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Perspectives

Multi-Species Individual Transferable Quotas: The Scotia-Fundy Mobile Gear Groundfishery

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Abstract *Few studies examine the economic effects of individual harvesting rights in multi-species fisheries. Using costs and earnings data from a multi-species individual transferable quota (ITQ) fishery in Nova Scotia, before and after the introduction of harvesting rights, the effects on inputs, outputs, prices, and vessel exit are examined. The results provide insights about the management of multi-species ITQs.*

Key words Fisheries management, groundfish, ITQs, multi-species, Nova Scotia.

Introduction

Individual transferable quotas (ITQs) are used in many fisheries and several different countries (Grafton, Squires, and Kirkley 1996). Of those ITQ programs currently in place, most have been established for single-species fisheries, where fishers primarily target a particular species. Some countries also use ITQs in a few multi-species fisheries, where a number of species may be targeted simultaneously. Unfortunately, many of the potential problems associated with so-called single-species ITQs are likely to be exacerbated in multi-species fisheries (Copes 1986). These problems include bycatch concerns, discarding, reconciliation of catches with quota holdings, and the setting of quotas that allow for flexibility in harvesting while ensuring the sustainability of different stocks (Squires *et al*. 1998).[1]

Many assessments of ITQs exist, including several books.[2] Despite the potential importance of ITQs in multi-species fisheries, few studies exist that examine the economic effects of transferable harvesting rights in such fisheries. Using individual vessel data from a multi-species fishery, Nova Scotia's ITQ program for mobile gear groundfish vessels 35-65 feet in length, the paper presents a review of the economic consequences of the introduction of private harvesting rights from the perspective of

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[1] In some ITQ fisheries, such as Australia's south-east trawl fishery, discarding appears to be a significant problem (Hogan, Thorpe, and Timcke 1999).

[2] Recent books include the National Research Council (1998) and Kaufmann, Geen, and Sen (1999), as well as proceedings from several conferences.

input use, output mix, and output prices. Insights from the study are used to provide suggestions regarding how to improve the management of multi-species ITQ fisheries.

Evaluation of Individual Transferable Quota Programs

Individual harvesting rights can potentially address a number of problems in fisheries. First, under limited-entry regulations, controls on the inputs may prevent fishers from optimizing their mix of inputs to minimize costs for a given level of output.[3] For example, restrictions on vessel size or gear may encourage fishers to substitute and use a greater amount of labor than is economically optimal. Second, limits on season length under limited-entry regulations may prevent fishers from achieving their desired scale of production, such that the capital employed on vessels is used at less-than-full capacity. Limits on season length imposed to conserve particular fish stocks may also prevent fishers from optimizing as to when and where they fish, such that their catch and mix of species provides less than the maximum possible return. Third, a move away from input controls to output controls may give fishers both the time and the incentive to improve the quality and increase the value of the landed product and avoid the "race to fish." For instance, with a longer fishing season and a fixed catch determined by individual output controls, the incentive is to maximize net returns per quota unit by landing higher-quality and higher-priced fish. Fourth, ITQs can provide fishers with a long-term interest in the resource that can improve overall management by giving them a greater incentive to be more actively involved in decision-making. Finally, transferability of the harvesting rights allows fishers with higher returns per unit of fish to increase their share of the harvest and, thus, should increase the rents from fishing.

Using data from the Scotia-Fundy fishery, some of the potential outcomes associated with a change from limited-entry regulations to ITQs can be explored. In particular, the study examines the impact on input use, outputs, and price changes in the fishery.

Multi-Species ITQ Scotia-Fundy Inshore Mobile Gear Groundfishery

To better understand the consequences of multi-species ITQs, their deficiencies, and how they may be improved, the paper reviews the Nova Scotia mobile gear multi-species fishery over a period that encompasses both pre- and post-rights-based management.

History of the Pre-ITQ Fishery

An important component of the groundfish fishery in the Scotia-Fundy region is the "nearshore" mobile gear fleet.[4,5] The fleet consists of vessels ranging from 35 to 65 feet in length that use otter trawls or Danish seines to fish cod, haddock, pollock, various flatfish, and some redfish. Only vessels in the required 35–65 foot range that

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[3] For a detailed discussion of the effects of limited-entry on fisheries, see Townsend (1990).
[4] See Crowley and Palsson (1992) for a description of Canadian fisheries and Grafton (1996) for a review of rights-based fisheries in Atlantic Canada.
[5] Other groundfish fleets in the same area are the fixed gear (under 65 feet) fleet, the Eastern Nova Scotia management fleet, and the offshore fleet.

use trawls are permitted to participate in the fishery, where controls on vessel length are part of a broad set of licensing regulations applied throughout groundfish fisheries in Atlantic Canada. For many decades, groundfish (particularly cod) have been heavily exploited in this sector and typically made up 30–40% of the total landed value of fish in the region (DFO Web Statistics, various years).

From the 1970s onward the fishery has been regulated by a total allowable catch (TAC) that has limited the total catch for the fleet. During the 1970s and 1980s, fishing power and capacity grew in this fishery, in spite of limited entry regulations and input restrictions.[6] In particular, adoption of the 200-mile limit in 1977 encouraged the purchase of bigger and more powerful vessels during the period 1978–82. For instance, in a study conducted in 1986, researchers found that the inshore mobile gear fleet was four times bigger than the size required to harvest the TAC, set at the $F_{0.1}$ level (Barbara, Brander, and Liew 1995). This was in spite of regulations designed to limit effort in the fishery. Fleet capacity further increased in the period 1986–87 in response to very high prices for Canadian groundfish in Boston.

By the late 1980s, managers were concerned about two things. It had become clear that the set of traditional management tools (including length restrictions, gear restrictions, limited entry restrictions, and fishing ground closures) employed had not prevented overcapacity in the fleet. In addition, the status of groundfish stocks off the Nova Scotia coast was showing evidence of severe declines in biomass (DFO 1995). The Canadian Stock Assessment Secretariat Science Sector (1998) advanced a number of causes as contributing to these declines. These factors included: high quotas and over-optimistic assessments, high effort and wasteful fishing practices, inadequate enforcement, harsh environmental conditions, and seal predation. Figures 1 through 3 show landings and spawning biomass estimates for cod, haddock, and pollock—the main species for this fishery—for various fishing regions in the Scotia-Fundy area for the past two decades. For cod and haddock, in particular, the biomass fell sharply in the late 1980s with a concomitant decline in harvests.

Due to concerns about the decline in the stocks, in 1989 the Scotia-Fundy inshore mobile gear fishery was closed midyear and did not reopen until 1990. As a result, a task force was established to look into the overcapacity and low stock problems. It recommended the creation of an ITQ program for the fleet, which was subsequently introduced in January 1991.

The Multi-Species ITQ Fishery

Under the ITQ program, each license holder was given an individual quota allocation calculated on the basis of the average of the best two catch years during the 1986–89 fishing seasons (Barbara, Brander, and Liew 1995). Initially, only some stocks were subject to the ITQ program, namely 4TVn J-A cod, 4Vn M-D cod, 4VsW cod, 4X/5Y cod, 4TVW haddock, 4X haddock, and 4VWX and 5 pollock. In 1992, George's Bank (5Z) cod and haddock were added and, in 1994, flounder was included in the list of ITQ-based species. Each ITQ gave the holder a specific share of the total inshore mobile gear quota for each particular stock subject to this form of management.

Not all license holders eligible to fish under the ITQ system, however, initially took advantage of its provisions. Only 325 of the original 455 mobile gear license holders chose to participate in the ITQ fishery in 1991. Of the remainder, the disposition was as follows: 74 dual fixed/mobile gear license holders chose to opt out of the mobile gear ITQ fishery indefinitely and to remain in the non-quota, competitive

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[6] Dupont (1996) reviews the history of license limitation in Canada; in particular, Atlantic Canada.

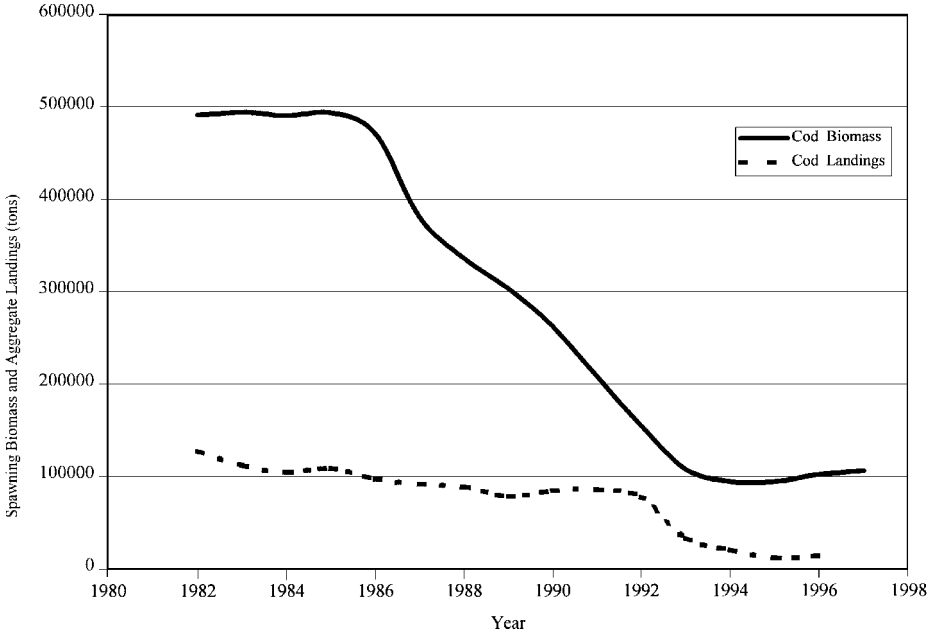

Figure 1. Cod Biomass and Landings (4VWX5Z)

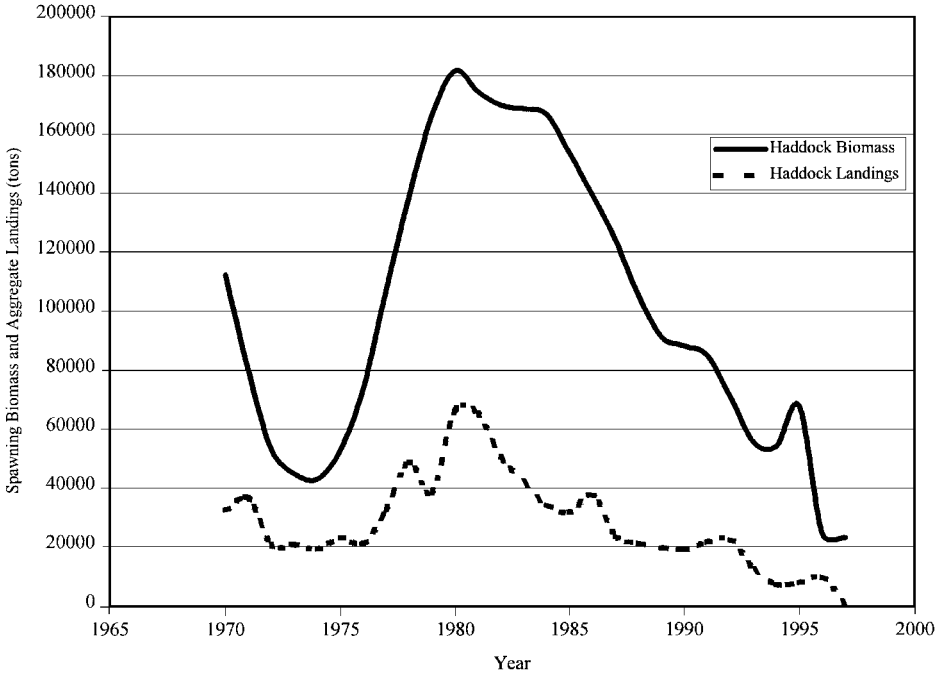

Figure 2. Haddock Biomass and Landings (4TVWX5Z)

fixed gear groundfish fishery; 6 licenses were cancelled entirely; and the remaining 50 license holders chose to participate in a "generalist," non-ITQ fishing pool using mobile gear. These 50 licensees pooled their individual allocations and agreed to fish their overall quota competitively.[7] Thus, in 1991, a total of 375 possible vessels could pursue groundfish in the region using mobile gear. Of this number, 325 pursued their own ITQs, while 50 fished a combined competitive fishing quota.

At the outset, the program allowed trading of quota amongst eligible quota holders, permitting fishers to acquire quota up to 30 days after landing the catch. Eligible quota holders included the 325 actual quota holders who chose to participate in the 1991 fishery, the 74 dual fixed/mobile gear fishers, and the 50 generalists. This made a total of 449 potential quota holders, which had fallen to 438 by 1998 (Liew 1999). Transfers of quota could be made between actual quota holders in the fishery, in which case only the ownership of the quota changed, not the vessel license. In addition, potential quota holders could purchase the quota license from an existing participant in the fishery, but only one license per vessel was permitted. An overall limit was also placed on the ownership of quota by one quota-holder equal to 2% of the TAC.

Initially, approval for transfers was granted by DFO only after the owner made a formal request to transfer an allocation, and the regulator verified that the owner had sufficient quota remaining as eligible for a transfer. A simplified transfer process was introduced on a trial basis in 1998 for four companies, and it appears to have halved the number of transfers that need to be processed by DFO, with a concomitant reduction in the administrative costs of the program. Recent changes in the program also allow individuals and companies to own more than one mobile-gear license, should they wish, to pool their quota allocations across their vessel licenses.

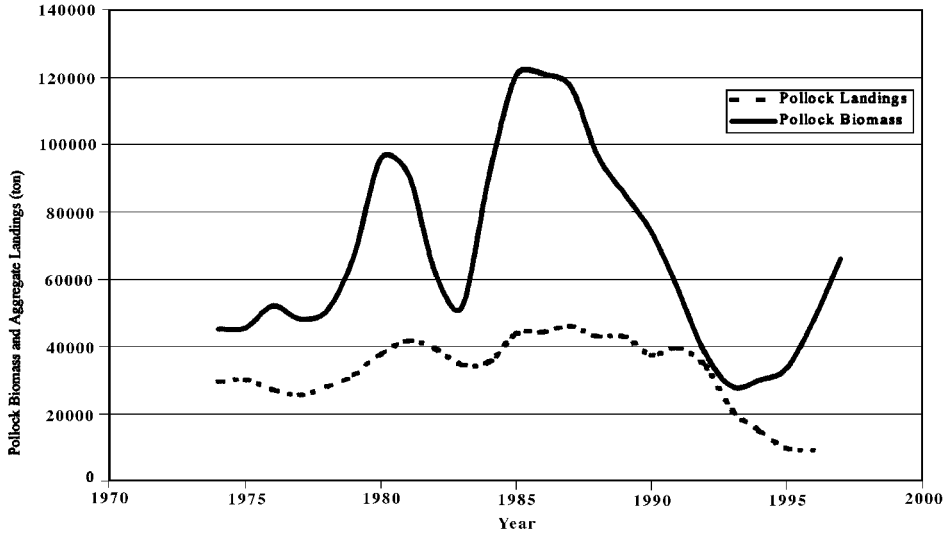

Figure 3. Pollock Biomass and Landings (4VWX5Z)

[7] This portion of the fleet was allowed to fish competitively for the so-called Generalist quota. Thus, the quota system as a whole entailed individual quotas for each of the 325 ITQ participants and an overall generalist quota for the 50 generalist vessels. The latter were not allocated a fixed quota, but could catch an aggregate amount of fish up to the specified overall generalist quota limit.

This has been facilitated by the increasing reliance upon the use of temporary quota transfers (quota purchased only for a specific year), as opposed to permanent quota transfers (outright purchase of quota holdings) (Liew 1999).

With the introduction of ITQs, fishers were subject to 100% dockside monitoring by a private company and occasional at-sea surveillance. Since 1992, fishers themselves have paid for the costs of monitoring and the use of at-sea observers. Changes have also taken place with respect to the landing of fish without quota. Initially, fishers had up to 30 days from the time the fish were caught to purchase a temporary quota. If the quota and catch were not reconciled within the 30-day period, fishers were subject to an escalating penalty (which depended on the size of the overcatch and other factors) but also reduced a fisher's ITQ for the following year. Starting in 1999, the penalty rates for failing to reconcile quotas remain the same, but fishers now have a longer time in which to purchase temporary quotas.

Economic Impact of Multi-Species ITQs

To examine the impact of the adoption of ITQs at the level of the individual fisher, we analyze vessel-specific data from two fishing years. The first is 1988, three years prior to the adoption of quotas—and the second is 1991—the first year in which the ITQ program was in place. Neither period is necessarily a "typical" fishing year but are two periods for which data were available. The first data point in 1988 provides observations of fishers prior to the collapse of the fish stocks in the early 1990s, and the second data point is the only period when data is available following the introduction of ITQs.

Data used in the analysis of the fishery include gear ownership and vessel characteristic information obtained from the Vessel Performance Questionnaire instituted by DFO. These are combined with yearly cost and earnings information in which the coverage of vessels in the detailed vessel-level data set varies by year. For 1988, the cost and earnings data includes 63 individual vessel responses that represent about 14% of the entire licensed fleet at that time. For 1991, the data includes 84 individual vessel responses, or some 26% of the total number of active vessels in the fishery for that year. As further data from the fishery becomes available, more detailed and econometric analysis of the changes brought about by ITQs will be undertaken.

Both data sets are from the DFO Program Coordination and Economics Branch, Scotia-Fundy Region. Together, these data present a "snapshot" of both fishing inputs and the resulting catches for 1988 and 1991. In addition to vessel-specific data, port-specific fuel prices (deflated by the GDP deflator) obtained from the Nova Scotia Utility and Review Board, and aggregate catch and value of catch data for the region from 1981 to 1995, are used to examine changes in the fishery following the introduction of ITQs.

Input Changes

Changes in input use may be expected with ITQs if the input controls that previously existed, such as a limited fishing season, are removed or mitigated. To examine the response to the adoption of ITQs, the mean values (and their standard deviations) for several key inputs for 1988 and 1991 are presented in table 1. The key inputs are for fixed or semi-fixed inputs: gross registered tonnage, overall length, brake horsepower, hold capacity, and variable inputs: the number of fishing days, quantity of fuel used, number of days at sea, crew-days, and crew-size. The mean values are calculated for two vessel sizes: small and large. The two vessel sizes reflect DFO licensing

Table 1
Mean Inputs for the Scotia-Fundy Groundfishery

Input	Vessels Less Than 45'		Vessels Between 45–65'	
	1988	1991	1988	1991
GRT	32.53	31.75	71.85	73.86
(tons)	(8.9)	(10.09)	(24.99)	(21.48)
Horsepower	246.40	258.65	439.55	448.69
(brake horsepower)	(82.03)	(77.40)	(167.74)	(142.77)
Length overall	42.91	42.75	58.65	59.47
(feet)	(1.62)	(1.77)	(6.98)	(6.17)
Crewsize	2.05	1.93	2.81	2.62
(number)	(0.67)	(0.72)	(1.14)	(1.06)
Fuel	27,729.00	23,598.60	56,897.49	52,476.94
(liters)	(19,788.16)	(13,464.05)	(27,220.72)	(24,767.06)
Days fished	87.20	84.97	103.05	95.25
(number)	(31.23)	(38.71)	(43.39)	(38.81)
Days at sea	96.97	96.14	118.05	108.94
(days)	(32.84)	(36.53)	(44.36)	(37.29)
Crewdays	200.32	185.76	347.23	294.38
(number)	(92.41)	(104.19)	(235.77)	(194.85)

Numbers in parentheses are the standard deviations for the variables.

policy and vessel replacement barriers, where "small" vessels are under 45 feet in length, while "large" vessels are greater than 45 feet, but under 65 feet long.

Table 1 indicates that there were no statistically significant changes in fixed or input usage, on average, for either large or small vessels during the post-ITQ year relative to the pre-ITQ period.[8] This may be expected, given that changes in fixed or semi-fixed inputs require an adjustment period of up to several years. Interestingly, no significant change in the variable inputs of fishers was recorded over the 1998–91 period.

Table 1 also reports on the standard deviations from the mean of the various inputs. There is an interesting difference in the results between large and small vessels. The variability in large vessels decreased for all inputs, implying a greater degree of homogeneity amongst these vessels following the introduction of ITQs. The opposite appears to be true for small vessels for many of the inputs including: gross registered tonnage, length, crew-size, crew-days, days at sea, and days fished. In particular, variability of the days fished increased significantly over the period 1988–91. This may be because some vessels adjusted to a longer fishing season following the change in the management regime, while others did not.[9] For the small vessels, only horsepower and, in particular, fuel use, show reduced variability between 1988 and 1991.

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[8] A series of two-tailed independent samples t-tests are performed to examine whether the mean values for the two years are equal. The sampling t-statistic is calculated by finding the difference between the means of the two years and dividing the result by the pooled estimate of the population standard deviation. This is a weighted mean of the individual year estimated standard deviations. Degrees of freedom are equal to 145—the combined number of observations (147) minus the number of samples (2).

[9] The Levene test verifies whether variability across years was constant by computing the absolute difference of each observation in a given year from its mean and then performing a one-way ANOVA on the differences. This is an F test with 1 and 145 degrees of freedom.

Although economic theory suggests that ITQs are likely to lead to a reduction in some inputs as vessel owners alter their input mix to minimize harvesting costs, this process is likely to involve an adjustment period. Thus, the lack of change in input use in the Nova Scotia mobile gear fishery in 1991 may be explained by the fact that fishers may not have had sufficient time to adjust their fishing operations to the new management regime. Such an outcome has already been found in the British Columbia halibut fishery, where few changes in efficiency occurred in the first year that individual harvesting rights were introduced into the fishery (Grafton, Squires, and Fox 2000).

While vessel-level data have not been collected since 1991, aggregate-level data on the fishery is available. Using these data, DFO employees confirm that the length of the fishing season in the Scotia-Fundy mobile gear fishery has increased in the past few years under the ITQ management program.[10] In particular, fishers are now paying more attention to poor weather conditions and choosing not to go out fishing when they are unfavorable. In addition, some fishers have concentrated more upon the targeting of their catches for specific markets and prices.

Output Changes

There are two important questions with respect to the impact of ITQs. One, to what extent do fishers shift their output mix in response to binding individual quotas in multi-species fisheries? Two, do ITQs encourage fishers to improve quality or change the product form so as to land a higher-valued product?

Table 2 presents the mean catch values for various species. It provides some evidence of an output mix response due to the introduction of selective ITQs in a multi-species fishery although, in part, the decline may reflect declines in biomass over the period 1988 to 1991. The data indicate that the mean catch for all three quota species (cod, haddock, and pollock) fell in 1991 for both vessel size classes, with the exception of large vessels, which caught more pollock, on average, in 1991 than previously. Moreover, a number of these changes in the means are statistically significant. Most notably, small vessels caught significantly less haddock and pollock, on average, in 1991, while large vessels caught significantly less haddock, on average. By contrast, small vessels switched to catching flounder, a species that subsequently became subject to its own quota in 1994. In terms of variability in the mean values, the mean catches of all ITQ species (with the exception of cod for large vessels) were smaller. At the same time, small vessels increased their (non-ITQ) redfish catches significantly in 1991, compared to 1988.

Price Changes

Table 3 gives the mean price (in 1991 dollars) for cod, haddock, pollock, and flounder. The table indicates that the prices of 1991 ITQ species (cod, haddock, and pollock) are significantly higher compared to 1988. The mean real price for flounder caught by small vessels fell over the period, but it rose for flounder caught by large vessels. A significant difference in prices between 1988 through 1991 does not, however, imply that ITQs brought about price changes, as market conditions varied over the two periods.

To assess the effect of ITQs on prices, supplemental price data for the period

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[10] Personal communications from Doreen Liew and Cindy Webster, Department of Fisheries and Oceans, Maritime Region, January and February 1999.

Table 2
Mean Output Quantities for the Scotia-Fundy Groundfishery

Output	Vessels Less Than 45'		Vessels Between 45–65'	
	1988	1991	1988	1991
Cod catch	75,652.60	61,550.08	177,756.70	169,561.70
	(84,074.00)	(57,894.53)	(148,166.10)	(171,257.60)
Haddock catch	34,225.77	17,330.50	77,253.60	40,500.92
	(42,934.16)	(21,618.34)	(70,091.02)	(28,673.37)
Pollock catch	25,609.21	13,189.71	62,794.05	67,046.42
	(39,932.74)	(22,218.72)	(51,220.02)	(44,995.05)
Flounder catch	45,858.81	37,445.13	35,393.65	34,843.69
	(37,706.41)	(41,471.51)	(47,837.94)	(40,121.34)
Redfish catch	2,683.88	15,530.42	19,349.75	7,082.86
	(4,409.32)	(49,133.63)	(36,381.83)	(20,141.33)
Mollusc catch	0.00	696.38	6.30	3,460.50
Total groundfish catch	192,201.00	148,330.90	389,045.20	323,400.60
	(135,133.80)	(117,912.40)	(169,854.80)	(185,343.20)

Numbers in parentheses are the standard deviations for the variables.

Table 3
Mean Output Prices for the Scotia-Fundy Groundfishery

Output	Vessels Less Than 45'		Vessels Between 45–65'	
	1988	1991	1988	1991
Cod price	0.78	1.13	0.72	1.14
	(0.11)	(0.19)	(0.11)	(0.26)
Haddock price	1.16	1.48	1.20	1.56
	(0.21)	(0.23)	(0.21)	(0.29)
Pollock price	0.36	0.67	0.36	0.71
	(0.11)	(0.15)	(0.06)	(0.13)
Flounder price	1.22	1.16	1.16	1.25
	(0.41)	(0.31)	(0.33)	(0.35)
Redfish price	0.48	0.40	0.47	0.48
	(0.18)	(0.18)	(0.15)	(0.18)
Mollusc price	0.00	3.08	1.97	1.42
Average groundfish price	0.95	1.09	0.79	1.10
	(0.24)	(0.27)	(0.18)	(0.21)

Numbers in parentheses are the standard deviations for the variables.

1981–95 is used to examine whether ITQs contributed to increased prices by encouraging fishers to land higher-quality fish.[11] Such increases in output prices have occurred in other ITQ fisheries, arising from a lengthened fishing season and the desire to maximize returns per quota unit. The price data is for two vessel types: fixed-gear (not subject to ITQs), which are more selective in their catches and tend to land

[11] Herrmann (1996) has also compared the price changes due to ITQs for the British Columbia halibut fishery.

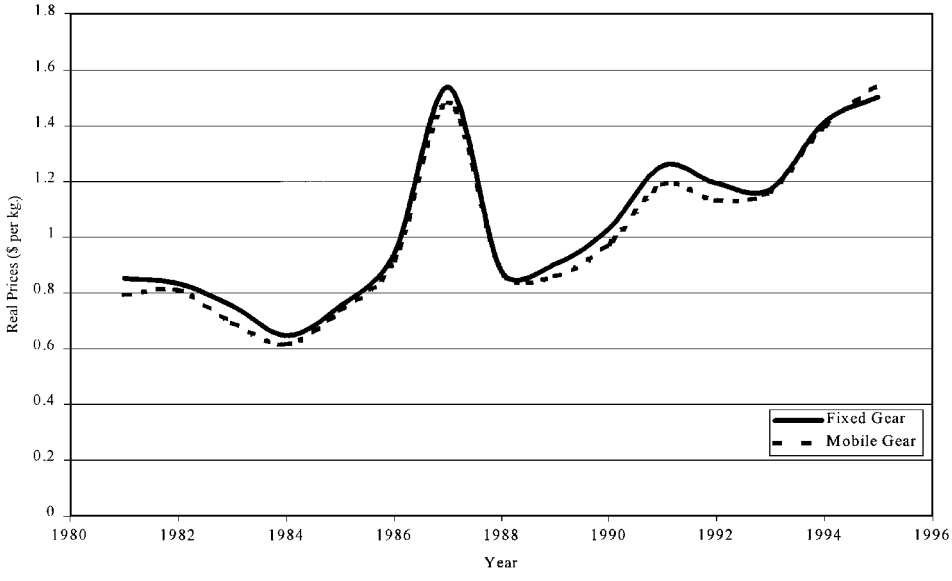

Figure 4. Average Real Cod Prices—Fixed Gear and Mobile Gear Groundfish Fleets
(Source: DFO Catch Statistics)

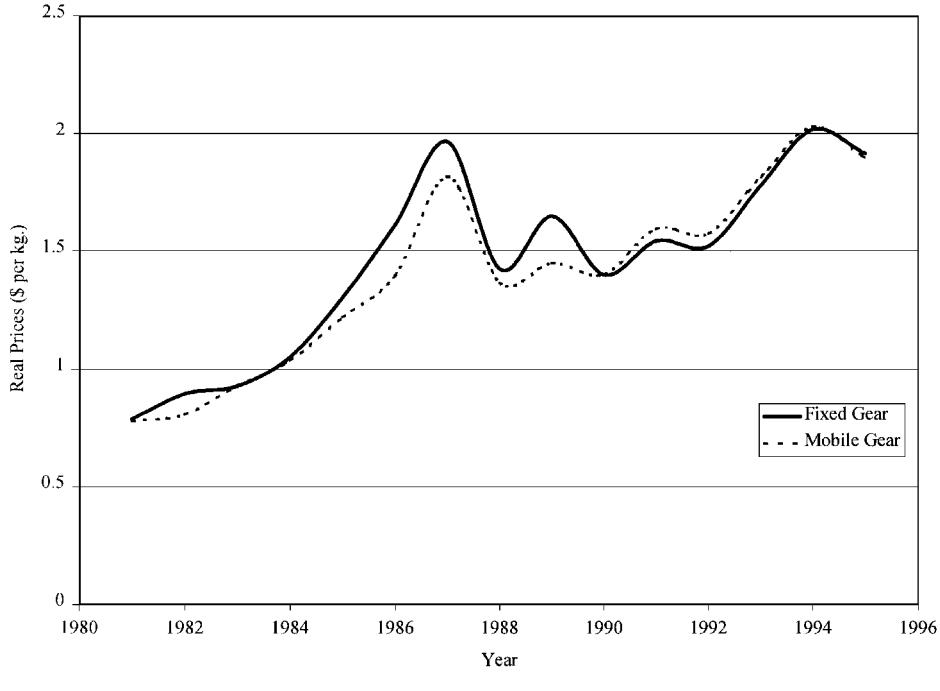

Figure 5. Average Real Haddock Prices—Fixed Gear and Mobile Gear Groundfish
(Source: DFO Catch Statistics)

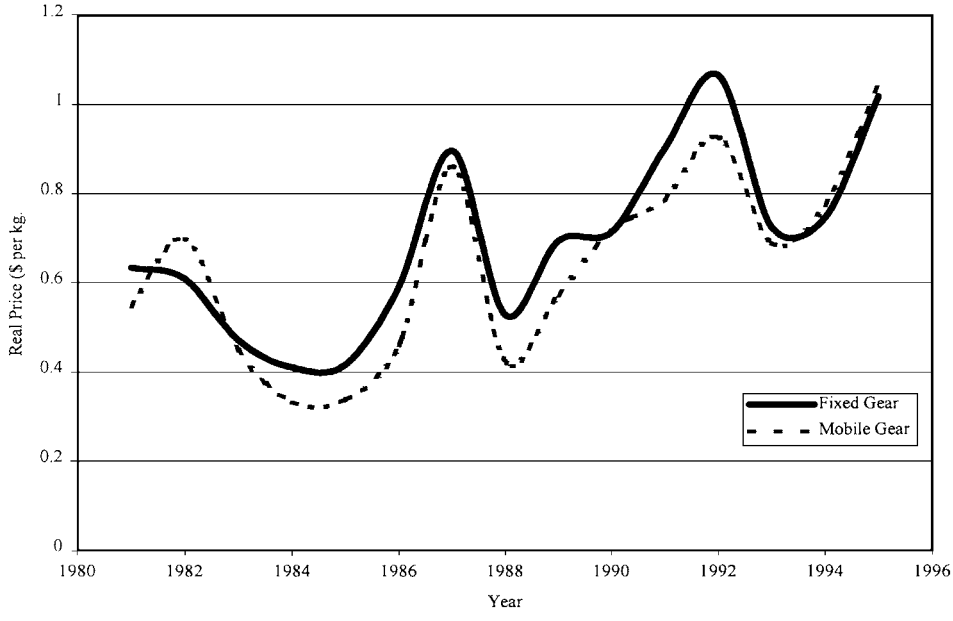

Figure 6. Average Real Pollock Prices—Fixed Gear and Mobile Gear Groundfish Fleets
(Source: DFO Catch Statistics)

high-quality fish, and mobile-gear, near-shore vessels (subject to ITQs since 1991), which are less able to target individual species and tend to land lower-quality fish. For each of the three quota species (cod, haddock, and pollock), fleet average real prices for the fixed gear and mobile gear fishers are available for the period 1981 to 1995 and are presented in figures 4, 5, and 6. In each case, the solid black line represents the real price series of fish caught by fixed gear, while the dashed line represents the real price series of fish caught by mobile gear. These figures show that average real prices for cod, haddock, and pollock caught with mobile gear (with the exception of the period 1981–83) were equal to or lower than that of fish caught by fixed gear over the period 1981 to 1992.

Since the introduction of ITQs, and particularly since 1993, it appears that the average real prices for fish caught by mobile gear have risen to be equal to or greater than those paid for fish caught by fixed gear. In order to examine whether ITQs have led to an increase in prices in the ITQ fishery relative to the non-ITQ fishery, a new variable was calculated for each of the three ITQ species. This variable was defined to be the difference between the mobile gear (ITQ fleet) and fixed gear (non-ITQ) price for a given species. The mean values for each of these new variables were calculated for two periods: pre-ITQ (1981–90) and post-ITQ (1991–95). A series of independent t-tests for equivalence of means shows that the mean price difference for haddock was significantly different in the two periods.[12] More-

[12] The mean difference for the price of haddock (mobile gear minus fixed gear price) for the pre-ITQ period was –8.05E-02, while the mean difference for the post-ITQ period was 2.45E+02. The mean differences for the two periods for cod were –3.47E-02 and –2.46E-02. Finally, the mean differences for the two periods for pollock were -5.79E-02 and –4.61E-02. The t-test for equality of means for haddock was –3.513, while for cod it was –0.286, and for pollock it was –0.360.

over, the price difference went from being negative (fixed gear price was higher than mobile gear) to positive (mobile gear price higher). In the case of the other two species, the mean price differences were not significantly different over the two periods. They remained negative for both periods, but became less negative in the post-ITQ period. The latter suggests that the price differential between the mobile gear and fixed gear fleets may be closing as a result of the introduction of ITQs for mobile gear fishers.

These data provide some evidence, albeit weak, that ITQs may have changed the incentives faced by fishers, and thus enabled them to land a higher-quality and higher-priced product. Supporting evidence for this interpretation is the fact that the pattern of fishing has changed since ITQs were introduced into the fishery. In particular, more fish are being caught towards the end of the fishing season than was the case prior to 1991 (Barbara, Brander, and Liew 1995). It should be noted that both fixed and mobile gear vessels are subject to the same reductions in biomass that occurred in the late 1980s and 1990s. Thus, increases in output prices for mobile gear (ITQ) vessels relative to fixed gear (non-ITQ) vessels from 1993 onwards cannot be attributed to lower stock levels.

Exit of Vessels

A widely cited economic benefit of ITQs is their ability to enable fishers to exit voluntarily from a fishery by selling their license and quota.[13] Since the introduction of the ITQ program, substantial changes have occurred at the aggregate level regarding the size of the mobile gear groundfish fleet. At the end of the first year of the quota program in 1991, 321 vessels had licenses with quota shares allowing them to catch fish to some specified limit. (However, the potential number of quota holders was equal to 449.) At the end of 1998, only 249 licenses continued to hold permanent quota shares.[14] In addition, the number of active ITQ vessels fell steadily from 268 in 1991 to 137 in 1998.[15] This was facilitated by the provisions that permitted multiple quota licenses being fished by a single vessel through the transfer of temporary quota.

A key benefit to regulators of ITQs is that the costs of voluntary exit of vessels are borne by those fishers who purchase the available quotas and licenses. By contrast, traditional license buybacks and regulatory approaches to reducing capacity are both expensive and are often ineffective.[16] Moreover, by encouraging voluntary exit from the fishery, ITQs may also reduce latent fishing effort which could be applied should East Coast groundfish stocks recover.

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[13] A model of the exit decisions by fishers in an ITQ fishery is provided by Weninger and Just (1997).

[14] Personal communication, Cindy Webster, Commercial Data Division, Fisheries and Oceans, Halifax, February 25, 1999.

[15] This is all the more remarkable when one considers the activities of the generalist fleet. This is largely composed of fishers primarily seeking flounder, but with bycatch of haddock and cod. When the ITQ program was initiated, 50 of these fishers chose to pool their individual allocations of quota for cod and haddock and fish them competitively. Each year, these fishers are allowed to leave the generalist fleet until mid-April and become part of the regular ITQ fleet. By 1998, only 28 of the original 50 generalists remained. The other 22 chose to return to the ITQ fleet. Thus, the 137 active ITQ vessels in 1998 includes the previously generalist fishers.

[16] Adjustment costs in assisting East Coast inshore groundfish fishers and fish processing workers since the collapse of the groundfish stock have, to date, cost over $3 billion; yet thousands of fishers still remain willing and able to begin fishing should stocks recover (Grafton and Lane 1998).

Insights for Fisheries Management

The experiences gained from the Scotia-Fundy groundfishery provide some insights for fisheries managers interested in applying multi-species ITQs. These issues are examined with respect to a number of criteria including data collection, characteristics of the harvesting rights, and the proliferation of harvesting rights.

Data Issues

A key to well-managed fisheries is to have clearly defined objectives, strategies, and tactics to achieve the specified goals. Without performance criteria to measure whether objectives have been achieved, or whether strategies or tactics have been successful, managers will not know whether their policies are effective or not. In terms of ITQ management, a common objective is that private harvesting rights increase economic efficiency and help overcome overcapacity.

In the Scotia-Fundy ITQ mobile gear fishery, costs and earnings data were collected from a sample of fishers in 1988 and 1991, before and after the introduction of private harvesting rights. Unfortunately, these data were collected neither systematically nor on a panel basis, and, thus, regulators were unable to measure annual changes in efficiency and individual vessel capacity over time. Moreover, the lack of economic data to quantitatively evaluate the successes and failures of ITQs is common to many fisheries. For example, despite being a world leader in the use of ITQs, New Zealand does not collect individual costs and earnings data in order to be able to effectively measure economic performance criteria in its fisheries. Ensuring such data are collected and available for analysis should be a high priority in the Scotia-Fundy mobile gear fishery, or any other ITQ fishery, and especially for multi-species fisheries where incomplete quota coverage exists over the species caught by fishers.

Characteristics of Harvesting Rights

The history of ITQ regulations in the fishery suggests that the regulator must take an active role in adapting regulations to suit the particular needs of the fishery. For example, initially fishers were allowed to exchange excess catches of one species for another at a predetermined rate. Unfortunately, this has encouraged the landings of species for which fishers did not have quota, and was subsequently dropped (Barbara, Brander and Liew 1995).

Recently, the regulator has increased the flexibility of fishers in reconciling their quota with their landings. Such changes should reduce transactions costs and mitigate the constraints on fishers. Nevertheless, limits still remain in the fishery, restricting the transferability of quotas and, thus, the potential for improvements in economic efficiency. For example, the regulator maintains a maximum quota limit of 2% of the TAC, a moratorium on the transfer of vessel licenses to fish processors and, until recently, a prohibition on the pooling of quotas by fishers with multiple vessels. These regulations attenuate the transferability and divisibility of the property right.[17]

The experience of ITQ management in the fishery also stresses the importance

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[17] See Grafton, Squires, and Fox (2000) for a detailed analysis of the implications of the potential effects on economic efficiency in the British Columbia halibut fishery.

of ensuring the quota is viewed as a permanent and durable property right. In the 1993 season, concerns over the size of the stock led DFO to stop all fishing halfway through the season. As a result, some ITQ fishers were unable to catch their quota for that season which, in turn, undermined the security attached to the property right. In turn, this may have affected the incentives of fishers with ITQs to spread their catch over the entire fishing season. Ongoing concerns also exist about high-grading at sea (Barbara, Brander and Liew 1995) which may limit the perceived exclusivity of ITQs by fishers. These, and other problems in the fishery, should be addressed as part of an overall approach that involves adaptive management and active cooperation between fishers and DFO.

Implications for Multiple Species Fisheries

ITQs have traditionally been defined for individual species, and the Nova Scotia experience conforms to that tradition. However, an examination of events post-ITQ in the Scotia-Fundy fishery reveals potential problems with this approach in an inherently multi-species fishery. If quotas were imposed upon a subset of species within a multi-species fishery, then theory would suggest that reductions in overall TACs for ITQ fisheries might lead to increased pressure upon non-ITQ stocks. In time, regulators might feel the need to make these previously non-ITQ species subject to quotas as well. This proliferation of quotas may increase the difficulty of administration and monitoring to the public sector, thereby reducing some of the positive aspects of ITQ management.

In the Scotia-Fundy fishery, drastic cuts in the TACs of ITQ species during the early years of the ITQ program—cuts that were necessitated by the large declines in the biomass—encouraged fishers turned to target other species, such as flounder and redfish. Fishing pressure upon these stocks subsequently led to an extension of the ITQ program over additional species. At the same time, DFO has been successful in passing many of the surveillance costs—including the costs of at-sea and dockside observers—onto the fishers who benefit from the ITQ program.

Concluding Remarks

In 1991, ITQs were introduced into the Nova Scotia inshore mobile gear fleet. From the original 455 license holders, 325 chose to fish that first year in the ITQ fishery, while 50 chose to pool their quota and to continue to fish competitively. Costs and earnings data from a sample of fishers, before and after the introduction of ITQs, suggest no significant change in the average use of inputs by fishers in the first year ITQs were implemented. Some changes, however, in the variability of the input measures across the fleet were observed, suggesting a possible differential response to ITQs depending on vessel size.

A comparison of price series for fish between fixed-gear vessels not governed by ITQs and vessels managed by ITQs, suggests that rights-based management, since 1993, has encouraged fishers to better allocate their catches over the fishing season and increased the quality and price for their product. In addition to these gains, ITQs have also assisted fishers to voluntarily exit from the fishery such that the number of active ITQ vessels halved over the period 1991–98. In an industry characterized by overcapacity and historically low fish biomass, adjustments that reduce the latent fishing effort are desirable. Moreover, in 1994, the majority of responding fishers elected to make the quotas permanent and to endorse the permanent

transfers of quotas (Barbara, Brander and Liew 1995). This support for ITQs occurred despite the fact fishers themselves pay for the costs of dockside monitoring and the use of at-sea observers required by DFO.

Despite the apparent support for ITQs by fishers, a reduction in the number of vessels in the fishery, and apparent price increases for ITQ-caught fish, the study suggests that regulators need to do far more than specify private harvesting rights to achieve the full benefits of rights-based management. To evaluate whether objectives (such as improvements in economic efficiency) have been achieved, individual vessel costs and earnings data must be collected on a systematic basis. Further, management should adapt to the needs of the particular circumstances of the fishery, involve fishers in the decision-making process, and be cognizant of the implications of quota programs on non-ITQ species. Finally, considerable care should be exercised in placing limits on the characteristics of the property right and, in particular, limits on transferability, duration, and divisibility.

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