

The Effects of Individual Vessel Quotas in the British Columbia Halibut Fishery

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Abstract *Implementation of individual vessel quotas (IVQs) in the British Columbia halibut fishery has provided a unique opportunity to examine the effects of this management technique on a previously intense "derby" fishery. This paper describes the changes that have occurred in the fishery since the introduction of individual vessel quotas in 1991. The results presented here are largely based on the findings of two surveys. In September 1993, we conducted in-depth interviews with most of the major halibut processors in British Columbia. These processors reported significant changes in the processing and marketing of halibut. In Spring 1994, we conducted a mail survey of all 435 licensed halibut fishermen. The survey consisted of several series of questions designed to measure changes in fishing operations (crew size, fishing practices, etc.), quota leasing activities, changes in fishing income, and opinions about the effects of IVQs. The results presented here provide important information about the effects of the British Columbia halibut IVQ program to date and will be useful for comparison to similar management programs implemented elsewhere.*

Keywords fishery management, ITQs, Pacific Halibut.

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Introduction

Managing a fishery through individual transferable quotas (ITQs) involves setting a total allowable catch (TAC) for a fishery and then allocating shares of the TAC to individual fishermen. The idea of using ITQs in fishery management originated from Christy (1973). Christy proposed ITQs as a means of improving efficiency in a fully or over utilized fishery. In subsequent more formal analysis, economists argue ITQs can improve efficiency in fisheries regulated by a total allowable catch by eliminating the "rule of capture" externality (Boyce 1992). Simply stated, the "rule of capture" externality pertains to the incentive fishermen have to compete for shares of a TAC. Since ownership of fish doesn't occur until capture, the harvest of one vessel imposes an externality on all others by reducing the remaining TAC. In such a situation, each fisher has an incentive to over-capitalize in vessel, crew, and gear in order to compete in the "race for fish". By providing ownership of fish prior to capture, ITQs eliminate the "rule of capture" externality and the over-capitalization incentive associated with it. However, as shown by Boyce, ITQs do not eliminate over-capitalization problems stemming from stock and congestion externalities.

While a considerable amount of literature exists speculating on how quota programs might operate in theory (Copes 1986, Moloney and Pearse 1979, Pearse and Wilen 1979, Campbell 1984, and Clark 1986), there is less concrete information assessing how they work in real settings. Various forms of individual quota systems have been implemented in New Zealand, Australia, Iceland, Canada, and the United States. Currently, there are over 40 individual quota programs operating in fisheries around the world, each with different design characteristics operating in different circumstances with respect to biology, fishing practices, management institutions, etc. Hence, there is accumulating evidence with which to evaluate the effectiveness of individual quotas as a management tool. Dewees (1989), Boyd and Dewees (1992), Sissenwine and Mace (1992) have examined the changes brought about by the ITQ programs operating in New Zealand. Similar studies have been done for individual quota programs in the U.S. Wreckfish fishery (Gauvin et al. 1994), the Southern bluefin tuna fishery (Geen and Nayar 1988), and the Icelandic fisheries (Arnason 1993).

In May 1991, Canada implemented a two-year experimental individual vessel quota system (IVQs) for the British Columbia halibut fishery. This system became permanent in 1993. Prior to the IVQ program, the British Columbia halibut fishery operated as a classic "derby" style fishery where each year fishermen had two to three short openings in which to harvest the TAC. This paper describes the changes that have occurred in the British Columbia halibut fishery since the introduction of an individual vessel quota program in 1991. We begin with an overview of the North Pacific halibut fishery describing the resource, fishing fleet, processing sector, and management history. Next, we describe the impetus for British Columbia's halibut IVQ program, the development process, and the program's design features. We then describe and assess the changes that have occurred in the fishery since the IVQ program was implemented in 1991 beginning with changes in ex-vessel prices and landing patterns followed by a more micro level description of specific changes in the processing and fishing sectors. We summarize our results in the final section and conclude with some thoughts about likely future changes.

Overview

The Fishery

The Pacific halibut fishery is one of the oldest fisheries on the west coast of North America and is exploited commercially by both the U.S. and Canada. Pacific halibut (*Hippoglossus stenolepis*) are flatfish found on sandy bottoms in the coastal waters of the Pacific Northwest, ranging from northern California to the Bering Sea. Halibut populations are most heavily concentrated in the more northern regions off of British Columbia and Alaska. They are a long lived species and may attain sizes up to 500 pounds in fish over 100 years old (Bell 1981). More typical ranges in the modern exploited fishery span 10 to 60 pounds. Halibut generally recruit to the fishery at an age of about eight years.

The directed fishery for halibut is hook and line. Almost all of the halibut is captured with longline gear and a small percentage is taken by troll gear. Halibut fishing vessels average between 40 and 60 feet in length and are used in other fisheries such as salmon and herring. Prior to IVQs, a very common fishing pattern for a British Columbia halibut fishermen was to gillnet (or seine) for roe-herring in early spring, switch to longline gear for the May halibut opening, switch to troll gear for the salmon season (July through August), and switch back to long line gear for a September halibut opening. U.S. halibut vessels follow similar patterns. There is, however, a fleet of large longline boats based in Seattle that longline throughout the year, targeting halibut and sablefish during designated area openings and groundfish at other times of the year.

Most of the firms processing halibut handle a variety of other fish species, predominately salmon with some firms also processing groundfish, sablefish, and herring. Halibut is almost always sold in the primary wholesale market as a whole, head-off, and gutted fish with filleting and steaking generally done by secondary wholesale distributors and retailers. The majority of U.S. caught halibut is sold frozen. This was also true for British Columbia prior to the IVQ program. Under the IVQ program, almost all of British Columbia's halibut is sold fresh. The United States and Canada are the main markets for halibut with the U.S. having the largest market share. There is also a small market for Pacific halibut in parts of Europe and Japan.

Regulatory Structure

The commercial harvest of pacific halibut is regulated by three organizations. The governments of the two countries set regulations for halibut harvested within their respective territorial waters and an international council called the International Pacific Halibut Commission (IPHC) sets regulations applicable to both territorial waters. Regulations set by the IPHC deal almost exclusively with conservation issues. In particular, this agency is charged with setting area-specific fishing seasons and TACs. It also sets minimum size limits and restrictions on harvest methods. Both U.S. and Canadian governments can introduce additional regulations to the fishery provided those regulations are more restrictive than the conservation measures developed by the IPHC. Figure 1 displays the delineation of fishing areas. Area 2B is defined as the exclusive economic zone (EEZ) of British

Columbia. The U.S. halibut grounds are comprised of many fishing areas, with the most productive areas located in the Gulf of Alaska (Areas 2C, 3A, 3B).

Each year the IPHC reviews stock assessments for each fishing area and assigns each area a TAC along with specific dates for taking the TAC. Major area openings during the early 1980s typically lasted two weeks. However, increased fishing pressure, arising from greater effort and improved harvesting technology, have led to area TACs being reached much faster. In order to prevent TACs from being exceeded, area openings became shorter each year during the 1980's to the point where major areas were only open for one to two days. In an effort to prevent large gluts of halibut coming into the market at once, the IPHC staggers fishing area openings starting in May and ending in September with major area openings occurring before and after salmon season (July through August).

Prior to adopting an individual quota system in 1991, the British Columbia halibut fishery operated under a limited-entry program (established in 1979) with 435 licensed vessels. Formerly open access, the U.S. halibut fishery began operating under an IFQ program in 1995. As an open access fishery, the U.S. halibut fleet was much larger than the B.C. fleet with three to four thousand vessels participating in the fishery each year. During the 1980's British Columbia's halibut fleet harvested approximately 20 percent of the total annual catch of Pacific halibut and in recent years the percentage has dropped to around 15 percent. While the U.S. fleet lands about four to five times more halibut than British Columbia, it has about eight to nine times more vessels participating in the fishery.

The fishing capacity of the B.C. fleet increased dramatically during the 1980's despite the limited entry program. Canadian halibut fishermen increased capacity with larger crews, electronic gear, more efficient circle hooks, automatic baiters, and hook disgorgers. By 1990 the Canadian fishery had been reduced to six fishing days per vessel from a 60 day season in 1982, even with a significantly larger overall harvest quota.

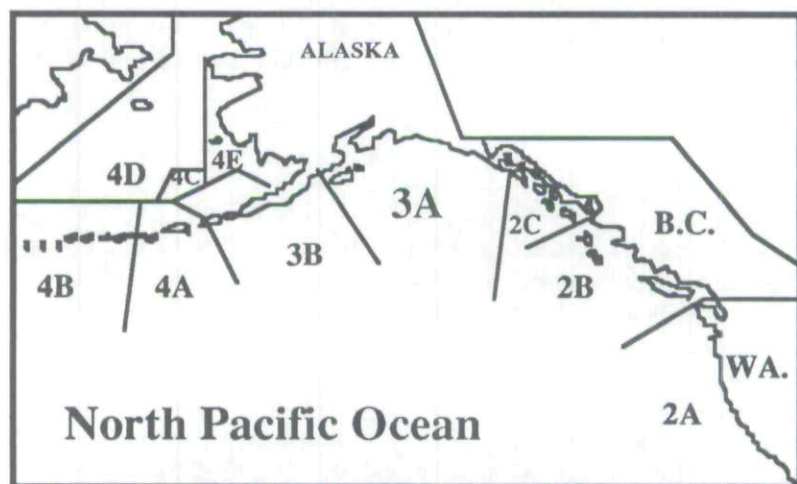


Figure 1.

British Columbia's IVQ Program: Impetus, Development and Design

By the end of the 1980's it was evident to many in the British Columbia industry and management that the existing management approach was not working. Fishermen fished in hazardous conditions continuously up to 24 hours per day and as the derbies became shorter, incidents of vessel sinkings, injuries, and loss of life became more common. The frantic pace of the derbies resulted in significant quantities of long line gear being left or lost on the fishing grounds. Biologists were increasingly concerned about the halibut mortality resulting from this abandoned gear. Fish quality was reduced by improper handling, processing gluts, and the necessity to freeze and hold the catch over much of the year. Managers were concerned that the existing system was breaking down in the face of growing capacity and shorter seasons. During the 1980's the allowable catch was exceeded in 8 of 10 years in area 2B and the overage in 1990 alone was 10 percent. In addition, a large amount of bycatch was being discarded and unrecorded for management purposes. Finally, budget cuts had reduced the ability of the Department of Fisheries and Oceans (DFO) to monitor the short frenzied season effectively, and there were rumors of considerable violations of regulations.

In the winter of 1988 and spring of 1989, fishing organizations met to discuss alternative management methods, including the possibility of an individual quota (IQ) program. In an initial survey, 77 percent of license holder respondents affirmed support for the use of individual quotas to manage the halibut fishery. This led DFO to facilitate the formation of a Halibut Advisory Board (HAB) to begin developing an industry designed program. Although the design negotiations were by no means without controversy and disagreement, by June of 1990 a complete proposal was developed by HAB, sent to license holders, and supported by a majority of 70 percent.¹ The proposal was ardently opposed by large processing companies and the crew member union.

In November 1990 the Minister of Fisheries announced that the industry's IQ program would be adopted on a trial basis for the 1991 and 1992 seasons. The key features of the trial program are summarized below.

- (1) The halibut fishery would remain open over the eight-month season from March through October, retaining the IPHC closures designed to protect halibut migration between fishing areas.
- (2) Each individual vessel with a limited entry license would receive an allocation specified as a share of the total allowable catch. Shares were assigned so that 70 percent was based upon the vessel's fishing performance between 1986-1989 and the remainder was associated with the vessel's length. Disputes were resolved with an appeal board.
- (3) An observer company and a team of Halibut Fishery Officers (HFOs) were hired to monitor and enforce the program. The system is self-funded (C\$.09/lb in 1993). Fishermen notify the observer company of their intent to fish (hail out) and probable landing date (hail in) and port and then upon landing, an observer validates weights and debit amounts from a centralized com-

¹ For details about alternative allocation proposals and events leading up to consensus, see Turris 1994.

puter. Stiffer penalties for violations were enacted, including forfeiture of quota.²

- (4) During the first two trial years, quotas were not allowed to be transferred while the HAB studied the implications of stacking. In 1993, limited transferability was allowed. Each vessel's initial allocation was allowed to be split into two equal sized units and holders may now lease out or lease up to two units from others (maximum aggregation of four units).

The British Columbia IQ program is unique in many respects. First, it was implemented in a fishery which had backed itself into an extremely untenable long run situation, with (1) fishing conducted over a frenzy of activity which involved high financial and physical risk to fishermen, (2) producing a low valued product, and (3) increasingly placing the fishery at biological risk due to over harvesting. Second, the British Columbia fishery implemented IQs as a pilot program side by side with the alternative open access which continued in the Alaskan fishery. This made it easy to compare the pros and cons of the new system because the status quo was readily visible in Alaska. Third, the IQ program was almost wholly industry designed with minimal assistance other than facilitation by the government. In the end, the ultimate design reflected the concerns and wishes of the majority of the license holders. Fourth, the system was not fully opened up to unlimited transfers of quota. This reflected the concerns and uncertainties of the industry and the modified system incorporates a "go slow" approach to capturing the efficiency. The issues of transferability and consolidation have been important in the design phase of many IQ programs and the B.C. decision to first freeze and then moderately relax constraints on transfers is unique.

Methods

During September 1993, Dewees and Casey conducted in-person interviews with 12 of the 14 primary halibut processors identified by the Department of Fisheries and Oceans (DFO). These 12 processors handled approximately 80 percent of the 1993 halibut landings according to DFO statistics. The questionnaire consisted of 35 questions. The interviews were used to collect data on (1) characteristics of the halibut processing industry, (2) product types, (3) marketing and distribution, and (4) IVQ problems and benefits. To minimize antagonisms, we made it clear to interviewees we were not associated with DFO and we assured interviewees of confidentiality. The interviews generally took one to two hours to complete.

In Spring 1994, we conducted a mail survey of all 435 licensed British Columbia halibut fishers. The questionnaire, with a cover letter from DFO, consisted of

² In an effort to deter violations, new and increased fines have been enacted. In addition, the Minister of Fisheries has shown a willingness to suspend the halibut fishing privilege of anyone flagrantly abusing the program. In 1991, the Minister suspended for the 1992 halibut fishery the fishing privilege of a vessel that failed to report its landed catch. The information about this vessel's activity came from industry participants and the suspended vessel's 1992 IQ was divided among all other halibut license holders. See Turriss (1994) for a further discussion of enforcement issues including a description of some self-enforcement aspects of the program. Also, E.B. Economics (1993) provides an evaluation of enforcement and monitoring based on convictions and pending charges incurred in the 1991 and 1992 fishing seasons and a survey in which halibut fishermen were asked to rate the degree of program compliance.

21 questions to collect data on (1) halibut harvesters and their vessels, (2) quota allocations, (3) changes in fishing under IVQs, and (4) opinions about IVQs. Whenever possible, questions were taken directly or adapted from a related ITQ socioeconomic study (Deweese 1989). The questionnaire was pretested with 20 halibut harvesters to identify vague questions, potential sources of bias and typical ranges of answers. The original questionnaire was followed up with a reminder letter and an additional questionnaire to maximize return rate (Dillman 1978). A total of 135 mail questionnaires were completed (31 percent).

Additional data on the halibut industry were supplied by the Canadian Department of Fisheries and from an earlier report prepared for DFO (E.B. Economics 1993).

Results and Discussion

Several dramatic changes have occurred in the British Columbia halibut fishery since the IVQ program began in 1991. Most notable, are changes in landing patterns and ex-vessel prices. Under IVQs, B.C. halibut landings are spread out over an eight month period. This is in sharp contrast to the pre-IVQ pattern of taking the TAC in two short derby openings. Figure 2 shows British Columbia and Alaska monthly landings patterns for 1989. Note that the bars are percents of each country's total landings taken by month. This pattern typifies the pre-IVQ period when the seasonal opening for British Columbia were set at intervals different from Alaska. The intent of the IPHC in setting several seasonal openings throughout the year was to try to spread out the supply of halibut into the market. However, the seasonal opening and the TAC allotted to those openings still resulted in large volumes of halibut entering the market in short periods throughout the year, especially in June and September when there are major openings in Alaska. In contrast, Figure 3 shows the landing patterns for British Columbia and Alaska during 1993. British Columbia's landings are spread out over the entire fishing season and there is very little halibut landed by British Columbia during Alaska's main seasonal openings.

The low volume of British Columbia halibut coming in throughout the year enabled processors to sell 94 percent of the product as fresh. This resulted in a

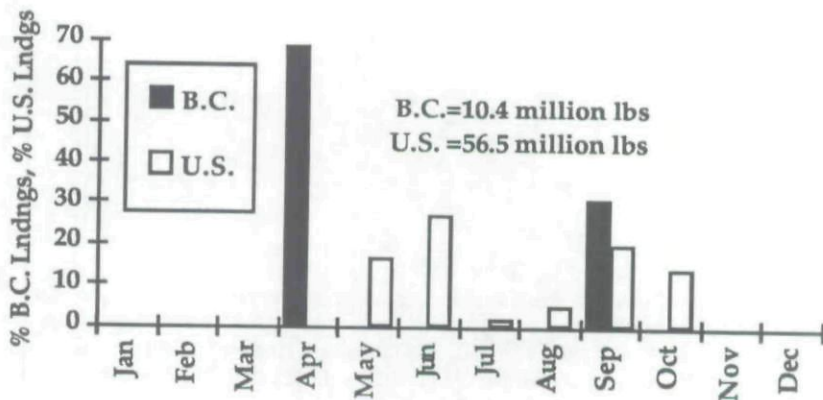


Figure 2.

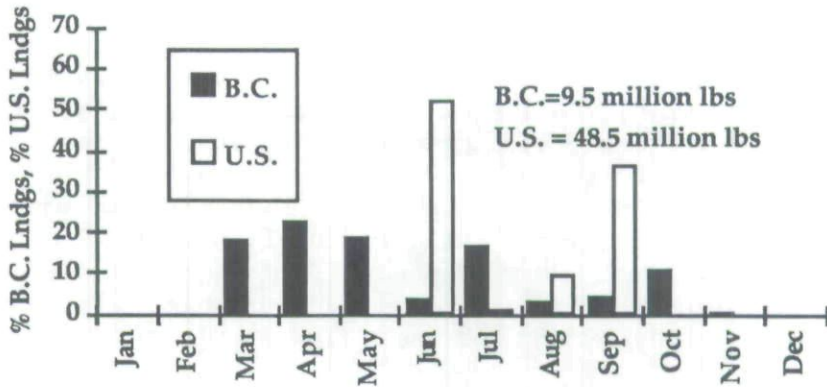


Figure 3.

higher ex-vessel price for halibut.³ Table 1 compares the average annual Alaskan ex-vessel price with the average annual British Columbia ex-vessel price for two time periods, 1988–90 and 1991–93. The price differential of US \$0.22/lb between the two countries in the pre IVQ period 1988–90 is largely attributed to the extra transportation costs associated with shipping Alaskan halibut to secondary wholesale markets, mainly in Seattle (E.B. Economics 1993). The price differential during the IVQ period is substantially larger, particularly in 1992 and 1993. The increase reflects the fact that practically all of the British Columbia halibut is now sold throughout the year as fresh where as Alaskan halibut is still predominately sold in the frozen market. Averaged over the 1988–90 pre IVQ period, British Columbia halibut carried a 15% premium (US\$/lb .22) over their Alaska counterparts in the ex-vessel market. Over the post IVQ period (1991–93), this premium increased to 70% (US\$/lb .99). Thus, there is evidence of an ex-vessel price gain associated with IVQs of about 55% (US\$/lb .77).

Table 1
Pacific Halibut: Comparison of Ex-Vessel Prices

Period	U.S. average ex-vessel price (US\$/lb)	B.C. average ex-vessel price (US\$/lb)	Price Difference	Price difference attributed to IVQs
1988–1990	1.50	1.72	.22	
1991–1993	1.41	2.40	.99	.77
1991 ⁴	2.00	2.64	.64	.42
1992	.98	2.31	1.33	1.11
1993	1.25	2.22	.97	.75

³ Weekly market demand for fresh halibut appears to become sharply inelastic once a certain volume is reached. As one processor described it, "There is a pipe line for fresh halibut going into the U.S. that can only accommodate so much halibut in a given week. Once that pipeline is full any product left over has to be frozen." In the pre-IVQ days, the pipe line was filled quickly, with most of the product having to be frozen. Under the IVQ system, landings in any week are low enough to be sold almost entirely as fresh.

Changes in the Processing Sector

IVQ implementation in the halibut fishery in 1991 led to some significant changes in the processing sector. Some of the changes measured in our interviews are summarized in Table 2.

A major change is the switch in the proportion of halibut marketed fresh from 42% in the pre-IVQ period to 94% in the IVQ period. The U.S. remains the primary market for fresh halibut (89%) with most of the product going to large Pacific coast cities. Several processors indicated increased efforts to market fresh halibut in the eastern U.S., Canada and Europe. About one-half (51%) of the frozen British Columbia halibut stays in Canada with the rest (49%) being marketed in the U.S.

The interviewees indicated that there was a transfer in market share from large traditional firms to smaller firms specializing in halibut. Five of the 12 firms interviewed increased their halibut processing volume but these were relatively small firms.⁵ Three firms decreased their volume processed and these were relatively large firms. On average the processors interviewed are purchasing halibut from fewer vessels. This appears to be due to some reduction in number of vessels fishing for halibut (consolidation of quota shares) and an increase in the number of firms purchasing halibut. Half the processors felt that the quality of fresh halibut was the same as before IVQs. Those who felt quality had improved attributed it to fishermen having more time to properly care for fish onboard. Two processors felt that quality was worse because of longer trips taken by some fishermen.

Table 2
Marketing Changes Since IVQs as Reported by 12 Major British Columbia
Halibut Processing Firms Under IVQs, 1993

Category	Percent	
	Before IVQs (1989-90)	Since IVQs (1991-93)
Halibut marketed as fresh	42%	94%
Fresh halibut marketed in the U.S.	89%	83%
Frozen halibut marketed in the U.S.	72%	49%

Additional changes in the processing sector are evident when our survey data and qualitative analysis of processor interviews is augmented with DFO and E.B. Economics (1993) data. Specifically, there is evidence of a shift in industry concentration, new firms entering the market, and changes in the locations of landings.

In the years just prior to the IVQ system (1986-1990), the majority of British

⁴ Unusually high U.S. ex-vessel prices occurred during the September halibut opening in the Gulf of Alaska causing the 1991 average price to be exceptionally high. High September prices are attributed to low halibut cold storage holdings. Cold storage holdings at the end of August, 1991 were approximately 5.2 million pounds compared to 14.7 million pounds in August of 1990 (Seafood Trend Newsletter 9/30/91).

⁵ Not coincidentally, all five of these believed IVQs made them "better off" where as other processors (who lost volume) believe they are "worse off" under IVQs.

Columbia's halibut was purchased by large salmon processors located in Prince Rupert and the lower mainland of British Columbia. Typically, these firms derived the majority of their earnings from salmon production with halibut constituting a small portion of their total sales revenues. The halibut industry was moderately concentrated during this period. Three firms had halibut purchases that individually amounted to more than 10 percent of the total British Columbia halibut catch and the average market share of the top four firms combined over this five year period was approximately 49 percent (DFO data 1986-1990).

Concentration in the halibut market during this pre-IVQ period appears to be the result of two factors. First, prior to the IVQ program, the substantial capital needed for handling halibut may have made it difficult for undercapitalized firms to compete with the larger salmon processors. In derby fisheries, large volumes of halibut come into a processing plant at once necessitating large freezing and handling capacity and (in some cases) the financial ability to hold an inventory to sell during the rest of the year.

Secondly, firms having a large share in the halibut market during this period often had a large share in the salmon market and were able to purchase halibut from their regular salmon boats. In the salmon market, fishermen generally sell to the same buyer every year. This is especially true in the salmon canning market (Pinkerton 1987). Several halibut processors we interviewed explained that fishermen generally prefer to sell halibut to the same processors they sell to in the salmon fishery.

Under the IVQ program, a substantial number of smaller, less capitalized firms have entered the halibut processing sector. New entry appears to be the result of a shift from a predominately frozen market to a predominately fresh market. In a fresh market, halibut buyers no longer need a large freezing/storage facility or the financial ability to hold inventories for long periods. Under new conditions, margins are made by creating and exploiting niches in the fresh market, which is potentially viable year round. Prior to the IVQ program, on average 57 processing firms purchased halibut each year. Under the IVQ program an average of 69 firms are active in the halibut market (DFO data 1991-93). Most of the new firms have market shares of less than 1 percent (Table 3).

There also have been some significant changes in industry concentration (Table 3). Most notably, one relatively new and specialized halibut buyer who had a modest market share prior to the IVQ program now buys approximately a third of the total British Columbia halibut catch. This firm focuses almost exclusively on halibut. The next three top buyers all have individual market shares of less than

Table 3
Average Market Share and Number of Firms Processing British Columbia Halibut, 1986-90 and 1992-93

Percent market share		Percent of firms (number)		Percent of firms (number)		
		1986-90		1992-93		
	MS	≤1	65	(37)	75	(52)
1<	MS	≤2	12	(7)	9	(6)
2<	MS	≤10	18	(10)	15	(10)
10<	MS		5	(3)	1	(1)
	Totals		100	(57)	100	(69)

10 percent and the total average market share for these four top firms during this period is approximately 55 percent compared with the pre-IVQ figure of 49 percent. This concentration ratio is somewhat misleading, however, since it is heavily influenced by the one new dominant firm. Excluding this one firm, the industry appears to be less concentrated with no other firms having more than 10 percent market share (compared with 3 before IVQs) and 52 firms having less than 1 percent market share (compared with 37 before IVQs).

The location of halibut landings has also changed under the IVQ program. These changes were first documented by E.B. Economics (1993), which reports that prior to IVQs (1983–1990), two regions, the Lower Mainland and Prince Rupert accounted for approximately 90 percent of British Columbia's total landings with no other region accounting for more than 5 percent. Since IVQs (1991–1992), the authors report that five regions had landings of 5 percent or more while landings in the two major regions, the Lower Mainland and Prince Rupert, fell significantly. Landings in the Prince Rupert region fell from 35 percent to 25 percent and landings in the Lower Mainland fell from 53 percent to 41 percent. This shift may have occurred because freezing facilities are for the most part no longer needed in the fishery and halibut can now be landed in many more ports.

Another notable change occurred in the grading system for halibut. Prior to IVQs, catch was sorted into several size categories, and there were separate prices for each size grade with larger sized halibut receiving a higher price. However, the grading system varied from one processor to another with some processors sorting by 3 grades and others by 5 to 7 grades. Now, the norm is for a halibut processor to offer fishermen a single price though the processor continues to sell by size grades in the secondary market. The majority of processors interviewed cited two reasons for the change to a single ex-vessel price. The first is a shift in market demand from larger (over 40 lbs) to smaller (10–40 lbs) size halibut. This shift is attributed to the transition to a predominately fresh market where larger size halibut are in less demand.⁶ The second explanation for a single ex-vessel price is increased competition among processors. Almost all the processors we interviewed described the halibut market under IVQs as being much more competitive in terms of fishermen shopping for the best price. With processors using different grading schemes, comparing price offers is complicated. A single price enables a fisherman to quickly and accurately compare offers from different processors.

Attributes of Halibut License Holders

The fishery sector is made up of largely experienced halibut fishermen, and none of the respondents were less than 27 years old (Table 4). Eighty-seven percent are married, and on average, support a household of 2 additional people. Only 66 percent reported partner income and the mean spouse/partner income was, on average C\$17,562.

⁶ Processors explained in the frozen market, most of the halibut is eventually steaked into uniform portions. With this type of processing, there is a greater yield recovery from large halibut. Thus, fishermen were paid premiums for larger size grades of halibut. In the fresh market, halibut is often shipped whole to retailers who can then cut portions according to customer's requests. Under this type of processing halibut size has little effect on yield recovery, hence, buyers are less willing to pay premiums for larger fish.

Table 4
Personal Characteristics of 135 British Columbia Halibut License Holders

Characteristics	Mean	(SD)	Range
Age	48.0 years	(9.4)	27-70
Halibut fishery experience	18.93 years	(11.69)	0-50
Years of education	11.61 years	(2.71)	6-21
Number of individuals in household	2.17 ind.	(1.47)	0-8
Spouse/partner income	\$ 17,562 ^a	(23,164)	0-150,000

^a 1994 monetary values are in Canadian dollars, at the time C\$1.00 ≈ US\$0.80.

Two-thirds of the respondents owned small fishing vessels less than 45 feet in length (Table 5). The majority of vessels were built in 1964-1983 which were years of rapid expansion of Pacific Coast fishing fleets (Dewees and Hawkes, 1988). The respondents estimated the value of their vessels and halibut gear (excluding license and quota), on average, to be C\$236,920. Over three-quarters of the respondents received 1993 halibut quota allocations between 10,000 and 40,000 pounds with an annual lease value of approximately C\$1.50/pound.

The majority (70 percent) of respondents reported fishing their entire quota in 1993 and another 17 percent fished their entire quota and leased additional quota shares. A smaller proportion (13 percent) leased out all or half of their quota allocation (Table 5).⁷ Eighty-seven percent planned to fish all or part of their quota during 1994 with very few planning to leave the halibut fishery.

The halibut license owners, like many Pacific coast small vessel owners, participate in several fisheries. Salmon is the primary fishery for many vessels, but some also participate in other inshore fisheries (Table 6).

Changes in Fishing Practices

Economists and other analysts of quota programs have cited the potential benefits to be gained by rationalization of fishing. Virtually all literature has focused on the input savings expected from reducing incentives to "capital stuff" and from consolidation of fishing capital, although the literature has not been precisely clear over whether we should expect dramatic changes in the configuration of vessels or mostly consolidation and reduction in the number of vessels. In the years preceding IVQs in British Columbia, the halibut fishery was characterized by extreme overcapitalization, both in terms of numbers of vessels and in terms of typical fishing practices. Typical practices under derby conditions were frantic, with crew working virtually continuously regardless of conditions until each of the short seasons were closed. We surveyed fishermen to determine how average fishing trips and fishing practices changed as a result of quotas.

Surprisingly, there was no dominant pattern of changes as indicated by Table

⁷ In comparison, DFO data on 1993 leasing activities for the *entire* halibut fleet indicates 17 percent of the fleet leased out all of their quota and 2 percent leased out half their quota.

Table 5
 Characteristics of 135 British Columbia Halibut Harvesting Business Mail
 Survey Respondents, 1994

Vessel length (feet)				Percent	
35	≤	vessel length	<	35	11
45	≤	vessel length	<	45	56
55	≤	vessel length	<	55	22
		vessel length			11
Value of vessel and halibut gear ^a				Percent	
100,000	<	value	≤	100,000	33
300,000	<	value	≤	300,000	63
		value			35
Halibut IVQ allocation in 1993 (pounds)				Percent	
10,000	≤	Quota	<	10,000	7
20,000	≤	Quota	<	20,000	43
40,000	≤	Quota	<	40,000	34
60,000	≤	Quota	<	60,000	10
		Quota			4
Year vessel built				Percent	
1926-1963				19	
1964-1973				25	
1974-1983				37	
1984-1993				19	
Use of halibut quota in 1993				Percent	
Fished entire allocation				70	
Fished entire allocation and leased additional				17	
Leased entire allocation (= 2 shares)				8	
Leased half of allocation (= 1 share)				5	
1994 Plans				Percent	
Fish some or all of quota				87	
Retire				1	
Switch to non-halibut fisheries				2	
Switch to non-fishing activities				1	
Other				9	

^a Monetary values are in Canadian dollars; at the time, C\$1.00 ≈ US\$0.80.

7. We would expect changes in fishing practices to be the result of two aspects of the IVQ program, the size of a vessel's quota allocation (relative to previous derby catches) and increased freedom in choosing the pace, location and timing of fishing.⁸ The formula used in allocating quota, resulted in a significant reappor-

⁸ Though we did not ask fishermen to describe the factors they consider in determining "when" to fish their quota, our interviews with processors suggests that fishermen are timing their halibut trips according to their expectation of ex-vessel price and their opportunities in other fisheries. For instance, many of the processors we interviewed reported that it is quite common for fishermen to call processors before deciding to make a halibut

Table 6
Fishery participation of 135 British Columbia halibut license holders in 1993

Fishery	Percent of halibut license holders	Mean number of weeks
Halibut	91	3.6
Salmon	89	10.2
Roe herring	28	3.6
Sablefish	5	9.3
Groundfish	16	7.5
On-shore work	9	17.8

tionment of the TAC among fishing vessels. Because most of the allocation was based on a vessel's *best* annual catch over a 4 year period (1986–1989), vessels with consistently high annual landings received the same quota allocation as same sized vessels having only one similarly successful year. Consequently, highliners tended to receive quota allocations significantly less than their previous derby landings and vessels with sporadic catch history received relatively more quota. Though the introduction of transferability in 1993 allowed fishermen to adjust their quota holdings, obtaining an optimal quota holding may have been difficult given the restrictions on quota trading.⁹ Thus, some vessel owners may have adjusted their fishing practices based on their initial allocation and whatever limited adjustments to quota holdings they could make. There has been little change in fishing travel distance, and the majority of fishermen report either no change or reductions in the total number of trips per season and average harvest per trip. Finally, most fishermen report either no change or reduction in average days at sea per trip and harvest per trip. These results are probably due to the new emphasis on higher quality landed fish since maximizing quantity in a short period is no longer necessary under the slower paced quota system.

Table 7
Changes in fishing practices after introduction of IVQs in British Columbia halibut fishing, 1993

Category	n	More	Same	Less
Number of trips per season	116	39%	34%	27%
Average days at sea per trip	111	23%	37%	40%
Average harvest per trip	103	24%	19%	57%
Average harvest per day at sea	96	33%	17%	50%
Average distance from port	109	9%	82%	9%

trip and elicit the processor's expectations of prices in the coming week. Also, both processors and DFO report fishermen frequently utilize an information hot-line provided by DFO that reports the number of halibut boats currently out on the grounds. In terms of timing halibut trips around opportunities in other fisheries, almost all processors reported buying very little halibut during salmon openings because most halibut fishermen had switched over to salmon fishing.

⁹ Recall that each vessel's quota allocation could be split into two shares and traded with no vessel allowed to hold more than four shares and a maximum of four trading transactions per vessel.

Changes in Crew and Share System

Since quotas reduce the individual vessel's risk associated with short derby openings and give new incentives for more orderly fishing, we expected smaller crew sizes. Our survey findings in Table 8 show some moderate move towards small crew sizes, with 44 percent reducing crew size (most by one crew member) and no respondents reporting increasing crew sizes. Based on our survey and additional data provided by DFO, we estimate the total reduction in the number of crew members employed by the fishery to be 32 percent. This is composed of an estimated 18% reduction in crew size on those vessels active in the fishery in 1993 and crew displaced from non-active vessels (an estimated 14%).

We anticipated that the remuneration system under the IVQ program will undergo realignment as the new system settles into its long term patterns, although in ways difficult to predict a priori. First, total crew labor input needs are changing. Generally, less crew labor is required on each typical trip because the pace of fishing has slowed. In addition, there has been consolidation so that fewer vessels are participating. At the same time, more total crew hours are probably being expended per vessel season since there is more consolidation of quota and expansion of total participation by those remaining. Hence although fewer numbers of laborers are being utilized, those remaining may be working longer seasons. Second, the existence of quota with a positive value should produce incentives to alter the share system to provide a payment for the opportunity cost of the quota itself. The manner in which this might be reflected is also difficult to predict, particularly since quota, vessel, and gear shares are often convoluted when vessels are operated by skipper/owners.

As discussed above, we found that 44 percent of the respondents reduced crew sizes. For the most part (59 percent) individual crew shares increased on those vessels operating with fewer crew members (Table 8). Thus remaining crew members seem to be made better off under the increased values being generated by the system. We did not examine the employment adjustments of crew members displaced from the fishery. Since most halibut crew members also work in other fisheries, displaced halibut crew members may seek to increase their level of participation in other fisheries or seek additional on-shore employment. A more complete analysis of the total impact on crew members thus should account for displaced crew members (i.e. re-employment, opportunity costs etc.). For vessels reporting no adjustment to crew size (approximately 50 percent), most (76 percent) kept individual crew shares the same. Those who kept crew size the same but changed the individual shares universally reduced them. Two vessel owners created a separate share for quota and eight chose to recover quota costs by adjusting the combined share of skipper and vessel.

All of these changes in both crew size and in the remuneration system reflect a system still in considerable flux. Since consolidation has been restricted, we would expect only moderate changes in actual crew sizes and this is mostly borne out by the survey. At the same time, the quota system should be adapting to reflect changes in relative shares going to the total crew, skipper, and vessel in order to accommodate the newly created capital values in quota shares. It should be kept in mind that in this particular fishery some of this structural change in the share system may have already occurred during the limited entry program to

Table 8
Changes in Crew Employment and Individual Crew Share in British Columbia
Halibut Fishery, 1993

Changes in Crew Employment			
	Percent		
Same number of crew	56		
Less one crew member	33		
Less two crew members	7		
Less three or more crew members	4		
Individual Crew Share			
	Percent		
	Increased	Same	Decreased
Those reporting <i>reducing</i> crew size	59	28	13
Those reporting <i>same</i> crew size	0	76	24

accommodate the capital value of limited entry permits. During the more lucrative years of the limited entry program, halibut licenses traded for values in the range of \$1,500–2,000 per foot of vessel length. Hence adjustments that are taking place in the share system now are really reflecting additional new rents being created from the increase in ex-vessel prices brought about by marketing changes, as well as additional values associated with cost savings, increased security, flexibility, and control and planning capabilities generated by the more secure property rights.

Quota transfers

Under the British Columbia halibut IVQ system quota shares were not allowed to be transferred during the first two years of the individual quota program (1991–92). In 1993, limited transfers of quota shares were allowed. Under the transfer rule, quota shares can only be leased annually but a vessel cannot hold more than four quota shares. Each vessel's initial allocation is divided into two equal shares and a vessel owner can lease a maximum of two additional shares and/or lease out a maximum of two shares. A maximum of four transfers are allowed to adjust the vessel quota holdings. According to Department of Fisheries and Oceans data, approximately 74 licensed halibut vessels were no longer actively fishing for halibut in 1993. We compared the characteristics of the vessels and vessel owners who leased additional quota in 1993 with the characteristics of those who leased out their quota share(s). The only significant difference between the two groups was the size of the initial quota share allocation (Table 9). On average, the initial allocation of those leasing additional quota in 1993 was significantly higher than those leasing out quota to other halibut vessel owners. This may reflect economies of scale or other incentives towards consolidation and may be indicative of what might happen under a relaxation of rules against "stacking" quota.

Table 9
Comparison of Initial IVQ Allocation of Halibut Vessel Owners Leasing Additional Quota and Those Leasing Out Their Quotas, 1993

	Vessels leasing additional quota	Vessels leasing out quota
Mean	28,346 lbs	18,579 lbs ^a
Standard deviation	16,572.82	9,744.53
Sample size	21	17

^a Means statistically different [modified t-test, assuming different variances between groups (Satterthwaite 1946, referenced in Snedcor and Cochran 1980)].

Opinions about IVQs

Quota owners generally had positive opinions on most features of the British Columbia halibut IVQ system (Table 10). The majority felt better off and more secure about their retirement under IVQs. The majority also saw advantages of better resource conservation and record keeping, as well as reductions in waste of bycatch and gear loss. The majority did feel that IVQs make it more difficult for young people to get into fishing. It is also interesting to note that 28 percent *disagreed* that IVQs make fishing safer. Their comments indicated that some harvesters would still take risks in rough weather if halibut prices are high.

In general, these opinions indicate a higher level of support for IVQs among British Columbia halibut vessel owners than Dewees (1989) found among New Zealand fishermen shortly after implementation of individual transferable quotas (ITQs) in most of their inshore fisheries.

Table 10
Responses of Pacific Halibut License Holders to Statements about Attributes of British Columbia's Individual Vessel Quota (IVQs).

Statement	Percent that agreed or strongly agreed ^a	95% Confid. Interval ^b
I am better off under IVQs.	80	73 to 87
I feel more secure about my retirement under IVQs.	84	78 to 91
IVQs conserve halibut resources better than other management techniques.	75	67 to 83
IVQs make it more difficult for young people to get into fishing.	77	69 to 84
IVQs increase my enjoyment of fishing.	79	72 to 87
IVQs make fishing safer.	72	64 to 80
I lose less fishing gear under the IVQ system.	73	65 to 81
I waste less by catch under the IVQ system.	68	60 to 76
I maintain much better halibut log book records under the IVQ system.	68	60 to 76

^a Choice of responses were strongly agree, agree, disagree, and strongly disagree.

^b All values significantly different from 50 percent (binomial chi-square test, (P ≤ 0.05)).

Summary and Conclusions

The British Columbia Pacific halibut fishery has undergone some significant changes since the introduction of individual vessel quotas in 1991. While British Columbia fishermen are essentially landing the same annual volume of halibut under the IVQ program, the timing of landings has changed dramatically. Instead of large volumes coming onto the market in two to three short derby openings, British Columbia's TAC is landed more gradually over an eight-month period. Under the IVQ program, fishermen are timing their halibut fishing trips according to the market price of halibut and their opportunities in other fisheries. The slower pace of landings has allowed processors to develop new market opportunities year round and sell essentially all of the halibut landed as fresh. The shift from predominately frozen to fresh product has caused a substantial increase in the ex-vessel price of British Columbia halibut. Additional changes have occurred in both the halibut processing sector and fishing sector.

In the processing sector, the number of firms buying halibut has increased substantially. Processors interviewed attributed new entry to the lower capital requirements for handling fresh halibut and to new opportunities for firms to establish niche markets. Halibut processors can also buy halibut from a much wider range of ports as there is no longer a need to land halibut in a port with a large freezing facility. As a result, landings have become less concentrated geographically.

Some important changes in the halibut fishing sector are a reduction in the number of participating vessels, changes in crew employment, and changes in vessel share systems. In 1993, 73 vessels leased out all of their quota and another vessel had its quota suspended leaving 361 vessels active in the fishery. Nearly one-half of vessel owners reported eliminating at least one crew member under the IVQ program although for those vessels reducing crew size, the individual shares of the remaining crew members generally increased. Since owning fishing quota presents a new opportunity cost for vessel owners, we expected the remuneration system to move towards recovery of some of the cost of using quota. Currently, 25 percent of those reporting no change in crew size reported reducing individual crew shares, presumably to accommodate the opportunity costs of quota.

In general, vessel owner's opinions toward the IVQ program are quite positive. Most fishermen report being better off under the IVQ program and feel IVQs conserve halibut resources better than previous management systems. However, most fishermen felt IVQs make it more difficult for young people to get into fishing and a substantial minority (28 percent) feel that IVQs do not make fishing safer.

Future Changes

Critical issues that are likely to have a significant effect on the British Columbia halibut fishery are potential changes in transferability restrictions and the introduction of ITQs in the U.S. Pacific halibut fishery. The current transfer restrictions of a maximum of four quota shares per vessel has, as was intended, limited fleet consolidation. Whether the current transfer restrictions will remain in future management plans is a contentious issue among halibut fishermen. Some fishermen would like to see quota share ownership caps increased or eliminated while

others prefer lower caps or no transferability at all. If transfer restrictions are relaxed or eliminated in future management plans, capitalization in the fishery could change significantly. Under the current quota transfer restrictions, fishermen cannot acquire enough quota to make halibut fishing their sole source of income and hence for most boats, halibut fishing is still a supplemental fishery to salmon. As a result, vessel characteristics such as vessel size and horsepower may be more attributable to capital needs in the salmon fishery than in the halibut fishery. If quota transfer restrictions are relaxed and the fleet becomes increasingly consolidated, halibut fishing may, for the fishermen remaining in the fishery, become their sole source of revenues, in which case, halibut fishermen may switch to vessels with characteristics that are better suited for halibut longlining and alter fishing practices.

The second issue likely to have a dramatic impact on the British Columbia halibut fishery is the introduction in the 1995 fishing season of an individual quota program in the much larger U.S. Pacific halibut fishery. Since 1991 British Columbia halibut fishermen have avoided the drop in fresh halibut prices that occurs when large volumes of Alaskan halibut comes on the market by not landing halibut during the weeks around the U.S. halibut openings. Avoiding direct competition with U.S. fresh halibut is no longer possible with the U.S. fishery operating under individual quotas. Competition from large U.S. fresh supplies will certainly result in lower ex-vessel halibut prices for British Columbia fishermen. The degree of this price decrease will depend on the price elasticity of demand for fresh halibut and the ability of the seafood industry to expand markets for fresh halibut. The British Columbia halibut industry will still have the advantage of lower transportation costs than Alaska given their closer location to U.S. markets.

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