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Consolidation in an Individual Transferable Quota Regime: Lessons from New Zealand, 1986–1999

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Abstract Market-based approaches to environmental regulation (such as tradable permits or transferable quotas) are frequently offered as innovative solutions to many environmental problems. Globally, one of the most well-established forms of this approach is individual transferable quotas (or ITQs) in fisheries management. Within the natural resource management community, there is considerable debate over the effects ITQs have on the fishing industry and fisher behavior although this approach is not well-established in the United States. The previously imposed moratorium on ITQs in the United States has expired and the 2006 reauthorization of the Magnuson-Stevens Act explicitly provides for limited access privileges (LAPs). A variety of fishers, regulators, and conservation organizations are enthusiastically seeking to introduce ITQ management. With debate over whether and how ITQs should be used in American fisheries reinvigorated, it is timely to examine the evidence on the social and economic effects of ITQs in other nations' fisheries. After briefly summarizing the debate on ITQs, we examine the case of New Zealand, one of the earliest and longest-lived ITQ-based fisheries regimes. We use multiple data sources and methods to analyze the extent to which industry consolidation and aggregation has occurred, including surveys of industry participants, expert interviews, reviews of academic reports and analyses, analysis of trade publications, and direct analysis of quota ownership patterns. This analysis shows a more complex outcome than recent debates in the ITQ literature would predict. These findings suggest that policy makers considering ITQs can learn from the experiences of other countries related to key issues such as quota allocation, aggregation limits, transferability, cost recovery, and resource sustainability when designing ITQ and other LAP systems. It is also important to explicitly identify economic and social objectives and then carefully design ITQ regimes to meet these objectives.

Keywords Aggregation · Consolidation · Limited access privilege · Fisheries management · Individual transferable quota · ITQ · Market based regulation · New Zealand

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Introduction

Market-based approaches to environmental regulation (such as tradable permits or transferable quotas) are frequently offered as innovative solutions to many environmental problems. Indeed, tradable quotas are suggested as policy solutions for problems as widely varying as: air pollution (Auer 2005; Popp 2003; Bohi and Burtraw 1991); climate change (Bell 2006; Tomkins and Twomey 1994); water pollution (Hanley et al. 1998); wildlife management (MacMillan 2004); tire recycling (Chang 2007); and water use (Panayotou 1998). Globally, tradable permits are most commonly used in fisheries management and usually referred to as individual transferable quotas (or ITQs) They have been used in a variety of countries and settings, including nation-wide systems in New Zealand and Iceland, and certain fisheries in the United States, Canada, Australia, Greenland, and the Netherlands (Leal 2002). However, the

overall social and economic effects of this environmental management tool are not well understood.

Within the natural resource management community (fishery management agencies, industry organizations, environmental conservation organizations) there is considerable debate over the effects ITQs have on the fishing industry and fisher behavior (see NRC 1999). In the ITQ approach, individuals, organizations, and companies own the right to commercially harvest a set amount (usually a proportion of the total allowable catch, or TAC) of a species or group of species within a specific area. This right may be bought, sold, or leased. The United States Congress placed a moratorium on the implementation of new ITQ management arrangements in 1996 and requested a National Research Council review. However, this moratorium has now expired (Federal Register 2006, 43706–07) and the 2006 reauthorization of the Magnuson-Stevens Act explicitly provides for limited access privileges including ITQs. There is considerable serious discussion taking place over whether and how ITQs or other forms of "limited access privileges" (LAPs) should be introduced in the United States (Environmental Defense 2007; Anderson 2006).

With debate over the use of ITQs in American fisheries reinvigorated, it is timely to examine the evidence on the social and economic effects of ITQs in other nations' fisheries. Below we briefly summarize the debate on ITQ management and then we examine the case of New Zealand, one of the earliest and longest-lived ITQ-based fisheries management regimes existing. This analysis examines the period from 1986 to 1999 when New Zealand had a pure ITQ management regime. We selected this period because 1986 was the start of ITQ management, while in 1999 the ITQ regime was modified to allow and encourage commercial stakeholder organizations take on selected management responsibilities (With this additional institutional layer, the regime since 1999 is best described as a co-management regime based on ITQs, rather than a pure ITQ regime. See Yandle 2003; Bess 2005; Yandle 2006).

The Debate over ITQ Management

The debate over ITQs and the reasons for and against introducing ITQ management is extensive and well-documented in the National Resource Council's "Sharing the Fish" report (NRC 1999) as well as other sources (e.g., Kaufmann et al. 1999; Grafton et al. 1996). A few key points in this debate are briefly highlighted below.

Arguments advanced in support of the market-based approach include: (1) the resulting improvement in economic efficiency and the higher incomes for fishers and the industry as a whole (Scott 1955; Clark 1994; Grafton et al. 2000; Repetto 2001); (2) ITQs can help to eliminate the race for fish (derbies) and its costly consequences and inefficiencies, including overcapitalization (Buck 1995; Grafton et al. 1996); (3) after initial allocation, ITQs can provide the industry with stability and ability to adjust quota holdings, so allowing both fishers and processors to make better operational decisions and investments (e.g., Clark 1994); and, ITQs can provide a form of property rights that provide incentives for the ITQ owners to enhance and conserve the resource, as well as participate in fisheries management (Yandle 2003; Bess 2005; Townsend et al. 2006).

However, these predicted positive outcomes are accompanied by rather a lengthy list of potential negative social outcomes which are often cited by ITQ critics. Many of these criticisms involve questions about who may own quota and how much quota may they aggregate. Industry consolidation, unemployment, and the loss of small-scale fishers are often viewed by critics as a negative result of the market-based approach (Young and McCay 1995; Palsson and Helgason 1996; Squires et al. 1995, Copes 1986; Copes and Charles 2004). Some of these perceived negatives, of course, are simply the "flip side" of the positive outcome of industry rationalization, which may have been inevitable. However, recent research in New Zealand suggests a more nuanced analysis, noting, "While it is clear that the number of small fishers has fallen since the introduction of the QMS [(New Zealand's ITQ-based "Quota Management System")] it appears that they, as a group, have been successful in finding alternative employment. From an employment perspective there is no evidence that New Zealand fishers have experienced significant social costs of restructuring the fishery." (Stewart et al. 2006).

Consolidation and aggregation of quota ownership into the control of a few companies can cause the wealth and control over the fishery to be moved out of a local community (Palsson and Helgason 1996), resulting in loss of community and damage to existing local institutions (Schlager 1990; McCay and others 1998). However, recent studies suggest that there is considerable complexity to the consolidation process and in the effects of its outcomes (e.g., Brandt 2005; McCay and Brant 2001; Dawson 2006). Encouraging the most efficient catching methods can also be the source of problems. For example, fishers have incentives to engage in other ITQ-specific forms of cheating, such as discarding lower-valued portion of their catches (highgrading) and not reporting landings (quota busting) (Copes 1986; Palsson and Helgason 1996; Turner 1997). Branch et al. (2006) recently presented a more nuanced analysis of the problem, noting that when ITQs were introduced in British Columbia discard issues declined, while in the non-ITQ US West coast fishery, discard increased markedly. They conclude that "full observer coverage, ITQs and mortality accounting" may provide the optimal setting for reducing discard issues.

Finally, ITQ management and other total allowable catch (TAC) based systems have high information costs compared to approaches that simply regulate fishing effort. To set TACs correctly, there must be a sound scientific understanding of the fishery's population dynamics. If the TAC is set too high the fishery can be overfished, (Copes 1986; Mace 1993; Loayza 1994). If TACs are set too low, a cost in the form of un-captured fishery output is incurred.

While the literature on ITQ management includes detailed discussions of the potential effects there is relatively little research which systematically reports the actual long-term effects of market-based environmental regulation, such as ITQ management. (Steelman and Wallace 2001; Imperial and Yandle 2005) This is probably because most transferable quota programs are relatively young or small scale. However, New Zealand's use of ITQs in their fishing industry has a relatively long history and nationwide implementation, providing a sound case for study.

This article examines industry consolidation from 1986 to 1999, the period that the ITQ system was managed by government (New Zealand Fisheries Act 1996; Amendment Act 1999). We concentrate on this issue because it is a key issue to those now considering market-based fisheries management approaches. As noted, since 1999, New Zealand has adopted a co-management regime based on ITQs which makes the more recent experience less relevant to the question of ITQ management effects. In the current co-management regime, ITQ owners and government share management responsibility. In 1999, New Zealand enabled the participation of commercial stakeholder organizations in fishery management, overlaying and integrating this institutional layer over the existing ITQ regime. Critical tasks, such as quota registry, quota trading, recordkeeping, some local management, and some research, was delegated to the private sector. This introduction of co-management creates an additional set of responsibilities and incentives that substantively changes fisher behavior. (See Yandle 2003; Yandle 2008; and Bess 2005 for a detailed discussion of this transition.) Thus, any data collected after 1999 would not be fully comparable with data collected before 1999. As a result, we restricted our analysis to the 1986–1999 period to ensure that our results focus on the effects of the initial government-managed ITQ system. Multiple original data sources are used, including historic quota ownership records, our surveys of fishers and fishing companies, and our interviews with key policy makers.

New Zealand Fisheries Case Background

The New Zealand fisheries management system regulates within a 200 Mile Exclusive Economic Zone (EEZ) covering an area of 1.2 million square nautical miles, or approximately 15 times New Zealand's land mass. There are approximately 1,000 species of fish and shellfish in the EEZ, of which 100 are considered commercially significant. In the late 1990s, the annual catchable stocks totaled 494,374 tons of quota-managed species, and 42,153 tons of species not under quota management (Clement and Associates 2001). In 2000, the fishing industry was New Zealand's fourth largest export earner, with exports totaling NZ$1.43 billion (SeaFIC 2002), with squid (*Nototodarus* sp.), orange roughy (*Hoplostethus atlanticus*), hoki (*Macruronus novaezelandiae*), and rock lobster (*Jasus edwardsii* and *Sagmariasus verreauxi*) the largest revenue earners (Statistics New Zealand 1999). With the exception of lobster, these are all mid- to deep-water species requiring large-scale fishing operations.

The industry is divided into two very different sectors. The deepwater industry, which targets species such as orange roughy, squid, hake (*Merluccius australis*), and hoki, is dominated by a small number of large vertically integrated harvesting and processing companies. The inshore industry targets species such as snapper *Chrysophrys auratus*), flounder (*Rhombosolea* sp.), rock lobster, and gurnard (*Chelionichthys* sp.). Inshore fisheries consist of a mixture of independent small-scale fishers who primarily sell their catch to the vertically integrated companies; and by boats that are owned by the vertically integrated companies with hired crews. The grounding of the fishing industry in local communities is and has been relatively limited.

The history of the fishing industry in New Zealand is very different than in many nations. The deepwater industry is relatively young, dating back only to 1983 when New Zealand declared its EEZ and began offering incentives for the then nascent domestic industry to replace the foreign fleets that had been fishing within the 200-mile limit. There is a longer (100+ year) history of fishing and governmental fishing regulation of the inshore industry (Annala 1983), and some towns have their origins as whaling and fishing ports (Johnson and Haworth 2004). However, historically strong community-based inshore fishing regulation, such as is found in New England lobstering (Acheson 2003), is lacking. (This may be due to the relatively recent early-19th century colonization of New Zealand.) The exception to this is the indigenous Maori, for whom fishing was an integral part of the traditional community and lifestyle (e.g., Bess and Harte 2001; Orange 1988). Furthermore, while there are strong nationally-based groups representing the fishing industry, the strong local institutions that are often associated with fisheries management elsewhere in the world are not present in the case of New Zealand.

While the New Zealand's deepwater fisheries were experiencing rapid expansion in the early 1980s, the inshore fisheries were experiencing a different set of challenges. In response to the inshore fisheries depletions of the late 1970s and early 1980s, the New Zealand government first

implemented a series of input-based management controls; then, in 1983, removed all part-time fishers from commercial fishing (Annala 1983). As a result, between 1983 and 1985 the number of licensed fishing vessels dropped from 4320 to 2744 (Department of Statistics 1985) representing a 37% reduction of the 1983 fishing fleet. This contrast is important because it both illustrates the different challenges facing the inshore and deepwater industries, and creates methodological issues (discussed below) for analyzing the effects of ITQs on consolidation.

In 1986, New Zealand became one of the first nations to adopt market-based fisheries regulation with implementation of its Quota Management System (QMS), with its emphasis on the use of Individual Transferable Quotas (ITQs), the removal of subsidies and promotion of exports. Rapid implementation occurred at a time of economic crisis when New Zealand switched much of its economic policy to nonsubsidized market-based approaches. New Zealand's system is now viewed as a long-standing example of the market-based approach to fishery management (Clark 1993; Batstone and Sharp 1999). Between 1986 and 1999, the scope of the QMS has expanded and changed in some details (e.g., a switch from tonnage-based quota to proportion-based quota; from resource rental funding to cost recovery funding; and the settlement of Maori fisheries rights disputes), but the fundamental principles of the system remained constant for the period addressed by this study.

As might be expected, New Zealand's QMS attracted considerable attention worldwide. Literature on the QMS is primarily made up of descriptions of how QMS worked (e.g., Clark et al. 1988; Annala 1996) or economic analyses that highlighted the success of QMS in conserving resources while encouraging improved economic performance (e.g., Clark 1993; Batstone and Sharp 1999). (Differing views are offered by Rennie 1998; Duncan 1993; and Wallace 1998.) Other articles focus on specialized issues such as enforcement (McClurg 1994), stock assessment (Mace 1993), and the more recent development of co-management organizations (e.g., Yandle 2003; Yandle in press; Bess 2005; Townsend et al. 2006; Harte 1998). Literature on the socioeconomic effects of the QMS has primarily been limited to the impact on the rural Northland and/or Maori communities (e.g., Fairgray 1986; Cassidy 1999). Additionally there is Dewees' research on the social consequences of QMS in the Auckland region (e.g., Dewees 1989; Boyd and Dewees 1992; Dewees 1996a, 1996b, 1998; Yandle and Dewees 2003).

Research Questions and Data Sources

In this study we systematically explore New Zealand's experience on the issues currently being debated in the literature. We examine industry consolidation, aggregation, and reduction in numbers of small-scale fishers by asking "to what extent does ownership of ITQ (and participation in the fishing industry) result in a shift from a large number of small-scale participants to a small number of large-scale participants?" (There is not a perfect correlation between ITQ ownership and fishery participation. For example, many fishers can fish "on leased quota," i.e., by purchasing annual catch entitlement or ACE each year). Thus, while ITQ ownership is not a perfect measurement of fishery participation, there is no simple resolution of this problem. Our examination takes place at both the national and Auckland regional level.

Data sources for this analysis include quota ownership records; surveys of fishers and fishing companies; and interviews. Descriptions of each data source and its use in this study are described in Table 1. (Detailed discussion of methods is available in Yandle 2001, and for the historical survey in Dewees 1989.) By using these multiple data sources (both qualitative and quantitative) we are able to 'triangulate', and thus increase our confidence in the findings (Yin 1993). According to Putnam (2000), "No single source of data is flawless, but the more numerous and diverse the sources, the less likely that they could all be influenced by the same flaw." Thus, whenever possible, combinations of multiple documentary sources and/or multiple interviews have been used to construct and confirm information presented. This approach encourages both the rigor and testing associated with quantitative research and the descriptive detail and insights associated with qualitative research.

Industry Consolidation, Aggregation, and the Loss of Small Fishers

Industry consolidation (the process of reducing the number of quota owners and fishers within a fishery) and aggregation of quota (a shift in quota ownership from its initial distribution towards a small number of companies) are two of the primary criticisms of ITQs. Critics argue that consolidation can be associated with the loss of small-scale fishers and a shift in power (and potentially management responsibility) from the "on the water" fishers to the fishing companies. Similarly, loss of small fishers can have negative effects in small, rural/coastal communities. On the other hand, proponents of QMS argue that increased efficiency is a positive outcome for longer run health of the industry and the nation. Consolidation and loss of small fishers can be seen as a natural (and desirable) consequence of increased efficiency, effort reduction, and industry rationalization.

Finally, as noted above, implementation of QMS in the inshore fishery came after the earlier removal of all part-

Table 1 Summary of study data sources

Data source	Description
Historical survey of Auckland region fishers	Three rounds of this survey were conducted in 1986, 1987, 1995, and 1999. It is based on a random sample of provisional quota owners in 1986. The same quota owners were surveyed in following waves of the survey and includes small scale fishers and companies. In 1999, there were 39 respondents (down from 62 in 1986 and 1987—most nonparticipants were dead, missing, or too ill to participate). Surveys were conducted by in-person interviews. This provides unique panel data, however it is limited by a dwindling pool of respondents and is restricted to a single region.
1999 Auckland small scale fishers	A subset of the historic survey of Auckland region fishers, this group is composed of all participants in the 1999 Auckland region fishers survey who were not representatives of a well-recognized, multi-vessel company. All of the participants in this smaller subset were individual operators, some of whom worked individually, and some of whom had small crews working on their vessels. There were 28 respondents in this subset. Surveys were conducted by in-person interviews. This provides a unique interview sample with existing confidence in the researchers. However, it is limited by its small sample size and restriction to a single region.
1999 national company survey	A subset of a 1999 nationwide fishing company survey, this includes 25 large and small fishing companies in New Zealand. A nationwide survey is used because the number of companies based in Auckland was relatively small, and companies based in other areas can fish in Auckland regional waters. Surveys were conducted by in-person or phone interviews. This provides a unique interview sample that is nationwide in scope. While not every firm is interviewed, we believe it is representative.
Historic quota ownership records	Data available from Clement and Associates (2001) (a fishing industry consulting firm) tracked quota ownership annually by individuals and companies (broken down by quota management areas and species) for 1986 to 1997. This provides independent data on quota ownership for most of the years in this study. However, data for two years (1998 and 1999) were not available from this source. This provides the data needed for a rigorous quantitative analysis but it is missing the detail and insights needed to understand the dynamics revealed by the data analysis.
Expert interviews	In-person interviews were conducted with key experts in New Zealand fisheries management. Since experts were from a variety of fields (academia, Ministry of Fisheries, Treasury, industry groups) there was no standard interview format. Instead, interviews were tailored to individuals. Experts reviewed and confirmed all quotes attributed to them. This provides nuanced insights into the events surrounding QMS; however, this type of data is limited by the biases and agendas of the individual interview subjects
Historical documents	Yearbooks, annual reports (government and industry groups), studies, position papers, parliamentary submissions, books, and articles published in trade magazines all provide data and rich detail not available from other sources. These provide historically accurate data (unchanged by the impression of later events) but were not always comprehensively maintained by the host archives.

time fishers from commercial fishing in 1983, resulting in a 37% reduction of the 1983 fishing fleet. This loss occurred before QMS was introduced in 1986, so this shift in harvesting and fishery participation away from the smallest of the fishers began in direct response to over fishing and before quota was distributed. Thus, we have a truncated data set where a large proportion of the small-scale fishers were already removed.

Trends in Quota Ownership

Historical quota ownership records are the most direct source of information about trends in quota ownership. Consolidation and aggregation are usually assessed by examining the proportion of quota owned by the largest players at different times. Typically, this is tested using Gini coefficients and Lorenz curves (e.g., Liew 1999; Connor 2001; Palsson and Helgason 1996). However, this approach is problematic in New Zealand because there are incentives for both companies and small fishers to split their holding among multiple legal entities. (For example, multiple holding companies can be used to circumvent aggregation rules. Or, for the smaller fishers, there can be both tax and compliance penalty avoidance advantages placing portions of quota in family trusts.) This can artificially reduce measured Gini coefficients and thus underestimate consolidation over time. An illustrative example of this problem is 1998 ORH7A stock where a single company in a relatively small fishery (in terms of numbers of entrants) used three holding and allied companies to hold 24, 22, and 171 tons of catching rights. By relying on proportion of large versus small holders, this information would artificially reduce the Gini coeffienct. By examining the change in the number of owners (regardless of size of catching right held) over time, consolidation can be more accurately measured (Yandle 2001).

To address this problem, our analysis focused on changes in the number of quota owners over time. While the 1996 Fisheries Act may have more tightly regulated holding companies and family trusts, we could find no evidence in historical documentation or interviews that this legislation or any other changes in the regulatory environment during the

study period increases the susceptibility of the analysis to this use of these legal entities. Furthermore, during the period under study, several important fisheries, including rock lobster and scallops, were added to the QMS. As a result, perhaps as many as 600 participants were added during the period under study (Dewees 1996a). Also, some participants sold out their quota and switched to fisheries such as tuna that were outside of the QMS. Thus, while we believe our analysis is robust to this issue, it is possible that consolidation and aggregation are under-estimated.

The number of quota owners for active fish stocks were compiled in 1986 and 1998 (1999 is excluded since the legislative changes enabling co-management were passed during the 1999 season) and noted whether the species were in inshore or in deepwater fisheries. Species were classified as inshore or deepwater based on the description of the species provided in Paulin 1998 and Annala et al. 1989. Changes in number of quota owners over time and between inshore and deepwater fisheries are compared using a two-way ANOVA test. This examines the degree to which consolidation occurred, and whether there is a difference in the degree in the inshore versus deepwater fisheries.

Results of this analysis (presented in Table 2) provide clear evidence that consolidation occurred, particularly in the inshore fisheries. For the within-subject effects, when we ignore the difference between inshore and deepwater fisheries, the change between 1986 and 1998 was statistically significant ($p < .001$) and explains 15% of variance in the number of quota holders. Also, the interaction between the location of the fishery (inshore versus deepwater) and time shows that the way in which the number of fishers changed depends to some extent on whether the fishery was inshore or deepwater ($p = .003$, 8% of variance explained). Finally, the analysis of the between-subject effect shows that if we ignore time, there were more quota owners in the inshore than deepwater fisheries ($p < .001$, 12% of variance explained). Together, these results are most readily understood by examining Fig. 1, which illustrates the difference between the deepwater and inshore fisheries. This shows that when all the deepwater fisheries are examined, the number of quota holders in the deepwater fisheries dropped from an average of 40 quota owners to an average of 35 quota owners, a drop of 13%. Meanwhile, when all the inshore fisheries are examined, the number of quota holders in the inshore fisheries dropped from an average of 95 quota owners to an average of 67 quota owners, a drop of 30%.

This analysis shows that during the period QMS was in effect, there was a substantial drop in the number of quota holders in the inshore fishery. This suggests that QMS, combined with reduced TACs and rising costs, led to many quota owners leaving the inshore fishery. In contrast, the deepwater fishing industry only began to develop in the early 1980s, meaning that for much of QMS period it was a developing fishery. Thus, with few quota owners to begin with, and an expanding rather than contracting sector, it is reasonable that the rate of consolidation was less for the deepwater industry. These results, particularly the difference between the inshore and deepwater fisheries fits well in the historical context of the New Zealand fishing industry where the inshore fishery was historically dominated by large numbers of small-scale inshore fishermen, and thus would be open to dramatic consolidation.

In addition to this analysis, two reports on consolidation use historical quota ownership data. These analyses focus on changes in the amounts of quota owned, providing direct evidence regarding aggregation of quota ownership. They are, however, vulnerable to the concerns mentioned above. Clement (1996) addresses this in a large owner analysis by identifying holding companies, then aggregating them together. However, this was not conducted for all quota owners. Connor (2001) did not address the holding company issue. The earliest was commissioned by the Fishing Industry Association to analyze changes in patterns of quota ownership (Clement 1996). While drawing no

Table 2 Two-way ANOVA analysis of changes in number of quota holders over time between inshore and deepwater fisheries

	df	*F*	Sig.	Eta squared
Within-subject effects[a]				
Time	1	18.782	<.001	.148
Time × location	1	9.231	.003	.079
Between-subject effect				
Location	1	15.205	<.001	.123

[a] Reported results using sphericicy assumed test

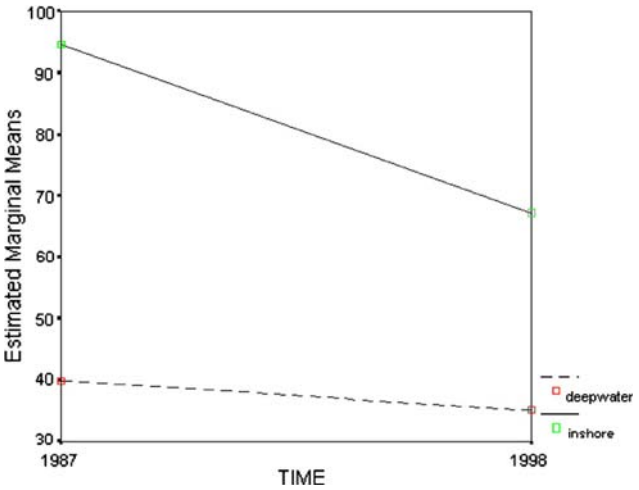

Fig. 1 Marginal measures of change in the number of deepwater and inshore quota owners

conclusions about aggregation or consolidation, the report observed that "forty-one percent of ITQ are currently owned as a result of initial allocations to these quota owners and 59% are owned through subsequent purchase" and that "75% of ITQ are currently owned by the ten largest companies, all of whom have purchased between 46 and 100% of their quota" (Clement 1996). Also, the report's analysis of the largest companies showed that these companies all steadily increased their proportion of total quota ownership. The most dramatic of these are Sealord's change from 10.7 to 25.5%, and Sanford's increase from 9.5 to 20.2% (Clement 1996). Together, these findings illustrate that by the 1990s an aggregation process was underway, largely through the purchase of quota by larger companies from smaller companies or owner-operators.

Connor (2001) focused on both quota ownership patterns and changes in the composition of the fishing fleet. Overall, in spite of a 15% increase in total allowable commercial catch (TACC), Connor found a 26% reduction in the number of quota owners (Connor 2001). Furthermore, smaller vessels, especially those 6–9 m in length "have been disappearing," while the number of mid-sized vessels remained stable, and the number of large fishing vessels increased (Connor 2001). This not only illustrates that aggregation was occurring, but there was also a shift away from the smaller-scale fishers towards a larger more industrialized fishery.

To summarize, all available analyses of changes in quota ownership provide direct evidence that industry consolidation and aggregation of quota ownership has occurred in the New Zealand fishing industry. Our analysis shows that consolidation – a statistically significant decrease in the number of quota owners—occurred between 1986 and 1998, and that the rate of consolidation was higher for the inshore fishery than the deepwater fishery. Other analyses provide further evidence that aggregation of quota ownership occurred.

For the inshore fisheries, the historical context and concerns over the state of the fish stock created a situation in which consolidation was possible (and even desirable for the fish stock). None the less, it is clear that when combined with Connor's (2001) findings about changes in boat sizes, there is considerable support for the argument that the number and proportion of small-scale fishers has been reduced during the QMS regime. Furthermore, this consolidation and aggregation occurred in both the inshore and deepwater fisheries—albeit at different rates—suggesting that the introduction of an ITQ regime did change the incentive structure to encourage both consolidation and aggregation.

Perceptions of Consolidation and Aggregation

Another source of information is our Auckland region and nationwide company surveys that examine the views of industry members. Surveys in the Auckland region were conducted between 1986 and 1999, while the nationwide survey of fishing companies was conducted in 1999. See Table 1 for methodology summary of data sources and methods. Unlike the data presented above, these surveys measure survey participants perceptions of change in the industry, tapping into the participants' collective knowledge rather than attempting to directly measure the change. By their very nature, these results are imbedded within the historical context (described earlier) within which QMS was implemented. For example, Auckland region has faced stresses somewhat more severe than other inshore fisheries, so these results cannot be interpreted as representative of *all* small scale or inshore fisheries.

Analysis of the 1986 and 1999 Auckland region surveys (See Table 3) shows that within the Auckland region there was consistent agreement (reflected in the mostly nonsignificant *t*-tests, indicating no change in opinion over time) that QMS made it difficult for the next generation of fishers to enter the industry as owners. Furthermore, among the respondents to the Auckland region survey who were still involved in the industry, their level of financial commitment had fallen from (on a four point scale) a mean of 3.04 to a mean of 2.58. This reduction in commitment, which is significant at the $<.05$ level, indicates that the small-scale fishers (who dominated the Auckland region survey) were losing their financial commitment to the industry, and thus loss of small fishers and aggregation would likely continue. Survey interviewees often cited reductions in snapper TACs (40%), rising QMS cost recovery levies, age and health, growth in allocations to recreational fisheries, and other employment opportunities as reasons for selling our or reducing their financial commitment to fishing.

Table 3 Auckland region survey responses on small fisher issues over time

	1986 Mean (*n*)	1999 Mean (*n*)	*T*	*df*	Sig. (two-tailed)
"ITQs make it difficult for young people to start fishing" (4 = Strongly agree, 1 = Strongly disagree)	3.54 (39)	3.46 (39)	.40	38	.637
"Current level of commitment to fishing business" (4 = increase, 1 = getting out)	3.04 (26)	2.58 (26)	2.484	25	0.020

A comparison of the small fishers in the Auckland region survey and the nationwide company survey (Table 4) show a striking difference in outlook between the companies and small fishers in 1999. Companies were consistently more optimistic than the small-scale fishers. (However, both companies and fishers agree QMS makes it difficult for young people to enter fishing.) Companies were increasing their commitment to the fishing industry, while the fishers were either maintaining or reducing their commitment ($p < .001$). Similarly, fishers on average expressed nearly perfect neutrality (mean = 2.55) on whether the industry was better off under QMS, while companies broadly agreed that the industry was better off ($p = .001$). Finally when asked to describe their economic condition, companies were generally optimistic (mean = 6.69) while small-scale fishers (mean = 4.19) were more pessimistic ($p < .001$). The difference in opinion suggests large companies succeeded under New Zealand's QMS, while small-scale fishers experienced considerable difficulties.

Examining these aggregate survey responses suggests that there was a fundamental difference of perception between the small-scale fishers and the companies. The companies were relatively unaffected by the turmoil in the inshore fishery, while the small-scale fishers were not considering the growth in the deepwater fishery. But a review of commentary by both fishers and companies shows a more complex picture. Some companies believed that the small-scale fishers "had their chance" but others watched the inshore situation with concern for the industry's futures:

> "The system has hurt small fishers and that shouldn't be. There were early capital problems and complete misunderstanding by small fishers...Its fundamental, the industry needs small fishers and fishing communities for the system to work." (Company Survey #4)

> "The reality is that there's been a restructuring in the industry since 1986, [with] quota in fewer hands [and] fewer registered vessels. There's pain in the smaller communities. But there's also more value added now either on the ships or on shore." (Company Survey #5)

> "Smaller fishers had their chance. They were allocated quota. Small fishers went wrong was selling quota with an agreement to continue catching. They sold themselves out for cash." (Company Survey #15)

> "I've been able to grow my company from one 42-foot longliner making $150,000/yr to a company turning over in excess of $10,000,000/yr." (Company Survey #16)

Opinions among the small-scale fishers suggest that the aggregate response of near perfect neutrality reflects a set of broadly divided opinions rather than a group of undecided individuals. A review of the comments shows that while some saw small-scale fishers as victims of QMS, others focused on choice and fishers' decisions to stay in the industry for the lifestyle. This is consistent with Gatewood and McCay's (1990) findings that individual fishers often stay in a fishery beyond when it is economically rational because of the value placed on nonmonetary rewards, such as the lifestyle. Fishers commented:

> "I don't think they [the government] want us, the little guys, in the system, we're a pain in the ass. They want big companies they can control." (Auckland Survey #18)

> "My son tried to get into fishing three times and each time he's gone bust — it's too expensive to buy or lease quota. Virtually no young people are coming up. ... I can see a time when ... nobody will be left to catch. The skill is going out of the industry." (Auckland Survey #19)

Table 4 Comparison of outlook of Auckland small-scale fishers and nationwide companies

	Fisher mean (*n*)	Company mean (*n*)	*T*	*df*	Sig. (2-tail)
"Current level of commitment" (4 = increase, 1 = getting out)	2.48 (23)	3.84 (25)	−6.753[a]	28.914	<.001
"My/my company's economic condition in the future" (1 = worst, 10 = best)	4.00 (20)	7.74 (25)	−5.580[a]	28.637	<.001
"My/my company's economic condition today" (1 = worst, 10 = best)	4.19 (27)	6.69 (26)	−4.418[a]	42.418	<.001
"My Economic Condition has improved under QMS" (4 = strongly agree, 1 = strongly disagree)	2.32 (34)	3.40 (20)	−4.342	52	<.001
"The fishing industry is better off under ITQs" (4 = strongly agree, 1 = strongly disagree)	2.55 (33)	3.35 (26)	−3.473	57	.001
"My/my company's economic condition before ITQs" (1 = worst, 10 = best)	7.41 (34)	5.13 (16)	3.624	48	.001
"ITQs make it difficult for small fishers" (4 = strongly agree, 1 = strongly disagree)	3.26 (35)	2.72 (25)	2.362	58	.022

[a] Reported results using sphericicy assumed test

> "Conditions are quite shocking. Only reason people are in it is the lifestyle. You don't like to leave it. People nearly go broke before they get out. We're fishing for our pride." (Auckland Survey #39)
> "They [small fishers] have done alright — you have to go for the higher quality and get better prices." (Auckland Survey #35)

In summary, commentary by both small-scale fishers and company representatives suggests that in spite of some dissenters, there was broad agreement that QMS and reduced TACs strengthened motivations for small-scale fishers to sell out, but there was a wide range of opinions over the causes and consequences.

Aggregation Limits

The rate of aggregation can also be gauged by examining the granting of exemptions to the aggregation limits. Under the 1996 laws, quota ownership was limited to 35% of the quota for any fish stock. There are the following exceptions: (1) 10% of rock lobster quota, (2) 20% of paua quota, (3) 20% of bluenose, and (4) 45% of any species brought in under the 5th schedule (Fisheries Act 1996). However, exemptions to these limits were granted. Thus, tracking aggregation limits provides insight into the degree of aggregation. We obtained from the Ministry of Fisheries a list and description of all exemptions approved from the start of QMS through 1999.

Analysis of these exemptions shows that there were 38 exemptions recorded between 1988 and June 1999. The rate at which aggregation exemptions have changed over time, beginning slowly during the early years of QMS, then peaking in 1997 and 1998. Often these exemptions covered multiple species (for example, one exemption in 1997 covered 26 different species). These exemptions are also substantially more than the limits described above. These exemptions defined the total percentage of a fish stock ITQ that a company or individual could hold. (For example, a 40% exemption would allow the exemption holder to own up to 40% of that fish stock) Exemptions of 35 or 45% of a fish stock were common, and in some situations, exemptions of up to 100% of a fish stock were granted. In some cases, two different companies were given exemptions for 45% of the same fish stock. In 1997, 45% of the fish stock for alfonsino and barracuda—among other species—was granted to two different companies.

Reporting on Consolidation and Aggregation

In addition to the direct information sources used above, articles in industry papers and the popular press expound on the consolidation, aggregation, and small-scale fisher issues. Industry publications, such as *Seafood New Zealand (SFNZ)*—the industry trade journal—provide a forum to discuss these issues. In the late 1990s, *SFNZ* published a series of articles profiling various ports throughout the country and describing the changes seen since the introduction of QMS. These articles are summarized in Table 5. The articles illustrated that since QMS, a major restructuring occurred throughout the country, with small fishers leaving the industry, and many rural communities losing traditional small fishing ports. In some cases, seafood companies switched some fisheries operations into the growing shellfish aquaculture and processing sector. At the same time, a few ports (such as Nelson) saw expansion as they grew to support and process deepwater species; and more broadly (e.g., Northland, Auckland region, Marlborough Sounds) aquaculture of shellfish and its associated processing also expanded. Both of these sectors provided alternative employment opportunities, sometimes in the same or nearby communities.

Analysis

This research uses a combination of quantitative and qualitative evidence to examine consolidation and aggregation in New Zealand commercial fisheries. This evidence includes four surveys (three rounds of the historical Auckland fishers' survey and the 1999 national company survey); historical quota ownership records; expert interviews; and extensive historical documentation. The results from analyzing this evidence indicates that within the inshore fishery, consolidation and aggregation of quota ownership clearly occurred coupled with a reduction in the number of small-scale fishers. In the deepwater fishery, the rate at which consolidation occurred was much slower in part due to continued growth of the sector. But consolidation is underway there as well. Thus it is apparent that quota aggregation is an issue that a QMS, as designed in New Zealand, had difficulty addressing—particularly in the deepwater fishery where two or three owners could control a fishery.

However, these findings must be examined in the context in which QMS was introduced. In the inshore fishery, there were serious concerns over the potential collapse of multiple fish stocks (Clark and Duncan 1986), which would have triggered a massive "consolidation". There was general agreement that the level of effort in the fishery needed to be reduced and efficiency improved (inevitably leading to fewer fisher numbers), and that QMS was the fairest and most efficient method to accomplish this goal. In many ways, the pain so vividly described in the inshore fishery was a direct result of the need to reduce fishing pressure on the fishery, and may have been more catastrophic if other more traditional regulatory mechanisms

Table 5 Changes in ports since introduction of quota management system—as described by Peter Stevens

Port/ region	Description	Fleet
Far north (Stevens 1999a)	Scalloping suffers under high levies and low profits, but lobster potting thrives. Finfishing dominated by company-owned boat based further south that discharge in northland. The local trawlers depend on leased quota.	19–20 lobstermen 20 company-owned trawlers 5–6 locally owned trawlers Local fleet smaller than pre-QMS.
Napier (Stevens 1999c)	Previously, Napier was a "busy bustling fishing port" but while fishing industry is still active, it no longer dominates. Similarly, owner-operators have less of a role than companies. But Napier continues to thrive as a fishing port for both the domestic and export market.	Lost 12 vessels in last 18 months. Rock lobster fleet down to four vessels in Napier and 13 in the region. Three quays one filled with small and mid-sized vessels are partially filled.
Gisborne (Stevens 1999d)	Before the 1960s, Gisborne was a small fishing port, which during 1960s–1980s grew into a bustling port both inshore and deepwater. Now, it is described as a "boutique," serving both the domestic and export markets. Fleet is considered stabilized.	Trawling fleet (now 8–9 vessels) is half the number and tonnage of the boom years. 11 longliners No set netters 25 rock lobster vessels in the region
Bay of plenty (Stevens 2000c)	This region has both an inshore fishery and a seasonal tuna industry headquartered in Tauranga, which is the primary port in the region. Many fishers went from quota species to non-quota tuna. Lobster gone from 128 to 48 boats, trawling declined to 7 vessels. Longlining is dominant, other methods also used. Rationalization in longlining expected and recreational/pleasure boats compete for port space and some species.	Tauranga—7 trawlers, 5 purse seiners, 5 danish seiners, 60 tuna longliners, 7 bottom longliners, some crab & setnetters. Whitianga—shifting from working to pleasure boats. 8 lobster, 13 longliners, 1 danish seiner Whangamata—3–4 scallop dredgers Whakatne—once commercial port, now 4 commercial and 28 charter
Taranaki (Stevens 2000d)	There are two ports in region. One has stabilized; the other is no longer in commercial operation. Inshore and mid-depth species fished. Steady long-term outlook.	Wanganui—was major port in 1950s now one part-time fisherman. New Plymouth—fewer vessels than earlier. 2 trawlers, 2 longlining, 4 lobster
Wellington (Stevens 1999h)	Less processing occurs here, instead, this port primarily served the local market. Deepwater trawlers often visit. Small and medium vessels are disappearing, some charter and recreational fishing development. Lack of investment in capital has hurt port's ability to compete.	Were mostly mid-sized boats, now larger deepwater vessels also. Island Bay—was fleet of 20+, now 2 vessels. Ngwi—20 lobster boats Others—down to 2–4 vessels
Nelson (Stevens 2000b)	The largest fishing center in terms of tonnage landed and processed, but much of this is from the deepwater fisheries, or shipped in from other ports. Three of the dominant companies are based in the region. Nearly 25% of the region works directly or indirectly for the industry. The inshore fishery is small and continues to lose small fishers, but scallop fishing is growing. Aquaculture increasingly important to region.	Nelson—large active port expanded for large vessels. Five small ports—no longer active. Westhaven—down to 3 lobster boats Waitapu—lost most fishers Tarakohe—6 boats, could expand to deepwater Motueka—most use for processing, 12 small boats do oyster and scallop catching, inshore trawl.
Marlborough (Stevens 1999b)	Traditional small fishers squeezed by quota costs. Deepwater fishing based elsewhere. Few processing facilities. Rock lobster, scallops, paua continue to be caught, but main growth is in aquaculture (Greenshell mussels) and recreation/ tourism.	Picton—no trawlers, 23 cray/line boats Port underwood—2 trawlers, 5 cray boats Kaikoura—Trawlers dropped from 4 to 2, set netters from 36 to 6
Lyttelon/ Christchurch (Stevens 1999f, 1999g)	A large port, multiple processing facilities (seven companies), as well as easy access to an international airport, this area is well set-up for the international and domestic markets. Also, the port is close to the deepwater fisheries.	Inshore fleet has declined to 28 vessels (mainly trawlers) further declines anticipated. Foreign charter fleet heavily uses port Other deepwater vessels discharge
Timaru (Stevens 1999e)	This is the second-largest fishing port in the country. Industry seen as primary economic engine of Timaru. On-shore facilities for the deepwater industry expanding. Loss of small fishers.	During late 70s/early 80s there were 40–50 set netter. Now there are 3or 4. Also 20 local inshore trawlers. Large deepwater trawlers and squid jiggers use port.

Table 5 continued

Port/ region	Description	Fleet
Otago (Stevens 2000a)	Inshore fishermen described as "despondent" and there are concerns for local processors. Some fishers who want to leave are unable to sell boat, house, or quota. Deepwater fishery is growing well in both catching and processing. While small towns and ports shrink, Dunedin has seen rapid growth in fishing and processing.	Omaru—was large port now 4 small trawlers Moeraki—12 vessels (down from 28) Karitane—5 vessels (down from 16) Port Chalmers—9 vessels (was 30+) Duneden—added 200+ jobs onshore & at sea. Taieri Mouth—10 vessels (was 13 a year ago)

were used. Nonetheless, there can be little doubt that the incentives and opportunities created by New Zealand's QMS sped up development of the deepwater fisheries and contributed to consolidation and aggregation in the inshore fisheries.

Summary and Conclusion

This research examines consolidation (including the aggregation of quota and reduction of small-scale fishers) in New Zealand's Quota Management System between 1986 and 1999. We used multiple data sources and methods, including surveys of industry participants, expert interviews, review of academic reports and analyses, analysis of trade publication, and (in the case of consolidation) direct analysis of quota ownership patterns.

Results from this analysis reveal a pattern of complexity and subtlety not often discussed in the literature surrounding ITQs (Branch et al. 2006, Brandt 2005, and McCay and Brandt 2001 are notable exceptions). On the contentious issue of consolidation, we found that within the New Zealand context and QMS design specifics, inshore fishery consolidation and aggregation of quota ownership clearly occurred and was coupled with a substantial decline in the number of small-scale fishers. Reductions in TACs to rebuild stocks, increases in cost recovery levies, high aggregations limits, aging of fishery participants, and the vertically-integrated seafood companies' desire to increase quota holdings all contributed to declines in numbers of small-scale fishers. There is also evidence that some inshore fishers may have simply shifted their effort from fisheries inside of QMS to other fisheries—such as tuna, which was for many years outside of QMS (Ministry of Fisheries 2003). However, in the deepwater fishery, the consolidation rate was much slower, due in part to continued growth in the sector during the 1986–1999 study period. Furthermore, New Zealand's QMS did little to address aggregation of quota ownership—particularly in the deepwater fishery where two or three owners could control a regional fish stock.

These findings must be looked at in context. When QMS was introduced in 1986, it was with the goals of using market-based approaches to rebuilding inshore fish stocks, promoting economic efficiency, increasing export earning, and developing valuable deepwater fisheries. These goals have largely been achieved. Moreover, the attrition of small-scale fishers would likely have occurred under other regulatory approaches that included the goal of rebuilding the inshore fish stocks, potentially with little or no compensation. Finally, other factors that were beyond the scope of this analysis (including various regulatory changes (e.g., the change from resource rentals to cost recovery), great in-country processing, and the rise of aquaculture may have influenced consolidation and aggregation in ways that could not be disaggregated and examined in this study.

This analysis shows a much more complex outcome than recent debates in the ITQ literature would suggest — regarding both the causes and consequences of consolidation and aggregation. Elements supportive of both sides of ITQ debates are present in these results; industry consolidation occurred in the New Zealand case, but the rate of change and degree of social impact varied between the inshore and deepwater fisheries.

These findings suggest that policy makers in the United States and other nations considering the adoption of ITQ systems should consider the experience of others when deciding when to adopt ITQ systems, and how to design the specifics of quota-based management systems to achieve desired ends. ITQ programs can be customized to address fishery goals as well as larger environmental, social, and economic objectives and tradeoffs. To a certain extent we see this occurring in programs such as Community Development Quotas (Ginter 1995; Matulich and Clark 2003), and a few of the more carefully prescribed ITQ programs currently existing in North America (Branch et al. 2006; Dawson 2006).

As discussion and design of new ITQ programs in the United States continues, there needs to be explicit discussion and agreement about fisheries' environmental, social, and economic goals so that agreed upon desirable features can be incorporated. In some cases, the existing United

States Regional Fishery Management Councils and state fishery agencies will be appropriate venues for this discussion; in other cases alternative organizations or venues may be more appropriate. Once these goals are agreed upon, details of management systems can be developed. For limited access privileges programs, such as ITQs, some critical issues include: initial quota allocation methods, who may own quota, aggregation limits, transferability rules, cost recovery, how to incorporate recreational fisheries, spatial/regional quotas, and first nations (indigenous) claims.

The key to all these adjustments is tailoring the management approach to the conditions present in each fishery. The New Zealand case also provides a reminder that the context in which policies are embedded is important. Matching policy solutions to context, rather than searching for a universally applicable solution is important.

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