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Technical Report No. 24

The Public Regulation of Commercial Fisheries in Canada

Case Study No. 4A

Regulating Pacific Salmon — The Alternatives Reviewed

by

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The findings of this Technical Report are the personal responsibility of the author, and, as such, have not been endorsed by members of the Economic Council of Canada.

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RÉSUMÉ

Cette étude de cas sur la réglementation de la pêche au saumon en Colombie-Britannique résume l'évolution des règlements appliqués dans ce domaine jusque vers le milieu de 1980. Elle divise toute cette période en deux phases distinctes. La première, où l'intérêt portait presque exclusivement sur la conservation des stocks, s'est caractérisée par la délimitation de zones et de périodes d'exploitation à accès libre, dans le but d'assurer aux divers stocks de saumon suffisamment de chances de s'échapper. Durant la deuxième phase, où la conservation des stocks demeurait encore un principe de gestion d'une importance primordiale, l'accent a été mis sur la nécessité de gérer les pêches en vue d'améliorer la performance économique des divers secteurs de l'industrie. Cette phase, qui a débuté par le programme de restriction des permis en 1968, se poursuit encore aujourd'hui.

Le succès de ce programme et la possibilité qu'il offre d'assurer la vigueur et la stabilité économiques à long terme de l'industrie constituent un thème central de la présente étude. La conclusion à laquelle nous arrivons comporte plusieurs éléments. Il semble évident que la limitation des permis a restreint, dans une certaine mesure, les investissements dans la flotte de pêche et qu'ainsi, face à la hausse rapide des prix réels dans cette industrie, les coûts d'exploitation ont été

maintenus à un niveau inférieur à ceux d'un régime d'accès libre. Mais il est évident aussi que cet effet de contrainte n'a pas été aussi marqué que prévu, et que des investissements trop nombreux et de double emploi dans des moyens de production ont contribué à réduire la richesse effective et potentielle de l'industrie. Le principal problème est venu de l'habileté avec laquelle les pêcheurs ont contrecarré constamment les efforts du gouvernement en vue de réduire les investissements excédentaires en biens d'équipement.

L'auteur conclut qu'améliorer le programme de limitation des permis, par l'application de règlements plus restrictifs visant les facteurs de production et leur remplacement, n'offrirait pas à long terme une solution aux problèmes économiques de l'industrie. La preuve est faite que de telles restrictions ne réussissent pas à diminuer les possibilités d'investissement et qu'elles ont une portée secondaire indésirable qui mène à la perturbation de l'ensemble des facteurs qu'utilise l'industrie. Les solutions à long terme devraient supprimer les motifs pour lesquels les pêcheurs sont portés à surinvestir, et non pas essayer de les restreindre artificiellement. À ce sujet, le moyen de gestion le plus direct et le plus efficace serait l'octroi de quotas individuels aux bateaux. Malheureusement, il serait difficile de le faire d'une façon directe à cause de la complexité de l'industrie de la pêche au saumon.

Le défi qui se pose donc pour l'avenir, sur le plan de la gestion, consiste à élaborer une stratégie permettant un système global de quotas individuels. À court terme, il faudrait mettre sur pied un programme de rachat financé par des redevances perçues sur les débarquements, expérimenter des systèmes de quotas par bateau selon les genres d'équipement employés dans des zones désignées, et intensifier les recherches relatives à cette forme de contingentement.

Summary

The case study on the regulation of the British Columbia salmon fishery summarizes the evolution of regulations in the fishery up until the middle of 1980. The study illustrates that there were two distinct phases in the regulatory history of the fishery. The first phase, concerned almost exclusively with conservation of the stocks, used area and time closures in an open access fishery in an attempt to ensure adequate escapement of the various salmon stocks. The second phase, while preserving stock conservation as a crucial element of the management rationale, emphasized the necessity to manage the fishery to improve the economic performance of the various sectors of the industry. This phase, which was initiated with the 1968 licence limitation program, continues today.

The success of the 1968 licence limitation program, and its potential to provide for long-term economic health and stability in the industry, are a central focus of the study. The conclusion is mixed. It seems clear that licence limitation had some constraining effect on capitalization of the fleet and so, in the face of rapidly rising real prices in the fishery, kept harvesting costs below the level that would have prevailed in an open access fishery. It is equally clear, however, that this constraining effect was not as significant as originally envisaged and investment in redundant fishing capacity has diminished both the realized and potential wealth in the industry. The chief problem has been the continued ability of fishermen to frustrate attempts by the government to cut-off investment in redundant fishing capacity.

The study concludes that further refinement of the licence limitation program, by the application of more restrictive input and replacement regulations, does not offer a long-term solution to the economic problems of the industry. It has been demonstrated that such restrictions are not effective in cutting off investment possibilities and have the undesirable side effect of distorting the input mix in the industry. Long-term solutions must remove the incentive for fishermen to over-invest and not attempt to artificially restrain it. In this regard, the most direct and efficient management option would be the introduction of individual vessel quotas. Unfortunately, the complexity of the salmon fishery mitigates the possibility of moving directly to an individual vessel quota scheme.

The management challenge for the future is to devise a strategy conducive to the comprehensive application of individual vessel quotas. A buy-back program financed by royalties levied on landings, experiments with vessel quota schemes for particular gear types in designated areas, and intensified research relevant to individual vessel quotas are recommended in the short-term.

INTRODUCTION

This study, by J. Douglas MacDonald, is the author's final version of his work on the regulation of the Pacific salmon fishery. An earlier version was released in this series as Technical Report No. 19, "The Pacific Salmon Fishery". This version, shorter but incorporating new data, was completed in late 1980, before the 1981 release of the first Pearse Report, Conflict and Opportunity: Toward a New Policy for Canada's Pacific Fisheries, Preliminary Report of the Commission on Pacific Ocean Fisheries. There is some overlap, but important differences. Douglas MacDonald deals only with salmon regulation, and his endeavour has been to apply the general approach of the group working on the public regulation of commercial fisheries in Canada to one specific case. His remarks on the applicability of a quota system to the salmon fishery come to a somewhat different conclusion from the Commissioner's.

As with other case studies, the references and citations are to the bibliography of the main study, edited by Anthony Scott and Philip A. Heher, The Public Regulation of Commercial Fisheries in Canada, pp. 69-76.

Anthony Scott

1. The Resource

Salmon is a highly prized, commercially valuable fish. Not only is it valued for its taste, texture and colour but it is also an exciting sport fish. There are five species of salmon -- chinook (spring), sockeye, coho, chum and pink which are all commercially exploited. Differences in taste, flesh colour, oil content and outward appearance determine the attractiveness of each species to the various commercial and recreational uses. Table 1 details some characteristics of each species.

All five species of salmon are anadromous fish returning to fresh water to spawn after a period in the open sea. The chinook, coho, pink, and chum all spawn in running streams while the sockeye generally spawn in tributaries of lakes. The amount of time a young salmon spends in fresh water before migrating to the ocean varies by species (and even within the species). Pink and chum salmon migrate early in the first year while sockeye generally spend at least the first year of their life in fresh water. All Pacific salmon reaching the salt water remain there until they mature (see Table 1). The time of year during which salmon run to their spawning grounds varies widely between and within species and can occur any time between early spring (for the chinook) to as late as November (for the sockeye).

Salmon are most economically harvested in or near the mouths of rivers as they return from the sea to run upstream to spawn. They do not school in the open sea and in the river their quality deteriorates markedly as they progress upstream. Sockeye, pink and chum salmon, being plankton feeders, stop feeding as they approach fresh water; in

TABLE 1

Characteristics of Various Salmon Species

	Average Weight (lbs)	Flesh Colour	Age at Maturity (years)	Gear Used*	Approximate Time of Availability in the Fishery
Sockeye	6	Red	4-6	Net	June - October
Coho	6½	Red	3-4	Troll	June - November (mainly in August)
Chinook	12-20	White Pink Red	3-7	Troll	March - October
Chum	11	Pale Pink	3-5	Net	July - November
Pink	4	Pink	2	Net	July 15 - September 30

*Gear used represents only the primary type of gear used to catch each species. Choho and chinook salmon are also the mainstay of the recreational fishery.

addition they tend at this time, to school in the ocean. These two facts make them most accessible to seines and gillnets. Chinook and coho, on the other hand, do not school so densely, nor do they stop feeding (on smaller fish), and they are generally caught with hook and line gear. Some salmon from Canadian streams spend part of their life cycle in American waters and may be caught by American fishermen as they migrate. Consequently, their management, particularly of those salmon coming from the Fraser River system, requires co-ordinated efforts on the part of the United States and Canada. On the Canadian Pacific coast the Fraser and Skeena Rivers are the major producing rivers, accounting for over 50 per cent of the salmon caught in British Columbia.

The anadromous nature of salmon has several important implications for the salmon fishery:

1. While salmon can be caught easily and cheaply they are also extremely vulnerable to overfishing and possible extinction
2. Because salmon spawn in fresh water and spend their early life in rivers and lakes, they are affected by economic activity outside the fishing industry. Blockages and industrial effluent in spawning streams have, in the past, had disastrous consequences for certain salmon runs. By the same token, however, fresh water spawning raises the possibility of enhancement (artificially increasing the number and quality) of the stock.
3. The size of the spawning area is relatively small and subject to overcrowding. A large spawning stock, which implies a high mortality rate for fertilized eggs, places an

upper bound on the desired escapement of salmon for spawning.

4. Salmon from the various rivers form distinct biological units each exhibiting differences in habits, methods of growth and periods of maturity. In addition, different species often run up the same river at the same time of year making species discrimination in the fishing difficult. These characteristics render the task of ensuring optimal escapement for each stock difficult.
5. Anadromous fishes are unique in that it is possible to get direct or near-direct estimates of the breeding population.

Because of the migratory habits of salmon, fishing is a seasonal occupation for both the harvesting and processing sectors of the industry. The timing of the runs varies from year to year while regulations further accentuate the stop-go harvesting of fish. In addition, there is a high level of variability in the runs of each species stemming from their dependence on fresh water environments for spawning, fluctuations in ocean survival rates and the fact that only one or two year-classes are subject to capture. Annual fluctuations are more extreme in the case of pink, sockeye and chum, than for coho and chinook because the latter two species are more widely distributed in their spawning environment. The seasonal and cyclical variability of salmon available for harvest induces a greater degree of capitalization in harvesting and processing facilities than would be required for a more stable fish population. The complexity and variability of the relationship between the spawning and recruitment and mature stock also makes it difficult to ascertain the value of any investment in enhancement. While enhancement may be able to increase the number of fish available for capture it may be more difficult to smooth the cyclical variability of the stock.

Salmon are only available for capture for short periods after which they die. This fact combined with the variability described above implies that a flexible management policy is desirable. The use of time and area closures in the fishery have been employed in an attempt to ensure adequate escapement from a variable stock.
The seasonal nature of the fishery also means that many salmon fishermen and vessels can continue to engage in another fishery.

2. The Industry

(a) The Primary Sector

Salmon are fished by three major gear types -- seiners, gillnetters, and trollers. The primary sector in the main is competitive, with no one vessel accounting for a sufficiently large percentage of landings to influence price. However, the existence of organizations representing fishermen, particularly the United Fishermen and Allied Workers Union (UFAWU) imparts some market power to fishermen. The union bargains with the Fisheries Association over minimum prices for each species, establishing a floor price for salmon. In addition, the fleet is not entirely independent of either direct or indirect control by the processing companies. Direct ownership of the fleet by processing companies has hovered at just over ten per cent while indirect involvement in the fleet has taken the form of the provision of financial services, supplying net lofts and gear storage facilities and operating a packer fleet. The participation pattern of each gear type has varied by species and final market (See Table 2). In general the troll fleet has concentrated on the chinook and coho species and has supplied the fresh/frozen market. The net fleet (seiners and gillnetters) has concentrated on sockeye, pink and chum and supplied salmon for canning purposes. This distinction has, however, become blurred with trollers catching increasing quantities of sockeye and pink salmon while the net gears have become more important suppliers for the fresh/frozen market.

T A B L E 2

Percentage Landings of Salmon by Species and Different Gear Types -- Four Year Averages, 1960 - 1977

Percentage of Total Landings by Weight

	Sockeye	Coho	Pinks	Chums	Chinook	All Species
Gillnet						
1960-1963	81.3	25.1	32.3	57.5	30.3	41.7
1964-1967	75.8	25.0	29.9	53.8	25.5	39.7
1968-1971	96.2	22.0	25.6	62.3	19.4	40.6
1972-1975	64.8	18.3	19.6	51.1	15.4	38.6
1976	62.0	12.6	17.7	44.3	13.2	30.9
1977	62.0	13.6	22.1	53.4	15.0	33.4
Seine						
1960-1963	18.0	12.8	62.1	42.4	4.9	3.91
1964-1967	21.9	11.4	59.3	45.7	5.6	33.1
1968-1971	23.6	11.9	61.4	37.1	7.6	32.6
1972-1975	28.9	16.6	67.4	48.5	6.9	33.3
1976	35.6	12.8	75.0	55.3	6.3	43.4
1977	35.9	20.1	51.8	44.8	12.3	37.7
Troll						
1960-1963	.7	62.1	5.6	.3	64.8	19.2
1964-1967	2.3	63.6	10.8	.5	98.9	27.2
1968-1971	7.2	66.0	12.9	.6	73.0	26.8
1972-1975	6.3	65.1	13.0	.4	77.7	23.1
1976	2.4	66.3	26.1	1.8	72.7	28.9

Source: Sinclair (1978, Vol. 1, 74).

The composition of the primary sector has not been invariable, particularly since the implementation of the licence limitation programme in 1969. Notable changes have been: the increase in the number of seiners and the decrease in the number of trollers and gillnetters; the increase in the number of combination gear types and the decline in the number of single gear vessels; and an increased level of capitalization per vessel for all gear types. Associated with this last point has been the increasing production potential of a vessel, particularly a seine vessel, of a given size (measured by length or net tonnage).

Table 3 shows that the number of vessels in the salmon fleet decreased overall between 1967 and 1977. However, the various gear types reveal very different trends. The gillnet fleet declined sharply by about 600 vessels), the troll fleet experienced a smaller decrease (about 300 vessels) but the seine fleet had about 150 more vessels in 1977 than 1967.

The source of the increase in the seine fleet after the advent of the licence limitation programme came largely from a transfer of longline vessels from the halibut/troll fishery to the salmon seine fishery. More came from the "pyramiding" of non-seine vessels (gillnetters and trollers).[1] Less significant sources of increase were the transfer of licences from salmon trollers and gillnetters to seine vessels and from the Indian tonnage bank.[2] The decrease in the number of gillnetters and trollers is explained by retirements to facilitate expansion of the seine fleet and by withdrawals resulting from the buy-back programme of the early 1970s.

Another trend illustrated in Table 3 is the increasing proportion of combination vessels within each gear classification. In fact, while

TABLE 3

Number of Vessels by Gear Type, 1967-77

Year	Seiners			Gillnetters			Trollers		
	Single	Combination[a]	Total	Single	Combination	Total	Single	Combination	Total
1967	232	181	413	2,041	1,749	3,790	2,187	126	2,313
1968	271	120	391	2,146	1,614	3,760	2,217	132	2,349
1969	286	84	370	2,462	961	3,423	2,211	126	2,337
1970	293	132	425	2,307	1,189	3,496	2,138	128	2,266
1971	253	152	405	2,144	1,071	3,215	2.046	141	2,187
1972	247	146	393	2,065	957	3,022	1,957	131	2,088
1973	228	228	456	1,798	1,151	2,949	1,580	209	2,789
1974	233	255	488	1,944	1,024	2,968	1,563	245	1,808
1975	230	242	472	1,690	1,198	2,878	1,540	230	1,770
1976	226	283	509	1,562	1,294	2,856	1,602	279	1,881
1977	221	293	514	1,524	1,308	2,832	1,708	322	2,030

Source: Sinclair (1978, Vol. II, various tables).

[a] Combination vessels are defined as follows: A vessel which fishes with seine gear and any other gear, within or outside the salmon fishery is defined as a combination seiner; a vessel which fishes with gillnet gear and any other gear except seine gear, within or outside the salmon fishery is defined as a combination gillnetter; a vessel which fishes with troll gear and any other gear except seine and gillnet gear, within or outside the salmon fishery is defined as a combination troller.

total fleet numbers declined by about 750 vessels, the number of combination vessels in the fleet rose by about 750. The increasing use of combination gears has two origins. The halibut fishery has traditionally been an important source of income for seiners and trollers, accounting for over 40 per cent of the gross income of combination seiners in 1970 and over 60 per cent of the gross income of combination trollers in 1972. However, the emergence of a lucrative roe herring fishery in 1973 seems to have induced many more salmon seiners and trollers to acquire the necessary gear for this fishery. Neither seiners nor trollers have had much interest in acquiring new types of gear to fish within the salmon fishery.[3] In second place, the 1970s were characterized by rapidly rising prices for salmon and increasing restrictions on the net fisheries. These two factors induced many fishermen formerly fishing only with gillnets to acquire troll gear.[4] Therefore these vessels can not only fish with gillnet gear during the prescribed openings for that gear type, but also fish the rest of the time with troll gear. Accordingly, income generated from the salmon troll fishery has been the prime supplement for income earned from the salmon gillnet fishery for combination gillnetters.

The significance of this discussion is that a large part of the increase in combination vessels has resulted from events outside the salmon fishery. While there has been an increase in gillnet-troll combination vessels, the emergence of the profitable roe herring fishery is the most important factor underlying the increase in combination vessels.

Finally, in all gear types there have been significant increases in the level of capitalization between 1969 and 1979. The Sinclair Report (Sinclair, 1978)) provided estimates of these increases, showing that in this period the real value of capital per vessel in the seine fleet rose by between 43 and 55 per cent; almost all of this increase occurred in the combination-gear category. The real value of capital per vessel in the gillnet fleet rose by between 24 and 40 per cent. In this case the increase in capital was spread fairly evenly between single and combination gears. In the troll fleet the real value of capital per vessel rose by between 69 and 78 per cent; the rise was much larger for single than combination trollers. Combination seine vessels accounted for about 75 per cent of the total increase in capital in the salmon fleet over the 1969-1977 period.

Vessels with the highest levels of capitalization in each gear category obtain, in Sinclair's figures, significantly higher returns to capital than those with lower levels. In the seine fleet, the highly capitalized, highly productive vessels built after 1968 tended to be smaller and exhibited different structural characteristics than those built earlier. Of the vessels landing over 150,000 pounds of salmon per season in 1979, those built before 1968 averaged about 70 feet and 55 tons while those built after 1968 averaged only 63 feet and 28 net tons.

Finally, there is evidence that seine vessels are becoming much more mobile. A study by Hillborn and Ledbetter (1978) points out that in 1973 mobile boats outnumbered stationary boats by five to one while in 1976 the ratio was twelve to one.[5]

(b) The Secondary Sector

Although there were 108 buyers of salmon in 1977, the secondary sector of the industry is nevertheless concentrated. Over 50 per cent of total landings in 1977 were accounted for by three firms (see Table 4). Concentration in the secondary sector varies by area, by species of fish purchased, by gear type and, most importantly, by the end use of the raw material purchased.[6] Concentration among buyers in the fresh/frozen sector is considerably less than among buyers in the canning sector.[7] The slightly declining trend in the relative shares of the top three firms illustrated in Table 4 can be largely attributed the increasing share of the resource entering the fresh/frozen market. Nevertheless, concentration remains high, even among buyers in the fresh/frozen market.

An important aspect of the salmon industry is the vertical integration between the primary and secondary sectors. This has taken the form of direct ownership of vessels, financing of vessels and equipment and the provision of services to fishermen by processors. A substantial proportion of the fleet, 12 per cent in 1977, is owned by processing companies.[8] Such direct ownership varies widely by gear type, being estimated at 24 per cent for seine vessels, 15 per cent for gillnetters and only .5 per cent for trollers. Company financing of vessels has also been extensive but has decreased significantly between 1970 and 1977. (See Table 5). For example, the number of vessels reporting debt to processors had declined from 1,472 in 1970 to 475 in 1977.

The concentrated structure of the secondary sector can have important implications for regulation of a fishery. The design of regulations in the harvesting sector has become increasingly sensitive to economic considerations. In particular, attempts to control the number of vessels and level of capitalization in the harvesting sector is an important aspect of management plans devised for the salmon fishery. Concentration

TABLE 4

Shares of Raw Salmon Purchases by Buyer Category 1973-77

	1973		1974		1975		1976		1977	
	% of Value	% of Weight	% of Value	% of Weight	% of Value	% of Weight	% of Value	% of Weight	% of Value	% of Weight
Top Three Non-Co-Op Firms	59.1	60.5	57.1	58.0	42.3	42.2	50.0	53.0	52.4	53.4
Co-operatives	8.5	7.8	10.0	9.1	18.1	19.7	11.2	9.3	13.3	12.1
Other Processors	29.2	29.4	20.8	31.1	33.2	32.9	35.5	30.9	29.1	30.5
Cash Buyers	3.1	2.3	2.1	1.8	6.2	5.0	3.3	2.8	5.2	4.0
Total	100	100	100	100	100	100	100	100	100	100

Source:

TABLE 5

Estimated[a] Indebtedness of Licensed Vessels in Total and to Processing Companies, 1970-1977

	1970	1971	1972	1973	1974	1975	1976	1977
Total Vessels Reporting Debt	2,819	2,568	2,357	2,136	2,669	2,713	2,879	2,682
Percentage Reporting Debt	41	39	38	29	38	37	38	41
Number Reporting Debt to Processing Companies	1,302	1,022	770	569	652	612	478	294
Percentage Reporting Debt to Processing Companies	19	15	12	8	9	8	6	5
Amount of Total Debt ($ millions)	22.2	21.2	23.2	26.0	45.8	60.4	69.0	76.7
Percentage of Total Debt to Total Vessel Value	22	20	21	16	17	23	23	24
Amount of Debt to Companies ($ millions)	7.9	6.4	5.4	5.1	6.8	11.1	7.8	5.0
Debt to Companies as a Percentage of Total Debt	36	30	23	20	15	18	11	7

Source: Sinclair (1978, Vol. II, 24).

[a] These figures are based on data given by fishermen in their licence applications. Processing Company debt does not include debt jointly assumed by company and a financial institution.

in the processing sector, however, may result in most of the resource rent accruing to that sector and not to the harvest of the resource.[9] To the extent that this is true, fishermen will have less ability to finance excessive capital investment in the fleet. Regulation and control of this sector may be more important than regulation of the harvesting sector.[10] The implications of market structure on economic efficiency and rent dissipation in a fishery are not fully understood. More work is required in this area.

(c) Marketing Considerations

World production of commercially sold salmon is dominated by a very small number of countries. As illustrated in Table 6 Canada's share of world production fluctuated between 9.1 per cent in 1974 and 18.7 per cent in 1977. The relative share of the Canadian catch in total world production is not distributed uniformly among the five species. Canada's share of the world catch is largest for sockeye, chinook, and coho species.

The percentage of production that is canned has declined in relation to fresh, frozen and smoked products. The canned product relies more heavily on a domestic market protected by a 7.5 per cent tariff and dominated by a few large firms. Since 1969 exports of canned salmon have been between 30 and 50 per cent of total canned production while exports of frozen production have been between 50 and 90 per cent of total frozen production. Canada's share of world production in exported frozen salmon is approximately 50 per cent.

The United Kingdom has traditionally been the largest consumer of Canadian canned salmon but consumption has been falling since the 1960s. Japan is the other important market. For frozen salmon, the United States

TABLE 6

Canada's Share of World Production

Metric Tons, Round Weight (and per cent of world production)

Year	Pink	Chum	Sockeye	Chinook	Coho	Total
1974	11,207 (11.9)	12,479 (10.3)	21,694 (41.0)	7,637 (31.6)	10,378 (24.1)	63,985 (18.7)
1975	10,239 (6.0)	5,389 (4.2)	5,681 (14.7)	7,289 (29.4)	7,737 (24.2)	36,335 (9.1)
1976	17,056 (11.7)	10,922 (8.9)	12,339 (20.5)	7,776 (28.8)	9,322 (24.2)	57,415 (14.4)
1977	24,723 (11.0)	6,032 (5.1)	17,388 (27.0)	7,522 (28.5)	9,857 (31.6)	65,522 (14.0)

Source: Adapted from McEachern (1979, 6).

and west European countries were, up to 1978, the largest consumers of Canadian exports. Since that time Japan has imported more Canadian frozen salmon than any other country. The primary reason for the surge in Japanese imports was a decline in landings of Japan's own fleet due to the establishment of the 200-mile fishing limit in the United States and Canada.[11]

Marketing considerations have several implications for the management of the Pacific salmon resource. Canada accounts for a substantial proportion of world production and exports, especially in the frozen salmon market. In addition, the domestic market depends almost entirely on local production. It follows that management programmes that increase the quantity of salmon harvested will not necessarily increase the net revenues from production. Because of its major market share, an increased supply from Canada will moderate the benefits by depressing price.[12]

Management programmes and institutions must be flexible enough to adapt to changing market conditions. To the extent that regulations allocate the catch between gear types based on non-economic criteria that are not responsive to changing market conditions, some of the potential benefits of the resource are lost. The present area and time closure regulations, which attempt to maintain the traditional shares of each gear type, and the possibility of a formal allocation of the catch between gear types impede marketing flexibility. Finally, regulations can affect the quality of the product both directly and indirectly. Salmon is a very fragile commodity and quality is an important aspect, especially in the export market.

3. Special Considerations

(a) The Sport Fishery

The salmon sport fishery in British Columbia represents a significant and growing use of the salmon resource. Available data indicates that over 500,000 (see Table 7) were caught by sport fishermen in British Columbia in 1976. This data should be used with a great deal of caution, however, as the Department of Fisheries has little confidence in the reliability of any data in the sport fishery. Referring to the data presented in Table 7, a 1977 study conducted for the Salmonid Enhancement Program stated, "Unfortunately, staff in the region estimate that these figures are biased downwards by as much as 50 per cent." (Masse and Peterson (1977)). Another study (Masse and Sterne (1977)) indicates that the reported catch may be only one-third of the actual catch. The unreliability and downward bias of available data may mean that the significance of the sport fishery is vastly underestimated.

The sport fishery is primarily a salt water activity[13] as the fresh water fishery has been severely restricted and many areas closed entirely because the stocks have diminished.[14] (Fresh water fishing is still important in northern areas particularly in the Lower Skeena River system.) Accordingly, this section focusses primarily on the salt water fishery although, with the Salmonid Enhancement Program, it is expected that the fresh water fishery could grow.

The importance of the sport fishery varies widely by area and species. Table 7 shows that chinook and coho salmon are by far the most important sport fish. The sport fishery, therefore, competes mainly

TABLE 7

British Columbia Sport Catch and Effort
by Year and Species[1]

Species	1972	1973	1974	1975	1976
Spring and Jacks[2]	118,207	116,009	112,320	155,306	216,055
Coho	107,680	119,162	247,315	163,067	174,600
Spring grilse[3]	35,520	32,239	36,694	48,685	76,345
Coho grilse[3]	48,412	57,283	65,269	60,383	57,603
Pink	5,424	25,767	8,827	17,756	13,706
Sockeye and Chum	1,866	4,508	3,440	2,296	1,239
Total	317,109	354,970	483,775	447,413	539,548
Fishing Effort-Boat Days	325,652	350,082	370,522	378,706	391,337

Source: 1976 Salmon Sport Fishing Catch Statistics, Department of Fisheries and the Environment, Table 1, p. 10.

[1]The members of fish caught were derived from estimates of field officers with the Department of Fisheries and Oceans. They are believed to be significantly understated as described in this section.

[2]A Jack is a small Red Spring salmon.

[3]A grilse is an immature salmon.

with the troll fishery (which also concentrates on these species) for a share of the catch. While the sport fish catch is a small percentage of the total catch, it can be a very important factor in certain areas for a given species. For example, in the Strait of Georgia, British Columbia's most important salt-water sport fishing area, sport fishermen are estimated to take 83 per cent of the total coho catch and 65 per cent of the total chinook catch.

The number of participants in the British Columbia sport fishery is large. In 1976, it was estimated to be 500,000 for the sport fishery overall and 300,000[15] for the tidal water sport fishery. The estimated growth in the number of participants is five per cent, about double the provincial population growth rate. About 90 per cent of saltwater sport fishermen live in the Vancouver lower mainland. In addition to the expansion in effort because of the growing number of fishermen, vessels in the fishery have become increasingly mobile and more efficient at catching salmon owing to improved gear and fishing techniques.

Sport fishermen's expenditures related to fishing, are large. Of the $100 million spent directly on the sports fishery about $30 million went to the salt water salmon fishery. (Masse (1977)).

The sport fishery suffers from the same common property problems as the commercial fishery, (complicated by the greater difficulty of quantifying the benefits and costs of non-commercial activities). The benefits must include not only the act of catching a fish but all of the associated pleasures of participation in the fishery. But the dependence of these benefits on either the amount caught or the amount spent is not clear. For example, while there are necessary direct fishing costs (gear, tackle), there are also indirect costs that are only partly used for the fishery (boats, recreational vehicles, food, etc). Not surprisingly, quantifying these benefits and costs is, because of such conceptual and data problems, a complex assignment.[16]

Several important points can be made, however. With virtual open access in this fishery most benefits from this use of the resource accrue entirely to the participants. With a large number of participants and a zero price on the resource itself, the consumption of this form of recreation will proceed beyond the level that is desirable from society's point of view. As in the commercial fishery, the result is economic waste of time, work and capital and also excessive pressure on the stock by all participants.

An immediate problem is to determine the allocation of the fish between commercial and recreational uses that is desirable. On efficiency grounds the resource should be allocated between the two uses by distributing it to those users willing and able to pay the highest price for it. However, the added benefits of any management programme must be measured against the costs incurred in achieving these benefits. The enforcement and managerial costs of achieving the maximum benefits from the sports fishery may be even higher than for the commercial fishery, and an appropriate adjustment made. In addition a management programme must reflect the non-economic societal (recreational and redistributive) objectives, and be sensitive to the political environment in which it will operate.

At present the tidal sports fishery in British Columbia is not highly regulated. Open access has prevailed and, in general,[17] no licensing system has been implemented. The tidal fishery has catch and size limits varying by area and gear restriction.[18] The fresh water fishery comes under provincial jurisdiction, is subject to area and time closures and is licensed by the province.[19] The regional director of fisheries can establish discretionary closures in the fresh water fishery to ensure escapement. However, while management goals in the commercial fishery since 1969 have been at least partially based on economic considerations this has not been so for the sport fishery.

The burden of conservation regulations in the recreational fisheries is not evenly distributed. The non-tidal fishery is much more highly restricted than the tidal fishery and in many areas may be closed entirely. The commercial fishery, particularly the net fisheries, with more restrictive area and time closure regulations and a limited entry programme is also left relatively worse off.

It is likely that mandatory licensing will be implemented in the recreational fishery in the near future.[20] This could be a personal yearly licensing scheme with a minimal charge for the licence (perhaps $5). This regulation will facilitate the generation of better information concerning catch and effort levels in the fishery. The fee associated with the licence can also help defray the costs of the Salmonid Enhancement Programme.

The proposed personal yearly licensing and fee system is desirable in that it facilitates greater control over the sport fishery and establishes the concept that sport fishermen should pay for the use of the fish resource. Furthermore, the concept of licensing has general acceptance in the industry. "Discussions with organized sport fishermen, representatives of the sport fishing industry and with individual sport fishermen, have extended over several years on the topic of licensing. These discussions have resulted in agreement to saltwater licences in principle. In addition they have indicated that a simple personal licence would be most acceptable and easily understood by anglers" (Masse (1977)). Increases in fees in the future would allow the government to appropriate more significant revenues from the sports use of the resource.

A personal licensing and fee system, however, is not an efficient instrument to attempt to achieve maximum economic benefits from the recreational use of the resource. The criticisms of a vessel licensing fee system to be discussed in the commercial sector equally apply to a personal licensing and fee system for the recreational sector. The information costs of establishing an appropriate fee would, if anything, be even higher than in the commercial sector. The fact that the fee is not directly related to the impact on the resource leads to significant problems of efficiency and equity. Similar problems exist in the commercial sector. These will be discussed in more detail later.

The most attractive alternative to a system of personal licence fees is a property rights system. The optimal scheme from the abstract point of view of efficiency would be one that involved the auctioning of the total salmon quota with participants in both the commercial and recreational fisheries bidding equally for the quotas. (Divisibility of quotas would be necessary for this plan.) The result of the programme would be to distribute quotas to those who were willing to pay the top price for them, whether they were commercial or recreational fishermen. The economically rational allocation of the resource between the two sectors <u>and</u> within each sector is the attractive feature of this programme.

Practicality, however, would dictate the establishment of an initial allocation of shares of the total quota or TAC between the two sectors, based on estimates of the historical landings in each sector. Since the present allocation is not obviously based on any social or economic goals, the initial allocation could be revised appropriately as market information from both sectors emerged. The most efficient way to facilitate this subsequent redistribution of shares would be to allow transferability of the quotas between the commercial and recreational fisheries in a market-like fashion.

The distribution of the recreational fishing quota is a complex problem. Ruling out bidding, we must establish some other orderly, efficient, equitable, flexible allocation market or system for quota rights within the recreational fishery <u>and</u> between the recreational and commercial sectors. The unfamiliarity of any solution of this type and the many complex issues involved, suggest that its implementation is probably not immediately possible or advisable. An immediate move can be made, however, to establish the principle that recreational fishermen should have to pay. On the one hand a landing fee (or royalty) could be attempted although this would be difficult to enforce owning to the fragmented nature of sport fishing. On the other hand, a licence fee for the right to fish could be emphasized. Either programme should, in addition to constraining effort and appropriating rent for the government, be designed to provide information on the value placed on fishing by recreational fishermen.

(b) International Considerations

The various species of salmon follow wide-ranging migration patterns. A portion of the salmon spawned in Canadian waters spends part of its life cycle in American waters.[21] The international nature of the resource raises particular problems for management. As the stocks are not unique to either nation a common property exists between them. Each has an incentive to intercept the stocks while they are within its own jurisdiction. (See Table 8 for actual interceptions of salmon by United States and Canadian fishermen.) Gains from not intercepting the migratory resource (that is, increased stocks in future years) only partially accrue to the nation which foregoes the catch. That nation has then a reduced incentive to invest (by enhancement facilities and by regulating catch levels) in its own waters, or to "abstain" (a phrase used in treaties) from catching fish spawned in the other country.

TABLE 8

Interceptions of Salmon
(100's of fish)

Origin of Stock	Intercepting Fishery	Pink	Sockeye	Chum	Coho	Chinook
Canada	Alaska	311	116	24	96	130
Alaska	Canada	204	12	45	75	-
Wash.,Ore., California	Canada	204	7	37	1,322	676
Canada	Wash.,Ore., California	1,212	1,854	126	430	108
Balance in Favour of United States		1,115	1,951	68		
Balance in Favour of Canada					371	438

Source: U.S. Department of Commerce (1977, 15).

Therefore, in the case of salmon, there is need for international co-ordination to manage the stock effectively.

A series of meetings and negotiations between the United States and Canada have discussed since the 1890s how the two countries should jointly manage the salmon fishery. These meetings resulted in the formation (by Convention, in 1937) of the International Pacific Salmon Fisheries Commission (IPSEC), set up initially to allocate the catch of sockeye in the Fraser River-Juan de Fuca Strait area between the two countries. The distribution of catch agreed upon was 50/50 within convention waters. In 1957, the Commission's mandate was extended to include pink salmon as well as sockeye.

Salmon spend a great part of their life cycle in international waters and before World War II were fished by an international fleet, largely Japanese. The United States and Canada became very concerned about the size of the Japanese catch and in 1952, under the terms of the International Convention for the High Seas Fisheries of the North Pacific Japan was induced to agree not to fish for salmon east of 175°W. This prevented the Japanese from harvesting Canadian salmon stocks.

More recently high seas salmon stocks have been a topic of the Third Law of the Sea Conference. It is widely recognized that the states of origin incur many costs in maintaining the fresh-water habitat of the salmon and therefore the Conference considered a resolution which would disallow high seas fishing for salmon except where this would result in economic dislocation for a state other than the state of origin. Although international conventions are unenforceable the attitude demonstrated was in Canada's favour.

With the introduction of the 200-mile economic zone and the implementation of salmonid enhancement programmes, there has been renewed interest by the United States and Canada in the problem of salmon interception. The increasing value of the salmon resource has led to increasing pressure on the stocks of salmon in both countries as the amount of capital employed in the fisheries has risen. It has also, however, led to increased potential benefits from coordinated, effective management of the resource. Despite this, stable and effective joint management of the salmon stocks between the United States and Canada had not been achieved by the end of the 1970s. The turmoil within the International Pacific Salmon Fisheries Commission in 1980 illustrated the problems of joint management of an international resource. Different internal policies within countries may narrow their ability to enter into, and maintain, agreements that could increase the benefits from the resource to both countries. The less the extent of such agreements, however, the less attractive are the expected potential benefits from management of the resource by only one country.

(c) The Native Indian Fishery

To understand any discussion of native Indian participation in the British Columbian salmon industry it is necessary to define the classification "native Indian." Legally speaking, a "native Indian" fisherman is one whose name is on an official "Band List" maintained by the Department of Indian Affairs. There are many "non-status" Indians who are not included in this category and do not qualify for the special provisions and programmes designed for Indians by the federal government despite the fact that they have the same background and problems in the fishery as status Indians.

Native Indians have both non-commercial and commercial fisheries rights not shared by non-Indian fishermen. Indians have traditionally used salmon as a major source of food. This creates a claim on the salmon resource, accepted as a priority in the sharing of the catch between commercial and non-commercial users. In the commercial fishery native Indians are considered to be worthy of special considerations for several reasons. Many Indian villages and reserves are heavily dependent upon commercial salmon fishing, especially in the northern part of British Columbia. Changing conditions in the fishery can affect the very survival of a village and consequently have serious social and economic repercussions.

Again, native Indians tend to have fewer employment alternatives than non-Indians. Although low opportunity incomes are not unique to Indian fishermen, they are a much more general and enduring problem than among non-Indian fishermen. Similarly, Indians have less access to capital markets than non-Indian fishermen. Many Indians live on reserves and lack the collateral necessary to obtain loans. Associated with this is the high proportion of rental vessels which are operated by Indian fishermen (and owned by processing companies).

Finally, native Indians maintain that their Aboriginal Rights imply that they should always be able to participate in the British Columbia fisheries unencumbered by licence limitations effected for the general non-Indian population.

These features of the Indian salmon fishery have produced some unexpected and undesirable effects on Indian fishermen. They also explain the special programmes and provisions incorporated into management plans to address the special concerns of the Indian fishermen. The most important of these were the Indian Fishermen's Assistance Programme initiated in 1967 and the special "AI" licence category designed for Indian fishermen.

Despite various problems associated with the special programmes designed for Indian fishermen, the reversal of the decline in the number of Indian fishermen and vessels which prevailed until 1973 indicates that these programmes have been at least partially successful (see Table 9). While it is difficult, in assessing the success of programmes designed specifically for Indian fishermen, to differentiate the impacts of market forces from those of the special programmes enough has been learned to justify special sensitivity to Indian fishermen's needs in designing future programmes to increase general economic efficiency in the salmon industry.

TABLE 9

The Indian Owned and Indian Operated Fleet, 1968-1976

	1968	1969	1970	1971	1972	1973	1974	1975	1976
Number of Indian Owned and Indian Operated Vessels	1161	917	980	855	860	790	824	952	933
Proportion of Total Fleet Owned or Operated by Indians (%)	17.5	14.5	15.5	14.4	15.1	14.4	13.5	15.7	14.6
Number of Indian Owned Vessels	570	540	645	600	583	509	518	641	602
Number of Company Owned and Indian Operated Vessels	591	377	335	255	277	281	306	311	331
Proportion of the Indian Fleet Owned by Companies (%)	49	41	34	30	32	36	37	33	35

Source: <u>The Sinclair Report</u>, Vol. I, p. 196.

4. Historical Management of the Resource

(a) Managerial Developments in the Fishery, 1890-1969[22]

The commercial salmon fishery began around 1870 when salmon canning became feasible and was introduced to Washington, Alaska and British Columbia. At the outset companies were granted exclusive canning and fishing rights over specified waters of British Columbia. Regulations primarily designed to ensure adequate spawning escapement were introduced on the Fraser River in 1890. These included time closures, mesh size and gear restrictions, boat limitations and licence fees. In these early years the canners holding exclusive fishing rights made various attempts at self-regulation, recognizing the unprofitability of competing for a share of a given catch by adding to harvesting facilities. These private attempts continued until the late 1920s, but were undermined by government management policy and the lack of sufficient barriers to entry in the processing sector.

Prior to 1969 the primary objective of government regulation was to ensure adequate spawning escapement for salmon stocks. Other non-economic objectives such as employment creation also were part of management policy in the salmon fishery. Despite the lucid description of the need for economically motivated regulations contained in the Sanford-Evans Commission report of 1917 and short-lived experiments with licence restrictions on canneries, substantial licence fees and landings taxes, no significant attempts were made to manage the fishery according to economic principles.

By the late 1920s the commitment to free entry in the salmon fishery began to conflict with attempts to manage the resource biologically. Area and time closure regulations, the chief tools used in the biological management of the resource, had to become increasingly restrictive to ensure adequate spawning escapement. The degree of restrictiveness of these regulations accelerated through the 1950s. The number of allowed days per week fished in the Strait of Juan de Fuca fell from 5 1/2 in 1951 to 3 1/2 in 1959.

The number of vessels participating in the fishery was increasing at the same time as the fishing capability of each vessel was rising. Works by fisheries economists in the mid-1950s pointed out that a common property fishery left to free market forces was not only undesirable from an economic point of view but could lead to serious conservation problems for the resource. This was clearly occurring in the British Columbia salmon fishery. In recognition of this fact, the government commissioned Dr. Sol Sinclair, an economist, to conduct an investigation into problems in both the salmon and halibut fisheries. The main problem to be addressed by Dr. Sinclair was described as follows:

> The licensing policy of the Department has restricted the fishery to Canadian citizens but otherwise licences are issued freely. The fishermen's union has pressed strongly for a more restrictive policy but this is not an easy solution against a background of freedom on entry into the industry. Restriction on efficient gear and vessels would lead to still higher costs in an already high cost industry. Relaxation of conservation measures would destroy the fisheries." (Sinclair (1960, 3))

Dr. Sinclair's report was completed in 1960. It urged that a restrictive licensing system and licence fees be introduced in the industry. After a ten-year delay Dr. Sinclair's major recommendations were implemented.

(b) Managerial Developments in the Fishery, 1969-1980[23]

The new management programme introduced in 1969, known as the Davis Plan, was to have four phases.

The initial phase of the programme was designed to freeze and gradually decrease the number of vessels engaged in the fishery. All vessels participating in the fishery were granted an "A" or "B" licence depending on the level of salmon landings recorded in one of the previous two years.[24] Vessels qualifying for an "A" licence could be withdrawn from the fishery and replaced with a new vessel but vessels with "B" licences could not be replaced once retired from the fishery. "A" licences were transferable and subject to a licence fee of $10. Although a licence holder could fish with any of the three gears used in the fishery, no new licences were to be issued. Finally, the number of licences owned by companies was fixed at the 1969 level.

Phase II of the Davis Plan was designed to achieve a substantial reduction in the size of the salmon fleet. The programme called for the phasing-out of all "B" class licences over a ten year period. A buy-back programme was established to allow fishermen voluntarily to sell their vessels to the government.[25] The programme was to be financed by increases in licence fees on vessels holding "A" licences. By 1971 the fees were $200 for vessels under 15 net tons and $400 for vessels 15 net tons and over, where they have remained.

Another important element of phase II was an amendment in the rule for replacement of "A" vessels. In phase I vessels having "A" licences could be replaced simply on a boat-for-boat basis. This rule was changed so a new vessel could replace a retired vessel only if its net tonnage was equal to or less than that of the retired vessel. In addition, processing companies agreed to decrease their fleet at a rate equal to the shrinkage of the entire fleet. Finally, special provisions for Indian fishermen were adopted within phases I and II.

The buy-back programme was terminated in 1973 because of the sharply increasing cost of retiring vessels from the industry in the face of limited funds.

Phase III was aimed at increasing the quality of the salmon landed by the fleet and improving vessel standards. This programme, implemented in the 1973 season, applied to the Pacific fishing industry as a whole.

Phase IV of the Davis Plan was never implemented. It was intended to revise the area and time closure regulations which had evolved since the early years of the fishery. It was hoped that decreased pressure on the salmon stocks resulting from phases I and II would mean that area and time closures could be reduced. Increasing fishing pressure on the resource, has, however, made phase IV of the Davis Plan impossible to implement.

A joint federal-provincial Salmonid Enhancement Programme was announced in 1975 and implemented in 1977.[26] The first phase is estimated to cost $150 million and is intended to increase salmon production by 50 million pounds per year. This is to be achieved by providing hatcheries, spawning channels and fishways. Depending on the results of the first five-year phase of the programme, a second phase is envisaged to raise future production by 190 million pounds. Cost recovery in the form of a landings tax in the commercial fishery and personal licence fees in the recreational were to provide funding for the programme. However, neither of these recommendations has yet been acted on.

Beginning in 1977 a number of new regulations were introduced which were refinements of the vessel replacement rules defined in phases I and II of the Davis Plan. In July, 1977 a new regulation was introduced to prevent vessels transferring a licence from retired gillnet or troll vessels to a new seine vessel, that is, a seine vessel had to be retired before a new seine vessel could be licenced in the fishery. In June 1978 a measure was adopted to control the size of vessels newly licenced in the fishery. This measure specified that if two or more vessels were retired from the fishery and replaced by a single vessel that vessel must be under 50 feet long. In January 1979 a revision to the ton-for-ton replacement rule was made. New vessels replacing retired vessels must not only have a net tonnage equal to or less than the retired vessels but must also be equal to or less than the retired vessel in length. Finally, in mid-1980, a new regulation explicitly prohibiting the "pyramiding" of vessels (see footnote 1) was implemented. Prior to this regulation a small seiner and any number of gillnetters and trollers could be retired and replaced by <u>one large seiner</u>.

In addition to modifications in the vessel-replacement rules, the 1970s have been characterized by changes in area and time closures. Precise documentation was not available on changes in area and time closures over this period but some general observations have been made. First, the number of days per year for which the net fisheries have been open has decreased since 1969 by increasingly restrictive area and time closures. Second, the troll and tidal recreational fisheries, not generally restricted by area and time closures, suffered poor runs in 1980, particularly for the chinook species, and the imposition of area closures for the first time. The small runs also caused, for net fishermen, a significant decrease in the number of open days, and for trollers, the establishment of retention limits for sockeye, pink, and chum.

5. Evaluation of Salmon Management to 1980[27]

The Pacific salmon fishery may be the most studied of all Canadian fisheries. The reasons for this are diverse. The interesting and complex biological characteristics of the various species, particularly their anadromous nature, together with the high value of salmon in both its commercial and recreational end-uses have attracted attention and research. The high value of the resource and the potentially low harvesting costs indicate that the fishery could make a substantial contribution to the economy as a whole. Finally, the innovative and sometimes controversial licence limitation implemented in 1968 has stimulated much research.

(a) Biological Management of the Resource

As an earlier section of this study notes, the maintenance of adequate spawning escapement to ensure sustained desirable stock levels has been a primary objective of regulations in the fishery. The explanation for the need for such stringent controls lies in the theory of common property applied to the fisheries. The implications of the common property resources are described in detail in Part I. Suffice it to say here that since the individual fishermen cannot expect higher future catches from reducing present catches, he cannot gain from doing so. In fact, it makes sense for him to attempt to maximize his share of the present catch, disregarding the future, as long as the catch revenue covers its cost.

There are in consequence serious conservation problems in the salmon fishery. Since salmon have a high value and low potential harvesting costs relative to other fish, fishing pressure will be high. Furthermore, there is little to slacken this pressure until the last few fish are caught. This is because salmon congregate in schools in preparation for their up-river migration so that catching costs do not increase significantly as stocks are reduced.

As the real value of salmon rose over the years and with no regulations prior to 1969 to reduce the fishing capacity of the fleet, conservation of salmon stocks became increasingly difficult. The only qualified success of the licence limitation programme in checking the growth of fishing capacity (to be discussed in detail later) implies that pressure on the resource has continued to increase after 1969. The increasingly restrictive application of area and time closures, the two principal tools used to ensure adequate spawning escapement, confirms it.

Nevertheless, the relative constancy of salmon landings through the years in the face of intensive fishing pressure suggests the general policy of using controls to conserve the resource has achieved some measure of success. Several reservations must be expressed, however. First, the success of biological management has been uneven. Species primarily subject to the troll and recreational fisheries, which are not subject to extensive area and time closures,[28] have experienced significant declines in stock levels. The chinook species, in particular, appears to be in considerable trouble. (This suggests that regulations, where they are applied,are useful. In addition, while stocks of salmon have in general been preserved, it is claimed that many small stocks have been severely depleted or even wiped out. A run of salmon is composed of many small stocks of various species. An allowable catch that lets escape a given percentage for a run as a whole can jeopardize the survival of individual stocks within that run. Second, research done for the Salmonid Enhancement Program predicts that, in the absence of enhancement, catches would decline by between 20 and 30 per cent from their current levels by 2007. In fact, many claim that without the present enhancement programme stocks would have already shown drastic declines. The anticipated decline in catches in 1980 has evoked widespread fear for the future of salmon stocks.

Another reservation about the "success" of salmon stock conservation policy is the cost it has imposed both on the salmon fishery and on the people of Canada generally. It has been estimated that the cost of regulating the salmon fishery in 1977 was approximately $20 million, more than ten per cent of the landed value of the catch.[29] It is safe to say that biological management costs have escalated rapidly since this time. Since revenues appropriated from the fishery by the government (other than the usual income tax revenue) have only been in the neighbourhood of $1 million, the majority of management costs are borne by the citizens of Canada.

Biological management of the salmon fishery has then had at least partial success in preserving the salmon stocks and may have prevented the virtual extinction of the resource, at least in a commercial sense. The cost of achieving this success has, however, been great.[30] Furthermore, the verdict is not yet in. Fears about the state of salmon stocks and about their increasingly precarious biological management have been front-page news during the 1980 fishing season.

(b) Economic Management of the Resource

The principal tool used to pursue economic efficiency in the salmon fishery was the Licence Limitation Program implemented in 1969. Its goals were:

> "1. To reduce the salmon fishing fleet so that the remaining vessels could be more efficiently utilized.
> 2. To reduce capitalization of the salmon fishing fleet.
> 3. To increase the net earnings of the salmon fishermen.
> 4. To provide the opportunity for government to obtain economic rent from the salmon fishery.
> 5. To provide the basis for improved conservation techniques."
>
> (Sinclair (1978, Vol. I, 44-45))

and it was to be achieved through the Davis Plan detailed on pp. 37-38. The basic premise of the Plan was that if the number of vessels in the fishery could be reduced and the total net tonnage of the fleet controlled then the capitalization of the fleet and its total fishing capacity could be reduced. It follows that fishing costs would fall and the fishery would be more profitable to participants remaining in it. The increased profits (or more correctly rents) could provide increased operating revenues for fishermen and increased revenue for the government. The smaller total fleet fishing capacity would also decrease the pressure on the stocks and facilitate better resource management.

The number of vessels in the fleet dropped from slightly over 6,100 in 1969 to about 5,300 in 1977, however real capital employed rose significantly (see Table 3). This new capital entered in several ways. Before the initiation of the ton-for-ton replacement rule, 76 vessels were retired from the fishery and replaced by vessels with a combined tonnage of about three times that of the original vessels. The criteria which permitted vessels outside the salmon fishery to enter the fishery resulted in 67 longline-trawl vessels entering the fishery as seiners.

Net tonnage is a flexible concept and a poor measure of fishing capacity. Within each gear type, vessels were retired and replaced by vessels with an equal or smaller net tonnage but a much higher level of capitalization and fishing capacity. Note the significant rise in the real capital value of vessels of each gear type illustrated in the Primary Sector section of this study. The net tonnage replacement rule permitted pyramiding, small vessels being replaced by one large vessel subject to the net tonnage constraint. The new, large vessel, however, could have a much higher level of capitalization and fishing capacity. Again, since an "A" licence permitted a fisherman to utilize any gear type or combination of gear types the fishing capacity of a vessel of a given gear type could be increased through additions of other gear types. Thus, for example, gillnetters could and, in fact, did add troll gear to their vessels to expand their fishing capability. It is by no means clear, however, that the increase in the value of real capital in the fleet due to increases in the number of combination vessels can be totally, or even largely, explained by events within the salmon fishery. See the section of this report on the Primary Sector for an explanation of this. Finally, a vessel could increase its level of capitalization and fishing capacity by adding new gear and equipment while maintaining the same net tonnage.

While the quantity of capital employed in the fishery was larger in 1977 than before licences were limited, it is useful to try to ascertain whether licence limitation had any constraining effect on capital accretion. Pearse and Wilen (1979) have estimated that capital had an average annual growth rate of 5.7 per cent between 1957 and 1968 and 3.7 per cent between 1969 and 1977, despite an estimated constancy in the growth of real fleet revenue over the entire period. They concluded: "This admittedly rough evidence suggests that the fleet rationalization scheme has been partially successful in checking the expansion of capital engaged in the fishery."

It can be concluded, therefore, that the licence limitation programme has not been an economic success in reducing the capitalization of the fleet although it may have constrained its growth.

Net earnings of fishermen have probably risen during the 1970s. (Pearse and Wilen (1979)). The emergence and continuance of a high price for salmon licences indicates that rents emerged in the fishery which were not entirely dissipated in new investment. This must be used carefully as unrealistic expectations (caused, for example, by the Salmonid Enhancement Program) and short-term economic conditions may have given fishermen a false impression of the returns the future may provide. The persistence of high licence values over a reasonably long period of time, however, is an encouraging sign.

While licences are expensive, rent extraction from licence fees has remained insignificant, especially in the light of the huge expenditures made by the government to manage the fishery. The last increase in licence fees was in 1971, and since then salmon licence revenues as a percentage of total resource landed value have fallen from 2.4 per cent to under 1 per cent. It is clear that while fishermen holding licences in 1969 may have benefitted from the programme through increased earnings and windfall gains from the sale of vessels and licences, government has been a net loser. Additional costs of establishing and monitoring the programme, compensating fishermen selling out of the industry and insulating certain groups from the adverse impacts of the programme have not been matched by increased revenues from the fishery. For example, from 1970 to 1973 all of the revenues derived from licence fees was spent to buy back retiring vessels. (See Campbell (1974)).

Finally, as has already been pointed out, conservation of the resource does not appear to have been greatly facilitated by the licence limitation programme. Implementation of Phase IV of the Davis Plan has not been possible. There are two questions to be addressed: Why did the Licence Limitation Program have only modest success and will the modifications to the Programme, the Davis Plan, be more successful in inhibiting further capital accretion in the industry?

The licence limitation programme and subsequent replacement restrictions did not tackle the fundamental problem in the fishery: they did not remove the incentive for fishermen to over-invest in harvesting facilities. Instead, they attempted to inhibit a fisherman's ability to over-invest by limiting his capital investment options. The increasing profit potential in the industry in the 1970s resulted in fishermen devising unanticipated methods to circumvent restrictions placed on them.

The new replacement regulations plug many of the loopholes in the original programme and prevent further capitalization by some of the methods fishermen have used, although much damage has already been done. However, it can be expected that new loopholes will appear. For example, new vessels can still enter the fishery with the same length,tonnage and gear type as vessels they replace but employ much more capital and have a higher fishing capacity. This is especially important for the seine fleet.

Regulations intended for the conservation of salmon -- area and time closures and restrictions on the type and quantity of gear -- have had an undesirable side effect. Because closures are irregular, fishermen have invested in troll gear, the most versatile but also probably the least efficient gear. This increases still further harvesting costs which are in any case too high. Given the complex set of regulations designed to restrict the investment behaviour and fishing practices of fishermen, the structure of the fleet is probably very different from what would be consistent with least-cost harvesting of the resource. The frequent changes in regulations that have occurred in the past and which, in all likelihood will be necessary in the future, complicate long-term investment planning by fishermen in the industry.

The buy-back scheme has been credited with achieving some success for the Licence Limitation Programme. During its three years of life, 350 vessels (about 5 per cent of the fleet) were retired and significant rents (measured by the estimated value of licences) emerged. It ended in 1973 because it had only limited funds and could no longer competitively bid for licences.

The buy-back programme suffered the same problem as the licence limitation programme generally. There was no effective tool with which to appropriate any rent accruing from the programme. Licence fees generated some revenue but remained at a low level. In the short term the result was a rise in the value of a licence as the number of vessels was reduced and rents emerged in the fishery.[31] In the long term, it would be expected that much of this rent would be dissipated in redundant capital. As will be discussed later, a tax system combined with the buy-back programme could be expected to yield much better results.

As noted above the Salmonid Enhancement Program involves large expenditures shared by the federal and provincial governments. By increasing the stocks of salmon, however, it also offers large potential benefits for the industry. These potential benefits will be realized, in the words of the Program's information branch ". . . assuming that additional capital inputs will be disciplined" (Canada Department of Fisheries and Environment (1977)). As explained above, it is doubtful that the present regulations in the fishery can achieve this discipline. The proposed tax on landings in the commercial sector and personal licence fees in the recreational fishery would enable the government to recover its costs but their proposed level is too low to act as a significant constraint on effort. Even these minimal proposals have, however, not been implemented to date. This being so, there is fear that the net benefits of the Program to society will be negative.

The licence limitation programme was a useful beginning. It helped identify the fleet so that management of and planning for the fishery could be carried out in a more informed manner. However, the programme and its recent revisions in the replacement regulations do not appear to form the basis of an adequate and efficient long-term management strategy. New management tools are needed in the fishery. Several alternatives are evaluated in the next section.

6. Evaluation of Alternatives

The alternatives evaluated below assume that emphasis on economic efficiency in the fishery will continue and grow in future years. It is clear that the licence limitation programme, by itself, cannot bring about further increases in economic efficiency in the industry. If the present system is maintained it can be expected that, given rises in the real price of the resource, increased pressure on the resource will necessitate more stringent area and time closure regulations or more stringent (and costly) enforcement of the present ones. It is also probable that as time progresses new regulations will be needed to restrain attempts by fishermen to increase the amount of capital employed in the fleet. Economic waste will persist and biological stock management and protection will become increasingly difficult and costly.

The problem addressed here is how to correct effectively the incentive to over-invest. The licence limitation programme is largely a failure by this criterion, limiting effort directly but not removing the incentive to circumvent the limitation. The alternative solutions to the problem are a taxation scheme and a property-rights scheme. These schemes represent major departures from the present programme, both in their administration and incidence, and in their aim -- a drastically different and smaller fleet.

However, despite the obvious need for an improvement over licence limitation and its extensions, it does not follow that the proposed alternatives are better than the old. A cautious approach should be taken and both adopting and implementing any new programme should show cognizance of the following points.

1. Rationalization necessarily implies dislocation of capital and probably of labour from the fishery. While it is not possible to ascertain the relative efficiencies of various gear types and groups, it is certain that some will be harder hit than others. A new programme must allow for compensation or incentives for individuals to leave to permit a smooth adjustment to a more efficient fishery. Besides being socially desirable such an approach is undoubtedly politically necessary.

2. Evidence from the 1969 licence limitation programme suggests that the maintenance of a fleet independent of company control is a high priority in the fishery. Companies and individuals with easy access to capital may have an unfair advantage in acquiring vessels or rights to fish if capital markets are not functioning properly. Social acceptability may dictate the provision of some mechanism to prevent concentration of licences or property rights in the hands of specific interest groups. In any event, the management scheme should be designed to minimize any negative impact of poorly functioning capital markets.

3. Considerable socio-economic research should precede the proposal of a new management plan. Such research should attempt to isolate potential administrative problems and the distributional impacts of the new programme. At the present time, there does not seem to be enough information available to researchers and managers to ascertain all of the economic and social consequences of imposing either new type of management programme. Since both taxation and

property rights systems are novel approaches to fisheries management, careful and detailed explanations of their functioning and goals should be presented to fishermen. One approach might be to initiate the programme in a small area before proposing a more widespread implementation. This would provide data on the actual dynamics of the programme and would, if successful, illustrate its advantages for fishermen in other areas. The buy-back programme implemented in the east coast lobster fishery, for example, was introduced first on an experimental basis in Prince Edward Island. Its success brought demands for its implementation from lobster fishermen in other parts of the Maritimes.

4. The salmon fishery has two parts -- the commercial fishery and the sport fishery. Both sectors use the same stocks of fish and the appropriate maximization of net benefits from the resource should cover both sectors. The _ad hoc_ evolution of regulations in each sector results in a haphazard allocation of the stock between them. Regulations designed to induce efficiency in the use of the common stock in one sector must be complemented by appropriate action in the other.

5. The impact of any salmon management programme on other fisheries should be examined as fully as possible and measures should be taken to coordinate the management plans of various fisheries. For example, if vessels and labour were displaced from the salmon fishery they might gravitate to fisheries where entry was not restricted, lowering returns there.

6. Any management programme should try to obtain a better balance between government expenditures in the fishery and revenues derived from it. This is already being attempted by Salmonid Enhancement Program.

7. Variations in prices and availability of resources have been important in the salmon fishery. A management plan must be flexible enough to respond to both inter- and intra-seasonal variations in these variables.

8. A new management plan should be sensitive to the fisherman's long-range plans. In particular, once the new plan is set in place major changes in regulations should be avoided.

How do the two proposed alternative management strategies -- taxes and property rights -- stack up in the light of these eight points?

(a) Taxes

There are two forms that any tax system could take: licence fees or landings taxes. Both methods would decrease the incentive for fishermen to over-invest by extracting rent from the industry. A licence fee is an input tax[32] while a landing tax is, of course, an output tax. Aside from their efficiency, both are sometimes advocated to enable the government at least to cover its costs.

The great advantage of a licence fee system is that it is already in place in the fishery and would have only to be updated from the 1971 level at which it is now set. A great deal of information is required to set and maintain the fee at an optimal level, but at the same time changing licence values could be used to monitor whether the level of the fee is set too high or too low. Licence fees share many of the problems of landings taxes that will be described below, but they have some additional limitations:

1. The present licence fee structure was established in the 1971 season with three levels of fees -- \$100 for vessels less than 30 feet in length, \$200 for vessels greater than 30 feet but less than 15 tons and \$400 for vessels 15 tons or greater. This raises problems both of efficiency and equity which would be magnified if fees were raised to generate larger revenues for the government. The tiered system tends to distort investment decisions as fishermen attempt to minimize the licence fee per vessel ton. For example, under the present system (if the fees were significant) one would expect a cluster of vessels at the 15 ton capacity level and greater capital (fishing power) per ton. Again, since fees are not related to landings, low volume producers in each vessel category suffer a greater burden from the fees than do high volume producers.

2. The absence of a relationship between licence fees and landings has another serious problem. Although very high licence fees would undoubtedly force vessels out of the fishery, they do not raise the marginal cost of fishing in the short run. While in the long run an appropriately specified fee system could result in efficient fishing, its short run impact on effort is much less

clear. In particular, it would be a particularly unwieldy instrument for effecting intraseasonal adjustments in effort.

In conclusion then, while moderate increases in licence fees could be useful to extract some additional rent from the fishery, their use as a major management tool is not recommended. High licence fees would reduce the number of vessels and the total amount of effort in the fishery and perhaps area and time closures but their drawbacks are great. Licence fees would, of course, have to be supplemented by area and time closure regulations, although these could be reduced if they were set at a level that significantly reduced the size of the fleet.

A more promising scheme is a landings tax. This has already been suggested to recover the costs of the Salmonid Enhancement Program. Sinclair (1978) proposed that a royalty tax be introduced in the salmon fishery beginning at a low level of 2 per cent of the value of the landed product. The advantage of a royalty or landings tax is that it does not lead to the distortion of capital and the equity problems of a licence fee system.

A taxation system, in theory, can be used to move the fishery to its economically optimal level of production. To do so, however, the tax would have to be differentiated according to time, species and area. It is not known what degree of differentiation in the tax structure for salmon would be feasible at a reasonable cost but there is clearly some point where the benefits would be less than the additional costs of imposing them. It may be, however, that as the fishing fleet became increasingly rationalized under a taxation scheme, the possibility for additional specifications would also increase. By raising the marginal fishing costs to a level reflecting the value of the resource to society, a tax would reduce effort in the fishery and pressure on the stocks.

There are several theoretical and practical objections to the exclusive use of taxes to rationalize the fishery. Some of the most important are the following:

1. To set the tax at a level that approaches the economic optimum assumes a level of knowledge of costs, stocks and prices that is unavailable. This would not seem to be an insurmountable problem as the tax could be adjusted over time as more information (for example, licence values) became available. In practice, however, things would not be so easy in the salmon fishery. The year to year variability in the fishery and the inability of biologists to make precise predictions about stock levels implies that the tax would have to be changed frequently. On-line changes in tax levels would imply the existence of one man or one body that had the discretionary authority to do this. The volatility of the salmon fishery raises serious doubts about the ability of administrators to gather and analyse information fast enough to respond to rapidly changing conditions.

2. Even if taxes could be altered at short notice, their impact on the effort directed at the stock is unclear. Participatory behaviour of fishermen is not sufficiently understood to allow managers to predict their response to increased taxes. A fluctuating tax could also complicate the decisions of fishermen to such an extent as to make planning difficult.

3. Before the impact of a certain tax level could be ascertained it would be necessary to determine the incidence of such a tax. The tax burden will be shared by fishermen, fish buyers, sellers at the wholesale and retail levels and consumers to a varying degree depending on market structure and value added. This may well mean the impact of the tax will be felt more by some fishermen than others. For example, trollers who are not unionized and sell in the relatively competitive fresh/frozen market will be affected differently by tax than unionized seiners selling to oligopsonistic processors. This diverse impact of the tax on different fishermen may not be desirable and could lead to distortions of fishermen's behaviour as they attempt to minimize the tax burden borne by them.

4. A tax system will reduce effort in the fishery by increasing the costs of fishing to fishermen. In a fishery where costs are already high and where many fishermen are at the margin it seems inevitable that a good part of this effort reduction will occur by the involuntary withdrawal of vessels from the industry rather than through a reduction of landings for participating vessels. Note that with licence fees the whole reduction in effort occurs by forcing vessels out of the industry The social desirability and political acceptability of such an outcome is dubious.

A particular distributional problem is that the three gear types will be affected by a tax according to their relative efficiencies. Under the present system, each type is allocated a share of the catch (through area and time closure regulations that vary by gear type) to ensure that the more inefficient gear types remain viable. It is assumed that a tax system would also imply a phasing out of such efficiency-reducing regulations and in consequence certain areas and well defined groups of fishermen would bear the brunt.

A tax on the value of landings is a useful tool to extract rent from the fishery. It can also, if set high enough, curtail effort by increasing the marginal cost of fishing. However, it is doubtful that, despite their usefulness, either a landings tax or a licence fee system would alone be adequate tools to make a serious attempt to optimize returns in the fishery. A high tax would reduce pressure on the stock but it is clear that taxes and licence fee systems are not precise stock management devices. On-line area and time closures would still be crucial to ensuring adequate escapement of the various stocks.

At least some portion of the rent extracted through taxation would have to be returned to the fishermen. Some version of the buy-back scheme could be used to compensate fishermen forced out of the industry.[33] It is more difficult to come up with a scheme to allocate some of the rent to remaining fishermen. What is clear, however, is that the revenue generated from a significant tax would have to be returned, in part at least, to fishermen. This view is in agreement with the stated goals of most fisheries management programme -- to increase the incomes of fishermen.

(b) Property Rights

The second alternative management structure considered here is a property rights scheme, overseen by a quota management agency. There are two such forms a scheme could take. One would involve the allocation of geographic rights to individuals or companies. The geographic area specified under such a scheme would have to be large enough to impart complete control over a stock of fish. The second would be to allocate to individuals or companies rights to a specified quantity of fish.

The first of these is not practical in a fishery such as the salmon fishery where the fish stock is mobile over a wide geographic area. It would imply conferring sole ownership over a large part of the Pacific coast on one individual or company. In an industry with a large number of independent fishermen such a scheme must be viewed as socially inequitable and politically infeasible. The second approach offers more promise.

A system of property rights, appropriately specified and enforced can lead to economically efficient fishing (see Moloney and Pearse (1977) and Part I of this study). The common property problem is addressed directly by distributing usufructuary rights or quotas to the stock to individuals. An individual, with his total production specified by the quantity of rights held, has an incentive to minimize the cost of achieving this level or production. For maximum efficiency the total harvest level should be based on economic criteria but, with with some efficiency loss, it would be set on a biological basis to lower the information requirements for determining the total allowable catch.

For maximum effectiveness quotas should have the following characteristics:

1. The quotas must be freely transferable. The market can subsequently be relied on to allocate quotas to least cost harvestors. Given perfectly functioning capital markets, only the most efficient fishermen can afford to pay the price for a quota on the open market.

2. Quotas must be sufficiently divisible to be within the production scale of smaller producers. Divisibility also allows small producers to compete more equally in capital markets with larger operators or fish buying companies.

3. The tenure of quotas issued must be specified. Quotas could be given in perpetuity or could be allocated for a period as short as one year. Perpetual quotas would have the advantage of being easier and less costly to administer while creating a more certain environment for the fishermen to plan future decisions. Year-long quotas imply that the value of the quota would be lower and the impact of poorly functioning capital markets on smaller producers would be decreased as a result of lower entry costs. In addition, they may offer some distributional advantages over a perpetual quota which would provide a once-and-for-all windfall to the original holders of quotas. Perpetual quotas could be taxed, however, without any alteration in the investment incentives of the fishermen. The rent could

be spread out between original and future holders of quotas. In practice, an intermediate scheme which allocated quotas for some specified number of years may be the answer.

4. Criteria for allocating quotas to fishermen would have to be devised by which the social and distributional objectives of the government in the fishery could be furthered. If the government felt a commitment to advance the interests of a particular group in the fishery, that group could receive a relatively large share of the total quota allocation.

5. If optimal efficiency is to be achieved, quotas should be specified by species, time, and area so that fishermen do not compete to maximize their catch of fish at times and areas for species that offer the highest net return. This will result in investments in capital that are not consistent with least cost harvesting of the resource. It could also have other wasteful results such as the dumping of low-valued species of salmon. In addition certain species and stocks of salmon may become subject to excessive fishing pressure. Area and time closure regulations would, therefore, have to be maintained. It should be noted, however, that any power of closure left to the management body will alter the incentives to the individual fisherman. If the fisherman perceives the managers may close the fishery, there will be an incentive for the fisherman to attempt to get his quota while the fishery is still open. This incentive could be avoided to some extent by undertaking to compensate those with unfulfilled quotas by the time of closure.

6. Some mechanism would have to be devised to deal with the variability and unpredictability of salmon stocks. If the TAC was substantially underestimated some of the economic potential of the resource would be lost. If the salmon stocks were overestimated the potential benefits of the system would be entirely lost. Two suggestions are put forward here. The first is that quotas, when initially distributed, should give each fisherman a percentage share of the total allowable catch for a given period of time. When sufficient information is available, prior to the season, to set the expected total allowable catch, the percentage quotas could then be converted into actual quantities.

   The second suggestion is that the government, through a quota marketing agency, retain a proportion of the quotas for itself. This would build a "safety margin" into expected allowable catch estimates. The agency could auction off its proportion of the total quota if the actual run of salmon met or exceeded expectations. It could also enter the market and buy quotas if the actual run of salmon fell below the conservative quantity of quotas distributed.

7. An adequate enforcement system would have to be devised to ensure compliance with the quotas. Fishermen would naturally have an incentive not to report catches and the existence of a large fresh/frozen domestic market would hamper attempts to record the catch of each vessel.

8. The government may want to appropriate revenue from the fishery, at least sufficient to recover the costs of managing the fishery. Note that the quota marketing agency described above would be one way of generating revenue since it would receive revenue from the quotas it auctioned off.

This form of quota, or property rights system has some significant advantages over the other management techniques mentioned above. Taxation systems require continual and intensive research to keep the level of the tax at an appropriate level in the face of changing market and stock conditions. With the quota system, on the other hand, least cost fishing can result from the natural operation of market forces. Once the initial distribution of quotas is carried out the transferability of quotas will provide an incentive for inefficient producers to sell their quota and withdraw from the fishery with compensation.

There are, however, significant problems inherent in the introduction and in the ongoing administration of a quota system. Ideally, each quota would be specified by species, time of the year, location and gear (STLG). But such fine distinctions are often difficult to make and assign with economic and biological criteria in mind. Compliance and enforcement costs rise dramatically as more detail is embodied in quota specifications. Moreover, salmon quota rights are necessarily contingent upon the on-line judgement of the fishery officer who must "fine tune" the catch and escapement as last-minute information becomes available. His job is already difficult, and complicated quota enforcement will add another layer of difficulty.

For example, consider the quotas for a species that is usually caught in nets along with a second species, for which there are also fishermen quotas. The system would require that in order to land his total catch, each fisherman should have quotas for both species, in the proportion in which they appear in his net. A market in quotas would make this possible, and indeed would create incentives to concentrate where possible on plentiful species. This is a merit of the system. But in the salmon fishery quotas that were specific by narrowly-differentiated fisheries would involve the fisherman in a costly system of species identification, possible waste of thrown-back, incidentally-caught species, or, alternatively, an effective but very costly recourse to the marketplace for quotas. In fact for salmon the scheme sounds costly and difficult for all participants, and would probably be rejected in favour of less species-specific rights, at a necessary cost of foregone husbandry of both overfished and neglected minor species.

Area specification is also difficult to implement. The increased benefits from making quotas area specific may also be outweighed by associated problems and costs. The variability and unpredictability of salmon runs increase significantly the smaller the area defined. This implies great difficulties in pre-setting effective total and individual quotas for given areas and would complicate the job of the quota marketing agency. In addition, fishermen would be fearful of being locked into fishing in a specified area where the allowable catch could not confidently be predicted. While fishermen could over time spread their risk by acquiring quotas in different areas, measures to compensate fishermen for unfulfilled area quotas may be necessary. Under any quota system area and time closure regulations would still be necessary as more information becomes available.

Finally- the politics of a quota scheme must be considered. Transferable quotas immediately raise alarm about possible concentration and speculation in quota rights. The divisibility of quotas would go some way to alleviating this concern but additional measures may be necessary such as setting an upper limit on the quantity of quotas that could be held, for example, by processing companies. It can also be predicted that no matter what distribution criteria are used to allocate quotas many participants will not be satisfied. Greater specificity complicates the distribution process.

Having recognized these difficulties, the net advantage of quantitative rights (quotas) over other management approaches seems overwhelming: input licensing has proven too destructive of potential profits, fish populations and of managers who must fend off the massive fishing power already assembled in the licensed fleet; landing taxes are too difficult to administer and enforce, too unpopular with fishermen and are, presumably, politically unpalatable.

The chief difficulty with suggesting the quota management approach lies in its unfamiliarity for fishermen, managers, and the public. Quotas represent a new form of wealth and people are naturally cautious and suspicious when contemplating them.

One might suppose that fishermen in particular might resist quotas. No such sweeping prediction is appropriate, however. The fishery is diverse, and so are the men who exploit it. Some will embrace the scheme with more enthusiasm than others. But they are generally sophisticated in financial matters (already using the marketplace to value and trade licences), flexible in adapting new technologies, and, with important exceptions, mobile between occupations and within the fishery. Moreover, if historical and traditional rights of access are properly recognized in the initial allocation of quotas, most currently engaged fishermen can be made better off in both the long run, and through any transition period of reduced fishing (by "banking" their rights).

Put another way, the current licensing scheme, innovative in its day, has not been ultimately effective in reducing fishing power and protecting fish stocks. Fishermen generally recognize this disappointing result and accept that some other way must be found to protect their livelihoods. Landing taxes are rightly perceived as not supporting their incomes. Hence, quotas appear to be the only viable alternative.

However, there has not been sufficient research done yet to devise a desirable and workable quota scheme. Biological data, for example, has never been collected with quotas in mind. Financial institutions such as credit unions and local banks are unfamiliar with quotas as a form of wealth. Hence, a gradual and experimental approach to the introduction of quotas is urged. "Model" sectors of the fishery should be identified to serve as "demonstration farms" for other fishermen and to provide experience across the industry (including the administrative, processing and financial sectors) so that widespread introduction of quotas can be done with more confidence.

Meanwhile, it is essential to set the stage for the transition to a quantitative rights (quota) system by discouraging fleet development and by reducing financial commitments that people have in the fishery which cannot be prolonged, or justified in the longer term. For this, more vigorous buy-back (of licences) is the only alternative. Since licences have become scarce and valuable, the cost of an effective programme is not trivial and co-operation of the British Columbia government as well as of various federal agencies may be appropriate. Instead, or in addition, two sources for a "self-financing" buy-back programme should be considered: a significant royalty (landings tax) and a tax on the capital value of existing licences. These measures should be understood as only preparatory to the widespread introduction of quotas. Indeed, the contemplated abandonment of these fiscal measures will ease the introduction of the quotas.

There is no "easy way" to restructure the institutions which govern the salmon fishery. As a management tool, a quota system is the most attractive as a sustainable method for achieving widely-recognized social and economic objectives that command broadly based support.

FOOTNOTES

[1]Pyramiding occurs when two or more small vessels are retired from the fishery and replaced by one large vessel with a net tonnage equal to or less than the combined net tonnage of the small vessels.

[2]Estimates for the source of increase in seine vessels from 1969 to 1979 are the following: 67 vessels transferred from the longline trawl fishery, 60 vessels built by pyramiding non-seine tonnage, 18 vessels replaced retired troll vessels, five vessels replaced retired gillnet vessels, six vessels from the Indian tonnage bank and 11 vessels transferred from unknown fisheries.

[3]Note, however, that 66 trollers were retired and replaced with new seine vessels and it is possible that some trollers were converted into combination gillnet/troll vessels.

[4]It has been claimed that seiners are also showing increased interest in fishing with troll gear, the troll fishery being less restricted.

[5]Stationary boats fished only one of eight areas defined while mobile boats fished more than one.

[6]These factors are, of course, highly interrelated.

[7]In 1976, for example, over 80 per cent of canned salmon production was accounted for by the top three firms compared with only about 50 per cent of fresh/frozen production.

[8]Not that company ownership of vessels beyond this level is prohibited by regulation.

[9]In the polar case of only one buyer of fish facing an unorganized harvesting sector, all the resource rent accrues to the buyer.

[10]Note that regulation of the processing sector is largely a provincial responsibility.

[11]Note that the surge of Japan's investment in buying and processing facilities is directly related to an attempt to secure adequate supplies of salmon for the Japanese domestic market.

[12]This is an important consideration in the Salmonid Enhancement programme initiated in 1975.

[13]Estimates indicate the fresh water catch of chinook is about 11 per cent of the total chinook sport catch and the fresh water coho catch is between 9 per cent and 16 per cent of the total catch.

[14]It is argued that the fresh water sports fishery and the terminal gillnet fishery bear the brunt of regulations designed for stock conservation. The main reason is that at this point field officers can more easily identify the size of individual stocks and take appropriate action to ensure adequate escapement. This issue was of special concern during the 1980 salmon fishery due to low salmon stocks, particularly of the chinook species.

[15]Of this total, about 80,000 or 27 per cent are out-of-province fishermen. W.D. Masse, Recreational Fisheries Problems and Prospects — Development to 1985, Draft.

[16]For a methodology used to attempt this see Masse and Peterson (1977).

[17]Exceptions are that non-residents must obtain vessel licences and there are special areas that require personal licences.

[18]Certain areas of the B.C. coast were closed to sports fishermen in 1980 due to low chinook stocks.

[19]Licences are mandatory in the fresh water (non-tidal) fishery. Subject to exemptions for children and senior citizens a licence fee of $5 is charged for residents and $15 for non-residents for yearly participation in the fishery. Non-residents can also obtain special

three day licence for a fee of $6 and must obtain a special $25 licence in addition to the regular $15 licence in designated areas of the province. Enforcement of federal regulations for non-tidal fisheries is partly carried out by provincial officers.

[20]A reduced catch-limit for chinook salmon also could be implemented.

[21]Some salmon from American waters also spend part of their life cycle in Canadian waters.

[22]This overview of managerial developments in the salmon fishery is not comprehensive. For a more detailed description of events in the salmon fishery up to 1969, see Campbell (1969); Fraser (1977); Lyons (1969); and Sinclair (1960).

[23]For a more thorough discussion of licence limitation and associated programmes, see Campbell (1974); Sinclair (1978, Vol. I); and Fraser (1977).

[24]Note that this criterion was subsequently changed so that production in fisheries other than salmon fishery could qualify a vessel to obtain an "A" or "B" licence.

[25]For a thorough analysis of the "buy-back programme," see Campbell (1974).

[26]For an overview see Canada Fisheries and Environment (1977).

[27]The evaluation conducted here is for the commercial fishery only. For an analysis of the management programme in the sport fishery, see the section on sport fishery.

[28]For example, the weekly time closures for the net fishery do not apply in the troll fishery. While the design of closure regulations favours gillnet vessels over seine vessels, it is claimed that the implementation of these regulations is biased against terminal (near shore) gillnetters. That is, discretionary closures to ensure adequate escapement are made more frequently in the terminal gillnet fishery as information on individual stock sizes is more readily available at this point.

[29]The landed value of salmon of $159 million in 1978 was double that of the next leading fishery, the lobster fishery, with a landed value of $75 million. Only the roe herring fishery with a landed value of about $112 million in 1979 has approached the value of the salmon fishery.

[30]However, only part of the cost of regulating can be attributed to biological management of the resource.

[31]The sharp rise in licence values in 1973 (a proxy for the emergence of rent in the fishery) was primarily due to the large catch and rise in prices and not the buy-back programme.

[32]The licence fee system in the salmon fishery is really a tax on one input-tonnage. For an analysis of the distortion effects of input taxes see Scott (1979, 725-741).

[33]Since, with a tax, the capitalized value of rent in the licence would be low, the government would have to devise a new method of determining the payment to a fisherman for retiring the licence. See the lobster case study for one possible method to establish such a payment.

See Moloney and Pearse, Quantitative Rights as an Instrument for Regulating Commercial Fisheries, (1977), and Part I of this report.