQ from the previous year. Deemed values are the penalties incurred for landing excess fish they are usually based on the port prices. Fishers pay a penalty designed to be high enough to be a disincentive but low enough to discourage dumping at sea. In practice variable cost structures make it hard to meet both objectives (Peacey 2002).
[9] The indices are derived from Statistics New Zealand's Fishing and Hunting industry database prior to 1996 and the Fishing database thereafter. The base year (1000) has been reset to 1982.
[10] Matulich *et al*. (1996) note that for all the argued efficiency attributes of ITQ, success depends on instituting property rights that are politically acceptable. The processing sector is typically no less powerful than the fishing sector and the guarantee of throughput for processors is one way of gaining political support for QMS.
[11] New Zealand Maori – the Tangata Whenua, literally the people of the land – have a valid claim to a significant share of New Zealand fisheries assets under the Treaty of Waitangi, 1840. The role that they were to play and the allocations of fisheries assets has taken some time to negotiate and are still sources of contention.
[12] Lease prices equate to expected annual profit flow, sale price should reflect present value of expected future profit flows.
[13] Fleet structure and its interpretation are problematic as multi purpose vessels can be recorded several times.
[14] There is a small percentage of vessels that are recorded as 'Null' or 'Unknown', but this doesn't affect the trend described.
[15] Sanford was founded in 1881 and is New Zealand's oldest publicly listed seafood company (Titchener 1981).
[16] Gross profit is defined as Earnings Before Interest, Tax, Depreciation and Amortisation (EBITDA).

References

Anderson, J.L.

2002 Aquaculture and the Future: Why Fisheries Economists Should Care. *Marine Resource Eco nomics* 17:133-151.

Annala, J.H.

1996 New Zealand's ITQ System: Have the First Eight Years Been a Success or Failure? *Fish Biology and Fisheries* 6:43-62.

Annala, J.H. *et al*. (Comps.)

2002 *Report from the Fish Assessment Plenary, May 2002; Stock Assessments and Yield Estimates.* Min istry of Fisheries, Wellington.

Arnason, R.

1991 Efficient Management of Ocean Fisheries. *European Economic Review* 35: 408-417.

Batstone, C.J and B.M.H. Sharp

1999 New Zealand's Quota Management System: The First Ten Years. *Marine Policy* 23(2):177-190.

Bess, R and M. Harte

2000 The Role of Property Rights in the Development of New Zealand's Seafood Industry. *Marine Policy* 24(4):331-339.

Bridge, G and A. Jonas

2002 Governing Nature: The Reregulation of Resource Access, Production, and Consumption. *Environment and Planning A* 34:759-66.

Chapple, I.

2003 Sanford Gets Teeth Into Toothfish. *The New Zealand Herald,*3 April, C3.

Clapp, R.A.

1998 The Resource Cycle in Forestry and Fishing. *The Canadian Geographer* 42 (2):129-144.

Clark, C.
1973 The Economics of Overexploitation. *Science* 181:630-634.
Clement and Associates (Comps.).
2000 *New Zealand Commercial Fisheries: The Atlas of Area Codes and TACCs 2000/2001*. Clement and Associates. Nelson, New Zealand.
Connor, R.
2001a Initial Allocation of Individual Transferable Quota in New Zealand Fisheries. In: R. Shotton (Ed.), *Case Studies on the Allocation of Transferable Quota Rights in Fisheries.* FAO technical paper 411, Food and Agricultural Organisation, Rome 2001. Pp222-250.
2001b Changes in Fleet Capacity and Ownership of Harvesting Rights in New Zealand Fisheries. In: R. Shotton (Ed.), *Case studies on the Effects of Transferable Fishing Rights on Fleet Capacity and Concentration of Quota Ownership.* FAO technical paper 412, Food and Agriculture Organisa tion, Rome 2001. Pp151-185.
Copes, P.
2000 *Adverse Impacts of Individual Quota Systems on Conservation and Fish Harvest Productivity. Discussion Paper 00-2.* Simon Fraser University, Institute of fisheries Analysis, Canada.
Dahl, A.L.
2000 Using Indicators to Measure Sustainability: Recent Methodological and Conceptual Develop ments. *Marine and Freshwater Research* 51: 427-433.
Food and Agriculture Organisation
2001 The State of World Fisheries and Aquaculture. http://www.fao.org/DOCREP/003/x8002e07. htm. Last accessed 7/28/01.
Fujita, R., T. Foran and I. Zevos
1998 Innovative Approaches for Fostering Conservation in Marine Fisheries. *Ecological Applications* 8:139-150.
Funnel, G.
1999 Scouring the Seafloor. *New Zealand Science Monthly.* October:6-8.
Garcia, S.M and D.J. Staples
2000 Sustainability Reference Systems and Indicators for Responsible Marine Capture Fisheries: A Review of Concepts and Elements for a Set of Guidelines. *Marine and Freshwater Research* 51:385-426.
Gordon, H.S.
1954 The Economic Theory of a Common Property Resource: The Fishery. *Journal of Political Econ omy* 62:124-42.
Grafton, R. Q.
1996 Individual Transferable Quota: Theory and Practice. *Reviews in Fish Biology and Fisheries* 6 (1):5-20.
Hannesson, R.
1993 *Bioeconomic Analysis of Fisheries.* Food and Agriculture Organisation and Blackwell, Oxford.
Hardin, G.
1968 The Tragedy of the Commons. *Science* 162:1243-8.
Hersoug, B.
2002 *Unfinished Business: New Zealand's Experience with Rights Based Fisheries Management.* Delft: Eburon
Hughey, K.F.D., R. Cullen and G.N. Kerr
2000 Stakeholder Groups in Fisheries Management. *Marine Policy* 24:(2):119-127.

Hundloe, T. J.
2000 Economic Performance Indicators for Fisheries. *Marine and Freshwater Research* 51:485-91.
Kimber, S.
1989 *Net Profits: The Story of National Sea*. National Sea Products Ltd, Halifax, Canada.
Le Heron, R. and E. Pawson (Eds.)
1996 *Changing Places: New Zealand in the Nineties.* Longman Paul, Auckland.
Matulich, S.C., R.C. Mittlehammer and C. Reberte
1996 Toward a More Complete Model of Individual Transferable Fishing Quota: Implications of Incorporating the Processing Sector. *Journal of Environmental Economics and Managemen.* 31:112-28.
Maunder, M. N and P.J. Starr
2002 Industry Participation in Stock Assessment: the New Zealand SNA1 Snapper (Pagrus Auratus) Fishery. *Marine Policy* 26:481-92
Ministry of Agriculture and Fisheries
1984 *Inshore Finfish Fisheries: Proposed Policy for Future Management*. Ministry of Fisheries and Agriculture, Wellington, New Zealand.
National Sea Products Limited
1991 *Annual Information and Management and Analysis of Financial Condition and Result of Opera tions for 1990*. April 18th 1991. National Sea Products Halifax, Canada.
Newell, R.G., J.N. Sanchirico and S. Kerr
2002 *Fishing Quota Markets.* Discussion Paper 02-20. Resources for the Future, Washington DC.
New Zealand Seafood Industry Council
2003 *New Zealand Seafood Industry Economic Review 2003*. SeaFIC, Wellington.
Parliamentary Commissioner for the Environment
1999 *Setting Course for a Sustainable Future: The Management of New Zealand's Marine Environ ment.* Office of the Parliamentary Commissioner for the Environment, Wellington, New Zea land.
Pauly, D.
1996 ITQ: The assumption behind a meme. *Reviews in Fish Biology and Fisheries* 6:109-12.
Peacey, J.
2002 *Managing Catch Limits in Multi-Species, ITQ Fisheries*. Proceedings of the Eleventh Interna tional Institute of Fisheries Economies and Trade, Wellington, New Zealand. CD Rom.
Rees, E.B
2003 QMS Driven Productivity and Performance Gains in the New Zealand Seafood Sector: The Case for Success at the Industry Level. In J. Gao, R. Le Heron and J. Logie *Windows on a Chang ing World.* Proceedings of the 22nd New Zealand Geographical Conference. New Zealand Geo graphical Society, Auckland. Pp 111-115.
Rose, R. *et al.*
2000 *Economic Performance Indicators for Fisheries*. *ABARE Conference Paper 2000.19.* Australian Bureau of Agricultural and Resource Economics, Canberra.
Sanford Limited
1978-2002 *Sanford Limited Annual Report*. Sanford Limited Auckland.
2002a *Addresses given by the Chairman and Managing Director to Shareholders at the Ninety-Eighth Annual General Meeting. Thursday, 5 December 2002.* http://www.sanford.co.nz/docs/Annual %20Meeting%20Addresses%202002.pdf. Accessed 6/20/03.
Scott, A.
1955 The Fishery: The Objectives of Sole Ownership. *Journal of Political Economy* 63: 116-24.

1986 Development of Property in the Fishery. *Marine Resource Economics* 5: 289-311.

Sharp, B.M.H.

1997 From Regulated Access to Transferable Harvesting Rights: Policy Insights from New Zealand. *Marine Policy* 21:501-17.

Shallard, B.

1996 *Concepts and Practice of Individual Transferable Quota for the Management of Fisheries - An Overview*. Presentation for the Ministry of Food Processing Industries Conference, New Delhi.

Statistics New Zealand

1984 -2002 *Business Activity Statistic.* Statistics New Zealand Te Tari Tatau Wellington, New Zealand.

Straker, G., S. Kerr, and J. Hendy

2002 *A Regulatory History of New Zealand's Quota Management System*. Motu: Economic and Public Policy Research Trust, Wellington, New Zealand.

Talley, P.

1999 Fishing Rights - An Industry Perspective: ITQ's and Fishermen's Attitudes: The Change from Hunter to Farmer. In R. Shotton (Ed.), *Use of Property Rights in Fisheries Management: Pro ceedings of FishRights 99 Conference, Fremantle, Western, Australia. 11-19 November 1999.* FAO technical paper 404/1. Rome: Food and Agriculture Organisation. Pp. 247-253.

Thrush, S.F *et al.*

2001 Fishing Disturbance and Marine Biodiversity: Role of Habitat Structure in Simple Soft Sedi ment Systems. *Marine Ecology Progress Series* 221:255-264.

Tietenberg, T.H.

2000 *Environmental and Natural Resource Economics.* 5th ed. Addison-Wesley Reading, MA.

Titchener, I. P.

1981 *The Story of Sanford Ltd.: The First One Hundred Years.* Auckland: Sanford Limited.

Wallace, C.

1998a Tradeable Quota in Practice: Decision Making, Institutions and Outcomes – the New Zealand Experience over 11 Years. In A. Eide and T Vassdal (Eds) *IIFET'98 – Tromsø.* Proceedings of the Ninth Conference of the International Institute of Fisheries Economics and Trade, Norwegian S chool of Fisheries, University of Tromsø, Norway. Pp. 637-648.

1998b Marine Management and the Quota Management System: Reform Required. In C. Wallace, B. Weeber and S. Buchanan (Eds) *Marine Ecosystems Management*. Proceedings of the February 1998 Sea Views Conference, Environmental and Conservation Organisations of New Zealand, Wellington, New Zealand. Pp. 62-78.

Wallis, P.

1997 *Industry Competitiveness and Performance*. Unpublished draft paper. Ministry of Fisheries, Wellington.

Whitmarsh, D. *et al.*

2000 The Profitability of Marine Commercial Fisheries: a Review of Economic Information Needs with Particular Reference to the UK. Marine Policy 24:257-63.