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Technical Report No. 16

The Public Regulation of Commercial Fisheries in Canada

Case Study No. 1

The Maritime Lobster Fishery

Anthony Scott
Maurice Tugwell
University of British Columbia

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THE PUBLIC REGULATION OF COMMERCIAL FISHERIES IN CANADA

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THE MARITIME LOBSTER FISHERY

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Anthony Scott
Maurice Tugwell
University of British Columbia

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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Table of Contents

List of Figures

List of Tables

R É S U M É

RÉGLEMENTATION DE LA PÊCHE MARTIME AU HOMARD

La pêche au homard est pratiquée à peu près partout dans les provinces de l'Atlantique, mais la taille et la valeur des prises et la durée de la saison varient considérablement d'une région à l'autre. Divers règlements ont été imposés, dont certains remontent à plus de cent ans, afin surtout d'empêcher que des homards soient capturés ou mis en conserve au moment ou leur valeur est très faible, soit à cause de leur petite taille ou de leur carapace molle, soit qu'il s'agisse de femelles oeuvées. Ces règles de base ont ensuite été incorporées dans un ensemble de règlements plus moderne mis sur pied pour freiner le déclin des stocks et des débarquements. Au cours des années 40 et 50, l'émission de permis a tenté de confiner la pêche à certains endroits, à fixer des limites pour la taille des prises et à faire respecter l'interdiction de pêche en dehors de la saison. Un troisième groupe de règlements imposés depuis les années 50 ont diminué le nombre d'entreprises détenant un permis de pêche et réduit le genre et le nombre de cages par entreprise.

Dans la présente étude, les auteurs examinent les règlements en vigueur et les controverses qu'ils suscitent. Il s'élève en effet certaines polémiques à cause du fait que, dans le cas de

chacun des nouveaux règlements, les répercussions sur les intéressés sont inégales, préjudiciables pour certains et utiles à d'autres, et que par ailleurs cette situation ne se révèle qu'après un certain laps de temps. D'autres discussions particulièrement orageuses s'élèvent parce que, sur le plan biologique, la justification des règlements parait incomplète; en effet, certains règlements actuels devraient être clairement qualifiés comme étant expérimentaux ou exploratoires. Le système requiert l'intervention continuelle des autorités qui doivent faire respecter les règlements concernant la taille maximale et le nombre des cages, la délimitation des saisons de pêche, ainsi que la protection des femelles oeuvées. Ces règlements ont subi de fréquentes modifications dans le passé, et ils sont continuellement réexaminés et renégociés. Sans l'accord des pêcheurs, leur application devient difficile et embarrassante sur le plan social. Les autorités ont également mis en vigueur des programmes visant à réduire le nombre des permis et à en autoriser le rachat. Ces mesures ont sensiblement diminué le nombre de pêcheurs autorisés. Les effets de ce changement sur les stocks ne sont pas encore apparents, mais la valeur des permis qui ont été retenus s'est nettement accrue.

Dans la dernière partie de l'étude, les auteurs examinent ces données en fonction de la mosaïque des règlements actuels, dans le but de dégager les possibilités d'application et les avantages des divers genres de tenures et de stimulants économiques. Dans

cette optique, ils étudient les systèmes de quotas, les impôts sur les débarquements et les régimes où une pêche devient la propriété exclusive d'une collectivité. Les auteurs concluent notamment qu'aucun de ces systèmes ne saurait remplacer l'application au jour le jour par les autorités des règlements visant à assurer la conservation du homard : il faudra toujours recourir à la fois à un nouveau système de propriété ou d'impôts, combiné aux règlements traditionnels imposant une taille minimale pour les prises et limitant les dimensions et le nombre des cages, ainsi que les lieux et les saisons de pêche. Toutefois, dans certaines conditions, les associations de détenteurs de quotas et les collectivités détenant un droit de propriété exclusif pourraient décréter et appliquer elles-mêmes leurs propres règlements. Un des objectifs du chapitre est de déterminer quelles seraient les conditions requises. Un autre consiste à souligner que l'aspect de l'équité ou de la juste répartition varie considérablement d'un régime à l'autre. Ainsi, le régime simple du rachat a souvent recours à des fonds publics; les systèmes de quotas favorisent ceux qui obtiennent un rendement supérieur; les systèmes d'impôts s'appliquent rarement de façon uniforme et les régimes communautaires excluent par définition les citoyens des autres régions. Dans la pratique, tous les régimes finissent par évincer certains pêcheurs ou les travailleurs d'autres industries ou régions désireux de faire la pêche; ils peuvent aussi s'avérer préjudiciables au consommateur ou au contribuable. Ces conséquences sont inhérentes aux régimes

eux-mêmes et doivent être bien compris au moment où la décision est prise de recourir à une mesure de conservation ou à des règlements visant à relever l'efficacité.

Summary

Lobster fishing is prevalent throughout the Atlantic provinces, but the size and value of catch and length of season differ greatly among districts. Regulations have been imposed for over 100 years, chiefly to prevent lobsters being landed, caught or canned when their value was low owing to small size, softness of shell or females being "berried". These original elements have been incorporated into a modern regulatory system intended to deal with excessive pressure on the stock and declining landings. In the 1940s and 1950s licensing became the means of confining fishermen to particular districts, setting size limits, and closing the fishery during off seasons. A third group of regulations introduced since the 1950s has reduced the number of licensed fishing enterprises, and the number and type of trap per enterprise.

The case study reviews the regulations in force and the controversy surrounding them. Controversy arises because each new regulation is uneven in its impact, hurting some and helping others only after some delay. Vigorous controversy also arises because biological justification is incomplet; indeed, some current regulations should be clearly labelled as experimental, or fact finding. The system depends on continual fisheries' officers interference, enforcing size limits' specifications of traps; dating of seasons; protection of egg-bearing females; and number of traps. These regulations have been frequently changed and are continuously under review and negotiation. Without fisherman agreement, their enforcement becomes difficult and socially disturbing. As well, fisheries officers have operated license-limitation and buy-back plans, which have drastically changed the number of legal

participants. The effects of this change on the stock are not yet apparent, but they have definitely increased the value of the remaining licenses.

A final part of the study takes this information into today's regulatory mosaic to examine the workability of economic incentives and tenures. Quota systems, landing taxes and sole-ownership by communities are investigated. One conclusion is that none of these could supplant the day-to-day lobster conservation control by fisheries officers: some combination of a new property or tax system with traditional size, place and seasonal limitation will always be needed. However, under certain conditions, quota holders' organizations and "sole-ownership" communities could make and enforce their own rules. One purpose of the chapter is to find what conditions must be present. Another is to indicate that the distributional or fairness aspects of the alternative economic schemes differ widely. A simple buy-back scheme, for example, often uses public money; quota systems help those who obtain the most profitable quotas; tax systems rarely work uniformly; community oriented systems by definition exclude citizens from other areas. All schemes discriminate in practice against certain fishermen or against potential entrants from other industries or regions, or against the consumer and taxpayer. These effects are inherent and must be thoroughly understood at the time that a conservation and efficiency-promoting measure is finally chosen.

Introduction

The Lobster Fishery is not only the back-bone of the inshore fishery in the Maritime region of Canada [1], but also produces a landed value second only to salmon in Canada as a whole. In 1978 Canadian landings totalled 42 million pounds, worth over 75 million dollars to the fishermen.

Lobster fishing is primarily an inshore or small-boat activity employing for some part of the year over 18,000 fishermen in 1978. This accounts for more than one-half of the fishermen on the Canadian Atlantic coast. For almost all it is part of a sequential series of inshore operations, fishermen in various regions moving between herring, groundfish, crab, tuna, etc. In addition, the industry does provide some employment for shore workers in handling, processing, marketing, and transportation activities, and in supplying boats, gear, fuel and other commodities and services.

The lobster fishery is extremely intense. In most areas it takes one-half to two-thirds (and greater percentages) of the available legal-sized lobsters each year.[2] Such heavy fishing, motivated by a strong market demand and consequent high prices for lobster, is possible because of the relatively low capital requirements for entry, and the lack of alternative employment opportunities for many workers. One result has been that in most areas the largest percentage of the catch has been taken at the beginning of the season.

Many commentators have argued that there has been too much capital and labour expended in the lobster fishery (i.e. Dewolf, Wilder et al.). The reason for this, as explained in detail within the general analysis section of our report, is that it is in no individual fisherman's interest to invest in the fish stock by reducing effort. This situation exists because the common property nature of the resource, will not allow the individual fisherman to reap a return from his

investment. This case study will analyze what has been done in the past to regulate the lobster fishery and also suggest alternative means of achieving regulatory objectives.

The study will proceed in the following manner. First the biological structure of the resource will be described. Secondly, the industrial structure of the fishery will be discussed. Thirdly, an analysis of past regulations will be presented. Finally, regulatory alternatives will be looked at.

1. The Resource

The American lobster is found solely in the waters off the Atlantic coast of North America from Labrador to North Carolina and is fished commercially from Newfoundland to Virginia. The areas of the greatest yield are Maine, southwestern Nova Scotia and southern part of the Gulf of St. Lawrence. Along these stretches of coast, lobsters have been taken for years within a few miles of the shore in depths of water down to about twenty-five fathoms. Recently, however, there has been a trend towards fishing the lobsters farther and farther offshore.

Lobsters begin their lives as fertilized eggs glued to the swimmerets on the underside of the mother. The eggs stay attached to the "berried" mother for about nine months to a year while they develop. Each female carries many thousands of eggs. When the mother feels that the eggs have developed sufficiently, she releases them by a rapid movement of her tail.

Once an egg hatches, the larva swims toward the surface and after a period of between four and seven days it molts for the first time. Molting is the process by which lobsters grow, the hard exterior shell being shed and the animal expanding by taking in seawater, after which a new shell is developed. It molts three times during the first month or two, staying near the surface through the second molt and settling to the bottom after or during the third molt. After the larva has molted three times, it is clearly identifiable as a lobster.

During the crucial period when the lobster larvae are swimming near the surface, their movement would seem to be dependent on the winds and ocean currents. Also during this period mortality is very high. Estimates made in the Gulf of St. Lawrence suggest that the mortality - to the point of bottom settlement is upwards of 95%, although fluctuating from year to year and place to place (Scarratt, 1979). Once the lobster settles it is still very vulnerable to predation so it burrows into the bottom for protection.

The lobster continues to grow by molting, the frequency being positively correlated with water temperature. Lobsters grow at different rates in different areas. In the Northumberland Strait they molt five to seven times in their first growing season decreasing to a molt every year or second year after five years. In the Bay of Fundy, on the other hand, where the water is colder, they probably molt fewer times both in the first year and in subsequent years as well (Wilder, 1953).

Lobsters also mature sexually at different sizes in different areas. In the Northumberland Strait the smallest mature lobsters are about 7 inches long whereas in the Bay of Fundy the smallest mature lobsters are about 12 inches long (Wilder, 1957). The age at which a lobster matures is not given by its size or other characteristics. This lack of age information causes obvious problems for predicting and modelling stock development.

Once a lobster reaches commercial size it is relatively free from predation by other fish except during those short periods (5 hours) when the new shell is hardening after a molt. Man is the most important predator of commercial sized lobsters.

The geographical mobility of commercial sized lobsters is an issue drawing much current debate. Until quite recently the prevailing working hypothesis among biologists was that mature lobsters did not move around very much (Wilder, 1953). Recently however, it has been suggested that at least some lobsters might migrate inshore-offshore depending on the water temperature (Stasko 1979). Another hypothesis is that as lobsters grow larger they tend to move offshore (Scarratt, 1979). As we write, there is no consensus on the extent of such possible mobility.

An even more contentious and important issue is the mobility of lobsters at the larval stage. As described above, the larvae drift with the current and their

movement is affected by the wind. Although stock inter-dependence between areas has been hypothesized to be a function of adult migration, a much stronger case can be made for stock inter-dependence due to larvae mobility. As put by Scarratt; "... larvae, particularly in stage IV, are relatively mobile, they still tend to be carried in the direction of the current, so that the lobsters that live in one place may well have been spawned several kilometres upstream." (Scarratt, 1979). The exact dimensions of larvae drift have not been determined and, as a result, the degree of inter-dependence of lobster fishing areas cannot be specified. It is fair to say, however, that the total distance can be measured in dozens, not hundreds of miles.

Biologists do agree, however, that lobsters tend to feed and molt more as the water becomes warmer, Thus their catchability is directly related to water temperature.

In summary then, the biological facts or non-facts that we have accumulated are the following:

1. The lobster resource is very different in different Maritime areas in terms of growth rates and size at maturity.
2. The relationship between stock size and recruitment in any one area is uncertain because of the lack of knowledge on the larvae movement, age and survival rate.
3. Stock inter-dependence between adjacent fishing areas exists, probably due more to larvae drift from one area to another than the migration of mature lobsters.
4. The movement patterns of commercial sized lobsters is uncertain.
5. The age of a lobster cannot be determined with current techniques.
6. The catchability of lobsters varies directly with water temperature.

2. The Industry

(a) Primary Sector

Since its beginning over 100 years ago, the Maritime Lobster Fishery has continued to be a small boat operation most boats being between 25 and 45 feet long. From this basic vessel size there have been slow technological advances, increasing the vessels' fishing power. In some areas, particularly southwest Nova Scotia, there has been a more pronounced move toward larger, faster vessels as the fishery has moved further offshore. As stated by Stasko (October 1970); "With the gradual increase in average boat size over the years and introduction of hydraulic trap haulers, depth sounders, radar and loran, the fishing efficiency and daily travel range have increased." Although supporting data is lacking, interviews and observation suggest that the rate of technological innovation has differed markedly in various regions in the Maritimes.

The main reason for this variation is that in some areas lobsters are found only close to shore while in others, stocks have recently been discovered and exploited much further out. An offshore fleet fishing beyond 50 miles from shore has developed along Browns and George's Banks since 1970. The advent of this fishery was part of a plan to convert displaced sword fishing vessels to other fisheries. Specially adapted traps are used as the method of harvest by Canadian fishermen although some American boats trawl for lobsters.

For purposes of regulation the offshore lobster fishery is defined as fishing activity 50 or more nautical miles from shore. Because of the great distances involved, offshore lobster fishing is more expensive than its inshore counterpart. The product is not as valuable either since live lobsters, which command the highest price, are desired for the restaurant lobster dinner tradewhile a one or one-and one-quarter pound lobster is considered optimal. Offshore lobsters run much larger than

this on average and must be used for lower value purposes than the "live lobster plate". Although only 8 vessels participated in this fishery in 1978, the offshore catch was about 1.34 million pounds. The boats fishing offshore tend to be larger than the inshore boats with lengths exceeding 66 feet.

The only legal way to fish lobsters in Canada is with the conventional trap. Two other techniques, trawling and diving, are not permitted. Although the size and design of lobster traps vary somewhat along the coast, they are usually in the form of a half cylinder two and a half to four feet long with wood frames covered with wood laths and netting. Most traps are divided into two compartments, the "kitchen" where fresh or salt bait such as herring or mackerel is placed, and the "parlour" from which escape is difficult. One to three funnel-like mesh entrances admit the animal into the kitchen and another leads from the kitchen to the parlour. The funnel-like entrances to the kitchen have traditionally been approximately 10-13 cm in diatmer but in some areas there has been a move to entrances of up to 25 cm in diameter to catch large lobsters that could not enter the smaller funnel. To make the traps sink and hold position, they are weighted with flat stones or concrete. While the lobster trap design has remained basically unchanged since the turn of the century, laminated bows, nylon nets, polypropylene warps and plastic buoys have replaced fir boughs, cotton, manila and cedar in its construction (Scarratt, 1970). According to D. J. Scarratt: "Obviously these modern materials are more efficient than the old, and allow more of the fishermen's time to be spent on the water."

The number of men working a lobster vessel varies from one to three in different areas of the Maritimes. Payment to non-owner helpers usually takes the form of a straight salary although sharing arrangements exist in some areas. Lobster vessels are almost universally privately owned, although in many cases

buyers and processors share both the initial and operating financing of the vessel and equipment.

Although the basic fishing technology is the same in all areas, the size and sophistication of vessels and the method of deploying traps varies substantially. Traps may be fished singly,in pairs or in "trawls" of 8 to 15 traps, depending on the weather, the bottom conditions and the density of the lobster stock. The method of setting traps singly is more suitable where lobsters are in patches, the bottom is rough, the tides strong and storms severe. The position of the traps is marked by wooden or plastic buoys brightly painted for easy identification. While lobsters are fished mainly from Cape Island vessels ranging from 30 to 45 feet, the size and sophistication of vessels has varied markedly between areas and over time. Several factors conditioning this variation are:

1. The proximity of the lobster stocks to the shore. In the many areas where lobsters are found very close to shore, they can be exploited in very small boats. In other areas, where exploited stocks are futher offshore, vessels tend to be more seaworthy, comfortable, larger and faster and use more electronic equipment.
2. The time of year during which the season is open. While most areas are open during May and June when weather conditions are generally favourable, several areas have fall and winter seasons that last for six months. To withstand the more adverse conditions, vessels must be larger and sturdier. In addition, because some of the winter fisheries exploit offshore stocks they have an increased demand for electronic equipment for navigational accuracy and safety.
3. Vessels participating in complementary fisheries such as herring gillnetting and dragging for bottom fish tend to be larger and more

sophisticated than ones which are used to fish only lobsters. Diversification varies by area and is increasing over time. The proliferation of herring gillnetters in recent years and the opening up of the snow crab fishery are only two examples of the increasing participation by lobster vessels in other fisheries.

Most fishermen fish within ten miles of their home port and land their catches daily. In a few places, however, operations are carried on from rather isolated island bases nearer the fishing grounds, with catches being landed on the mainland at approximately weekly intervals.

Until the late 1960's, there was considerable annual turnover of the group of lobster fishermen. With a lack of effective barriers to entry, and with lobster fishing a seasonal occupation, the fishery contained a large number of casual fishermen using small boats and few traps. Fishing by young, more mobile men was largely correlated with variations in alternative employment opportunities. Government licensing policy since that time, however, has discouraged such casual participation in the fishery, and fostered a fishery in which all participants depend mainly on fishing for their livelihood. The buy-back programs initiated in the mid-1970's have further decreased participation by casual fishermen. As a result, the flow of participants between the fishery and other sectors of the economy has decreased and the industry is characterized by more fully committed fishermen.

Besides a boat, traps, rope and buoys, a lobster fisherman may own a shed, wharf, salting vats or puncheons for bait and a truck or trailer. No comprehensive figures are available on the value of the capital investment for a "typical" enterprise although the value obviously varies considerably from one fishing region to another.

Over the past sixty years, the total annual Canadian lobster catch has been relatively stable, ranging from a low of 28 million pounds in 1918 to a high of 52 million in 1956. Catches declined steadily from 1956 to 1974 but have recovered somewhat since then.

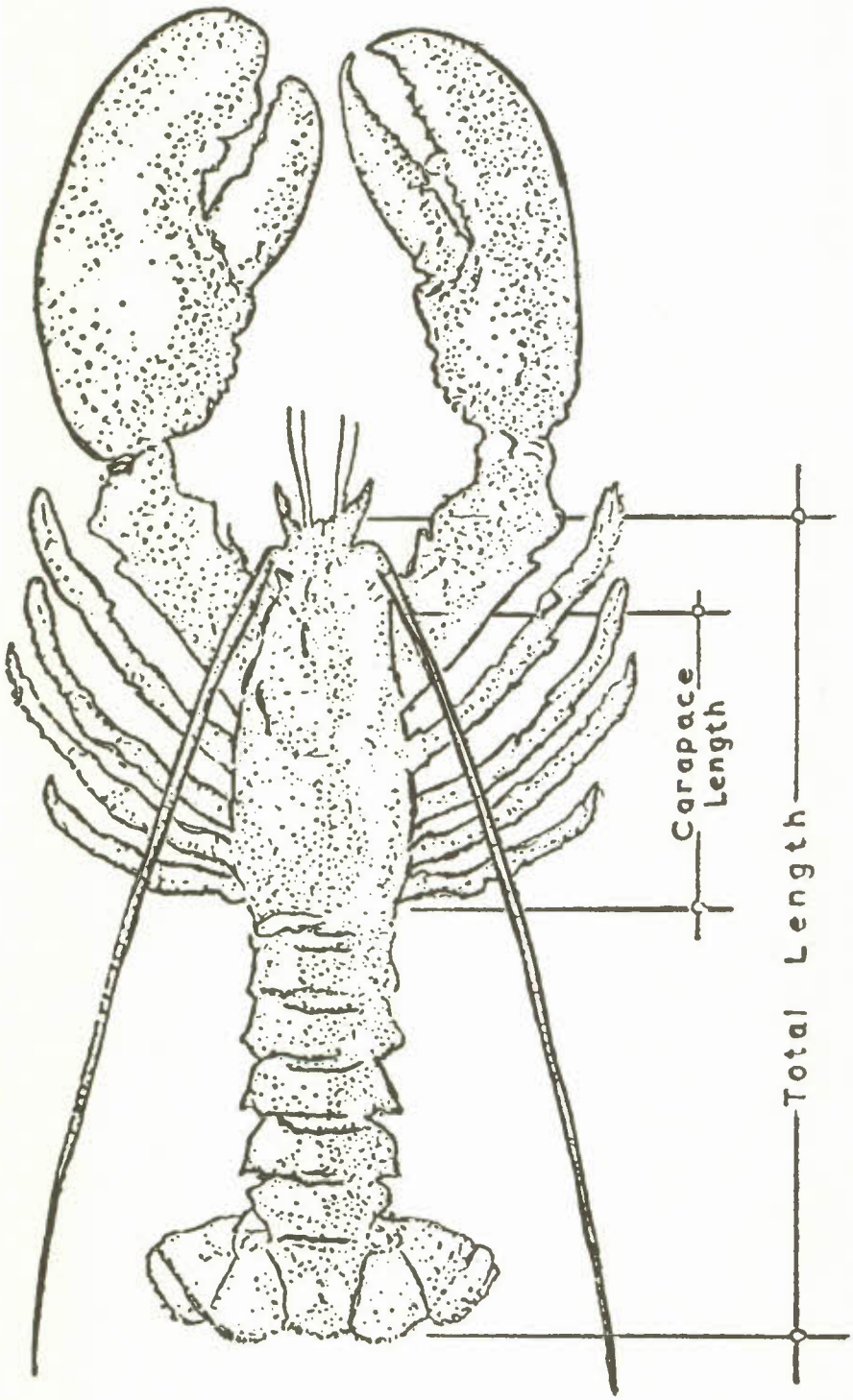
Steady growth in demand for lobsters has not been matched by increased production with the result that the average landed price per pound has increased from 35 cents in 1960 to $1.67 in 1978. As much as $4.25 per pound has been received by fishermen for their catch in the low-landings high-demand Christmas period. Accordingly, landed value of all lobsters has increased from $18 million in 1960 to over $65 million in 1978.

Of course, the gross returns to a particular lobster fisherman depends upon his quantity landed and the price he receives. Annual variations in his total catch result mainly from changes in the stock caused by natural factors in different areas. Large and persisting differences also exist between fishermen as a consequence of differences in fishing skill and, the amount and efficiency of gear and equipment.

Prices are affected by variations in the size and quality of the lobster, and by the seasonal pattern of landings. "Canner" lobsters, 2 1/2 to 3 3/16 inches carapace length (see Figure 1) bring a lower price than "markets", those over 3 3/16 inches. Price differentials exist on the Boston market between Nova Scotia and Newfoundland lobsters. The latter product must be moved a greater distance and the lobsters are in poorer shape upon arrival at their destination. Regarding seasonality, it is generally the case that prices are low in the late spring and early summer when landings are high, and high during the winter when landings are low.

Fishermen also perceive that the prices that they receive can be affected

Figure 1



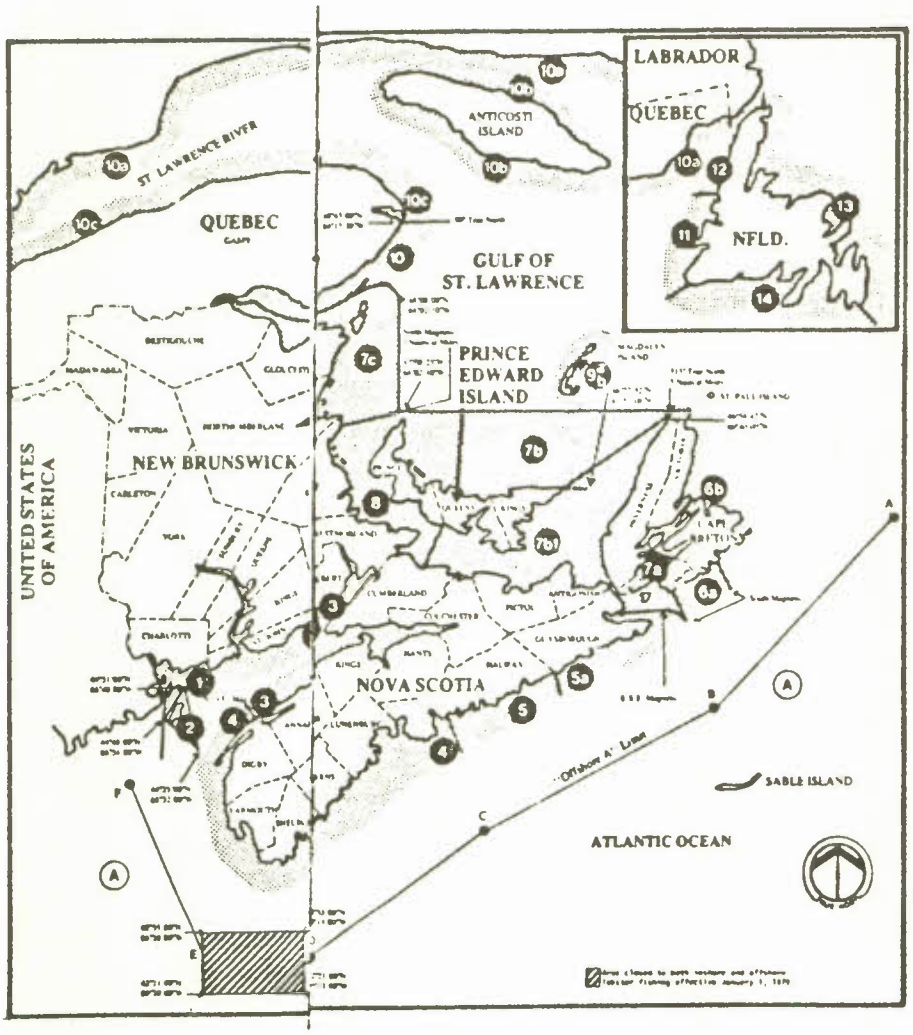
by the size and market power of the buyer facing them. This feeling, along with other benefits of collective action, has induced the organization of a large number of fishermen's associations more than a dozen existing in Nova Scotia alone. These associations tend to be geographically specific rather than representative of all fishermen of a particular species. They also serve a wide range of philosophical approaches, from cooperation (United Maritime Fishermen) through unionism (Maritime Fishermen's Union) to small business (Nova Scotia Fishermen's Association).

Some fishermen can earn a very good living from lobster fishing activities, but most do poorly indeed. Although there are large variations in gross returns among fishermen within a particular fishing district, the contrast is much greater between, for example, a Northumberland Strait fisherman who fishes an eight week season catching primarily canners with a thirty foot boat, and a southwestern Nova Scotia fisherman who fishes a six month season catching markets at periods of peak demand with a forty-five foot boat. To emphasize the point, District 4 fishermen (encompassing the southern coastal region from Digby, Nova Scotia to Cole Harbour, Nova Scotia) consider lobstering operations to be their major fishing activity. But many Northumberland Strait and Gulf of St. Lawrence fishermen see lobstering as a brief (albeit relatively lucrative) seasonal fishery to be engaged in along with ground fishing, Irish moss harvesting or non-fishing employment (see Figure 2 for a map of the Lobster Districts).

Although the basic technology used to harvest lobsters is the same in all areas of the Maritimes, each area is unique in terms of season length, season timing, number of traps fished, vessel characteristics, biological characteristics of the stock, number of fisheries participated in and profitability. Provincial breakdowns show that in 1978, Nova Scotia fishermen landed about 13.5 million pounds of lobsters worth 30.5 million dollars while New Brunswick fishermen landed

Figure 2

Lobster Fishing Districts



9.2 million pounds valued at 14.9 million dollars and Prince Edward Island fishermen landed 10.3 million pounds worth 15.5 million dollars. The much higher average value of Nova Scotia lobsters results from a relatively larger proportion of highly priced "markets" in the catch than in the other two provinces.

Another major inter-provincial difference in 1978 was the share of the lobster fishery in each province in the total value of all fish caught. In Prince Edward Island lobster fishing accounted for about two-thirds of the value of all fish caught by fishermen in that province. In New Brunswick the figure was about one-third while in Nova Scotia the value of lobster landings was only 16% of the value of all fish landings.

The Maritime lobster fishery is divided into eight statistical districts, some of which are divided further into A, B and C sub-districts. As shown in Table 1, the lobster fishery in the Bay of Fundy and along the south coast of Nova Scotia is open for more than six months each year although the actual time spent lobster fishing is considerably less owing to weather conditions. All other lobster fishing districts (i.e. in the Gulf of St. Lawrence, Northumberland Strait, in waters surrounding Cape Breton Island and along the east coast of Nova Scotia) basically have a two month season.

Rough estimates of the number of licenses fished and quantities landed show that of the eight lobster districts, districts 4, 7 and 8 accounted for about 74% of total licenses and almost 90% of total landings. In general, the Gulf of St. Lawrence and Northumberland Strait region accounted for 45% of licenses in 1978 and about 64% of total landings. Historical statistics on landings show that very different trends have occurred in the various regions of the Maritimes. In the Bay of Fundy area (Districts 1, 2 and 3), the quantity landed has shown a slow decline from a high of 1.8 million pounds in 1969 to 1.0 million pounds in 1978. In southwestern Nova Scotia (District 4) landings were relatively stable to 1975 but dipped sharply in 1976 and as of 1978, landings

Table 1

Lobster Regulations

Lobster Fishing District (see figre 1 for Map)	Closed Season	Minimum Size Limit	Maximum Number of Traps for Category A License	Maximum Number of Traps for Category B license
No. 1	Third Friday in June to the second Tuesday in November	3-3/16 inches	300	90
No. 2	Third Friday in June to the second Tuesday in November	3-3/16 "	375	113
No. 3	January 1st to the last day of February and August 1st to October 14th	3-3/16 "	300	90
No. 4 (between Burns Point and Baccaro Point)	June 1st to the last Monday in November	3-3/16 "	375	113
No. 4 (between Baccaro Point and Cole Harbor)	June 1st to the last Monday in November	3-3/16 "	250	75
No. 5 and 5a	June 21st to April 19th	3-3/16 "	250	75
No. 6a	July 21st to May 19th	3-3/16 "	250	75
No. 6b	July 16th to May 15th	2-3/4 "	275	83
No. 7a	July 1st to April 30th	3-3/16 "	275	83
No. 7b	July 1st to April 30th	2-1/2 "	300	90
No. 7b 1/	July 1st to April 30th	2-1/2 "	300	90

Lobster Fishing District	Closed Season	Minimum Size Limit	Maximum Number of Traps for Category A License	Maximum Number of Traps for Category B license
No. 7c	July 1st to April 30th	2-1/2 inches	375	113
No. 8	October 11th to August 9th	2-1/2 "	250	75
No. 9	July 11th to May 9th (January 1st to December 31st) [1]	3 "	300	
No. 10a	August 1st to May 19th	3 "	300	
No. 10b	August 16th to June 14th	3 "	300	
No. 10c	July 28th to April 30th	3 "	300	
No. 10d	July 18th to April 30th	3 "	300 [2]	
No. 11	July 6th to April 19th	3-3/16 "	-	
No. 12	July 11th to May 4th	3-3/16 "	-	
No. 13	July 16th to April 19th	3-3/16 "	-	
No. 14	July 1st to April 19th	3-3/16 "	- [3]	
Offshore Lobster Fishing District A	3 month closure	3-3/16 "	Not applicable	

Format Source:

[1] Applies to the lagoons of the Magdalen Islands

[2] The province of Quebec has a uniform maximum of 300 traps per vessel but does not have A and B license categories

[3] The province of Newfoundland has no trap limits

were less than 50% of the peak year, 1969. Along the eastern shore of Nova Soctia and in southeastern Cape Breton (Districts 5, 6a and 7a) the fishery has virtually collapsed. These areas which once accounted for landings in excess of 3.5 million pounds, had landings of about 200,000 pounds in 1978. In contrast, landings in northeastern Cape Breton (District 6b) have been remarkably stable, at least over the past twenty or so years. The important Gulf of St. Lawrence and Northumberland Strait area did experience significant decline in landings up to the mid-1970's but the fishery has since recovered to have landings of about 80% of the peak year of 1960. In fact, in district 7c, landings in 1978 were higher than in any of the preceding 20 years.

Data in Tables 2 and 3 shows that in some areas the lobster fishery is by far the most important source of fishing income while in other areas it is an insignificant portion of their total income.

From statistical data available, it is impossible to get an accurate impression of the profitability of the lobster fishery in the various areas. Data on the value of landings per license and buy-back statistics do provide some guidance although they must be interpreted cautiously. Data on value of landings per license show that the Grand Manan Island area had value of landings per license of almost $15,000 followed by District 8 with about $13,000 and District 7b with $12,600. The only other area close to these was District 4 with a value of landings per license of about $9,000. Note that while Districts 2 and 4 had 6 and 7 month seasons to accumulate this value, the season in Districts 7b and 8 was only two months in duration. Other important differences are that fishing costs can be conjectured to be higher in District 4 owing to fishing further off-shore, and the prices received for lobsters in Districts 2 and 4 was markedly higher than in the other districts. On the other side of the scale Districts 5, 6a and 7a had a value of landings per license of less than or about $1,000.

Table 2

Value of Lobster Landings Related to Value of All Fish Landings by Lobster District, 1978

District	A Lobster	B All Fish	Lobster Value as a Percentage of Total Value
1	494,103	9,759,793	5.1
2	1,883,205	6,267,671	30.1
3	760,364	6,624,908	11.5
4	21,287,610	147,390,000	14.4
5	453,217	13,116,162	3.5
6a	80,340	112,044	71.7
6b	3,016,398	15,008,111	20.1
7a	83,422	3,975,763	2.1
7b1	7,212,606	12,787,699	56.4
7b	7,270,045	10,555,495	68.9
7c	7,453,812	27,052,188	27.6
8	10,183,799	13 565,047	75.1

Table 3

Indicators of Primary Sector Performance by Lobster District, 1978 data for columns 1-4

	1	2	3	4	5[3]	
	# of Licences	lbs/licence	price/lb.	$/licence	% of licences bought back	Lobster value compared to value of all landings (%)
District 1	247	695	2.88	2,000	14.9	5.1
2	128	5,414	2.72	14,713	4.7	30.1
3	137	2,184	2.54	5,550	18.9	11.5
4	2,321	3,428	2.68	9,172	18.2	14.4
5	651	341	2.04	696	45.6	3.5
6a	72	611	1.83	1,116	43.6	71.7
6b	690	2,672	1.64	4,372	11.1	20.
7a	138	287	2.11	605		2.1
7b1	1,229	3,813	1.54	5,869	6.2[1]	56.4
7b	577	8,457	1.49	12,600	-	68.9
7c	1,046	4,768	1.49	7,126	3.3	27.6
8	777	8,775	1.49	13.107	5.7[2]	75.1

Sources

[1] just the N.S. side buy-back statistics

[2] just N.B. and N.S. Side

[3] column 5 represents licenses bought back from mid-1978 to December 16 1979.

Statistics on the lobster license buy back program[4] for each District, although incomplete also give indications as to the profitability of the lobster fishery. It is important to remember that different opportunity costs for labour and capital in the various districts can lead to a variation in the percentage of licenses bought back for a given level of profitability of the lobster fishery. In addition, the maximum buy-back price of $6,000 per license weakens the ability of the program to retire licenses in areas where the fishery is capital intensive and carried on for six months of the year . It is clear, however, that with over 40% of licenses retired in Districts 5, 6a and 7a, the lobster fishery in these areas was not a profitable undertaking. By contrast, less than 5% of licenses were retired in Districts 2 and 7c and only 5.7% in District 8.

(b) Secondary Sector

Lobster fishermen normally sell their catch to buyers, who in turn hold the lobsters for short periods of time before selling them to larger buyers, assemblers, processors, tidal pound operators or retailers. (The processors in turn produce frozen or canned lobster meat, paste and tomalley.) Live lobsters are stored in floating wooden crates or larger "cars", wooden shore-based tanks supplied with running sea water, or in tidal pounds. The pound operators buy lobsters when they are abundant and hold them until seasonally reduced catches raise the selling price. Lobster retailers sell either the live or processed product.

Lobster buyers fall into three general categories: small independents, fishermen co-operatives and commissioned agents. While Prince Edward Island has a large proportion of commissioned larger buyers, southwestern Nova Scotia has many independent buyers. Local co-operatives buying, holding and selling

are prevalent in New Brunswick and the Northumberland Strait area of Prince Edward Island and Nova Scotia. The majority of these local co-ops are affiliated with the United Maritime Fishermen (UMF). This umbrella organization provides marketing services along with purchasing inputs in bulk for the locals and lobbying the government.

All three types of buyers are represented in most areas. There are a large number of lobster buyers as very little capital is required to undertake a middleman role. Prices change frequently, and offer opportunities to move the product or hold it, in hopes of large returns. However, the degree of competition suggested by the presence of many buyers can be misleading, since several buyers with their agents, account for most of the transactions. For example, the lobster task force in 1975 estimated that less than ten firms accounted for over 80% of lobster purchases. The task force also estimated that in 1975 there were approximately 150 independent buyers.

Integration is fairly common within the secondary sector. Individual buyers may be permanent or occasional agents for larger concerns that hold, process, transport or retail lobsters or lobster products. Credit operations link many fishermen with particular buyers. Buyers provide mortgage money for boat purchases, preseason advanced for gear repair and supply bait during the season. The credit/debit relationship is sometimes described as a natural convenience offered by buyers. However, in times where prices are low and sales difficult, the tie has been felt as a means of reducing the opportunities for fishermen to sell under competitive conditions. Buyers rarely own or operate boats outright but attempt to secure a lobster supply through the ties and good-will created by credit links and in-season service.

Most lobster canneries are located in the Gulf of St. Lawrence area where

warmer water allows lobsters to mature at a smaller size than in other Atlantic coast areas and here federal regulations provide for the taking of canner size lobsters. The principle involved can be illustrated by an example. If, for example, a canner size limit existed in southwest Nova Scotia, very few lobsters that were caught would be mature animals and this might seriously reduce recruitment.

Live market lobsters are shipped by truck to the Boston market or flown by air freight to Europe. The price of live market lobsters fluctuates greatly during the year in response to movements in supply and demand. The supply of New England caught lobsters is greatest during the summer months[5] and prices are low during that time. During the Christmas period, through to Easter, demand for live lobster is high and supply is low, therefore the prices paid tend to rise.

3. Regulatory Policy

(a) History

Lobster fishing on a commercial basis has been taking place in Canada for over one hundred years.[6] The first lobster cannery in Canada was established in New Brunswick about 1845 and the number of canneries increased steadily until peaking at over 750 at the turn of the century. Canned lobster meat was then sold largely in the United Kingdom.

The live or market lobster trade was not established until about 1880 when fishermen from southern New Brunswick and eastern Nova Scotia began exporting their catch to Boston. Proximity to the market was a most important factor in the development of the live lobster trade. Meanwhile the value of canned output continued to increase until about 1920, since which time it has declined steadily. The value of exports of live lobsters has increased since the 1920's with the greatest expansion coming after the second World War.

Since its beginning the lobster fishery is considered to have gone through three phases:

"The first phase of rapid expansion, when new areas were being discovered and the fleet was growing quickly, was accompanied by a steady increase in landings to a maximum of about 100 million pounds in 1887."

"During the second phase which lasted to about 1918, the catch declined steadily. The average size of the lobsters also declined appreciably. It now seems apparent that during the latter part of phase one and the early part of phase two, the Fishery was removing accumulated stocks considerably faster than the grounds could replace them."

"....Since 1918 ... landings have been relatively constant, averaging 40 million, and ranging from 30 to 50 million pounds. During this phase the Fishery

and stock have remained more or less in a state of balance[7].

Early in phase one concern was expressed over exhaustion of the lobster stock and the first regulations were instituted in 1873 when an Order in Council prohibited the capture of soft-shelled lobsters, egg-bearing females and lobsters less than 1 1/2 pounds in weight[8].

The prohibition on soft-shelled lobsters was actually a quality-control rather than a conservation measure, an attempt to prevent lobsters in poor condition from being canned, unlike the regulations protecting small lobsters and egg-bearing females. Unpopular with fishermen and cannery operators alike, both sets of regulations were modified in less than a year. A closed season instead of a prohibition on the capture of soft-shelled lobsters was introduced for July and August, and the weight limit was changed to a 9-inch total length limit on the grounds that it was difficult to enforce the weight limit. The restriction on the capture of "berried" lobsters was retained. These three are still the main elements of the lobster fishing control today.

As virtually the complete catch of lobsters was canned during this period, the canneries were a pressure group to be reckoned with. At their insistence the closed season in 1876 was shortened and moved to late August and September thereby extending the canning season.

In 1879, eight-month closed seasons were established in different fishing regions. The closed-season regulations have continued to be modified and refined right up to the present time. As a consequence of the establishment of the long closed seasons, lobster fishing generally became a part-time activity.

It is interesting to note that during the late nineteenth century the cannery operators had actually established implicit property rights over particular fishing

grounds, often controlling a two to four mile ocean frontage. Successful canning operations attracted new entrants to the area, leading to reduced profits for the existing operators and causing canneries to press for a leasing system that would strengthen and define their territorial rights. But, despite this strong lobbying pressure, the federal government maintained free competition and entry, arguing that exclusive rights to grounds would create monopoly buying power and take away the bargaining strength of the individual fishermen.

During this early period of the fishery, the closure and size regulations mentioned above that had been established were generally ineffective; unenforced and believed to be unobeyed. It was not until the decline in landings,that began in 1887, that official interest in regulatory measures was renewed. Introduction of the gasoline-powered boat around 1900 and improved lobster traps put even greater pressure on the stock.

Nine commissions were appointed in the fishery between 1887 and 1927. As a result of these commissions' investigations, regulations on the boundaries of fishing districts, lobster size, closed seasons and trap construction were variously modified, rescinded, reintroduced and further modified. More significantly perhaps lobster fishermen were required in 1918 for the first time to obtain licenses before they were permitted to fish, and in 1934 this restriction was extended by the introduction of a regulation prohibiting fishermen from fishing lobsters in more than one district in any one year.

Size limits, fishing districts and closed seasons have been adjusted slightly in the past 40 years but the major changes in lobster fishing regulations have been in the area of factor input limitation, that is gear, vessel and fisherman restriction. A major instance was that of 1945, when capital, vessel and gear mobility were drastically restricted by the introduction of a regulation which stated that no one

could use in lobster fishing any boats, traps or other lobster fishing equipment that had been used during that year in lobster fishing operations in any other lobster district[9]. (Later, enforcement difficulties caused that part of the regulation referring to traps and other equipment to be rescinded in 1959.) Again in the 1960's, license and trap limitations were introduced with the aim of controlling fishing pressure and so increasing the net incomes of fishermen.

(b) Existing Lobster Fishing Regulations

The existing lobster fishing regulations are listed in general categories in the table below and a few comments of explanations are given in the following pages.

Principle Canadian Lobster Fishing Regulations, 1979

1. Licensing of fishermen and boats
2. Division of the coastal areas into 22 lobster fishing districts
3. Restriction of fishermen and their boats to one district in a season
4. Allocation of fishing seasons by districts
5. Limitation of number of traps fished per enterprise by districts
6. Limitation of licenses
7. Buying back of licenses
8. Minimum size limits by districts
9. Restriction of gear type to the trap
10. Prohibition against taking egg-bearing lobsters

All boats used in the lobster fishery, together with all lobster fishermen and those who assist them are issued with licenses annually. The fee for an operator's license is $2.00 and for a helper is $1.00. The fee for registering a vessel is $5.00 in the provinces of Nova Scotia, New Brunswick and Prince Edward Island and $3.00 in Quebec. The licenses are issued for fishing in one district only and an individual can only hold one license. Regulations for each fishing district specify the dates for setting gear at the beginning and removing it at

the end of the season. Some attempts have been made to organize the seasons in a manner so as to avoid flooding the market.

Control of number and type of traps commenced in 1966 when the Department of Fisheries placed an upper limit on the number of traps which could be fished from each lobster vessel in District 8.[10] The following year a similar trap limit was introduced in part of District 7b and by 1968 trap limits had been extended to all Maritime lobster districts . In 1969 the limit on the number of operators was changed to a limit on the number of boats, and a new regime was introduced which would provide for phasing some vessels out of the fishery.

There were then established two classes of licenses which applied to boats engaged in the lobster fishery. Initially class "B" licenses were issued to all boats from which less than one hundred, seventy-five or fifty traps, depending on the district, were fished in 1968. (Subsequently these limits underwent slight modification.) Class "A" licenses were issued to almost all other boats, that is boats and replacements from which a number of traps greater than the upper limit for class "B" were fished in 1968. The maximum limit established in 1968 of course applied as a minimum to these "A" boats.

The difference between "A" and "B" licenses is their duration. When a fisherman using a class "B" boat stopped fishing, the license that went with his boat was not renewed. If, however, a fisherman using a class "A" boat ceased to fish, whoever bought his boat also acquired his "A" license, and so was allowed to fish. At the time of the institution of these regulations, the government also reserved the right to purchase boats along with the associated licenses.

In 1977 administrative changes were made to these factor input regulations, with the revoking of the category A and category B vessel classifications, and a reversion to the pre-1969 concept of licensing fishermen rather than vessels. (The ease with thich these changes could be made reflects the large preponderance of one or two man vessels.) Thus were created Category A and B licenses for the fishermen[11]. The substance of the previous regulations remained unchanged, with the relevant trap maximums applied to the boats operated by fishermen with Category A or B licenses. Category A licenses are clearly designed to be held by "full-time" fishermen as the regulations state that such a license "shall not be issued to a person who (a) is fully employed in employment other than primary industry employment or (b) has full time seasonal employment unless he can establish that his gross annual earnings during the twelve-month period immediately preceding his application for the license do not exceed what he would have earned if paid the minimum wage plus twenty-five percent during that period".[12]

In July of 1978, the federal government introduced the Lobster Vessel Certificate Retirement Program in Nova Scotia and New Brunswick, commonly referred to as the Lobster License Buy-Back Plan. This program followed a pilot project successfully introduced a year and a half earlier in Prince Edward Island. The stated purposes of the buy-back programs are to ease the pressure on the resource and to increase the incomes of those remaining in the fishery. The Prince Edward Island project was implemented under terms of the Prince Edward Island Comprehensive Development Plan with the funding of vessel purchase shared by the province and the Department of Regional and Economic Expansion with DREE providing 90%. The three year P.E.I. pilot project had by its half way point succeeded in inducing the voluntary withdrawal of over 50% of its declared target objective of 400 lobster fishermen.

Table 4

PEI Buy Back Program*

	Number of Licenses Bought	Total Licenses	% bought
Western PEI	96	627	15.3
Central PEI	24	197	12.2
Eastern PEI	62	676	9.2
Total	182	1500	12.1

Average landings of licence holders who were bought out (average landings over 1974,5,6,) 4,234 lbs.

Average Compensation Paid $4,642

*Unfortunately the data on the PEI program was not collected by Lobster district. This data was collected from the start of the program (Feb. 3 1977) to March 31, 1978.

The objective of the larger Nova Scotia and New Brunswick Buy Back Plan is to retire an estimated 1,060 category "A" licenses in a three year period. The program is described as intending to help those fishermen who want to withdraw voluntarily from the fishery to turn to other occupations but are prevented from doing so by fixed investments in lobstering which would have limited current market value.

Compensation received under this federal program is tax free. The amount is determined by multiplying the applicant's "average annual documented landings" of lobsters plus an additional 20% by the average 1977 landed value per pound in the lobster fishing district of the applicant. The average landing is arrived at by averaging the documented landings of the fisherman during the 1976, 1977 and 1978 fishing seasons. The same base years will be used throughout the life of the program to ensure consistency in the calculation of every claim. In the lobster districts with a fall and winter fishery or a fall and spring fishery, the 1975/76, 1976/77 and 1977/78 seasons are being used throughout the life of the program. Each compensation offer shall not be less than $2,000 nor more than $6,000. A built-in appeal mechanism is available for those who feel their initial offer is not satisfactory.

It is worth noting that this is a license buy-back program and does not include the purchase of vessels or equipment. The compensation, therefore, represents an estimate (within the established limits) of the capitalized value of the individual's lobster fishing rights. Furthermore, the program specifies that once a license has been sold to the government, the previous holder cannot engage in the lobster fishery for a minimum of three years, and after that only by replacing another licenseholder. No fisherman may participate in the buy-back program more than once.

Until 1979, lobster purchaser licenses were required by the Nova Scotia government. As it was felt that such licenses were serving little purpose, they were eliminated in that year, however, they are still required by buyers in the

other Atlantic provinces.

There is no explicit regulation of the quality of live lobsters. The market does discriminate according to quality through the prices paid for catch from various sellers. Quality standards in lobster canneries are enforced by the federal fisheries authorities on behalf of the Food and Drug officials.

Lobster pound operators are required to be licensed, and in addition, special licenses are required for pound operators who "retain, sell or otherwise dispose of female lobsters to which eggs have become attached during the time they were impounded".[13]

(c) Evaluation of Current Management Techniques

One can hardly disagree with the introductory statement in the lobster Fishery regulation section of the 1979 Fisherman's Information Manual: "All changes in the regulation of this Fishery must be seen as an attempt to progress towards more rational management of this important species, where all relevant social, economic and biological factors are taken into account. This requires stepped-up research and more frequent and complex consultations with fishermen".[14]

From reviewing past legislation in conjunction with talking with government officers, we have identified four official primary management objectives:

1. Conservation of the resource
2. Preservation of the employment opportunities in the lobster fishery
3. Creation of a "reasonable" level of income for those involved in the fishery
4. Organization of the catch so that the markets for live lobsters are not flooded.

Compared with the earlier regime of unenforced seasonal limits, some rather significant regulatory changes and policy measures have been instituted in the past two years. More are contemplated for the 1980 season. To facilitate a systematic analysis of these and the other lobster fishery regulations, each

principle regulation will be considered in turn beginning with those currently under review. The management tools will be discussed in light of the objectives previously stated.

Minimum Size Limits

In the one hundred years or so of lobster fishery management, minimum size limits have been under almost constant discussion. Two benefits of larger size limits are perceived: higher prices for "market" ratherthan for "canner" dimensions; and a higher fertility rate. The limits for canner and market lobsters were changed frequently in earlier years but no adjustment has been made since 1952 when the size limits in the market areas were raised to 3 3/16 inches and in canner areas raised to 2 1/2 inches.

Renewed concern about declining lobster landings together with new evidence from fishery biologists of the wisdom of increasing size limits[15] has caused the fisheries officials to consider increasing the minimum size in some districts as early as the 1980 spring season. The buoyant market for live rather than canner lobsters has pointed the same way. Opposition to this move is being voiced by fishermen in some fishing areas, however, and the authorities have promised further consultation with those affected before making final decisions on the exact amount and timing of size increases.

Canadian and United States fisheries biologists meeting in St. Andrew's, New Brunswick in October 1978 concluded that lobster size limits should be raised in all fishing areas.[16] This, it was argued, would allow more lobsters to reach maturity and replenish the population. On the strength of this recommendation and with the support of their fishermen, the United States is contemplating a move from 3 3/16 inches to 3 1/2 inches legal minimum size in the near future. The Americans already have a uniform size limit for all lobsters caught as there is no

canner classification in the U.S. fishery.

Because of the heavy dependence of suppliers on United States markets, it is likely that a change in the U.S. size regulation could precipate a similar change in Canada. Canadian fishermen's opposition to modified size limits is confined for the most part to the increase being considered in the canner lobster category. Quite apart from the potential increased yields resulting from allowing a larger portion of the lobster stock to reach reproductive maturity, the considerable price advantage of market lobsters over canner lobsters would seem to indicate that fishermen collectively could gain by leaving small lobsters to grow to market size; although more biological and economic work need to be done before exact costs and benefits of size limit changes can be established.

Fishermen are, of course, concerned with the effect on their landings during the period of introduction of any minimum size increase and are engaged in intense discussions with fisheries officials on alternative compensation schemes. "Compensation" might be needed for any one of the following reasons:

1. The fishermen are not convinced that there is a net economic gain to be made and therefore must be "bribed" to agree to the program;
2. The costs of the size increase would be born by different people than would reap the benefits;
3. The capital markets fishermen face are not perfect and therefore they cannot borrow against future returns to cover current costs.
4. Cannery operations would also be affected by such a change and many fishermen have vested interest in the level of employment of their family members in the processing sector.

Fisherman acquiescence is needed to make enforcement of size limits effective. Government officials have told us that in many areas the limits are not now observed. There would seem to be local private outlets for short lobsters. Strict enforcement of the size limit would be very costly, unless it was strongly supported by the fishermen.

Fishing Technology

Since 1914 the lobster trap has been the only legal method of fishing for lobsters in Canada. The basic construction of the trap remains largely unchanged although traps may vary slightly in size from one fishing area to another.[18]

Whether the regulation restricting the method of lobster harvesting to the standard trap has affected catching efficiency is difficult to ascertain. However, it is notable that commercial lobster fishing in the state of Maine is indistinguishable in terms of fishing technology, from its Canadian counterpart, despite the absence of harvesting technology regulation in that fishery.

Until recently a large number of American boats have dragged for lobsters on the banks off the northeastern United States. However, with reduced stocks in the offshore area these fishermen have been switching from trawls to traps, the latter equipment apparently being more efficient for use with highly exploited stocks.

It appears that in recent years an increasing number of fishermen have been using larger rings or hoop sizes in their traps, making it possible to trap the larger lobsters. The larger females are considered by many to form the basis of the reproducing stock. During the current fishing year, federal fisheries department officials have been attempting to determine the extent of use of these large ringed traps, in an effort to assess their impact. A maximum ring size of 6 inches

is being enforced this year in newly created district 5A to aid in the information gathering process. Should regulatory measures restricting the hoop or ring size be deemed necessary (no such regulation exists presently), Department officials indicate they will be implemented during the 1980 fishing season.

Lobster fishermen will also be surveyed regarding the use of escape mechanisms on their lobster traps. The escape mechanisms, plastic laths with circular or rectangular openings, allow undersized lobsters to escape rather than be brought to the surface and then returned to the water. Their use is voluntary at the moment[20]

Both harvesting and stock benefits can be expected to be derived from the use of these escape mechanisms. From the fisherman's point of view, it has been found that traps so equipped land up to 12 percent more legal-sized lobsters during the course of a season. An additional benefit would be the reduction in the labour involved in handling undersized lobsters. Figures compiled by the Prince Edward Island Department of Fisheries over a three year experimental period show that a fisherman who lands 10,000 pounds of lobsters in a season handles approximately 23,000 short lobsters. If the recommended 45 mm escape holes are used, the fishermen would handle only approximately 40% of these undersized lobsters. From the stock point of view, when undersized lobsters are discarded from the catch and thrown back overboard they are sometimes eaten by other fish, such as cod, before they can return to the bottom and find cover. And finally, biologists believe that each time a lobster is handled, its growth rate is affected and that claw loss of from 5 to 20 percent can be attributed to the handling of lobsters.

The costs to the fisherman of introducing the escape mechanisms are twofold. One, the mechanisms would have to be installed, and two, when market sized lobsters are caught, they could stick part of their bodies outside the trap to be crushed in handling or eaten by predators. Most fishermen are not now convinced that the mechanisms would increase their direct return.

In addition to the consideration being given these two conservation measures - controlling trap entry rings and allowing for better escape mechanisms - lobster traps used in the 1980 fishery will not be allowed to exceed the conventional (though previously unregulated) size, that is 1.22 metres (48 inches) in length overall, with a perimeter of 3.6 metres (141 inches) at its bottom. Larger traps, up to 3.28 metres (129 inches) in length, are now in use in some lobster districts.

In light of the evidence favouring trap escape mechanisms, a regulation requiring their use would seem desirable if the fishermen can be convinced it is an economically rational move. Broad implementation of entry ring restrictions should await the results of current investigation. Maximum trap size restrictions are a complement to the existing trap limitation rules for the purposes of effort limitation, and it is surprising that the former are just now being introduced. It should be clear that each of these regulations poses considerable enforcement difficulty which will be discussed in greater detail later on.

Closed Seasons and Areas

Closed seasons were originally introduced to prevent capture and canning of lobsters in poor condition and to prevent fishing when the weather was poor. As an effort reducing regulation, closed seasons were not found to be very effective as the fishery, when seasons were shortened, simply employed more men and gear and therefore, the overall rate of exploitation did not decrease.

Of course, the pattern of lobster landings is largely determined by the timing of the opening of the season in each district and existing seasonal closures prevent Canadian landings from coinciding with the peak United States harvesting period of August through November.

Fishery biologists have argued that closed seasons improve lobster quality by minimizing landings during the summer months when lobsters are soft-shelled, difficult to hold and ship, and give a poor meat yield.

The difficulty with regulation of seasons is that there are several conflicting considerations. If lobster quality, which would also have a bearing on price, is of main concern, then a closed season from July to September seems warranted. If price is of prime concern, then thought should also be given to alleviating the depressing influence on prices of large landings in late spring. Economic efficiency arguments would modify widespread seasonal closures because of the extra costs of peak and overtime work introduced into the harvesting and processing sectors.

The wisest proposal on balance may be that of Wilder [21] who argues that thought should be given to a universal open season between October and June. Lobster landings under such a regime would probably be concentrated in early fall. Fishermen taking into account weather, possible catch and price would learn how much gear to use and when to fish.

Closed areas have not been a consideration in the lobster fishery until this year when fisheries officials, acting on increasing evidence of some relationship between offshore lobsters and the inshore lobster population of southwest Nova Scotia, closed Browns Bank to all lobster fishing activity. While lobster larvae are found in both areas, indicating hatching of eggs both inshore and offshore, there is a much greater abundance of "berried" (egg carrying) lobsters offshore despite a scarcity of young (undersized) lobsters there. Since prevailing surface currents would carry lobster larvae from Browns Bank toward southwestern Nova Scotia, it would appear that at least some recuritment to inshore areas is being provided by offshore populations.

However, fishery biologists do not feel that the recent decline in inshore catches along the southshore of Nova Scotia results primarily from the offshore catch. Instead it appears that the decline relates to a combination of local

overfishing and a change in local ecology.[22]

Whatever the eventual understanding of the long term biological relationships between the inshore and offshore lobster fisheries, the present state of uncertainty would suggest that great caution be exercised. Under such circumstances establishment of closed areas would seem like an appropriate interim management decision.

A portion of lobster district 7b is closed to Irish moss harvesting. This regulation was introduced in 1971 in order to eliminate the possibility of long term damage to lobster stocks inflicted by the moss-harvesting equipment, which rake the bottom destroying lobster habitat. Retention of this regulation appears necessary. A periodic review should be undertaken of the Irish moss-lobster fishery interaction so that other instances of spill-over effects may be noted and met with appropriate regulation.

Catching lobsters out of season can be a real problem in some areas, for example, in western Prince Edward Island and western New Brunswick where different seasons exist in areas which are close together. As it is impossible, without physically checking, to tell whether a fisherman has a license to fish in that district or not, poaching is difficult to prevent. As is the case with short lobsters, marketing poached lobsters would not seem to be a difficult task.

Protection of Egg-bearing Females

The lobster fishery regulations state that "no person shall at any time fish for, sell or have in possession any lobster with eggs attached".[23] No relationship has yet been firmly established between the number of egg-bearing lobsters and either the adult population or commercial landings, although some relationship probably does exist. As lobster larvae are moved around by winds and currents during their surface swimming stage, the stock recruitment relationship is very difficult to estimate. Given the current state of knowledge,

abandonment of the law protecting egg-bearing lobsters might have disastrous long run consequences.

Protection of egg-bearing females raises a particular problem for lobster pound operators. They are required to liberate females that become "berried" during impoundment unless a yearly payment of $1,000 is made, in which case a separate enclosure must be provided for their retention. If he has paid this fee, a pound operator may "scrub" the "berried" females and proceed with their marketing.

It has been suggested on occasion that the government purchase "berried" females from pounds and hold them until the eggs have hatched and the lobster larvae may be released. This measure, however, would involve considerable expense for uncertain benefits.

Trap Limits

Limitation of the number of traps per boat was introduced in the Maritime lobster fishery during the 1966-1968 fishing seasons. Despite the obvious intention of such regulations, trap limits in all lobster areas except district 8 were set at too high a level to reduce the number of traps fished. For example, the maximum trap limit in lobster district 3 is 300. Yet only 12 of the 231 vessels in the fishery in both 1967 and 1978 were known to fish more than 300 traps in 1967.[24] Furthermore, many fishermen who formerly fished below the maximum allowed, increased the number of traps fished to the maximum when it was introduced. However, it is impossible to be precise regarding the number of traps actually fished before or after trap limits were introduced because some fishermen apparently apply to fish more traps than they actually use.[25]

What is required to make maximum trap limits an effective effort reducing measure (assuming license limitation is also in effect) is to review established

maximums for each district and progress toward reducing these limits to meaningful levels [26] at the same time as the capacity to enforce these limits is improved.

Enforcement of trap limits is a very tricky problem. The current method of enforcement is as follows. Every fisherman is issued a number of trap tags, equal to the trap limit, which must be placed on his traps. The fisheries officer, at sea, has the right to haul traps and check them for tags. The problem is that a fisheries officer cannot prove that a man is fishing too many traps unless all of the suspect's traps are hauled. This is next to impossible as the fisheries officer could never find all of one man's traps.

The reasons why a fisherman cannot be charged in a court of law if a few traps are found tagless are the following:

1. The fisherman could say that the tag fell off the trap, which is quite possible (during a storm).
2. The fisherman, if he is fishing illegal traps, might not use his distinctive marker buoy to mark the trap. When an untagged trap is hauled by the officer, it cannot be traced back to anyone.

For the above reasons, a fisheries officer, when he finds an untagged trap just destroys the gear rather than attempting to track down the offending fisherman.

It would seem that the present system could be improved upon. The chief enforcement problem is to link fisherman, buoy and trap in a way that identifies both ownership and number. For example, each fisherman could be required by law to set traps identified by his own distinctively coloured buoys. The fisherman could be charged and penalized if he had buoys other than these. Then when the officer finds an illegal trap he should be able to identify the offender. Also, if the fishery officer ran across an unidentified buoy, the traps attached to that buoy would be immediately cut off without checking them. Note that the fisherman

could still claim that another fisherman was using his buoy markers.

If the enforcement problem could be solved, effort could be reduced by incremental reductions of 25 or 50 traps per enterprise per year until the number of pounds landed per trap rose to an agreed upon "acceptable" level. A certain degree of arbitraryness is inevitable in the trap maximums finally settled upon and such maximums are, of course, greatly affected by the reduced number of fishermen resulting from the license Buy Back Plan. But provided trap limits can be enforced with some degree of certainty, fishermen appear to favour such measures. In the only category A fisherman, trap reduction measure instituted since 1968 - reduction from 400 to 300 traps in district 7b in 1977 - fishermen supported the move, because they saw it as an equitable way of sharing the available lobsters while reducing equipment and operating costs. In our opinion, it is probable that stronger official enforcement, restricted entry and increasing catches will lead to informal self-enforcement within the fleet from particular districts.

License Limitation and the Buy Back Plan

It has been evident for some time that in order to sustain an economically efficient, financially successful lobster fishing industry, harvesting effort must be reduced. While seasonal closures have been part of the fishery for one hundred years, it was not until the late 1960's that factor input restrictions were imposed, and 1977 that these input measures were extended effectively by inclusion of a license buy back program.

The gradual reduction in capital and labour investment brought about by the retirement of category B licensed boats and fishermen has been of some help to the fishery but such reduction in itself does not constitute a solution to the

problem. Category B license holders are, by and large, semi-retired or casual weekend fishermen with low opportunity costs and catches. To an outsider, the exclusion of B licensees sometimes seems both inefficient and selfish.

Category A licenses are reserved for persons who depend on the lobster fishery and who have no year round employment nor any full time seasonal job that coincides with the lobster season. An exemption is made where an individual earns a low wage; (52 weeks x minimum wage plus 25%) in this case an A license is granted. Category A licenses are transferable only to a fisherman of the same district who has fished commercially in two of the last five years. When the program began, the boat had to be transferred with the license but this has since been changed and now only the license need be transferred. Once a license is transferred, it must be held for two years before it can be sold.

The Lobster License Buy Back Plan, addressing as it does the matter of category A fishermen, represents the most innovative effort-reducing measure yet instituted in the Maritimes. We must be aware, however, that license limitation and trap restriction cannot be expected to reduce fishing effort to a desired level forever. Because fishing inputs are to a certain extent, and at some cost, substitutable for one another, the limitation of the use of one or two inputs will eventually result in the expansion of the use of other inputs, thus frustrating the initial measure. Not only enforcement, therefore,but flexibility in enforcement, in the spirit of preventing over commitment of effort, will be required. Nevertheless, the initial step was a courageous and farsighted one, creating opportunity for a continuing biological,economic and social improvement in the lobster fishery. Both the Prince Edward Island program and the Nova Scotia and New Brunswick buy-back programs calculate the compensation to be paid out in the

same manner. Compensation is equal to the average landed value of lobsters caught over the last three years plus twenty percent. The payment shall not be less than $2,000 or more than $6,000. Early indications are that a substantial number of fishermen consider the compensation scheme sufficiently attractive to induce them to retire voluntarily from the fishery. What remains to be observed is how much fishing effort is taken out of contact with the stock in each area. Fisheries officials should be closely monitoring the program with just such a question in mind along with estimation of the value of effort reduction in terms of increased catches, earnings and leisure for those remaining.

For the program in Prince Edward Island, it was predicted initially that 400 "A" licenses would be bought back. The program ended up buying out 187 licenses at $4,656 average compensation. Over the course of the final year of operation, only one license was bought. Fishermen evidently stopped selling licenses because the private license market, during the last year, began to value the right to fish at a higher level than the buy-back program could offer. The precise reasons for this increase are difficult to separate. Certainly some contributing factors were:

1. Biological recovery of the resource due to natural fluctuation.
2. Strong demand for the product.
3. Recovery due to the buy-back program's effect on excessive effort.

Research work is currently in progress within the Prince Edward Island Department of Fisheries which attempts to assess the effect of the buy-back program.

The New Brunswick, Nova Scotia buy-back program, which is operated and funded by the federal government, started out with a predicted retirement of 1060 "A" licenses in the two provinces. Up until March 31, 1980, the program had already

retired 1,027 licenses , at an average price of $2,968. The program is scheduled to run until August 1981.

The objectives of both of the buy-back programs were to stabilize the resource stock and increase the average income of fishermen remaining in the fishery. The first objective was to be attained by allowing the program to increase yield and stock by reducing effort in the fishery. So far, data is not available to test whether movement towards this first objective has been made. The second objective was to be met by both the improved yield and the lower costs of fishing, through effort limitation, as well as by having fewer participants. Again, it is too early to assess the effectiveness of the buy-back strategy towards achieving this objective, although the effectiveness of entry limitation programs to achieve the above objectives is questionable. It should be remembered that if inputs are substitutable effort will not be reduced in the longer term by following one strategy. In the lobster fishery, for example, reducing entry is bound to fail if the number of traps per vessel is increased proportionately. Regulation or control is needed along each "dimension" that makes up fishing effort.

An important future consideration is the matter of potential readmission to the fishery of buy-back plan participants. (A three year waiting period has been established from the time of license buy-back until a fisherman's application for re-entry. To re-enter the fishery, a fisherman must replace another "A" license-holder.) It might even be suggested that successful effort reduction, leading to much improved conditions in the fishery, would allow for a small number of new licenses to be issued by competitive bid, and that aspiring re-entrants be participants in this process. Certainly if conditions improve significantly as a result of the restrictive licensing and buy-back plan, one might argue that lobster license fees reflect some portion of the capitalized value of harvesting privileges.

Violations and Enforcement

The most common violations of lobster fishing regulations involve the taking of under-sized lobsters, fishing out of season and employing traps in numbers in excess of the legislated maximums. For example, in 1977,in Prince County, Prince Edward Island fishery officers destroyed 2,058 traps set illegally in a closed season, and liberated 20,454 lobsters from these traps. Also, it is estimated that in the same year, 30% of canner-sized lobsters were landed as "shorts" with an estimated value of $200,000. [27]

Realizing the seriousness of such violations, fishermen and the Federal Fisheries Department,in 1978,entered into a joint program to combat illegal fishing. This program featured the employment of additional wardens hired by the Prince County Fishermen's Association working under the supervision of federal officers, and the formation of lobster fisherman management committees in various ports. The results of these efforts have been encouraging and command a high degree of fisherman support. Expansion of these measures to other ports in fishing districts 7b and 8 is currently being undertaken. Such fishermen support of enforcement initiatives is essential for the continued survival of the fishery, because as would follow from our earlier discussion of trap regulation enforcement, both lobster size and trap limits are almost impossible to enforce in the face of fishermen apathy or co-operation in illegal activities.

It is clear that,because of common property in the fishery,if measures designed to promote conservation of the lobster stock and restrict fishing effort are to realize their purpose, both regulation and enforcement are necessary. Gear restrictions, lobster size control and factor input restrictions cannot be effective without an extensive enforcement program.

Preaching the need for "enforcement" may be adequate for scientists, bureaucrats and scholars, but it may not be enough for the fishermen and companies. As imposed on the fishing grounds, particular regulations may seem to embody mere interference for its own sake. Fishermen who have invested their time and capital in risky fishing ventures are understandably disinclined to obey the letter of the law every time the opportunity arises to gain from a small infraction of controls on fishing area, season, type or amount of gear, or size of lobster landed. To prevent the possible massive failure of regulations that can result from the myriad of minor and trivial violations, it is necessary that every participant have an almost religious belief in the need for and efficacy of each regulation. This implies that the fishery authorities must be ever ready both to relax (or abandon) regulations the usefulness of which they cannot demonstrate, and to simplify those that are essential. Mere non-enforcement is not enough. (The record of the department on this score is pretty good.) Furthermore, it means that the Department must be in continuous consultation with fishermen so that understanding and revision of regulations is a two-way street. Finally, it means that the true measure of success in the enforcement of regulations "against" fishermen lies in the extent to which the word "against" can be replaced by the word "by". In other words, successful enforcement is a process in which both individually and as a group, fishermen become willing to co-operate with officers to prevent violations from taking place, and, when necessary, to assist officers to identify and if justified, penalize, those who have damaged the common wealth in fisheries.

4. Management of the Lobster Fishery by Adapting Private Incentives and Tenures

A review of the previous section will convey the extent to which lobster fishery management, even if simplified, depends on continuous fisheries officer interference. The common-property resource is made to yield private incomes by frequent interventions in the manner and timing fishermen would choose to fish if left to themselves. As other studies, and our own over-all survey of the field make clear, this is inevitable if biological and economic goals are to be reached without changing the common-property status of the fishery.

In addition to the obvious costs and difficulties of making safe and uniform regulations, the costs and frictions of enforcement, and the wastage of effort and skill that result from imposed uniformity of behaviour on experienced and responsible fishermen, the regulatory route evaluated in the previous section suffers particularly from the characteristic that it tends to reward individual ingenuity in evasion of regulations. Put otherwise, it does not tend to create constructive fisherman incentives to preserve and enrich the resource stock, cut harvesting expenses, and improve working conditions, leisure and safety for fishermen. Instead, in the lobster fishery, the learning, observation and innovative capacities of fishermen are largely wasted, because regulators, by their very assignment, tend, to regard new harvesting methods as a threat to the managed fishery, rather than as an opportunity for widely-shared gain.

Of these perverse tendencies, none is more serious than the absence of any means, in the regulated fishery, to encourage individual fisherman to invest in the long-term maintenance of the fish stock. There is no way by which regulation can link individual "investment" (the abstention that builds the stock and allows individual lobster to grow to optimum size) to an ultimate individual pay off. Investment and conserving behaviour, both because the fisherman cannot exclude others from the locations where his "investment" or act of conservation took place, and because the larvae and mature lobsters in any case migrate to other locations, benefit other fishermen as much or even more than the investor, deprived of tenure or property right in the fruits of his own actions.

An obvious solution to this and other problems is to create a form of property right in the animal or tenure in the location of fishing. In our approach to this type of solution we shall distinguish between two property rights systems, both of which may be, with study and cooperation between regulators and fishermen, developed to make the best of fisherman skill, time, technology, capital and the ocean resource.

The first type involves fishermen holding of property rights in the fish stock, and we shall discuss two sub-types of this approach: division of the stock on a territorial basis and on the basis of percentage shares of the catch (without detailed regard to location). Both sub-types rely on market-like transactions in inputs and outputs, and in the property rights in tenures, to replace widespread regulation.

The second type avoids some of the difficulties (discussed below) of the first approach by giving the right to use, manage and perpetuate the stock to

one managerial unit: a person, firm, cooperative, or local community. This has been called the sole-ownership, or "internalised" route to stock management. The behaviour of the individual fisherman is not restricted by regulation, nor by market-type relations between fishermen, but by the terms of his contract or employment with the larger firm (of which indeed he may be a co-owner or director). This approach too has its difficulties as will be discussed later.

The first type entails the division of the common property, the fish stock, into private excludable portions, allocated to individuals. By private excludable portions it is meant that the individual property owner must have the right to harvest a unique stock of fish, and that others cannot encroach upon this right. This ownership right would be freely tradeable and, assuming a competitive marketplace, efficient utilization of the fish stock, as a whole, should result. (For a theoretical discussion, see the appendix to Maloney and Pearse (1970)).

The first approach alters the behaviour of the fisherman by changing the opportunities open to him. The fisherman now has his own separate portion of the stock of fish to exploit. Therefore he has an incentive to treat that fish stock as he would any other capital asset, to husband it over time, in a manner that allows him to squeeze the maximum return possible out of it. Also, if some other fisherman can more efficiently utilize the stocks than he, the more efficient fisherman will be able to offer enough to purchase the first fisherman's rights. By this buying and selling, efficient utilization of the stock as a whole will result. The obvious difficulties are defining the private, enforceable property rights to portions of the stock. Equally perplexing is deciding upon the initial distribution of those rights.

Turning to the lobster fishery specifically, one way to define property rights might be along territorial lines. Individuals could be assigned the exclusive right to fish a particular area of ocean. The biological condition necessary to use this approach would be that an identifiable resource stock be specific to each geographic area; the lobster stocks should be geographically isolated from each other. This is needed because it creates an incentive for the fisherman to treat "his" lobster in the same economising manner he would treat other capital assets.

This biological condition, giving a property-zone allocation to every current lobster fisherman, would not be satisfied in the lobster fishery. One reason is that mature lobsters do move around somewhat. Another is that lobster larvae move around substantially while they are in their surface swimming stage. Thus to geographically enclose a specific stock would require very large zones, and this would make the initial allocation of zones to individuals impossible.

However, there are ways that non-specific stocks could be managed by territorial license-holders, although at a cost.

If the migration of adults and larvae across territorial limits was small relative to the stocks, strong incentives would still exist to manage the stock efficiently. For example, managers would still gain from letting "their" lobster grow to market size, even if some fraction spilled over to be caught by neighbours. Although economic theory tells us that reciprocal spillovers (lobster crossing in both directions) would not be managed as carefully or efficiently as would completely enclosed stocks, nevertheless, if the extent of the spillover were understood and the number of neighbours small, agreements and bargains could lead to those who were net gainers compensating those who were net losers for their

abstention from early harvesting of growing lobsters. Such cooperation or bargaining between small groups of neighbours could indeed, apart from the difficulty and cost of bargaining, lead to the same efficiency of management as if there were no migration of the stock across neighbours limits.

A special advantage, if migration were not excessive, would be in the relief of each fisherman from the need to "race" other fishermen for most of "his" lobster catch. (Under common property without rights of the kind being described here, much of the waste of labour and capital stems from the need for speed and capacity to forestall or anticipate catching by neighbours who have equal rights to each animal.)

The real test of the strength of reciprocal neighborliness or agreement would lie in the presence or absence of decisions to allow escapement for spawning purposes. The temptation to take all the stock, on the theory that all the eventual offspring would almost certainly either perish or mature in other fishermen's area, would be almost overwhelming. We do not believe that the rights described here would be adequate to create an incentive to encourage proper spawning escapement (in the absence of impermeable fences between adjoining areas). Instead, it would be necessary to have additional general regulations, or agreements or bargains between very large numbers of fishermen, to achieve adequate reproduction of each year class.

An informal geographic rights scheme does exist along the Cape Breton coast near Little River. The fishermen that we talked to in this area said that they made a better income than fishermen just down the coast. The fishermen operating within this scheme also said that most of them fish well below the maximum number of traps. Note that this area has a unique ocean topography,

being rocky for the first mile or two offshore and mud after that. Therefore, the lobsters are located very close to the shore. The geographic rights are defined in strips equivalent to the water frontages owned by the individuals. This method of demarcation would be less feasible in other regions, where administrative difficulties of keeping fishermen's areas distinct and their individual management of "their" stocks co-ordinated with that of their neighbours may be so great that the costs of attempting to do so may be greater than the benefits. In such regions, regulation can support and buttress weak property rights, for example to simplify negotiation for compensation, and to guarantee provision for spawning and growth.

The second sub-type of property-rights scheme is one under which individual fishermen have a right to harvest a specified portion of the stock in a large region, regardless of the location of the catch. Acknowledging that it is presently technically infeasible to emulate the management of common range lands, where shepherds and cattlemen can identify their own animals even though the flocks and herds graze together, a fisheries system has to be assigned instead to give to each participant an enforceable claim to catch and land a certain number of the joint stock of lobsters. Under this sub-type, extra agreements or regulations would be needed to make sure that fish grew to market size, were landed in seasons when their value was high and catching costs were low, and reproduced in amounts great enough to keep the common stock at optimum size.

Although monographs and scientific articles have set forth suggested characteristics of this sub-type of property system, we must make clear that the precise privileges and responsibilites specified in the "right" must differ from

fishery to fishery, both in response to different fishing conditions and different aims and alternatives of the fishermen and their communities.

With respect to lobsters, a workable basis for study, discussion, experiment and extension might be the following. In a region the bounderies of which had been determined, a total allowable catch (TAC) would be published. This number would be suggested by biologists and operators on the basis of both expected biological and expected market conditions. The TAC would be divided up into individual catch quotas. These quotas would be "rights", expressed as a number of lobsters to be taken by a licence holder during the coming season, or left as a percentage of the published TAC. As the season progressed, there would be revisions of the TAC, and these changes, up or down, would have to be passed through the system to become changes in the quotas to be caught by fishermen. (It has been suggested that the quotas assigned to each licence-holder, instead of being flexible, should be definite in amount, but adding up to, say, only a cautious 75 percent of the initial TAC. Near the season's end, there would usually be a large or small margin left over that could be shared out as a bonus on each licence-holder's seasonal quota. Many other ways of combining fisherman certainty and TAC flexibility can be devised.)

Ideally, the rights or portions of them would be marketable, for lease for a season, for a certain number of lobsters, or for permanent sale. Rights could be valid for a number of years, or in perpetuity. Normally they would be valid only within the demarcated region for which TAC has been published; but it is conceivable that fishermen and administrators could give this regional restrictiveness some year-to-year flexibility, on a reciprocal basis, or at a price. Because a lobster fishing right would be a private marketable, bankable,

asset, (like titles to land) its meaning and duration would have to be clearly understood and unchangeable without consent. But, as with land titles to unfenced neighbouring lands, owners could agree to change what is allowable, and what they decide need not be the same in all regions or periods.

There are serious problems involved in making this system work. Many of these problems are already inherent in the system of lobster regulation used today, but it is important in each lobster region to recognise them and decide whether they are serious enough to justify abandoning the rights approach.

The first problem is that any rights system is thirsty for information. The uncertainty about TAC, location, migration, reproduction, and growth now dealt with by opening and closing the fisheries and changing trap or vessel regulations, could not be dealt with so casually when each participant held a numerical right to part of the harvest. There would have to be more research into the demarcation of reliable natural stock areas, into larval migration from year to year, and into ways of posting or marking each fisherman's catch, and its timing location and size. This information would be necessary not only to keep order and allow peaceful harvesting, but also to help determine future rights and obligations of quota-holders in succeeding seasons.

The second problem concerns the capacity of a rights system to deal with "racing" for the lobsters at the opening of each local season. A guaranteed quota may not reassure many fishermen, who will reasonably argue that a lobster in the boat is worth several quota lobsters still in the water. Furthermore, fishermen will know that catching costs are lowest near in the opening days of the season, when the total stock is more abundant.

A third problem is that no economic incentive, other than consumer price, exists for efficient harvesting in the sense of allowing small lobster to grow to a more valuable size. To amplify the third point, a fisherman operating under a quota system who catches a market-sized lobster has no incentive to return that fish to the sea even if that lobster would be substantially more valuable after another year's growth. The reasons for this are that the individual fishermen must incur additional cost to fill this year's quota if he throws the lobster back whereas the extra returns from throwing it back will not accrue to him but will be spread among all fishermen.

If we reintroduce regulations to the property-rights system, it is not difficult to correct the above problems. The first problem, the incentive for fishermen to race could be reduced by making the quote time specific. For example, the season's quota could be given out on a weekly basis. The second problem could easily be avoided by continuing size limits and/or restrictions on gear (i.e., use of trap escape mechanisms).

Note that we have assumed that the TAC is set accurately and the fishermen believe that it is set correctly. If the fishermen don't have complete certainty in the accuracy of the TAC then there will be an incentive for the fisherman to ignore the opportunity to take his quota at his leisure, on his own timetable, and to get his quota while the fish are still there.

Under a quota scheme, protection and enforcement costs would persist. Catches will have to be checked against quotas, and buttressing regulations will have to be enforced as well. As with a regulatory approach, all such enforcement could be costly or even impossible, unless a substantial amount of cooperation and self-enforcement developed. Self-enforcement is most effective when experience convinces fishermen of the truth of what the administrators and

officials are claiming, that rule-breakers take money out of the pocket of their fellow-fishermen; and when example convinces them that the social and economic penalties of exposing or preventing the activities of cheaters and poachers are not great.

The above discussion of problems of a technical nature are mostly those encountered in keeping a property-right or tenure system going. Some of them would be worst at the outset (such as enforcement of catch quotas); and others would worsen as the stock grew, catches improved, and the rewards of stealing or lying increased.

The transition to a tenure, quota or rights system, however, would be most controversial when discussions and conferences dealt with the distributional question of how the rights should initially be shared out. This matter is discussed elsewhere, at length, in our report. The buy-back scheme is itself a means of initial share-out, chiefly of benefit to those persons or families in at the outset. Lotteries, auction sales, tendering, and sale of licenses (that is rights or tenures) are systems that have their supporters. Note too that there are factors other than the initial distribution of rights which will influence the ultimate distribution of wealth resultant from the use of resource. These factors include the availability of information on the future value of the resource right and efficiency of capital markets. Both of the above factors could bias the distribution of wealth away from the small lobster fishing interest unless appropriate government action were taken. The manner in which the wealth from the lobster resource is distributed is a crucial consideration with respect to the political acceptability of scheme as a whole.

Thus many issues, both technical and political, have to be discussed, understood, agreed and introduced before a private property rights scheme becomes a viable alternative to a multi-regulatory regime.

The other option to overcome the common-property problems of the resource is for the state to rely on its sole ownership of the resource to introduce detailed management of each segment as part of a Crown fish-producing public utility. The state would first have to choose between two types of public management. First, it could acquire any existing rights, and proceed to manage and conserve the lobster stocks by placing all necessary activities in the hands of state employees or departmental public servants. Fishermen would become like postmen, working for the government.

Second, the gcvernment could set up a Crown agency or authority for overall control, but subdivided into local Crown corporations or branches, with subtantial autonomy to make the best of the existing resource on behalf of the local economy and the in tune with the needs of the local communities. This approach could obviously be modified to permit a large degree of local participation in providing information, making decisions, and, as decided, sharing the profits.

Third, the government could set up local units to manage the fishermen on a rent-sharing basis, the local units to be independent of the crown, and having either exclusive tenure in perpetuity or for a fixed number of years. These managing bodies could be independent, such as specialising firms or cooperatives, or linked to local municipalities, parishes, fishermen's unions, or other social units. There is no reason to insist that the same type of "sole-ownership" structure should be used uniformly. Technical features like the length of the season, spawning locations and larval mobility, lobster migration, the size of the community, the availability of other catches and shore employments, and the national policy about excluding excessive fishermen

and sharing the resultant rents among the survivors, would all come into the decision. We would encourage the government to try out different types of managerial units with differing membership policies in different locations.

Whichever of these three types of sole ownership was employed, it would be important to make sure that spawning, protection and growth were taken into account as well as fair and efficient harvesting. Bodies that depended on government regulation for these functions would not be much if any improvement over the present buy-back scheme except in strengthening the motivation behind regulation enforcement except in three respects, neither of which may be essential for the lobster fishery. First, community or parochial sole ownership could greatly strengthen, and reduce the cost of regulation enforcement. This seems obvious, but sole-ownership should be kept in mind as the ultimate degree of deregulation, which resides in self-control and self-government.

Second, sole ownership would allow for great strides to be made in harvesting rationalisation and technological improvement. When the people whose new methods threaten the fish stock are the very people who "own" the fish stock, society need not worry that (in 99 percent of the cases), these owners will be tempted to push their catching power to the point of extinguishing the lobster resource. Self-interest and conservation become identical.

Third, harvesting can also benefit, in some locations, from despatching fisherman to certain areas so that the whole region under the organization's control will be most effectively worked over. Put otherwise, over-concentration of gear in the best known areas can be avoided. Information can be freely exchanged. Despatching is, so far, chiefly practiced in socialist-style economies' fisheries, as with taxi, truck, air and rail despatching, and by the fleets

working with factory ships. But, despatched fishing is a system that, with modern communications should be simple for sole ownerships to work out on a larger-than-one-vessel scale.

A final approach for the lobster fishery also requires that the state exercise its full ownership powers, but in this case as tax-collector and overlara, rather than as rent-collector and landlord.

In particular, the government could manipulate taxes and royalties, perhaps in harness with special regulations, to encourage optimal harvesting and even optimal escapement and spawning. In the abstract, we can picture a well-informed government setting a tax rate on each lobster landed, according to location, season, place caught, and size or quality, in such a way as to guide or induce the fishermen, collectively to put out the right amount of effort to achieve the highest return from the stock. The tax would lower the value of a lobster in the fisherman's hand and, in theory, induce fishermen to leave low-valued lobsters on the bottom if that is the most efficient move from an industry point of view. Once again the information requirements for setting such a tax would be dauntingly costly, as would the enforcement requirements. Taxes would have other problems. For example, at least initially, the tax would have to be high, which would create substantial incentives to evade the tax rather than cut the catch. In practice, the taxation approach in an over-crowded fishery would operate by decreasing the return from fishing and forcing some fishing effort out of the fishery. This would be unpopular with most primary harvesters as almost all would be losers, or break even, compared with a no-tax system. Most making a substantial amount of money would make less and those on the margin would be forced out.

A more politically acceptable approach to follow might be to cushion the taxation blow to the primary sector by implementing an effort limitation and effort buy-back program along with the landings taxation scheme. This program could be designed, by first increasing fishermen's incomes, to prevent them from being unduly squeezed and suffering under the subsequent application of the taxation scheme. This sequence raises the question whether the effort limitation and buy-back systems might not be undermined by substitution (and capital stuffing) before net income could increase enough to make the tax system tolerable. The timing involved in the introduction of the various elements, obviously, is crucial. The temporal relationship between input substitution and the ability of effort restricting programs to generate increasing net incomes will determine how successful this sequence would be in introducing a long range taxation approach.

A general statement would be the following. As effort has many dimensions the limitations of all dimensions is not possible. Therefore any increase in net income may be eroded through time as input substitution takes place. The individual fisherman perceives it in his interest to attempt to increase his personal fishing effort as increasing net incomes appear in the fishery through effort limitation. The individual fisherman acts in this manner so that he can capture an increased share of the net income available. Of course all fishermen acting in this manner will tend to dissipate any increased net income. The rate and the extent of the dissipation of net income is dependant on the substitution possibilities, between restricted and unrestricted elements of effort, over time.

Turning to the application of this statement to the lobster fishery, it is our perception that the known production technology in this industry provides only limited possibilities for rapid or early input substitution, especially in comparison to other fisheries such as salmon or herring. Therefore, it might be a candidate for the taxation type of regulatory alternative, supplemented by initial license limitation.

In concluding this discussion we must remind ourselves that rationalising the fishery, conserving the stock, and assisting the local community by stabilising employment and income, will not necessarily enrich the fishermen. The extent to which they gain arises from the details of the regulations or property rights selected in each area.

Improvement of the regulation of lobster fishing by any of the methods discussed here will lead to the expansion of the total rent, and its concentration as a surplus rather than in the incomes of un-needed gear, vessels, and man-hours. But a high licence fee, high prices for rights, high fines for violations, or high landing taxes or royalties, can leave many fishermen little better off than they are today. Those who discuss and negotiate the setting-up of improved regulatory or ownership schemes will have to take into account national policy, and local alternatives and incentives, in deciding how much rent is to go to fishermen and their communities.

It is already obvious that a complex of regulations allows open entry, dissipated rent and lowers fishermen's earnings. A rights scheme might end these problems, but wind up by handing over the rents to those who first held the rights, subsequent fishermen doing little more than working for a wage. Even the rights holders might not get their rent, if the rights were taxable by some sort of asset tax. As has been seen, a taxing scheme at the dock would take the rent out of the fishery as soon as it appeared, unless the rate were

set low enough: and then it could not be relied on to protect the stock and preserve the value of the fishery. For any new scheme to be acceptable the fishing industry must be convinced that the new scheme would make better use of the stock in the interest of all users and for themselves.

Footnotes

1 Lobster fishing is carried out in Prince Edward Island, Nova Scotia and New Brunswick as well as in Newfoundland and parts of Quebec. The Fishery makes a much larger contribution to the economies of the three Maritime Provinces than it does to Newfoundland and Quebec, and most of the on-going fisheries management policy discussion and policy implementation applies to the three smaller provinces. We shall concentrate our analysis on this area as well, although with minor qualifications the description of the Lobster Fishery which follows applies equally well to the Newfoundland and Quebec regions.

2 These very rough figures were obtained from the Department of Fisheries and Oceans in Halifax.

4 The buy-back program will be discussed in detail further on in the paper.

5 There are no closed seasons in the United States.

6 A. Gordon DeWolf, op. cit., p. 15. DeWolf has an excellent account of the history of lobster fishery regulations. See especially pages 15-28.

7 D. G. Wilder, Lobster Conservation in Canada, Rapp. P.V. Revn. Cons. Perm. Int. Explor. Mer, 156 (1965), p. 21.

8. DeWolf, op. cit., p. 17

9 DeWolf, op. cit., p. 26

10 Input limitations were adopted in segments of the Atlantic coast lobster fishery prior to the introduction of the Federal Government regulations in 1966. Trap limits were voluntarily adopted in 1942 in the Lismore, Nova Scotia area and have since been in force. Trap limits were applied in the Quebec lobster districts by the Quebec Government in 1949. Federal Government regulations to limit effort were considered as far back as 1913 when the Dominion Shellfish Fisheries Commission reviewed proposals but did not recommend adopting them.

11 A category C license was introduced at this time as well. It was designed to handle the case of some fishermen to whom A and B licenses did not apply and who acquired a registered vessel in a year subsequent to 1968. Category C licenses were not issued after the 1978 fishing season.

12 Lobster Fishery Regulations, section 9 (3).

13 Lobster Fishery Regulations, section 6 (2).

14 1979 Fisherman's Information, Fisheries and Marine Service, Halifax, p. 48.

15 However, while this biological information is interesting, it is by no means conclusive. Growth per unit of time has not been determined and in any case, it is likely to be very different in different areas.

16 The Sou'wester, Yarmouth, Nova Scotia, November 15, 1978, p. 17

18 Biologists have undertaken experiments with metal traps of the same design but results indicated no clear advantage over conventional wooden traps. However, wire mesh traps which are much lighter and more durable than wooden ones have become increasingly popular in Maine in recent years and are now being produced and used in limited quantities in the Yarmouth, Nova Scotia area.

19 From 1949 to 1955 a lath-spacing regulation with the same purpose in mind was instituted in the entire Atlantic region. However, the combination of fishermen's opposition to this requirement and general enforcement difficulties caused the regulation to be recinded in New Brunswick, Nova Scotia and Prince Edward Island although it has remained in effect in Newfoundland.

20 In an effort to encourage use of the device, the Prince Edward Island Department of Fisheries in 1979 offered up to 300 escape mechanisms free of charge to licensed Island lobster fishermen.

21 D.G. Wilder, "Regulation of the Lobster Fishery", The Canadian Fish Culturalist, vol. 22 (May 1958), p. 14.

22 The Sou'wester, Yarmouth, Nova Scotia, November 15, 1978, p. 17. The most likely explanation for inshore decline here is that kelp beds in the area have been eroded as a result of a marked increase in abundance of sea urching. The reasons for this are as yet unclear, but the relationship between changes in lobster stocks and kelp beds is under continuing investigation.

23 Lobster Fishery Regulations, section 3 (3).

24 D.B. McEachern, "Progress Report on the Trap Limit and License Control Survey, Maritimes and Newfoundland Lobster Fisheries," Economics Branch, Fisheries Service, Department of the Environment, Ottawa, 1969, p.36.

25 Each trap fished requires and identifying metal tag provided by the Department of Fisheries.

26 Restriction of the number of trap hauls (the act of lifting, emptying rebaiting and replacing a trap) permitted would be a more precise effort reducing measure but one impossible to enforce.

Fishing boat size and engine horse power rating influence effective harvesting effort as well. Such regulations have not been adopted in the lobster fishery to date and because they are essentially inefficiency creating measures they are not a recommended management option.

27 The Sou'wester, Yarmouth, Nova Scotia, January 1, 1979. p. 12.