# The Fisheries and Science

By D. B. FINN

IN a world of complex industries, perhaps one of the most complex is the fishing industry. The very nature of its products, and the men who get them, make it so. Perhaps no other industry has for so long withstood modernization or rationalization or even co-operation. The fishermen who are the primary producers are individualists who not only risk their lives daily in pursuit of their calling but are prepared to suffer economic hardships in order to keep at it. They are peculiarly fitted by temperament and training for their jobs and possess qualities of character which would make it difficult, if not impossible, for them to successfully engage in other activities.

The supply of raw material to the industry is extremely inconstant for not only is it seasonal in abundance but the amount caught is constantly influenced by wind, wave, tide and temperature. The mackerel, the herring, the smelt, the salmon and even the cod, to mention only a few, are migratory and are only caught at one or other stage of their migration. Added to this are the elements which make fishing either impossible or supremely possible. Together these two things cause the supply of fish to continually fluctuate between a condition of glut and one of scarcity. It would be easier for the industry to accommodate itself to this condition if it were at all predictable, but so far this is not possible although the indications are that it will be so, if enough study is given to the problem. Continuity of supply, which is so important to modern methods of marketing, is thus denied the industry and constitutes one of its most grevious problems.

Another factor which adds to the complexity of the situation is the extremely perishable nature of fisheries products. Unlike the meat industry it cannot bring its raw material "on the hoof" to the manufactory and keep it until it is needed, but must pack it in ice, transport it by water and process it immediately. Whereas beef is not considered fit to eat until it has been hung for a sufficient length of time, usually ten days, unprocessed fish, if it is to be fresh, must be sold and consumed before this time has elapsed, and, the largest proportion of fish is consumed in the unprocessed state. This limited period has the effect of increasing difficulties in catering to far distant markets and thus cuts down consumption.

This, of course does not apply to those products that are preserved in such a manner as to enable them to withstand long periods of storage, such as canned or heavier salted products. But here we find that the industry is largely dependent upon export markets the availability of which is determined to a large extent by trade agreements, currency fluctuations and the political and economic equilibrium in the country to which the exports are made. Such factors are beyond the direct control of the industry no matter what its internal state of perfection may be, the other difficulties are to a large extent internal and thus are amenable to proper application of knowledge.

Thus science is presented with two important problems which may be framed in two general questions. How can the supply of fish be made more continuous and more uniform, and how should the raw materials be preserved and used after they have been caught? Both problems arise from the necessity for better management, for better mastery over this natural resource. Both must depend upon scientific effort for solution. Hence it is here that science is influencing fisheries economy.

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The first problem, that of continuity and uniformity of supply may be divided into a number of others, each dealing with a certain phase of the general problem. Thus we have the effect of migration, the effect of depletion through fishing effort, the effect of oceanographical conditions on the presence or absence of fish, and the effect of weather upon man's ability to catch them. All these can be measured and where they cannot be brought under control they can at least be predicted which is the aim of the scientist.

In Canada the biologists of the Fisheries Research Board are engaged in studying the migration of fish by catching the living fish, marking it by means of a numbered metal tag and liberating it. Subsequently some of these are caught and the location of capture recorded. It has been found that the cod, which is not usually regarded as a migrating fish does move regularly from place to place in the sea every year. Therefore a place which may furnish good fishing at one time of the year may fail to do so at another. Moreover it seems that the cod family consists of several races, so to speak, just as the human species do. Each of these races may have different habits of movement which makes the task of recording migration the more difficult. Unfortunately the study of movements of fish is a difficult one since they cannot be directly observed and recourse has to be made to the indirect tagging method. Through the years, however, this is revealing the story, which, when it is completely told, will enable fishermen to know where they may expect fish at any time during the year.

It is not yet definitely known why fish migrate but the evidence points to water temperatures as being of very great influence. Cod are most plentiful in water which is in the neighbourhood of from 34°F. to 36.5°F. while haddock seems to favour water from 38.3°F. to 41°F. Oceanographers have found out that the temperatures of the sea are determined by the currents of warm and cold bodies of water such as the Gulf Stream and the Arctic Current. Further they have shown that these currents do not mix haphazardly, but in well defined stratifications. Thus the water of the ocean is made up of several moving layers of water—the coldest not always being on the bottom. These movements appear to be cyclic but are also influenced by the winds, the tides and the atmospheric pressures above the sea. Thus the factors affecting temperature, and therefore fish, are many and varied and so it is important that oceanographers, biologists and meteorologists, the world over, continue their efforts so that they may be able, eventually, to predict these variations, and thus remove some of the guess work from fishing.

There is another very important contribution which the biologist is making, that of determining the effect of fishing effort upon depletion and, when necessary, finding out what must be done in order to maintain the numbers of fish at an economic level. They believe that this is not a serious problem with such fish as the herring, cod and others because they reproduce fast enough to withstand depletion. With others, such as the lobster, salmon, halibut and haddock it is a very serious problem because they are not able to stand more than a certain intensity of fishing.

The study of such a problem is also very complicated because there are so many factors which influence depletion. For instance it is difficult to estimate the degree of depletion in any one place, whether, if there is, it is due to migration, or disease or absence of food, or whether it is simply due to depletion through failure to breed fast enough—more of the sexually mature animals having been caught than should have been. It takes years of time to properly elucidate such a matter, but, it is essential that it should be done, in order that intelligent regulation may be had, which, together with fore-knowledge of fishing conditions, will do much to bring about a continuity and uniformity of supply.

Supply of raw materials is however only half the problem with which science

is dealing. The other half is how to treat them when once they have been obtained, that is, how to preserve fish until they are consumed. The ideal preservative is one that would keep fish in exactly the same condition as they were in, when they first came from the water, for an indefinite period. Canning, smoking, salting and pickling, the familiar methods, all depend for their action upon some change in the nature of the product. In other words a canned, or smoked, or salted fish is never mistaken for an untreated fresh fish. Some detectable change has occurred by which they are easily distinguished. The nearest approach to the ideal preservative is obtained by simply lowering the temperature. Decomposition is a chemical change and it is true of chemical changes that the lower the temperature the slower they are. It is found that in the neighbourhood of -10°F. the change in fish is so slow as to be scarcely detectable, and, providing the fish are quickly reduced to this temperature and stored at it out of contact with the air, the thawed-out product is more like a fresh untreated fish than that preserved by any other means. It is in fact better than unfrozen fish unless the latter are consumed very soon after catching, and this is more difficult to accomplish the more distant the market.

When this knowledge is allowed to have its full effect it will be possible to save the product during times of plenty for use during times of scarcity. However there is still much to be done before this can be fully realized, but most of the difficulty in bringing it about is not technical—it is commercial.

Perfected technology in an industry usually means the employment of machinery and other expensive devices. Moreover it implies that proper control over the quality of the product be exercised from the raw state until it reaches the hand of the consumer. For these reasons the application of science to the fishing industry is making for centralization rather than decentralization. It is a much more difficult thing for, let us say, one hundred small businesses with little capital to bring about adequate improvement than it is for ten large ones with a correspondingly larger amount of capital. The smaller business units not only lack the capital to bring about improvement but they lack the influence and bargaining power to deal with the large purchasing organization, such as the chain store, which by virtue of its tremendous buying power is in a position to dictate to any but the very largest of producers.

This tendency towards centralization of the industry furnishes science with another problem, that of finding fisheries commodities which may be produced by outlying fishing populations whose means of subsistence is fishing. Efforts are being made to bring about greater utilization of canneries, which are ordinarily used only for a short time during the year for the canning of lobster. New products are being experimented with which may be manufactured on a small scale. Old products must be improved by newer methods. But even if the technical problems are solved, and it is reasonable to suppose that they will be, the principal problem is one of finding a market for these goods. It is here that the establishment of the co-operative movements amongst the fishermen seems to be furnishing a way out for it provides the method of unification and co-ordination which is necessary.

These are some of the ways in which science is affecting the part which fisheries plays in national economy. As I have tried to show, new knowledge is making possible new methods which will inevitably displace the older ones with a consequent change in some of our ways of living. These changes will occur gradually and we shall most probably accommodate ourselves to them. As an aim we should strive to reach and maintain that balance where the people dependent on the industry can secure a proper livelihood when the price of fish bears the proper relationship to that of other food commodities, while at the same time, the raw materials are reproducing fast enough to withstand the demands made upon them.

In summing up the answers to question 2, therefore, we find that a few large items, particularly flour, corn, tropical fruits and vegetables, which constitute an annual cost of from $4,000,000 to $5,000,000, cannot be successfully produced in this province. Half of the $4,000,000 spent for dressed meats is made up of fresh beef. Only a portion of this product could probably be successfully produced by Nova Scotia farmers. The other items for pork could no doubt be met by efficient production and marketing. With butter, poultry and eggs there is a large field and this situation is gradually being met by producers.

The answer to Question No. 3, while the most important, is no doubt the most difficult. To state that Nova Scotia annually imports a large quantity of food stuffs and that because of this farmers here should produce these, will not remedy the situation. There must be constructive thinking and constructive programs. One program alone will not be sufficient. If, however, one were asked to give one remedy only to meet the situation, the writer is of the opinion that the answer would be "improved soil management and fertility."

The major products which probably could be produced here are grain and grain products for live stock feeding, certain dressed meats, butter, poultry and eggs. The cost of feed is the biggest item in "cost of production" with live stock production. We have in Nova Scotia conditions suitable for producing economically, high class pastures, large crops of hay and excellent crops of roots. Today the majority of the farmers are making a fair success in connection with these items. Their big costs are for grain and grain products purchased. If the soil were improved by judicious use of lime, more efficient fertilization, coupled with crop rotation and the use of good seed, the yield per acre could be greatly increased. This is especially true in connection with grain. At present Nova Scotia produces annually around 90,000 acres of oats, 10,000 acres of barley and 7,000 acres of mixed grains. The average production per acre on the bushel basis for the past five years for these crops is 33.8, 27.4 and 32.7 respectively. These yields, while quite comparable to yields in other provinces in Eastern Canada, are pathetically low. By better soil management and general improved crop production, the yield of these grains on the present acreage could be increased ten bushels per acre. This would result in an annual increased production of close to 20,000 tons of live stock feed. This would represent at least half of the present purchases and greatly improve the production costs. This therefore seems like the logical method to follow in increasing total grain produced and decreasing annual importations.

When yields have been brought to a higher level it would then be very practical to slightly increase the acreage in each farm. Yields per acre, however, cannot be increased overnight. Soils must be built up and this is a costly and slow process. Many yields at the present time are low because of inadequate drainage. Considerable land is not producing satisfactorily because the soil is sour. The application of limestone would remedy this situation. The average cost of this, however, would amount to over $6.00 per acre, which is a large item. Individual farmers throughout the province, however, realize the necessity for action in this regard and are making their plans accordingly. The main drawback is lack of finances.

In connection with the production of hogs, it has already been pointed out that considerable progress has been made along this line. Farmers in many areas are endeavoring to turn off each year two bacon hogs for each dairy cow maintained. Cooperative live stock shipping, with sales made on the live, graded basis, have materially assisted in bringing this about. Three times as many hogs were marketed thus up to date in 1937 compared with the corresponding period of 1936. With better production the tendency is upward. The quality of the breeding stock is fairly high.

Statistics show that there are 114,000 dairy cows owned in the province. Ap-

proximately three quarters of these are producing milk for butter production, the balance catering to the fresh milk trade. An increase of 50 lbs. of butterfat per cow each year would be sufficient to meet the annual importations. The low production of butterfat per cow is at present largely due to inadequate feeding rather than inferior breeding. Increased crop production per acre and per farm will remedy this situation.

Real strides have been made in poultry and egg production. Each year the quantity of imports is decreasing. Probably poultry presents one of the best examples of what can be accomplished in a short period of time by a constructive program in breeding, feeding and marketing. Poultry producers in Nova Scotia have complained for many years that they have found it difficult to satisfactorily market their dressed poultry each fall. They contended that it was difficult for them to find a market that would take their product in volume and pay a price comparable to what the imported product was realizing. They also contended that the existing system of purchasing on a flat rate with no differentials for quality was not conducive to improvement. With the view of remedying this situation, poultry associations were organized in a number of sections of the province. Instruction was given in a number of matters including breeding, feeding, care and management, finishing and dressing. At the end of the season the birds were brought together at a central grading house where the poultry was graded, packed in an up to date manner and offered for sale to the wholesale trade. Under this pool system some 9,000 lbs. were marketed in 1934; 12,000 in 1935; 42,000 in 1936; and it is estimated that 100,000 will be marketed under this system in 1937.

These figures indicate a fair gain.

The figures covering improvement in quality are even more outstanding. In 1934, 25% of the birds were placed in the first grade, and 41% in the third or lowest grade; but in 1936, 60% were in the first grade and 10% in the third grade, which clearly indicates the necessity of sale and purchase on a graded basis. Farmers cannot be expected to improve quality if the resulting improved product, which has entailed increased labor and expense, does not bring an increased price over an average or a low grade product.

This year, Nova Scotia graded poultry is a factor in Nova Scotia markets. Producers are selling their products at a price comparable to the imported product and farmers have been encouraged to increase and improve their flocks. If the present rate of gain continues, Nova Scotia will shortly be not only able to produce her own requirements but have a certain quantity for export.

In the foregoing, the writer has merely dealt with some of the highlights in connection with the general question of making the province agriculturally self sufficient. He has not endeavored to deal with the broader picture of balancing importations against exports. All sections of Canada are not equally fitted for the producing of the same kind of crops. Nova Scotia has no peers in the production of many other agricultural commodities, particularly apples, potatoes, vegetables, hay and pasturage. The annual value of the exported apple crop alone amounts to around $5,000,000. This at least would neutralize importations of flour.

The greatest improvement in meeting the present situation has been brought about through farmers working collectively on a community basis. The problem must be first met by improving the soil. As this improves, production costs will lower and if these activities are associated with a sound marketing policy, with payment to the producer on a graded basis, production will gradually increase to a point where we become agriculturally self sufficient. Such production, however, will not preclude the importation of certain agricultural products which other sections of Canada or other countries are in a better position to produce, but it is hoped that the production can be increased to a point where the net exports will be greater than the net imports.