A COMPARATIVE APPROACH TO DECISION-MAKING: RISK-TAKING BY FISHING BOAT CAPTAINS IN TWO CANADIAN FLEETS

by

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ABSTRACT

This thesis is concerned with a number of important issues in economic anthropology. Substantively, it focuses on explaining differences in the production strategies of commercial fishing captains in two Canadian fleets. At a more general level, it explicates a methodology for formal model development from ethnographic description.

During a study of deepsea fishing in Newfoundland, I discovered that captains differed in their risk-taking when trying to locate fish resources. By using certain conclusions from the literature on decision-making in economics and psychology, I was able to build a model of the fishing situation which accounted for the observed differences in fishing strategies.

The next step in the research process was to take this model and transform it into a more general one which would have predictive power in other contexts. Three important dimensions of a decision-maker's situation were taken from the Newfoundland model- information, capability, and motivation). The dimensions were combined to generate twelve hypotheses about risk-taking.

The general model and six of the hypotheses were tested in the Alert Bay, British Columbia, seiner fleet.

Quantitative data was collected by participant observation on the boats. The data allowed me to accept five of the hypotheses, and reject one.

In addition to making and testing certain conclusions about risk-taking by fishing captains, the thesis demonstrated that a situationally specific model can be used for comparative research. Such a model can be transformed into a more rigorous one which can be used predictively in other contexts.

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especially with the assumptions about equal weighting and additive relations between components of the model.

INTRODUCTION

This thesis is concerned with the problem of decision-making at two levels. Substantively, it will focus on the productive strategies of commercial fishing captains in two Canadian fleets. At a more general level, it will attempt to develop a methodology for the analysis and explanation of risk-taking in competitive situations.

My interest in the substantive problem occurred after making two trips on Fortune, Newfoundland, deepsea trawlers. Although faced with the same problems of locating and catching fish, the two captains differed markedly in their fishing strategies. Analysis of their decisions indicated that their risk-taking differed significantly.

While trying to account for the differences in risk, I discovered a more general problem. The literature on decision-making in anthropology did not suggest a well developed methodology. It was evident that in order to handle the substantive problem, such a methodology had to be included within the scope of the study.

Before outlining the approach to be used, it will be necessary to look at the reasons for doing this research. This will involve a general statement about fishing as a substantive area, and the relevance of decision-making to economic anthropology.

A. Fishing as a Productive Activity

Standard classifications of economies, using the criterion of production, have referred to five basic systems - hunting and gathering, herding, horticulture, agriculture, and industry (Bohannan,1963:212-219). The fact that some societies exploit a marine resource is generally overlooked. Certain of these societies, such as the Northwest Coast Indians, can be classified as fishing peoples since marine species are their primary source of subsistance (Forde,1963: 69-100).

Since fishing involves the exploitation of a marine environment, there are often special forms of technology, social organization, and production problems. Firth's analysis of the Malay fishermen (1965) points out a number of differences between peasant fishermen and farmers in the same geographic and cultural area. Equipment such as boats and nets is more open to damage and loss, therefore requires greater capital risk. Unlike farmers, the fishermen work in production units comprised only of men. Fish yields are normally on a daily rather than seasonal basis, which has implications for planning and co-operation.

Short term planning has been used by a number of anthropologists besides Firth to characterize fishing as a productive activity (Davenport,1960; Foreman,1966; Wadel, 1969b). However, a sample of sixty societies which engage in fishing, taken from the Human Relations Area Files, indicates that it is applicable only to certain types of fishing.[1]

Aquaculture tends not to require short term planning due to the method of catching fish. Among the Ifugao, for example, fish are raised along with wet crops. When the land is drained, the fish are collected at one time. The same pattern exists in Czechoslovakia, though fish are rotated with crops. When farm land is put to fallow, it is flooded and stocked with fish. Little else is done until the land is drained and the fish can be collected.

Although gathering of marine species is generally a short term project, it requires little planning. Gathering is normally limited to intertidal species such as shellfish and seaweeds. Occasionally, vertebrate species are collected (either through poisoning or tides), but again there is no need for search or major co-operation.

Trapping fish involves the placement of barriers in locations where fish are expected to travel. Generally this technique is limited to species having predictable movements or to environments which restrict travel (streams and narrow rivers). Trapping can be either active or passive. Active trapping involves the use of movable traps in order to exploit a range of possible fish locations. Passive trapping uses fixed traps in areas of restricted movement. As far as the actual exploitation is concerned, short term planning is much more important in active trapping since there is a range

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[1]See Appendix A for a list of societies in the sample.

of choice and varying yields from any one location.

The hunting of fish requires a more active search for species. The equipment used in hunting (harpoons, bows, spears, nets) require actually locating fish. In order to hunt effectively, frequent decisions must be made and a high degree of mobility is needed.

From the HRAF sample, it would seem that the importance of short term planning depends upon the technology used. In aquaculture, gathering, and fixed trapping the location of fish is not problematic. Without the necessity of finding fish, frequent decisions about how and where equipment will be used are not required. With active trapping and hunting, however, locating fish or productive spots is important.

The importance of short term planning in active trapping and hunting of fish is not restricted to traditional contexts. The use of capital intensive equipment in modern commercial fishing has not markedly decreased the need for frequent decision-making in order to exploit the resource (Wadel,1969b). At a general level then, the analysis of fishing strategies in the Canadian commercial fisheries can lead to an understanding of a problem which characterizes certain types of fishing.

B. The Decision-Making Problem

The importance of decision-making as a problem area is not restricted to an understanding of fishing. Some economic anthropologists such as Firth (1951:125) see it as the subject matter of the discipline, "However defined, economics thus deals with the implications of human choice, with the results of decisions."[2]

This definition of the subject matter has a number of implications. First, it increases the scope of economic anthropology by eliminating the distinction between 'economic' and 'noneconomic' action (Belshaw, 1965:4-6; LeClaire,1968: 190). Second, it means that distinctions between market and non-market contexts are not as important (Cook,1968:221-223). The focus on choice means studying an aspect of all human action, and allows for the possibility of developing general theories of action.

In opposition to this approach, substantivists such as Dalton (1961:20) hold that such general theories cannot be developed. Although substantivists have not been explicitly concerned with the problem of choice per se, their argument implies that decision theories would be restricted in generalization. Theories concerned with 'material' wants would not be applicable to 'non-material' wants, and theories about choice in market contexts would not apply to non-markets (Arensburg,1957:110; Polyani,1957:248; Dalton,1968:143-167). Their argument rests on the assumptions that material/non-material and market/non-market involves different sets of constraints. Factors such as the existence of all-purpose

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[2]See also Herskovits,1952:45-46; Belshaw,1965:4-6; and Burling,1968:179.

money and contractual relations create types of situations which differ in kind, not degree (Dalton,1968:163).

The substantivist criticism does not imply that an explanation of differences in fishing strategies cannot be found. What it means is that there must be restrictions on the explanatory variables used, and the range of generalization. It implies that theories and models concerned with non-material and non-market choices cannot be applied to the problem; and that any explanation developed cannot be generalized to non-material/non-market choice.

The substantivist position can be rejected on a number of grounds. First, there are no a priori reasons for assuming that their distinctions (market/nonmarket, material/nonmaterial) are relevant. As Burling has stated (1968:184):

> "It (economics) would study an aspect of behavior, not a type of behavior, and it would be an aspect of behavior that has no more connection with the material aspects of behavior than with others, and no necessary connection with objects that are priced in our society."

Second, there are no reasons for assuming that the aim of economic anthropology should be the discovery of 'differences' as implied by Dalton (1968:153). Rather, Cook's position (1968:221-223) that the goal of the discipline should be the development of general theories seems more in keeping with scientific endeavour.

A more damning criticism of existing models of choice is that they have little predictive value. Kogan and Wallach's review of models of choice in psychology and economics shows that their predictive powers are little better than one would get by flipping a coin (1967:118). Similarly, Cohen (1967:104-108) states that theories of choice in the current literature are little more than tautologies given the assumption of maximization of goals. Such theories end up showing that any choice maximizes some goal, but cannot specify why one goal is more important to the decision-maker than others.

In the recent literature on decision-making, a suggestion has been made which may overcome the lack of explanatory and predictive power of existing models and theories. Ortiz (1967:197) and Kogan and Wallach (1967) suggest that existing explanations of choice have been problematic due to looking at choice 'in vacuo'. Rather than attempting to discover what is being maximized by a decision, they suggest also focussing on situational factors influencing choice. As Ortiz has stated (1967,197):

> "I suggest that the set of factors taken into account are determined not solely by the information available, the personnel making the decision, aspiration levels, the expectation of outcomes, the outcome itself, and the level of uncertainty, but by the structure of the situation which will define when and how these decisions are taken."

Incorporating this suggestion into the formalist orientation appears to be a useful approach. It gives a new direction for the development of general theories of choice, which should be applicable to the fishing problem. Also, it implies that any explanation made for the differences in fishing strategies analysed in the thesis may be relevant to the wider interests of the discipline.

C. The Approach to be Used

The substantive problem of differences in fishing strategies will be dealt with by focussing the element of risk involved. As Davenport (1960) states, this is the crucial aspect of catching fish given a range of alternatives differing in cost and pay-off. Following Kozelka (1969), the analysis will be made using a decision theoretical framework rather than game theoretical. The decision framework will be used since it does not require making assumptions about nature as an opponent. As Savage (1954) has pointed out, the notion of a malevolent nature is untenable.

In order to develop an explanation which may have a wider range of generalization, it will be assumed that the risk-taking of captains is no different from risks taken by other individuals, since they all refer to choices under conditions of uncertainty (Arrow,1951:404). This assumption allows me to test conclusions made about risk-taking in other contexts such as gambling experiments. At the same time, it also allows me to check my interpretations against other findings.

Since the ultimate goal is the development of a model which is more than ex post facto in nature, it must have predictive power. It will be assumed that a model which has explanatory power for the Fortune situation will also be able to account for risk-taking in other fishing contexts. This means that the 'logic' which is inductively derived to explain one case can be deductively extended to fit another case.

Given these concerns, the thesis will be organized in the following way: (1) an analysis of the Fortune context to determine factors differentially influencing the risk-taking of trawler captains.

(2) the development of a model which integrates these factors at a more general level so that predictions can be made for other fishing contexts.

(3) an analysis and test of predictions in the Alert Bay, British Columbia, seiner fleet.

(4) a conclusion about the implications of the approach for an understanding of the substantive problem, and decision-making in general.

CHAPTER I

FORTUNE NEWFOUNDLAND

In this chapter, the major setting factors for the research problem will be given. An understanding of fishing strategies requires a general overview of the occupational context. Although the primary aim is to de-limit those factors which appear to be relevant for the problem of differences in risk-taking, it will also be useful to look at the development of the modern commercial fisheries in Fortune, and its implications for fishermen's life styles in the community.[3]

A. Historical Background

Fortune is situated at the northwest tip of the Burin Peninsula, Newfoundland. Its location is ideally suited for a fish-based economy. The harbour is well protected, having a tidal estuary capable of handling vessels up to 4,000 tons. The climate is relatively mild, making the port ice-free. Finally, it is near a number of offshore fishing areas - the most important being the Grand Banks, St. Pierre Banks, and

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[3]This research was done in the summer of 1968 under the supervision of Dr. R. Andersen, and was sponsored by the Institute of Social and Economic Research, Memorial University, St. John's, Newfoundland.

the Gulf of St. Lawrence.

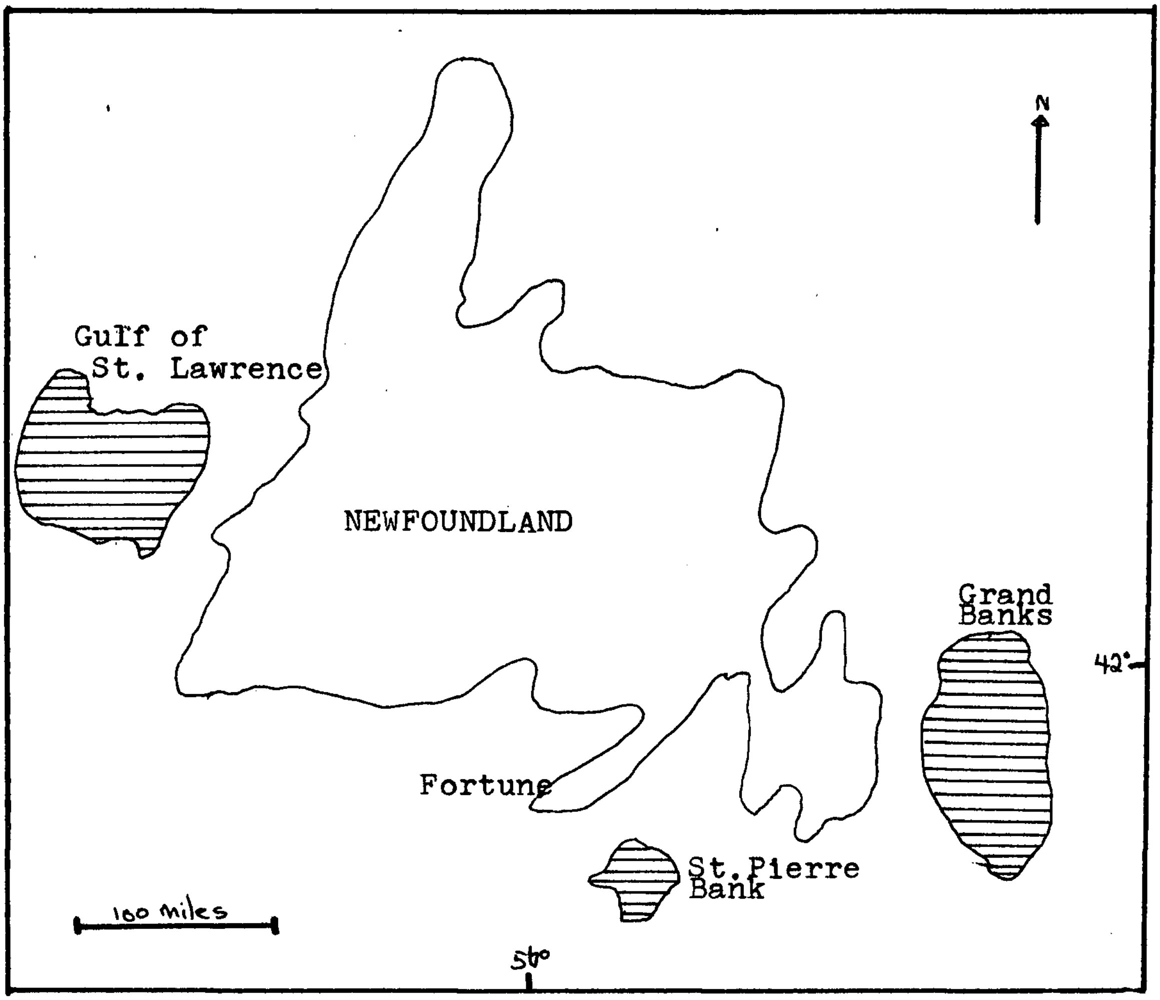

Figure 1: Map of Newfoundland and major fishing areas.

Since its settlement in 1811, Fortune's history has been closely tied to the North American fishing industry, especially to market demands. Until the 1950s, Fortune was involved with the salt cod market in the United States and the Mediterranean countries (Gerhardsen & Gertenbach,1949:66-69).

Fishing was done by individual fishermen using hand-lines and dories. In order to fish the offshore banks, this type of fishing required the services of larger vessels (the banking schooner) capable of carrying men and dories plus providing storage space for the fish.

These schooners were owned by local merchants who were in a patron-client relationship with the fishermen. The basis for this relationship was a capital-credit/labour-debt system. The banking schooners required a large capital investment which the fishermen could not afford. Second, the marketing of salt fish only occurred once or twice a year, which meant long periods without cash income. The merchants' capital permitted them to own the schooners and extend credit. In return they received the right to market the fishermen's catch. This form of transaction between merchant and fisherman generally lasted over generations, and seldom involved the exchange of cash (Wadel,1969a:16-22).

The banking schooner era ended with the development of new preservation techniques and more rapid means of transportation. By 1955, the demand for salt cod on the United States market was replaced by fresh and frozen fish.

The frozen fish market required large volumes of catch in order to offset the capital investment in the new forms of processing. The volumes needed could not be supplied by the banking schooner and handlining technique. Without the necessary capital for frozen fish processing and more efficient means of catching fish, the merchant control of the industry declined and was finally replaced by outside firms.

The contemporary era of Fortune fishing was a result of two factors - the interest of American firms in establishing plants in Newfoundland, and the start of a government programme concerned with industrial development.

American firms were interested in Newfoundland for a number of reasons. First, they would be closer to the major fishing grounds. This was important since it meant less non-productive time for its boats, and fresher fish. Second, wages in Newfoundland were lower than in the United States. Third, the provincial government was willing to grant foreign firms concessions in taxation.

At the same time, the provincial government was interested in modernizing its economy. Their plan was to move its rural population to larger centers which had more growth potential and could provide the necessary services and labour force to attract new industry (Wadel,1969a:126-130; Meninskai, 1969).

In the early 1950s, Fortune was designated as a growth center because of its natural advantages. An American firm, Booth Fisheries, established a modern processing plant in the community, and the era of the deepsea trawler began.

The provincial government's policy had a number of implications for the Fortune fisherman. First, it did not increase occupational alternatives in the community. Fortune was designated as a fisheries growth center which meant continuation of a single industrial base. At the same time, however, local control over production and marketing was replaced by foreign control. The paternalistic merchant/fisherman relationship, with its built-in economic security, ceased. In its place came wage labour involvement and a cash economy with low security and low control for the individual fisherman.

B. The Contemporary Community

By 1968, the population of Fortune had increased from 1200 in 1954 to 1680. Although the population figures do not show it, much of the increase was due to migration from nearby 'outports' after Fortune was designated as a fisheries growth center. Within the fourteen year period, over 100 families moved into the community - attracted by government re-location grants and job opportunities.

An interesting distinction between land and sea based sectors of the fishing industry was evident in that none of the fishermen were natives of Fortune. Part of the reason for in-migrants dominating on the boats was that the necessary skills for deepsea trawling did not exist in the community. Virtually all of the early immigrants had prior experience on trawlers, either in the United States or in Nova Scotia. Another reason was that the distinction between land and boat work soon took on status and reference group connotations.

Since deepsea fishing requires extended periods of separation from the community, differences between the life styles of fishermen and shore workers occurred. In general, it seemed that fishermen were much less involved in community affairs. With the exception of membership in the Canadian Legion, the only drinking place in town, fishermen did not belong to any of the voluntary organizations in the area. Similarly, no fisherman had held, or run for, public office.

Extended separation from the community also affected fishermen's families. Wives were responsible for virtually all of the activities in the family. They often complained that their husbands refused to accept any responsibility for child rearing. All of the wives interviewed stated that their husbands were overly permissive with the children, and disrupted household routines. One wife, when asked if she would prefer her husband to work ashore said, "Lord no. He'd just be under foot all day and I couldn't get anything done."

Observation of the crews that I fished with indicated a general pattern while in port. The normal arrival time was early morning. The crew would go home immediately, and stay with their families until early afternoon. By two P.M., most of the crew would be in the Legion Hall, where they would stay until supper time. Evenings followed the same pattern, with most of the crew drinking and talking about the last trip. Pressures were put on crew that did not visit the Legion. They were expected to have a good reason for not showing up, and were kidded about being 'henpecked'.

Shore workers considered fishermen to be 'high spenders', and drinkers. The fact that fishermen got shares rather than wages meant considerable fluxuations in income. When shares were high, fishermen tended to spend heavily on presents for their family and on drinking. This gave them a reputation among shore workers as being extravagent and irresponsible with their money.

The factors of being outsiders in the community, coupled with differences in life style contributed to making fishermen members of an occupational sub-culture in Fortune. Over two-thirds of their time was spent at sea, which further isolated them from their community. It will be seen later that an understanding of fishing as an occupation, and the problem of fishing strategies, can be understood without reference to the wider community. The boat, the natural environment, and the fleet structure can be seen as the major parameters for the research problem due to this isolation from the land.

C. The Processing Plant and Problems of Co-ordination

As a part of Booth Fisheries move into Fortune, the company built a processing plant to handle the fish input of their trawlers. The plant consists of four functional areas: cutting room, storage facilities, freezers, and fishmeal converters. Processing starts with the unloading of the boats, and storage of fish in iced pens. The fish are then taken into the cutting room where they are fileted by hand. Filets are skinned, packaged and quick frozen. The waste, or offal, is carried to the fishmeal grinders and cookers by conveyor where it is converted into fertilizer.

Regulation of fish intake is the most crucial problem for the plant since it involves co-ordination of boats, production facilities, and plant labour force. Fish cannot be stored for more than a few days, hence regulation of input is vital. Without such regulation, 'glut' periods would frequently occur - which would necessitate overtime work and increase chances for fish spoilage.

One of the policies instituted by the company to ensure stable fish inputs was a required 'daily hail' by each boat. The purpose of the 'hail' was to find out each boat's total fish catch so that landing dates could be co-ordinated. Without this information, management felt that production could not be controlled.

The requirement for co-ordinated landings based on daily hail information led to conflicts between the plant and the boats. The ideal situation for the boats was to remain at sea until full. Scheduled landings frequently did not allow this to happen. Boats were called in early to avoid 'gluts' and concomitant problems with labour and spoilage.

Given this conflict in goals, captains normally distorted their daily hails. The distortion gave captains more control over landing dates, and allowed them to maximize time at sea. The strategy used by captains was to under-estimate their totals, unless they were near capacity.

Under-estimation was general enough to have become institutionalized. The plant manager operated as if the captains always lied, "I add 50,000 pounds to whatever they say after the second day out." To test this, I asked the manager to keep a record of actual hails and his estimates of what was on board for the two trips that I made on trawlers. As the table in Appendix B indicates, even the 50,000 pound error factor did not provide the manager with accurate tallies.

During the summer months, the co-ordination problem was most severe. The plant bought fish from inshore fishermen in nearby outports, as well as from its own deepsea boats. On three occasions in the summer of 1968, conflict occurred over which source should be given priority. On one hand, the plant was obliged to take fish from its own boats. On the other, it was one of the two nearby markets for inshore fishermen, many of whom were in debt to the company for their boats and gear.

For the fishermen, this conflict in interest creates problems. As will be shown later, virtually all of the rewards from fishing are determined by performance measured in total landed catch. The fact that a boat could be called in early in order to regulate shore production means that performance and rewards can be affected. Uncertainty about time at sea puts additional strains on the captain and the importance of decision-making vis-a-vis his boat's catch.

D. The Deepsea Trawlers

As previously mentioned, handlining from dories could not supply the volume of fish needed for the fresh and frozen fish market. Neither could the traps used by the inshore fishermen due to the short periods of cod migration to the coast. Booth Fisheries' solution was the introduction of the deepsea trawler, a vessel capable of fishing the offshore banks on a year around basis. By 1968, the Fortune fleet consisted of six such boats - four of the older side trawlers, and two modern stern trawlers.

Both the side and stern trawler used the same fishing technique. The basic piece of equipment is the otter trawl, shown in Figure 2. The otter trawl is adapted for species

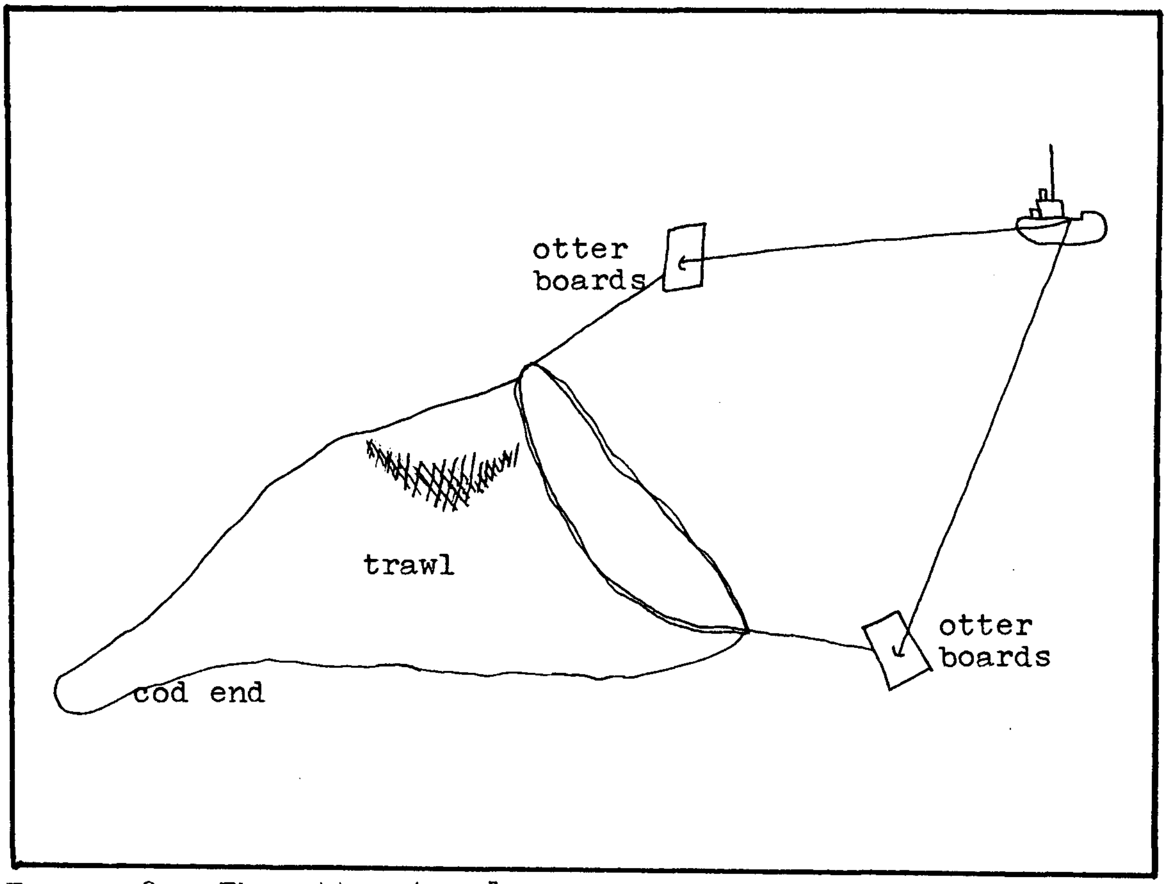

Figure 2: The otter trawl.

such as Atlantic cod (Gadus morhua), Redfish (Sebastes mentalla and Sebastes marinus) and American plaice (Hippoglossoides platessoides). These species are all bottom feeders, hence the trawl must be capable of remaining on bottom. To do this, otter boards are used, which keep the mouth of the net open and hold the trawl down. Fishing consists of lowering the trawl to the bottom ('shooting'), and towing for a short time period - generally two hours. Water pressure on the otter boards keeps the trawl in position, and fish are picked up and collected in the 'cod end' of the net. When towing is completed, the trawl is 'taken back' by power winches, and the fish removed.

Although the workcycle (shooting, towing, taking in) is the same for the side and stern trawler, the time required to complete it differs on the two types of boats. On the side trawler shooting and taking in takes 15 minutes more than on the stern trawler because of differences in the power winches. Similarly, unloading time is shorter on the stern trawler. Side trawler unloading involves repetitive steps, depending on the amount caught. Only one 'bag' (the tied-off cod end - approximately 3,000 pounds) can be brought on deck at a time. If more than 3,000 pounds is caught in one set, then the cod end must be lowered back into the water and filled by raising the rest of the net. On the stern trawler, this problem is eliminated by taking the whole net over the tapered stern in a single operation.

The unloading operation increases the difference in non-productive (non-fishing) time between the two types of trawlers as the amount of fish caught increases. With catches of 3,000 pounds or less, the workcycles differ only by the winch factor of 15 minutes. With any amount over 3,000 pounds, however, the side trawler takes an additional 20 minutes per 'bag'.

Timing the workcycles for various quantities of fish for the two boats that I was on, showed that the factors given above led to marked differences in non-productive time between stern and side trawlers:

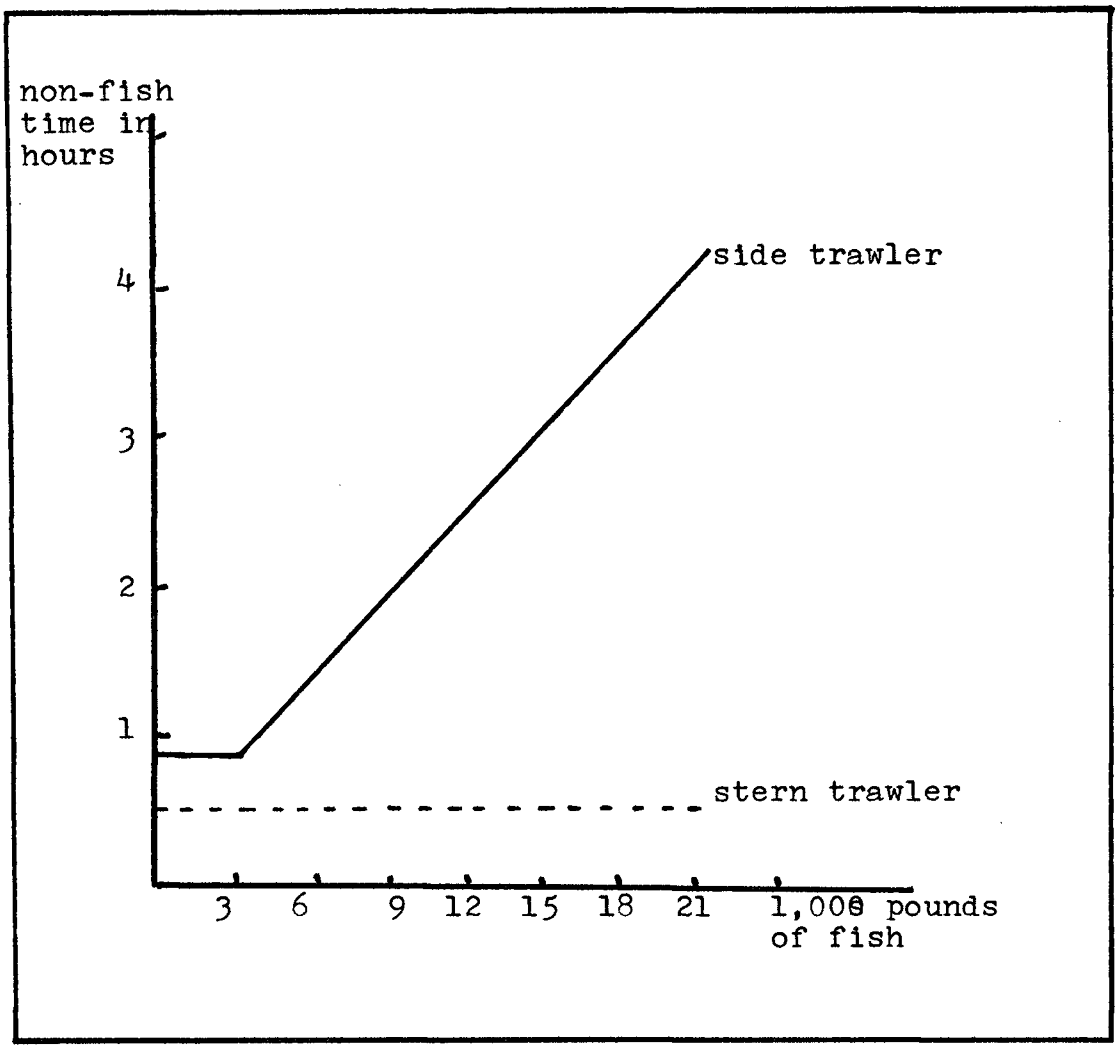

Figure 3: Differences in non-productive time for a side and stern trawler.

The stern trawler also had other advantages which effected fishing capability. It had a higher cruising speed, which meant less travel time to and from the fishing grounds. The stern trawler had a larger carrying capacity - 400,000 pounds compared to 250,000.

Combined, these advantages gave the stern trawler superior catching ability. With less travel time, and shorter workcycles, the stern trawler had significantly less non-productive time.

As an illustration, let us assume that a boat of each type will fish in an area 200 miles away for a five day period. If both boats locate spots where they can catch 10,000 pounds per set, the stern trawler will catch 360,000 pounds of fish in five days, while the side trawler will only catch 260,000 pounds. In travel time, the stern trawler would save 7-1/2 hours. It will also save 75 minutes on each work-cycle. Given a competitive situation, it is clear that the stern trawler fisherman has a marked advantage over the side trawler fisherman. It will be argued later that the difference in fishing capability between the two types of boats will influence the decisions made about how and where they will be used; given the importance placed on relative performance in the fleet.

E. The Organization of Deepsea Fishing

Deepsea fishing in Fortune follows the traditional pattern of 'co-adventure'. A crew is viewed as entering into a short term partnership with the boat owners (Booth Fisheries) lasting for one fishing trip. The company invests its boats and gear, and the crew invest their time and labour, in a speculation that they will catch fish. The return for both parties is a fixed share of the landed value of the catch. The shares are forty percent for the owners, and sixty percent for the crew - after deducting expenses such as food and fuel. The captain, mate, engineers, and cook receive fixed percentage bonuses on top of their shares.

Co-adventure and company ownership of boats has a number of implications for the fisherman. Under co-adventure, there are no income guarantees. It is possible to go fishing for two weeks, and return owing for food and fuel (a blank trip). In 1968, for example, catches ranged from 30,000 pounds to 320,000 per trip. For a deckhand, this would mean monthly incomes ranging from $40.00 to $400.00.

Job security is also relatively low, since there are no long term contracts between owners and crew. By tradition, the owners choose the captain, and the captain selects the rest of the crew. In neither case are there any guarantees that employment will last beyond a single trip.

For captains, job security is obtained by building a reputation as a fish catcher. In the company's view, a captain's worth is determined almost exclusively on the amount of fish he catches. Building or maintaining a good reputation requires competition between captains in the fleet. A captain is seen as 'good' relative to the performance of other captains in the Fortune fleet. At the end of each year, the company totals the fish caught by each captain. The top performer becomes the company 'highliner', and all other captains are ranked relative to his performance. A captain whose performance is consistently low will generally be replaced.

A captain's reputation is important in one other major way. The company uses performance standards in the assignment of its boats. The highline captain has the first choice of boats, and so on down the line. Similarly, a new captain will be given the worst boat in the fleet to 'prove himself'. Since the newer boats, such as the stern trawlers, have a greater fishing capability, they are highly desired. With a better boat, a captain is more likely to be able to maintain or build a reputation with the company.

The company's emphasis on relative performance leads to a highly competitive system. Captains compete for relative standing in the fleet which is used to determine prestige, job security, and assignment of boats. In addition, a captain's relative performance is used by crewmen to evaluate boats. Since crewmen are free to change boats if space is available, captains can also be seen as competing for crew. A review of company records indicated that the Fortune highliner replaced only one man in 1967-1968. In the same time period, the turnover for the lowest standing captain's boat was twenty-five men. Going out short handed, or with a crew that is not used to working together has implications for a captain's overall performance. Differences in crew stability tends to re-enforce high and low performers retaining their standing by giving the high performance captain an advantage in addition to a better boat.

The competitiveness between captains in the Fortune fleet is shown by their refusal to share information about fish locations. Although the captains generally talk to each other by radio-phone while fishing, they deliberately lie about where they are and how they are doing. The standard answer to "how's it going?" was "really poor, only made 2,000 on the last set." Captains knew that if they told the truth, at least when fishing was good, other boats would move into the same area. The only instance of information sharing that I observed was between captains from different fleets. One of the Fortune captains shared 'coded' information with a friend from a nearby port. Coding was seen as necessary since other captains monitored radio conversations in order to get information. This instance of information exchange seemed to fit within the relative performance notion, in that the two captains concerned were not competing as members of the same fleet.

Depending on labour supply, reputation as a worker is important for other crewmen. When the number of available fishermen is less than the fleet demands, job security will be relatively high. Captains will be forced to compete for crewmen. When the labour supply is greater than the demand, then job security is lower. Fortune fishermen still talk of the time when the new boats were introduced, "There was so many men looking for a place on them boats that if you even looked sideways you were told to pack your bags. Every man was expected to know as much as the mate, else find themselves ashore."

If a crewman is interested in getting on a high performance boat, or with moving up the crew hierarchy, then reputation as a worker is important. Hiring and promotion are determined by the captain, and with only a hundred men in the fleet, captains are aware of who have good and bad reputations.

One of the main criteria used by captains to evaluate crewmen is stability. It appears that a certain amount of movement between boats is advantageous in order to build up experience on different types of boats. Too much movement, however, means establishing a reputation which will exclude a man from being hired if other men are available.

The crew on the deepsea trawlers generally consists of thirteen men. It includes a captain, mate, bosun, chief and second engineer, cook, third hand, and deckhands. Their activities are organized in terms of four functional areas on the boat - the wheelhouse, deck, galley, and engine room.

The wheelhouse is the information center of the boat. Equipment such as radar, sounder, radios, and radio navigators are located there. Except for steering watches, the wheelhouse is the captain's territory. As Barth has suggested (1966:6-9), much of the captain's authority is based on his control over information and information sources. On my two trips, the only crewman that visited the wheelhouse while fishing were the mate, cook, and chief engineer.

By tradition, the captain is supposed to be the ultimate authority while at sea. However, it appeared that their use of authority was restricted primarily to selection of fishing spots, and how the gear will be used (towing time, and direction of tow). The only instances I observed of a captain's intervention in one of the other functional areas was when major problems occurred on deck.

On one boat, the captain felt responsible for supervising all major net repairs. This was resented by the deckhands in that they felt he did not belong on deck. His presence was seen as a lack of confidence in their work. Part of the reason for this restricted use of authority seemed to be the high degree of specialization. Only one captain in the Fortune fleet knew anything about the engines, none had been cooks, and only the younger ones were net experts.

The deck crew consists of a mate, bosun, charge hand and six deckhands. Depending on the captain, the mate and bosun might also be expected to take over the wheelhouse at times. Normally, however, they stayed on deck to supervise the use of the net and storage of fish.

The deck crew is divided into three work groups, under the supervision of the mate, bosun, and third hand. Two teams are on watch at a time, working eight hours and having four off. If needed, a watch could be 'broken' by calling in the team off watch to help with repairs or unloading. Each watch is responsible for shooting the net, taking in, and putting the catch in the storage pens.

The two engineers take care of the ship's engines and related equipment. Their work pattern is more regulated than in the case of deck crew. The first and second engineers rotate every six hours in the engine room, and have no other duties unless an emergency happens such as icing under winter conditions.

The cook's function extends beyond the preparation of meals, and keeping the galley clean. The galley serves as a general meeting and recreational area for the crew, as well as an eating place. The cook's ability to make the galley a pleasant place to relax is important for crew morale. His willingness to provide 'snacks', kid the men, and allow free use of stores helps make a 'good' ship.

Running a good galley is important given the tensions created by the functional divisions on board. The deck crew see the engineers as having a 'soft' job. All of their work is inside, they have regular hours, get more sleep, and earn more. I observed a tendency for joking relationships between the engineers and deck crew, which the cook arbitrated.

Similarly, there was often hostility between the captain and deckcrew. The captain's tasks were not seen as work by many of the deckhands, "All he does is stand around and watch us, and listen to the radio." Also, they saw the share differences between captain and other crewmen as too great. The captain earned twice the share of the mate, and three times that of a deckhand.[4]

In summary, the organization of fishing in the Fortune fleet puts considerable pressure on the captain. The company's stress on performance inhibits co-operation between captains, since their standing is determined by size of catch. His decisions about where and how to fish are one of the primary determinants of his performance, and he is isolated from his crew by convention and specialization of activities. The choices that he makes on the fishing grounds effects the income for himself and his crew, his prestige in the fleet, his job security, boat assignment, and crew commitment.

Before looking at some examples of captain's decision-making, there is one remaining setting factor which must be discussed. The environment and resource determine to a large degree the alternatives that are open to a captain, and the relative success of his strategies.

F. The Resource and Environment

As mentioned earlier, the three main species fished

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[4] See Appendix C for a breakdown of earnings for the two boats.

for are atlantic cod, redfish, and American plaice. Cod is the most important species commercially, accounting for 75 percent of Newfoundland's total catch (584 million pounds per annum) and 65 percent of the total landed value (15 million dollars) (Templeman,1966:19).

All three species range over a wide area. Cod and plaice prefer the cold water conditions along the Labrador coast and the east coast of Newfoundland. Redfish prefer the warmer waters of the Greenland current which moves through the Gulf of St. Lawrence and the southern Grand Banks. Variations in water temperature result in certain species being more plentiful at particular times of year. Cod is fished for in winter and spring, while plaice and redfish are fished for in summer.

For the trawlers, which fish all year round, the variations in water temperature require considerable movement. Fishermen cannot stay in one fishing ground and hope to catch fish. They must search for locations in the three major fishing banks, covering hundreds of square miles of ocean.

The search for good fishing locations is confounded by the fact that the species are bottom feeders. All three are normally found in depths over one hundred fathoms. This means that there are no natural 'signs' to indicate their presence. Since the resource can not be seen directly, there is a high degree of uncertainty about their actual location and the relative quantities to be found in different spots.

The available technology does not decrease the uncertainty about fish location to any degree. The major piece of equipment for this purpose is the fishfinder function of the depth sounder. Ideally, the sounder can discriminate between the echoes given off by the bottom, and those given by schools of fish. Unfortunately, sounder information is ambiguous. If a school is too close to the bottom, the sounder cannot discriminate, and there is no way of telling how large a school is.

The competitive nature of the Fortune fleet does not support the exchange of information between captains. The distortion of information that is exchanged does not allow captains to make judgements about the relative productivity of different areas.

Only the navigation equipment provides the captain with accurate information, but this cannot be used to locate fish in any direct way. It does allow, however, pinpointing locations for further reference and possibly building up a useful stock of knowledge about fish movement.

The lack of accurate information about the location of fish is coupled with another characteristic of the resource - lack of effective control (Christy & Scott,1965:6). Unlike inshore fishing where fixed traps can be established, deepsea fishing does not allow for control by any individual or group. The facts that trawling requires towing, and the species hunted are migratory, mean that no boat can claim rights over a spot and still catch fish. This aspect of the resource increases competition for good locations, and the importance of control over information.

It is clear that the lack of information, and ability to control a location have implications for the choices a captain must make. Without precise information, a captain is never sure how he is doing relative to other possible locations and captains. If a productive spot is located, a captain cannot keep others from sharing it - except by refusing to tell others where he is. Even this means of control is limited, since there is no way of stopping visual identification.

G. The Decisions

As discussed in the last section, the primary function of the Fortune trawler captain is deciding where and how to fish. Since the species fished for are migratory and pelagic, finding productive locations is the major problem. Given the range of possible fishing spots, and the differences in their productivity, coupled with the lack of information, the risk element is an important part of the captains' decision-making.

In this section, an analysis will be made of two problems facing the Fortune captain. They are of interest since the show that different strategies can be applied to their solution. Both problems require that the captains take risks, either in real or opportunity costs. The differences in strategies used by the two captains illustrates the substantive focus of this thesis.

1. Selection of a fishing ground

During the summer of 1968, Fortune captains were fishing for one of two species - redfish and plaice. Fishing for cod was not seen as an alternative because of their limited numbers at that time of year. In summer, cod follow the inshore migrations of caplin (Mallotus villosus) that is their major food source. Trawlers are prohibited from fishing inshore by Department of Fisheries' regulation, hence must search for species on the offshore banks.

The general fishing areas open to the Fortune captains were the Gulf of St. Lawrence and the Grand Banks - the first for redfish and the second for plaice. Fishing both areas in a single trip was seen as unprofitable since the distance between them required too much travel time.

The factors which appeared to be relevant for selecting between the Gulf of St. Lawrence and the Grand Banks were: (1) expected productivity of the two areas, (2) selling price of the species, and (3) time required to catch a given amount of each species.

The two captains I sailed with knew that the Gulf of St. Lawrence would be the most productive area. Past experience and information about catches by other captains indicated that redfish would be more plentiful than plaice at that time of year. Interestingly, only one of the captains selected this alternative. The other decided to fish for plaice on the Grand Banks.

The time required to catch a given quantity of fish tended to favour choosing the Gulf of St. Lawrence. Both areas are approximately twenty hours sailing time from Fortune, hence there would be little difference in non-productive time. Similarly, neither area was more likely to lead to an early landing date being given by the company manager. The larger expected yield of redfish, however, meant that less fishing time would be required for a full catch.

The marketing factor seemed to be the crucial variable in terms of the difference in areas chosen. Plaice had a landed value of 4-3/4 cents per pound, while redfish sold at 3 cents. Although expected yields still favoured redfish at that time of year, it still meant taking higher risks. In order to make a larger profit with redfish, a captain would have to catch at least twice the quantity in the same time period. Since Fortune trawlers make only twenty trips a year, taking a risk on a general fishing area could significantly influence a captain's total performance standing in the fleet.

As second aspect of the market factor was the likelihood that redfish could not be sold. Since the Fortune plant was buying cod from the inshore fishermen, it was possible that both boats would be required to take their catches to another port. The cod input at that time of year, coupled with inaccurate information for scheduling trawler landings, frequently led to 'gluts' in the plant. Since redfish was not as marketable as plaice, there was also a risk that it could not be sold except for fishmeal prices - 1/2 cent per pound.

It can be concluded that the side trawler captain, who selected the Gulf of St. Lawrence, was taking much higher risks than the stern trawler captain who went to the Grand Banks. Even if fish yields were as expected, the side trawler captain still faced the possibility of not being able to sell his catch for the full price. As it turned out, the risk was a real one. The plant manager spent three days trying to find a buyer in another port, and 20,000 pounds of deck fish had to be dumped overboard because of spoilage.

2. Selection of fishing locations

Even though the two captains fished in different areas and for different species, they still faced the same problem of determining where to make their sets. Both the Grand Banks and the Gulf of St. Lawrence cover hundreds of square miles of ocean, and neither species provides 'signs' that can be used to locate them. Each set requires a choice between a large range of alternatives, with the choices being made with little explicit information.

Preliminary selection is generally done on the basis of past experience and the use of oceanographic charts. These sources help narrow down potentially productive sub-areas. Factors such as previous catches, bottom conditions, and depth are used to determine where and how the sets will be made.

After preliminary selection of a sub-area, a captain must decide where to make his sets. In order to choose a location, a captain usually relies on other sources of information besides charts and experience. The information wanted is the actual yields of different locations. Time cannot be wasted on too much search, and making test sets. The number of alternatives are too many, and the travel time between sub-areas too great. The major sources for this type of information are the locations of other boats and the fishfinder function of the sounder.

Sometimes, other sources are used. A captain may have a 'buddy' with whom he can compare yields in different locations. Occasionally, he may overhear useful exchanges of information by monitoring the radio conversations of other captains. He may also be able to observe the catches made by other boats, especially with side trawlers. Counting the number of 'bags' taken in gives an accurate indication of another boat's catch. Unfortunately, towing time and the fact that other boats are not in every potentially productive spot limits the frequency of access to such information.

In using the sounder, a captain receives three types of readings: (1) a school of fish which is too high off the bottom to be caught by trawling, (2) a moderate school of catchable fish, and (3) no reading, which either means no fish or a large school which the sounder cannot differentiate from bottom readings.

The clustering of boats in one part of a sub-area is also ambiguous. It means assuming that the location is more productive than others where there are no boats. Fishing with other boats requires putting oneself into a highly competitive situation for the available fish.

The difference in strategies used by the two captains was evident in their choices of information sources. The captain of the stern trawler operated exclusively on the location of other boats. During an entire trip, he kept the fishfinder function turned off, on the grounds that the information it gave was useless. He had a 'buddy' relationship with a captain from another fleet, with whom he shared information. On a number of occasions, they would decide that the area they were in was not productive. They would then decide where they would go, generally be referring to past experience in other areas. Although they did not separate and compare yields from different locations, they did pool information about past performances which gave some basis for deciding on where to move.

The side trawler captain ignored the clustering of boats, and used the sounder readings to determine where to set. He never attempted to exchange even distorted information with other captains because he felt that no one would tell if they had a good location, "and I'm damn sure I wouldn't." The only time he deviated from ignoring other boats was when passing by a side trawler which was just taking in. After estimating that the other boat had caught 20,000 pounds, the captain decided to fish there rather than continue to move on. He made three sets near a cluster of other boats, and when the catches dropped to 4,000 pounds per set he decided to move on.

In using the sounder, the side trawler captain looked for spots giving type 3 readings. This meant making sets in locations which either had very few or very many fish. If the catch were low, then he would move on until he got to another location with the same reading.

The pay-off from fishing with other boats tended to be more stable than fishing alone on type 3 sounder readings. The catches for the stern trawler ranged from 3,000 to 9,000 pounds. For the side trawler, the range was greater - from 1,000 to 20,000 pounds.

It can be seen that the stern trawler captain took relatively lower risks than the side trawler captain. As in case of selecting a fishing ground, he took the 'safest' alternative. For both problems, the side trawler captain selected the alternative which had the highest possible pay-off regardless of the risk.

The risks taken by the two captains were not limited to fish intake. As Wadel (1969b:8) has pointed out, one of the major problems facing fishermen is the legitimization of decisions. Fish catches are seldom seen as high or low in any absolute sense. Without information about fish yields in other areas, judgements can only be made in relation to the performance of other boats.

Fishing in locations where there are other boats provides some legitimization and basis for comparison. Even if one boat's set is poor relative to the other boats in the area, the location is not in question. It just means that the boat had bad luck. The rationale is that other boats would not be clustered if the location was not productive.

Fishing alone, especially on type 3 sounder readings, does not provide this avenue for legitimization of decisions. The side trawler captain's crew constantly complained about his choice of locations, even when large catches were made. The absence of other boats was used as evidence that, "the old man had his head screwed on backwards."

I inadvertently discovered the importance of access to information in legitimizing decisions about fishing locations while on the side trawler. The fact that I could move freely between the wheelhouse and the deck meant that I had access to information that the deckcrew did not. I found that I was frequently asked if I could see other boats on the radar, and what the sounder readings were. When I told them that I could not see any boats, and that the sounder just showed a bottom reading, the deck crew had additional information to question the captain's decisions. I soon realized that the captain's choices were legitimized by the crew, in part, by a belief that he had information that they did not possess.

The side trawler captain's fishing strategy involved relatively high risks in relation to crew dissatisfaction and commitment. Even though we had a good trip, four men did not sign back on, and the boat had to go out short handed.

These two illustrations were not isolated cases of the captains' decision-making. They represent instances of relatively consistent choices on the part of the two captains. I observed over a hundred decisions by them, and only in a few cases did either captain vary from what appeared to be general strategies of risk-taking.

In the next chapter, I will argue that the differences in risk-taking that were observed can be explained by the emphasis placed on performance, the system of rewards, and the capability differences between the stern and side trawler. These factors combine to result in varying levels of motivation among Fortune captains, and varying abilities to catch fish.

CHAPTER II

EXPLANATION OF THE DIFFERENCES IN RISK-TAKING

In this chapter an attempt will be made to account for the observed differences in fishing strategies. The problem is one of determining which factors might influence the choices of the two captains. In order to show how such factors were selected, it will be necessary to state some assumptions about the nature of decision-making.

A. The Process of Decision-Making

All theories of choice focus on the problem of evaluation. Arrow (1951:404) states that decision-making is the ordering of all perceived consequences of actions, and selection or preference for the consequence of one action, or being indifferent to differences between consequences. Minimally, theories of choice are concerned with how evaluations are made, and what criteria are used.

The alternatives can be goals, resources, or ways of using resources (Stevenson,1968). Evaluation of alternatives is seen by Gyr (1960:39) as a transaction between the individual and his environment. The decision-maker will make trial solutions, or refer to past choices, in order to acquire information. When he has a sufficient level of information, he will commit himself to one course of action. The information input may even lead to a rejection of all the alternatives, if the perceived consequences of action are not preferred.

In the literature on decision-making the consequence of an action is called an outcome. Evaluation of outcomes is generally in terms of pay-off, or desirability. If, for example, an individual has fixed resources which can be used to supply a range of outcomes, it is assumed that he will act rationally and choose as a goal the alternative which is most desirable to him (Marschak,1964:103-106).

Evaluation may also refer to cost factors. Commitment to a course of action requires an investment of resources. Under the assumption of rationality, the decision maker will choose the alternative which minimizes costs. The costs may be of two types - real and opportunity. Real costs are the amount invested to achieve a desired outcome. In the fishing context, real costs are time and equipment which can be used to catch fish. If a captain decides to make a three hour set instead of a two hour set, he is increasing cost. Similarly, if he decides to fish in a rocky bottom area he faces a cost of gear damage which he would not have in a sandy bottom area.

Selection of one alternative means the rejection of pay-offs from other alternatives. This is an opportunity cost. Determination of actual pay-off from one course of action, using the rationality assumption, means evaluation of differences in pay-offs. In the fishing context, selecting a spot which yields 10,000 pounds of fish when other alternatives yield 8,000 pounds for the same investment means that the actual pay-off is only 2,000 pounds.

Evaluation of alternatives generally involves using both costs and pay-offs. How these criteria are perceived will determine the choices made. A decision-maker may decide that the costs are too high relative to the expected pay-offs, hence may reject a goal. Also, he may reject a high pay-off alternative since the costs of achieving it are greater than for a low pay-off alternative. Similarly, he might reject a high pay-off outcome since it requires a commitment of resources which could be used to achieve a number of other goals.

In many cases, the achievement of a goal is influenced by factors outside of a person's control (Edwards,1965:264). The decision-maker may have a complete knowledge of, or be indifferent to, what these factors are. In this case, evaluation will be strictly on the basis of costs and pay-offs. He may, however, be uncertain as to what state of affairs does or will exist, and know that that actual state of affairs will influence his pay-off. Under these conditions, we are dealing with a particular type of decision-making, that of risk-taking. Risk-taking can be defined as choice of alternative courses of action, when the consequences of action are incompletely known to the decision-maker (Arrow,1951:404).

When the decision-maker is aware that there is a likelihood that his goal will not be attained, then he will take into account the likelihood of the expected consequence occurring (Edwards & Tvesky,1967:7). Both costs and pay-offs should be evaluated in relation to such probabilities. In the fishing context, real costs can be said to be higher when the likelihood of gear damage or wasted fishing time increases. Similarly, fishing in a spot with a low likelihood of high yield in preference to a spot with a high probability of medium yields may increase opportunity costs, or actual pay-offs.

In Fortune, both captains were aware that their choices involved risk. In fact, their strategies represented differences in risk-taking. The stern trawler captain, by fishing in relatively stable yield areas, was taking low risks. In contrast, the side trawler captain's use of type 3 sounder readings indicated high risk propensity. He preferred locations which <u>might</u> have high yields even though he knew many of his sets would result in very low yields.

In so far as the captains used degree of risk to evaluate fishing locations, uncertainty about the consequences of choosing one alternative over others should be part of their information (Arrow,1951:405). In their case, uncertainty was a result of a particular combination of environment and technology - one that led to an inability to determine the actual state of affairs affecting fish yields.

1. Environmental uncertainty and evaluation of alternatives

Uncertainty is the inability to determine the consequences of following a course of action (Marquis and Reitz, 1969). Uncertainty may refer to real costs, such as net damage, or to opportunity costs such as differences in actual yields from alternate locations.

The Newfoundland deepsea fisheries is a context which results in a high degree of uncertainty about fish yields. Captains must select locations with little or no information about the actual quantity of fish that might be present. The species fished do not provide signs that can be used to locate them, or make estimates about quantity. Their depth of feeding, and migratory patterns make it difficult to determine where schools might be at any one time.

The technology available to captains does not decrease the uncertainty significantly. The fishfinder function of the sounder is the only piece of equipment designed to locate fish, and it provides ambiguous information.

Evaluation of real costs is generally done through the use of charts and past experience. Marine charts show bottom conditions which tell a captain what areas are more likely to lead to gear damage. Past experience in particular areas is generally used to determine setting time. If past yields are unknown, then captains will regard the first set as a test. The yield of that set will then be used to determine the length of other sets.

Opportunity costs, or differences in yield, are more difficult to estimate. Using other boats to find productive spots gives some indication of yield. Minimally, other boats mean that some fish are present. At times, it is possible to watch other boats taking in and use their catch as estimates of possible yields. The lack of information exchange between captains makes comparison of yields difficult. The only option for a captain is to search for information by moving from place to place, which involves a real cost of lost production time. Information about yields is of restricted value, since yields change quickly due to variations in water temperature and fish migration.

Deepsea trawler captains fish in an environment which provides little information about fish location and yields, and at the same time restricts the usefulness of search for information which might decrease the uncertainty. The range of alternatives is too large to permit effective comparisons of productivity. The distances that would have to be travelled would mean loss of productive fishing time. Competition between captains limits information exchange which might allow for comparisons.

For the problem of choosing from a set of alternatives, search for information which can decrease uncertainty can be important. Lanzetta and Kanareff (1962:459) argue that the notion of rational decision-making must include the capacity of the chooser to assimulate and organize information as well as the amount of information in the decision-maker's mind.

In an experiment Lanzetta and Kanareff (1962) gave subjects a basic amount of information which related to choosing from a range of alternatives. They were allowed to purchase additional information before making their choice, and were rewarded if they made the correct decision. They found that there was an overall low level of information purchase even when that information was low in cost relative to resources and potential pay-off. In addition, they found that information purchase decreased as cost of information increased, or as the ability to understand that information decreased. In the latter case, information which required greater amounts of time to relate to the problem was used to determine usefulness of information.

The experimental results suggest that decision-makers are not rational in terms of information search, even when cost of search is low. In contexts such as Fortune fishing, information search has high costs, therefore it is not surprising that neither captain spent fishing time trying to get information on other locations. Movement, or the selection of a new fishing ground occurred after the yield of a particular spot went below the captain's expectations. Movement to a new area was on the basis of past experience, and selection of spots was either by clustering of boats or sounder readings.

The literature on decision-making suggests that risk-taking is inversely related to degree of uncertainty. An experiment by Marquis and Reitz (1969), was concerned with determining differences in decision-making between situations where the risk was known, and where there was uncertainty about degree of risk. Subjects were put in a gambling situation, and given varying degrees of information about the likelihood of them winning. The results showed that amount gambled was inversely related to degree of uncertainty. Even when the expected pay-off from the gamble was zero, the same relationship held - the subjects were less willing to risk money when they were uncertain as to the likelihood of winning. They did find, however, that group decision-making increased willingness to take risks.

The experimental findings suggest that different fishing environments and shared decision-making would lead to more high risk-taking. Going after species when one has more information about actual yields should result in higher risks in terms of real costs. Similarly, if decision-making were between captains or by crew and captain, one would expect a greater willingness to take risks.

2. The captains' goals

In the earlier discussion of decision-making, it was stated that evaluation of alternatives would include the goal to which the action is directed. Using the assumption of rationality, it was concluded that the more important the goal the more a person would be willing to invest.

Looking at the problem of fishing strategies, it would seem that the goal for both captains was the same - that of catching fish. The importance of catch, however, can be translated into relative standing in the fleet. Relative performance is used in the Fortune fleet to assign rewards - income, job security, boat assignment, prestige. It is also used by crewmen to evaluate boats - a factor which seems to influence crew commitment.

If we regard relative standing as the goal of the two captains, then there are differences in the importance of the goal. The stern trawler captain was the company highliner, hence had the highest standing in the fleet. It seems reasonable to assume that he would be concerned with maintaining his position in that he could not increase it. The side trawler captain, on the other hand, was near the bottom of the fleet hierarchy. It follows, therefore, that he should be minimally concerned with maintaining position, and more concerned with increasing it.

Since risk is a cost, evaluation of alternatives as to degree of risk should be considered by the decision-maker. If a goal is less important to the decision-maker, then he should be less willing to increase cost. If additional performance is seen as a goal, then the stern trawler captain should be willing to invest less than the side trawler captain. Any increase in yield beyond that which is necessary to maintain highliner standing should be of little importance to the stern trawler captain. In contrast, the side trawler captain should see additional catch as more important since it increases his chances of achieving higher fleet standing.

The argument is that the two captains had in fact different goals, for one it was maintenance of standing and for the other it was increase of standing. Since standing is determined by catch over a one year period, additional performance was not as important to the stern trawler captain. The structure of evaluation and reward resulted in their goal differences, and hence in the importance of additional catch. The side trawler captain was more willing to take high risks because he saw it as a way of increasing his standing. The stern trawler captain was not as willing to increase his costs through high risk-taking, since performance beyond a level necessary to maintain position was of little importance.

Cancian (1967) makes a similar argument for farmers and willingness to innovate. He hypothesized that the higher the status of an individual, the less willing he would be to take risks on innovations. Using wealth as an indicator of status, he tested the hypothesis by using seven case studies on agricultural innovation. He found that wealthier farmers tend to take lower risks on innovations than poor farmers.

In his study, Cancian suggests that there are a number of different relationships which might fit the same findings. The relationship may be negatively linear, that is, risk-taking is inversely related to wealth. It may also be curvilinear, in which the middle status range are less willing to take risks than either high or low status farmers, or they may be more willing to take high risks. The variation in risk-taking in the middle status range suggests that the assumption of negative linearity is the most useful assumption to work with. This fits the conclusions of marginal utility theory for inelastic demands which postulate that the more one has of a given end, the less one is willing to invest for additional units of that end (Cohen,1967:104).

We can conclude therefore that the two captains evaluated different ways of using their time and equipment in terms of their goals. The structure of the Fortune fleet resulted in differences in the importance of these goals, and hence in motivational differences towards performance.

3. Differences in resources and risk-taking

The Fortune problem refers to choice about how resources (time and equipment) will be used. The degree of risk taken with these resources are the alternatives open to the two captains. The primary resource for the captains was their boats. Since the boats differed in capability, the captains had major differences in resources. The stern trawler averaged ten sets per day, while the side trawler averaged eight. The number of sets per day for the side trawler decreased with size of catch because each bag of fish had to be unloaded separately.[7]

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[7]See pages 22-24 for discussion of differences in workcycle time.

Performance, measured in landed catch, is primarily the result of a boat's capability and how it is used. Analysis of boat logs and company records indicated that although the stern trawler caught more fish in a year, the average per set was lower than for the side trawler.[8] Given the age of the side trawler, the high crew turnover, and slower speed, the fact that it caught even two hundred pounds more per set than the stern trawler indicates that its captain's strategy was more productive.

The additional capability of the stern trawler allowed its captain to maintain his performance standing without taking high risks. He was able to make more sets per day, which more than overcame his lower average per set. The side trawler captain had to take high risks in order to increase his performance standing given his inferior boat.

4. A model of Fortune

The discussion of risk-taking suggests that the Fortune captains differed in their fishing strategies due to differences in goals, and differences in fishing capability. Both capability and difference in goals were seen as a result of the structure of the Fortune fleet. The co-adventure system and company ownership of boats lead to evaluation by performance measured in landed catch. Performance was used

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[8]See Appendix D for performance comparisons.

to assign relative standing in the fleet, and to reward captains.

Since the standard of evaluation was the same for each captain, the stern trawler captain was able to maintain highliner standing by using his boat in a different way from the side trawler captain. His low risk strategy not only reflected low preference for additional performance beyond that needed to maintain his position, it also represented his greater fishing capability. The side trawler captain was forced to compete for standing with other captains who had greater capability (newer and more efficient boats). His low standing meant that he was concerned, not with maintaining his standing, but with increasing it. Increased standing by increased performance would mean more income, greater job security, better boat, higher prestige, and a more stable crew. It was concluded that he would be more motivated towards increasing catch, therefore would be more willing to take high risks. The system of evaluation and his low capability boat re-enforced the need for high risk-taking in order to increase standing.

Both captains used the same criteria for evaluating alternate ways of using their time and boats. Importance of additional catch, and cost of risk-taking were used to determine which alternative would be preferred. Although they both operated in an environment with a high degree of uncertainty about fish locations and quantities, they differed in their risk-taking due to differences in level of motivation and capability.

These conclusions suggest three propositions which can be used to account for differences in risk-taking. The first refers to uncertainty when evaluating alternatives. Although the captains faced an environment which led to high uncertainty about fish locations and yields, the literature on decision-making suggests that with a lower level of uncertainty their risk-taking would increase. Since uncertainty is a result of limited information which can be used to evaluate alternatives, one proposition is: risk-taking is inversely related to the level of information available to the decision-maker.

The second proposition refers to motivation. It was argued that the captains had different goals, the stern trawler captain being concerned with maintaining his standing in the fleet, and the side trawler captain with increasing his standing. Since evaluation and reward were based on relative catch, the two captains differed in the importance that they placed on maximizing catch. The stern trawler captain had low motivation for maximizing catch beyond the level needed to maintain his position, while the side trawler captain had high motivation for maximizing catch given his desire to increase standing. The proposition covering this aspect is: risk-taking is directly related to motivation.

Finally, it was argued that the differences in boats influenced their risk-taking propensity. The stern trawler captain was able to maintain his position without taking high risks due to the higher capability of his boat, while the side trawler captain's inferior boat meant that he had to take higher risks in order to increase his standing. It was concluded that with greater capability a captain is less likely to select high cost alternatives: risk-taking is inversely related to capability.

In conclusion, the Fortune captains' risk-taking differed due to a particular combination of the variables given in the three propositions. In the next section, it will be argued that different combinations of information level, motivation, and capability can be used to predict risk-taking in other fishing situations.

B. Transformations and Predictions

At this stage, the conclusions made about risk-taking in Fortune can only be considered as an ex post facto interpretation. In order to determine if the Fortune model has any predictive power, it should be able to account for risk-taking propensities in other situations.

One way of generating new predictions about risk-taking is to transform the original model. Levi-Strauss (1963:118) refers to transformation as the creation of a set of models of the same type from an original one. Hypotheses derived from the set of transformations are extensions of the 'logic' in the original one, and tell us what should happen in other contexts.

Predictions about risk-taking can be made by finding possible combinations of varying states of information, capability, and motivation. The states of the components are:

(1) Information - high or low: In the Fortune case, the environment and resource did not provide accurate information about fish locations and comparative yields. It is assumed that certain species, or technology, could provide a high degree of such information.

(2) Capability - high, equal, low: The stern and side trawlers constituted relatively high and low capabilities for catching fish due to differences in workcycle time. In other contexts, captains might have the same type of boat and gear, hence could be seen as having equal capability.

(3) Motivation - high or low: Given evaluation and reward on the basis of relative performance, it seems reasonable to assume that captains will have different goals - maintenance of position or increasing position. This means that some captains in the fleet will be more motivated to increase catch than others. In the North American fisheries, the evaluation and reward by relative performance is standard. I only know of one case where income guarantees were established, and even then other rewards (prestige, job security, crew commitment) were on the basis of relative performance standing. It is quite possible that evaluation and reward by performance does not apply cross-culturally. In one African society in the HRAF sample, hereditary fishing chiefs had the highest status, and were given portions of every fisherman's catch. It would seem though that the argument could still be maintained for status. If performance is not

important for status, then one would expect low risk-taking.

By referring to the conclusions made about the effects of these components on risk-taking, each state can be assigned a predicted relationship to risk-taking, as shown below:

TABLE 1

PREDICTED RELATIONS BETWEEN STATES OF COMPONENTS AND RISK

State	Risk-taking
High level of information	Low risk-taking
Low level of information	High risk-taking
High capability	Low risk-taking
Equal capability	No effect
Low capability	High risk-taking
High motivation	High risk-taking
Low motivation	Low risk-taking

In order to specify how various combinations of levels of information, motivation, and capability will influence risk-taking, certain assumptions have to be made about relationships between them. Given the lack of data on risk-taking under the conditions given in different combinations of these components, it seems reasonable to assume that they are combined in an additive way.

Without such data, it is impossible to determine if there are interaction effects between the independant variables, the kinds of interaction, and the degree of interactions. Without being able to specify beforehand if there will be interactions between information, motivation, and capability, it is safest to assume the simplest relationship (additivity), then modify the assumption after data collection (Coleman,1964:219-230).

Similarly, the amount of influence of each component level on risk-taking could not be determined beforehand. On the same grounds that additivity is assumed, it seems reasonable to assign each component equal influence until there are grounds for modifying the assumption.

With the assumptions of additiveness and equal weighting of components, we can make predictions about risk-taking for every combination of component states. A state which would induce high risk-taking will be assigned a score of +1. A state having no predicted effect on risk will be given a 0, and a state inducing low risk-taking a -1. By adding the scores for each combination, risk-taking propensity can be predicted. A (-) total score for any combination means that risk-taking will tend to be low. A (+) total means a high risk inducing combination. No sign indicates a combination in which no prediction can be made due to the equal weighting assumption. Also, the total scores can be used to predict which combinations should induce the highest risk-taking, that is, the combinations can be ranked relative to each other.

Each of these combinations are in fact models of possible fishing situations. Any particular empirical situation which fits one of these combinations can be used to test the explanation developed for the Fortune case.

TABLE 2

THE RELATION BETWEEN COMBINATIONS OF STATES AND RISK

Combin-ation	Information State Score	Motivation State Score	Capability State Score	Total Score	Risk-Taking
1	High (+1)	High (+1)	High (-1)	(+1)	High
2	High (+1)	High (+1)	Equal (0)	(+2)	High
3	High (+1)	High (+1)	Low (+1)	(+3)	High
4	High (+1)	Low (-1)	High (-1)	(-1)	Low
5	High (+1)	Low (-1)	Equal (0)	(0)	----
6	High (+1)	Low (-1)	Low (+1)	(+1)	High
7	Low (-1)	High (+1)	High (-1)	(-1)	Low
8	Low (-1)	High (+1)	Equal (0)	(0)	----
9	Low (-1)	High (+1)	Low (+1)	(+1)	High
10	Low (-1)	Low (-1)	High (-1)	(-3)	Low
11	Low (-1)	Low (-1)	Equal (0)	(-2)	Low
12	Low (-1)	Low (-1)	Low (=1)	(-1)	Low

Referring back to the Fortune model, it corresponds to combinations 9 and 10 in Table 2. The side trawler captain can be seen as being in combination 9, with low information, high motivation, and low capability. On the other hand, the stern trawler captain fits combination 10. He too operated with low information about fish locations and yields, but he differed in level of motivation and capability because of his position in the fleet and type of boat.

In the next chapter, an attempt will be made to test the Fortune model for 'fit' and predictions about risk-taking. The Alert Bay, British Columbia seiner fleet will be the context for these tests. Fit will be determined by examining the relationships between components given in the Fortune model. Predictions about risk-taking will be tested by assigning captains to appropriate combinations, and seeing if their decision making is as expected from the transformations.

CHAPTER III

ALERT BAY, BRITISH COLUMBIA

Alert Bay is located on Comorant Island in Johnstone Strait. It is approximately 180 miles from Vancouver, and two miles east of Vancouver Island.

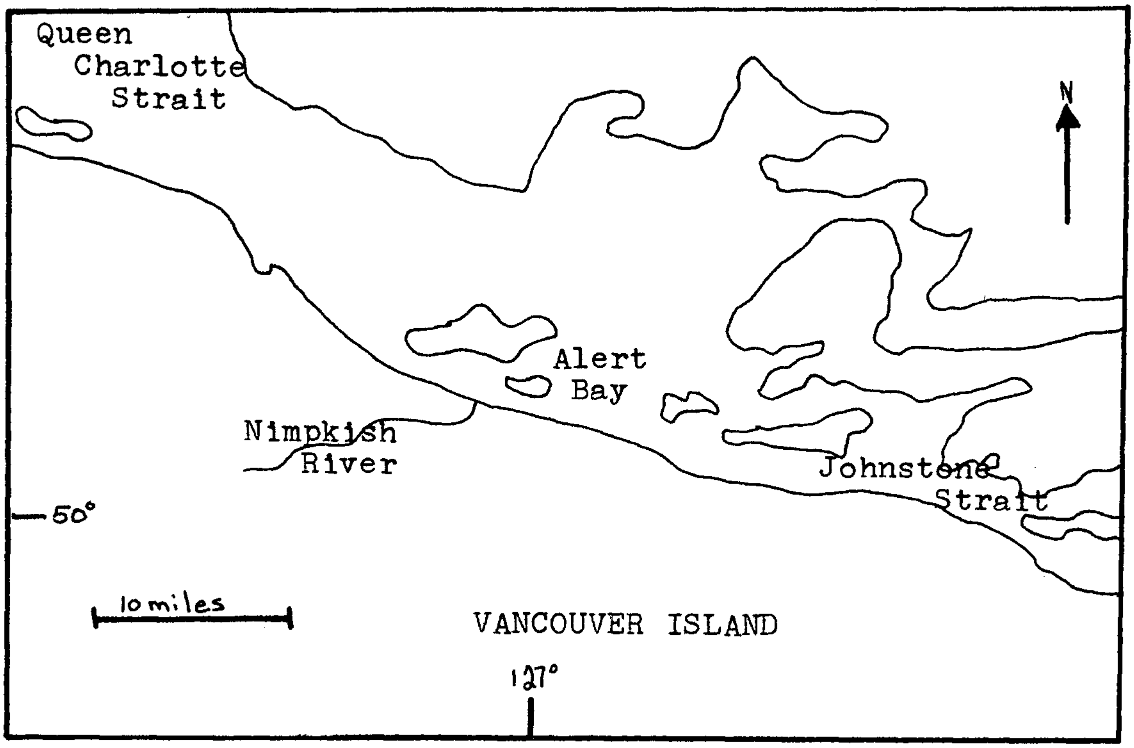

Figure 4: Alert Bay and major fishing areas.

As with Fortune, Alert Bay is well situated to be a fishing port. Vancouver Island and the mainland provide barriers against storms. The temperature seldom goes below freezing which means the port is ice free. Johnstone Strait and the Queen Charlotte Strait are two of the major inshore fishing areas in British Columbia because of the large number of salmon spawning grounds.

Even in pre-contact times, the indigenous Kwakiutl in the area used the salmon resource as their primary means of subsistence (Drucker,1955:35-42). The techniques used by the Kwakiutl included weirs, traps, dipnets, harpoons, and baited hooks (Forde,1934:76-79). Since the salmon runs were highly predictable, and spawning rivers such as the Nimpkish were close at hand, fishing occurred more inland than in the straits. The rivers and streams allowed for the establishment of weirs and traps, and relatively easy exploitation of the resource.

In the 1880s, fishing started to change from a subsistence to a market activity. In 1881, the first commercial cannery was established in Alert Bay, and since then market fishing has become more and more predominant (Lyons,1969:118).

Today, the port is used by many other fishermen besides the local inhabitants. Its harbour and service facilities, plus its nearness to major fishing grounds, have made Alert Bay a major port. Boats from Victoria and Vancouver use it as a base as they follow the salmon runs through the straits.

Approximately two hundred fishermen live in Alert Bay. Related industries such as boat yards provide the other major sources of employment in the community. Although the total population is equally divided between Indians and Anglo-Canadians (920 and 843), over two-thirds of the fishermen are Indian.

The same form of occupational sub-culture seemed to exist among the Anglo-Canadian fishermen as in Fortune. Although fishing weeks were normally only three to four days long, there was still a problem of separation from the family and community. As one wife put it, "Its funny, we've only been married for a couple years but I still find it strange when he's home. When he's fishing, I tend to get into a routine around the house, and do a lot of visiting. Sometimes, I resent it when he comes home, then I feel guilty about it."

As in Fortune, none of the Anglo-Canadians had ever been on, or run for, town office. The town council is generally made up of professionals and merchants.

In the Indian community, it is difficult to define anything like an occupational sub-culture. Virtually all adult males are fishermen, and many of them take members of their families (wives and children) out fishing with them. Indian fishermen are much more involved in their band government, in fact, the elected chief is a fisherman.

A high degree of factionalism is noticable in the Indian community, and in the total community. The Indians and Anglo-Canadians tend to live and interact within their own spheres. Reservation land is separate from the rest of the community, and has its own administration. Even with common voluntary organizations, such as women's auxillaries, there are often two groups - 'Indian' and 'White'.

Migration of Indians from other bands into the Nimpkish reservation has led to considerable rivalry. The summer potlaches in 1969 showed that band and kin groups were attempting to outdo each other in status claims and presentations.

In my first few weeks in the community, I was frequently warned to "keep away from _______. He's no good." I found out later, that many of these warnings were due to rivalries between families and bands, rather than on individual reputations.

Interestingly, the rivalry in the Indian community and occupational sub-culture features among the Anglo-Canadian fishermen led to solidarity among them. They tended to use the same public places, and worked together. Every one of the seiners had mixed crews, regardless of captaincy. It seemed that Indian captains preferred having a 'White' to a member of a rival band or family.

The rivalry was used by one company manager in a very conscious way. He owned a number of seiners, and purposely recruited captains from rival groups. He said that in his experience the traditional rivalries extended to performance at sea, and also avoided the possibility of dominance by a chief/captain. He said that in other Indian fleets, where the captains came from the same band or faction, no one would try to out perform a superior. Also, a traditional chief who was respected by all captains could consolidate his position and fight against the company's authority.

A. Fit of the Fortune Model and Its Transformations

The Fortune model and its transformations were concerned with defining a range of possible fishing contexts which should influence risk-taking in certain ways. Before a test of predictions about risk-taking can be made, it will be necessary to determine if the relationships given in the model and its transformations are valid in Alert Bay.

To do this, we must look at the organization of fishing in the new context. Although there are many factors in common between Alert Bay and Fortune, there are also a number of differences. In order to understand the problems and alternatives facing the Alert Bay seiner captains, it will be necessary to discuss what the similarities and differences are. This will mean not only looking at factors such as environment/resource, boats, and companies, but also factors not present in the Fortune context - a fishermen's union, and a wide range of government regulations.

1. The Department of Fisheries

On the Canadian westcoast, the Department of Fisheries plays a more active role in determining how fish resources will be used. In order to effectively control the exploitation of salmon, the federal government felt it had to make and enforce laws aimed at commercial fishing. The fear was that unregulated fishing would lead to a dangerous decline in the salmon population, as it had with herring.

In order to maintain a viable salmon population, a certain percentage of escapement must be allowed to replenish the stocks. One means of insuring escapement is to restrict commercial fishing.

The predictability of salmon movement allowed the Department of Fisheries to close certain areas to commercial fishing at crucial times of year. Restrictions on time and place are to ensure that a sufficient number of salmon reach the spawning grounds to maintain a population level. At present, salmon fishing is restricted to a maximum of four fishing days per week, and to three or four months per year.

Regulations were also set up to restrict the technology used by commercial fishermen. Specific laws exist which limit size and materials of nets, and the use of certain types of equipment. In effect, some of the regulations have curbed innovation in the industry. For example, prohibitions have been placed on monofilament nets and sonar.

In 1968, the Department announced a new set of regulations aimed at reducing the number of commercial salmon fishermen. The programme involved a new licensing system which restricts the number of boats to those with recorded landings in 1967. Boats with poor fishing records, less than 10,000 pounds of pink salmon or equivalent in one year, receive a 'B' permit. A 'B' permit means that the owner cannot do extensive modifications, sell, or replace the boat (Canada, 1968).

In addition to making laws, the Department is also an enforcement agency. The Department has two permanently stationed officers in Alert Bay, and a patrol boat with a crew of four men. It also has four smaller patrol boats that work in different areas in the straits.

While on patrol, the officers are primarily concerned with data collection and enforcement of regulations. Data on fishing landings is used to determine length of fishing weeks, and possible closures.

To the commercial fishermen in Alert Bay, the Departmental officers are policemen. They argue that most of the regulations do little more than, "fuck the fisherman," and the officers, "don't know a damn thing about fishing let alone fish."

Conflict between fishermen and Department of Fisheries' officers was evident throughout most of the fishing season in 1969. Due to very low fish stocks, the Department was unwilling to make long range forecasts about length of fishing weeks. They preferred to have day-to-day information to ensure that areas were not overfished.

Without long range forecasts, the fishermen felt that they could not plan where to fish, especially if it meant travelling a long distance. Finally, a meeting was asked for by the Indian fishermen. The Fisheries officers argued that the decisions about fishing weeks were out of their hands, and that all they could do is pass on the information.

One of the fishermen said that the whole regulatory system was a waste of time and money in that all it really did, "was save the fish for the damn Russians fishing outside." The officers at the meeting tried to defend the system, but could not convince the fishermen that the lack of long term forecasting was necessary.

2. The companies

There are three fish processing firms with seasonal offices in Alert Bay - Nelson Brothers, British Columbia Packers, and Canada Fish. Although they do not process salmon in the community, they still send local managers and staff to supervise their fleets. The company representatives are there to buy fish, co-ordinate activities, and arrange for services such as docking and repairs.

Not all the boats in a company fleet are owned by the company. Some of them are privately owned by their captains, and others are mortgaged through the companies. Differences in ownership effect the degree of control that a company can exert.

With its own boats, a company has much the same arrangement as Booth Fisheries had with its trawlers. The companies hire captains for their seiners, and the same co-adventure system is used. The only difference is that captaincy is usually given for a fishing season, though it can be withdrawn at any time if performance is too low. As in Fortune, job security and assignment of boats is determined solely by relative performance.

For mortgaged and privately owned boats, job security is relatively high. An owner/captain is virtually free from company control, though he usually stays with the same company in order to sell his catch. He is not obligated to do so, but there are advantages such as use of company docks, loans, and shore facilities. Mortgaged captains do not have the same freedom to sell to other firms. However, relative performance is not crucial to job security as long as payments are met.

Regardless of ownership, income is determined by the landed value of catch and a share system. An owner/captain will receive a share for the boat which means additional income in comparison to company captains. Even on the company boats, captains were encouraged to buy their own nets. This provided additional income from the net share for some of the company captains.

Prestige was established on the highliner system. Owner captains and company captains competed within the company fleet for the highliner position. Oddly, there was no mention of an Alert Bay highliner even though the number of seiners was small.

The limitations on fishing days imposed by Department of Fisheries' regulation, and the absence of local processing plants seemed to lead to less conflict between managers and captains than in Fortune. Without having to schedule production, the company managers wanted maximum catches from each boat.

I could find only one instance of conflict between managers and captains, and that occurred in 1958. Due to unregulated fishing and a large salmon population that year, the firms were constantly glutted. They were forced to put a limit of 2,000 salmon per boat per fishing day. With the Fisheries' regulations, however, this problem did not occur again.

The managers were much more involved with their boats than in Fortune. They all had small cruisers which they used to tour the nearby fishing grounds. They acted as information brokers, telling their captains about fish yields, and often got needed parts and supplies for their boats.

In comparison to Fortune, it could be argued that the lack of conflict between captains and management meant less strain on the captains. Without a scheduling problem, seiners can remain on the fishing grounds as long as the Department of Fisheries permits. One aspect of competition between captains in the same fleet is removed in that staying out is not at the expense of another boat being forced to land early. Similarly, knowing that a glut situation may lead to landings in other ports or not being able to sell at a top price is eliminated. In conclusion, the lack of conflict implies lower uncertainty for captains in terms of performance and rewards which should mean a lower overall propensity towards risk-taking in the fleet.

3. The fishermen's union

The United Fishermen and Allied Workers Union is the major organization for commercial fishermen in British Columbia. All fishermen who are not boat owners are required to belong either to the union, or to the Native Brotherhood.

The major function of the union is to act for the fishermen vis a vis boat owners - especially the packing companies. The union has the power to bargain with the companies and other boat owners over fish prices, working conditions, and obligations for the parties concerned.[8]

The power of the union was seen by many Alert Bay fishermen as too strong. A threatened strike in the summer of 1969 over fish prices worried a number of fishermen. They felt that they were being pulled into a strike by more militant members in other parts of the province. As one captain put it, "My men may have to strike for a price that will give them less than the informal arrangement I've got with one of the cash buyers."

Locally, the union did not seem to be active. Very few of the Alert Bay fishermen belonged to the union, and there was little pressure to make them join. As the local secretary told me, "If I'm on a boat, you can bet that everyone

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[8] See Appendix E for the 1967-68 agreements.

else will be in the union damn quick. I figure that its up to every union man to do the same thing. Nobody bothers much around here though. We all know each other, and really don't need the union to get anything done."

4. The seiners

In Alert Bay, there are ninety-four operating commercial fishing boats. The total is made up of two trollers, thirty-five seiners, and fifty-seven gillnetters. Due to time limitations, and differences in technology, my research was restricted to the seiners.

All of the seiners fished for the three packing companies previously mentioned. British Columbia Packers had eighteen seiners, Nelson Brothers had eleven, and Canada Fish had six. Three were privately owned, ten were company owned, and the rest were mortgaged through the companies.

Due to the presence of three firms in the same port, it is difficult to talk of a seiner fleet, Rather, it appears that the term should be restricted to all seiners fishing for the same company. The company fleet constitutes the primary reference group for a seiner captain in that it is the major group for identification, and for evaluation of performance. As one new captain put it, "I'd like to be the best captain on the westcoast, but the main thing is to do better than everyone else fishing for Nelson Brothers in Alert Bay." He also expressed a feeling much like that found in Fortune, "I don't really care how much I catch as long as its better than the other guy."

Crew organization is much less specialized than on the deepsea trawler. The crew consists of a captain, cook, and deckhands. Both the captain and cook work on deck when the net is taken in, and usually one of the deckhands will take care of the engines.

The captain's main function is again that of decision-making. His primary work area is the bridge, though it is not restricted as on the deepsea trawlers. The crew visit the bridge frequently, and even use it as a relaxation spot. According to Barth (1966:7-8), a seiner captain cannot exercise his traditional authority because seining requires a high degree of co-operation from the crew. In order to get the needed co-operation, the captain allows his men to impinge on his traditional rights.

The exercise of authority is restricted in other ways besides access to the bridge. The captain and crew interact constantly during sets, and are always on a first name basis. The terms captain, skipper, and old man are only used in a kidding fashion.

One Alert Bay captain who had experience on deepsea boats said that he had to make an effort towards this form of equality. He often asked older crewmen for advice, and it was not unusual for them to tell him where he ought to set.

The fact that captain and crew have access to the same sources of information means that a captain's decisions cannot be legitimated in the same way as in the Fortune case. With the same information, crewmen are in a better position to evaluate fishing locations, and criticize the choices made. This implies that the Alert Bay captain will be more concerned with how crewmen evaluate his decisions than the Fortune captain, and that overall risk-taking will be lower. I even observed two cases of crewmen refusing to obey orders from the captain. In neither case did the captain do anything more than refuse to talk to the men. In contrast to this restricted use of authority, Walsh (1967:8) describes what happened to four trawler men who refused to obey a captain's orders. The captain threatened to withhold their shares if they did not return to work, and took them to a maritime court when they landed.

The organization of work on board a seiner centers around the seine. The seine has four main parts - a web or net, a corkline which keeps the web afloat, a leadline which keeps the web perpendicular to the surface, and a purseline which is used to draw the bottom of the web together.

Seining can be either a hunting or movable trapping activity. If fish are sighted, the seine can be used to enclose and capture them. Otherwise, the seine will be set in expected paths of travel and closed as if fish were inside.

A set is made by dumping over part of the seine, which is attached to a skiff operated by one or two men. If the shore is nearby, the skiffline is often tied to a tree or rock to hold the seine in place. After the seine and skiff are released, the seiner moves in a wide arc until the whole web is out. After holding the arc for approximately fifteen minutes, the seiner and skiff come together to form a circle with the net.

When the circle is closed, the skiffmen go back on the seiner and start taking the net in. As the net is taken in, the purseline is drawn, making a bowl from which salmon cannot escape. The size of the bowl decreases as more of the net is taken in. If the number of salmon in the bowl is large, then the catch will be 'brailed', that is, scooped out by a dipnet. If the catch is small, then the remaining bowl will be taken in over the stern and the fish dumped out.

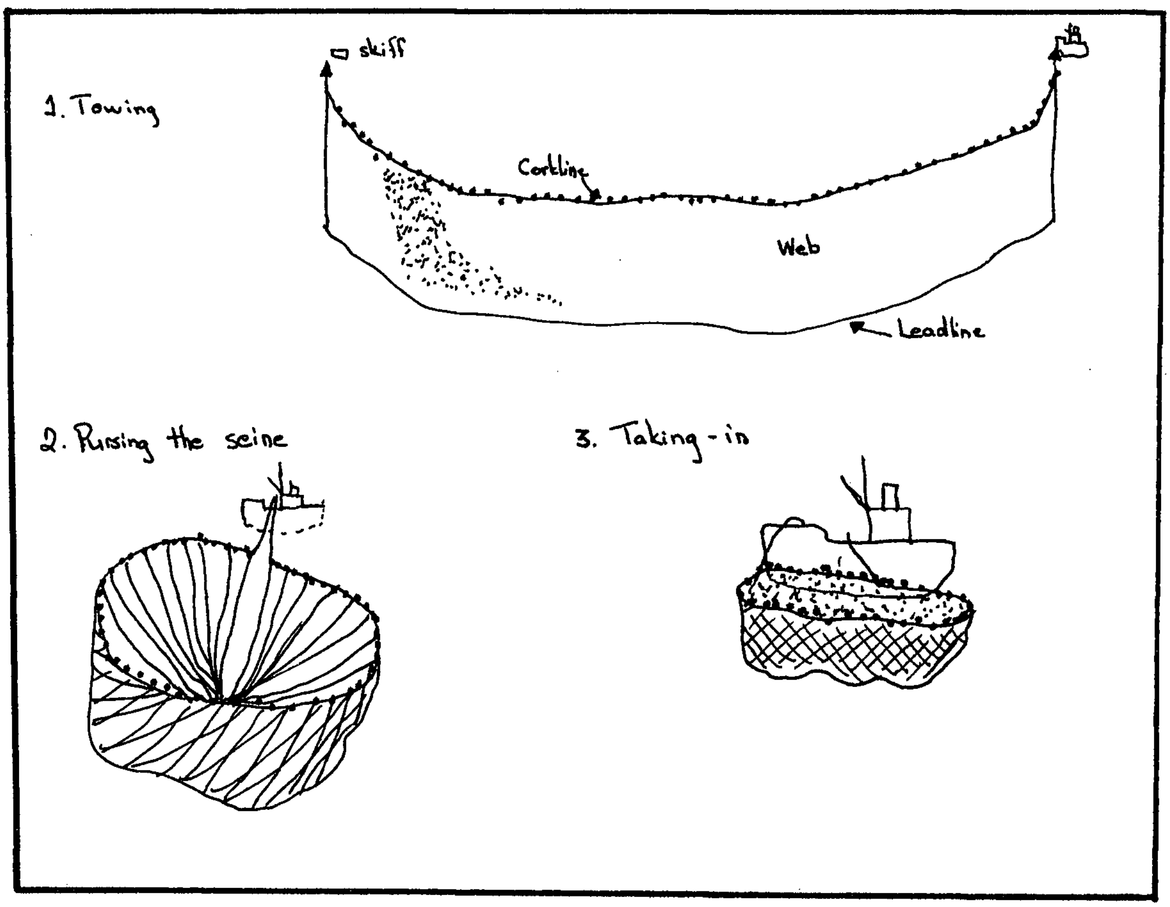

Figure 5: Stages of setting the seine.

The only other major activity performed during the workcycle is 'plunging'. Until the bowl is completed, salmon can escape by swimming under the seiner. To prevent this, a deckhand will plunge a pole or weighted line into the water to scare the fish back. There is some disagreement as to the effectiveness of plunging, though it is done on all the Alert Bay seiners.

The workcycle described above is common to all seiners. There are, however, differences in the time required to complete the cycle. The time differences are due to types of equipment used - powerblocks and drums for shooting and taking in.

On powerblock seiners, taking in is done by a hydraulically powered block. On a drum seiner, taking in is done by winding the seine on a powered drum. The advantage of the drum is that the seine can be taken in in about one-third the time required with a powerblock. A complete workcycle for a typical drum seiner is thirty five minutes, while for a powerblock seiner it is fifty minutes. The differences in time allow for twice as many sets per day, and for greater ease in getting out of trouble when currents are unfavourable.

The drum operation also allows for smaller crews. A seiner with a drum can be operated by as few as three men, while a powerblock seiner of the same size requires at least six men.

Some fishermen argue that the tableseiner can outfish a drum seiner in terms of catch per set. The web used for drum seining is shallower, hence misses deep swimming fish. Although this argument may be valid, the larger number of sets per day more than overcomes any possible advantage of having a deeper net.

Deckhands prefer the drum to powerblock for two reasons. First, there is less manual labour involved with the drum. Second, the greater number of sets and fewer crew mean higher shares per man. The only disadvantage that I ever heard mentioned was that the use of a drum requires a faster workpace. The speeds at which sets can be made means that the crew are always 'highballing' on many boats.

In comparison to the Fortune trawlers, the seiners have much less in the way of informational equipment. Only two Alert Bay boats had radar, and none had sounders with a fishfinder function. The only reason that I can suggest for the lack of locational technology, outside of cost, is that the Alert Bay seiners fish a limited area. With the aid of landmarks and experience, a captain can locate potential spots without using such equipment.

Although all the seiners had at least one radio, they were used much less than in Fortune. It was not unusual to find radios shut off for most of the trip. Captains seldom bothered to monitor conversations. In fact, there was a general dislike for boats that talked among themselves. Alert Bay captains called them 'radio captains', or someone who could not find fish on his own.

If information was exchanged, it normally took place when visiting another boat. I was only able to find three cases of 'buddy' networks in which information was regularly shared. Two were between father and son, and one was between a seiner and a gillnetter. The second is of interest, because the two types do not compete - either in fleet terms, or for fishing locations.

The final major difference between trawlers and seiners is the degree of co-operation required. The relatively small size of Alert Bay seiners (60 feet and under) coupled with a floating type of net often lead to a need for assistance. Changes in wind or current frequently caused boats to drift into their seines. In order to get clear, another boat would have to tow them out.

Any boat not setting is expected to help another boat in trouble. One captain was criticized by his crew for making a set when another boat was in obviously potential trouble. During my period on the fishing grounds, I did not observe a single case of refusal to aid. A few captains, though, felt that many of the problems were a result of captain error rather than circumstances outside a captain's control. They would still help a 'greenhorn', if for no other reason than reciprocity if the situation was reversed.

In some cases, co-operation extended to dominance of a fishing spot. Although salmon are a common property resource, seining permits a degree of control. Unlike trawling, seining does not mean moving through an area. A set requires holding a fixed arc, which is then closed. Three or four seiners can co-operate by taking turns in the same spot. Newcomers would be kept out by having to wait their turn, which would mean too much non-productive time. Violation of the turn system is handled by setting within the violators arc (corking). Corking is a means of effectively cutting off fish before they can get into another net.

Corking was seen as legitimate only if someone stepped out of turn, or corked another without reason. Occasionally, though, corking did occur when large salmon schools were spotted. As one captain said, "Its alright to be a gentleman when there's nothing going on, but if you see a school then its every man for himself. I remember seeing nine boats all corking each other. It took three hours for everyone to get their gear in."

With the exception of above, seiner captains are as competitive as in Fortune. The co-adventure system and importance of relative performance lead to many of the same attitudes which inhibit co-operation. In fact, the fixed nature of setting means possibly more competition since particular locations can be controlled to some degree.

5. The salmon resource

The Pacific salmon (onocorhynchus) is the main genus fished by the Alert Bay seiners. Within the genus are five species (Carl,1964:25-32) - sockeye (nerka), pink (gorbusha), coho (kisutch), chum (keta), and chinook (tschawtscha).

Sockeye is the most prevalent species in the Alert Bay area.

Salmon are anadromous, living in both fresh and salt water at different stages in their lifecycle. They are born in fresh water streams, and generally remain in fresh water lakes and rivers for the first year. In spring, the fingerlings move to the sea, where they remain until maturity (2 to years depending on species). At the end of their lifecycle, they return to their streams of origin to spawn (Canada,1967).

Alert Bay fishermen can estimate the relative quantities of a given species that will pass through the straits in any particular year. The quantity depends on the number spawned at the start of that generation. The peak year of 1958, for example, was dependant on the numbers spawned in 1953. Similarly, the poor fish runs in 1969 were expected - with the predictions based on knowledge of the 1964 spawning. As a general rule, fishermen know which years will be the most productive, and which the least.

The fact that salmon return to their streams of origin means high predictability about productive fishing areas. Most salmon fishermen follow the migration paths of different species, starting in River's Inlet and moving south during the summer and fall.

Knowledge about feeding and migration also allows the commercial fisherman to predict the best times and places to fish. Salmon are thought to move with the tides, and remain still when the tide is slack. Many captains do not bother making sets when there is no current.

Even though captains know the general migration paths and when fish are likely to be plentiful, there is still uncertainty about differences in yields in various locations. Any given fishing area will have a number of possible setting spots, which means a wide range of choice.

In addition to characteristics of salmon themselves, there are other natural signs that can be used to locate salmon. The presence of food such as herring is used by many captains as a sign that salmon are nearby. Similarly, the presence of natural barriers that might interrupt salmon travel are often used to locate fish. Salmon are thought to travel along the shoreline in different areas, and the presence of land spits or kelp beds are seen as providing natural weirs directing salmon back to more open waters.

The one sign that all captains used and agreed on was the presence of 'jumpers'. Salmon tend to travel near the surface. Occasionally, salmon will jump above the surface. Captains use this sign to locate schools, although there did not seem to be any correlation between number caught and number sighted.

Alert Bay captains talk about making 'blind' sets most of the time, that is, they have no specific information about fish location (jumpers). For the problem of risk-taking the existence of natural signs means that seiner captains operate under varying levels of information or uncertainty. When fishing blind, they are under much the same sort of constraints as the trawler captain. When jumpers occur, however, they do have specific information. The difference in using the seine as a hunting rather than movable trapping technique is related to the level of information. If the conclusions drawn from the Fortune model are correct, the varying levels of information should lead to varying degrees of risk-taking, even for the same captain. Predictably, risk-taking should increase with an increase in information.

6. The environment

The British Columbia coast is suited for supporting a large salmon population. There are thousands of streams and rivers, a high annual rainfall, and a well sheltered inside coastline. Within fifty miles of Alert Bay alone, there are over eighty productive spawning grounds.

An understanding of the commercial fisheries must, however, take into account the artificial environment created by the Department of Fisheries' regulations. In fact, it can be argued that the seiner is more of an adaptation to legislative constraints than to natural ones. Outlawing commercial fishing in the spawning rivers, and the use of fixed traps and weirs, has forced the contemporary fisherman into the straits where seining is necessary. Rather than acting as trappers in areas of known fish movement, they are forced to hunt and trap fish in areas with much less information about fish location.

Changes in fishing times and open fishing areas makes it difficult for captains to make long term decisions. During the 1969 season, the normal procedure was to post opening times and places two days before fishing began. On a number of occasions, the week was limited to one fishing day.

Although the seiner is designed for mobility, the absence of longrange forecasts tended to prohibit movement outside of the Alert Bay area. Factors such as fuel and food costs required higher yields to make such moves profitable.

One captain had planned for over a month to go fishing further north. He did not go because he had no information about openings and length of fishing weeks. As he put it, "Its like having a set of scales. If I knew that we'd get even three days next week it would be enough to tip the balance. I'd go north in a minute. The way these bastards have been operating, its just as likely that they'd close the whole thing and we wouldn't make a dime."

It may be argued that the government regulations and lack of long term forecasting have eliminated many of the advantages of the environment/resource base. The predictability of salmon locations is offset by restrictions on time and place of fishing. Seining appears to be more of an adaptation to a social rather than natural environment. The government's policy forces the seiner captain to make choices in an environment with generally low levels of information.

In conclusion, the Fortune model and its transformations can be seen to have a reasonably good fit with the Alert Bay fisheries. The same factors of evaluation by performance, information from environment/resource base, and capability determined by type of boat apply in both contexts.

The major areas of difference between Alert Bay and Fortune are the result of two organizations - the fisherman's union, and the Department of Fisheries. The union provides the commercial fisherman with greater control over work and more job security, as well as higher income than in Fortune. The fact that the union was not active locally appears to limit any potential effects it might have on the role of captain and his decision-making. The Fisheries regulations seem to have two areas of influence for captains' decision-making. The licensing system means that a minimum level of performance is required for all captains, even independant owners. Losing an 'A' certification would inevitably lead to leaving the fisheries due to limitations on upgrading technology and replacement of boat. The second area affected by the regulations is the environmental restrictions which lead to a general low level of information and limitation on range of alternatives. The restrictions force the seiner captains into a higher level of risk-taking than the environment/ resource base would in itself.

Two minor areas of difference between Fortune and Alert Bay not identifiable by the transformations are the low level of conflict between companies and fishermen, and the lower use of authority by captains in relation to crew. Potentially, these two factors should lead to an overall lower level of risk-taking.

Before going into the linkages and testing of predictions from the Fortune transformations, it will be useful to look at a few examples of the decision problems facing the seiner captains and the choices that were made. The examples selected are not to be viewed as representative, but rather as ideal cases to highlight alternatives and production strategies.

B. The Decision Problems for Seiner Captains

The Alert Bay captain is faced with essentially the same problems as the Fortune trawler captain. Although the environment, resource, and technology differ he still must decide where and how to use his equipment and labour. Captains in both places must select from a range of possible locations, and their decisions coupled with the capability of their equipment determine to a large degree overall performance.

Decisions about where to fish for the most part involve short term commitments. The constraints imposed by the Department of Fisheries tend to work against movement away from Fortune. Most fishing is done within twenty miles of Alert Bay.

Choices of actual fishing spots by seiner captains involve more precision than with trawling. First, seiners fish a spot rather than tow along a course. Second, the fact that the seine floats means that it is more subject to damage - especially when fishing near the coast. Reefs, rocks, and currents are part of the environment. Casting too near such obstacles or making the wrong arc with the seine can readily lead to net damage. It is unusual for a seiner to be out more than two days without having to replace parts of the seine or do major repairs.

The number of alternatives in any given sub-area are fewer than for deepsea trawling. Through past experience captains know which spots in an area will be productive, and which ones never have fish. Similarly, an area will have many locations which cannot be fished at all due to bottom conditions. As a general rule, captains share the same body of knowledge about productive locations, that is, where the fishing spots are. Personal experience, and evaluations of these alternatives differ as will the decisions made. Most captains tend to favour certain sub-areas and spots, and have fairly consistent fishing patterns. Some understanding of differences in fishing strategies can be gained by analyzing the risk element. It will be argued later that the captain's agree on evaluative criteria for selecting locations and determining risks. The interesting problem, though, is that they do make different choices when faced with the same alternatives.

1. A high risk captain

One consistent high risk taker was a young Anglo-Canadian captain for B.C. Packers. He fished on a company owned boat which was technologically inferior to the others in the fleet. Although it had a drum, so did the others in the fleet. Its drum was an older mechanical/hydraulic type which was prone to breakdown. The work area on board was limited, and the drum arrangement made net repairs and fish removal difficult. In terms of relative capability, his boat was inferior to others in the fleet.

The captain seemed to be more concerned with performance than other captains in the fleet. It was his first year as a captain, and he knew he had to prove himself to the company. He wanted to build a reputation which would allow him to keep his captaincy, and hopefully get a better boat in the next year. As he put it, "If I don't do well this year, I'll probably be stuck with the same boat again. What I'd like to do is catch enough so that I can ask for a better boat when the time comes."

He also realized that his performance was important for other reasons than job security and boat assignment. He had trouble getting a crew in his first year, and had to go one man short most of the season. He knew that a bad year would make it that much more difficult to get good men in the following year.

Income was important too. He had made a down payment on the seine, and needed a good season to keep it in repair and make payments.

Power over his crew was another consideration. He wanted to get the boat in good condition, and he knew that the company was reluctant to put money into it. To get things done, he and the crew had to do most of the work.

He could do it only when he was able to convince the crew that it was to their benefit. Most of the work had to be done during 'closures' and without pay. He found that, "When we're doing well, I can ask tham for anything. When we have a poor week, I might as well forget it. The way I operate now is to keep a list of things I want done to the boat. When we have a good week, I can get them to get two or three things fixed. Maybe by the middle of the summer I'll have a good boat."

He was very aware of relative performance, both seasonally and within the fleet. "Its funny, this year we're going after fish that we'd have turned our noses up at last season. I can remember times when we wouldn't bother to set unless we could braille." Similarly, the company fleet was his reference group for evaluating performance, "I don't give a shit about how many I catch this year. I know its going to be a bad season. You've got to make a hundred dollars a day to make it worthwhile, and we won't get anywhere near that. As long as I catch more than the other guy I'm alright. I don't give a damn if I only catch 200 fish as long as everyone else only lands 100."

One aspect of his fishing strategy was concern over collecting information. Three times during the 1969 season, I went out with him the day before fishing began. The purpose of the trips was to scout for likely fishing spots near

Alert Bay. We would cruise through different sub-areas looking for jumpers, and checking currents. He generally followed the same pattern on opening day by going out ten hours early and cruising again.

The information that he collected during these trips was used to select a sub-area for opening day. The amount of information collected varied considerably. Often there were no jumpers, and weather conditions might change just before fishing started. The cost of scouting was low, though. Going out during closure did not mean losing fishing time. The only real cost was fuel, and this was low since he seldom travelled more than thirty miles.

As an example of his decision-making, one week of fishing will be referred to. The sub-area he selected was Parsons Bay. He was embarrassed about fishing there because of its reputation. Locally, it was called the 'old man's home' since it had one very safe and reasonably productive spot. The crew kidded him about being there, and he said we would move if it did not turn out as he expected.

In Parsons Bay, there were four possible fishing spots, as shown in Figure 6. Experience had shown that other spots were either non-productive, or had too many obstacles such as reefs or rocks.

Spot 1 was the 'old man's home'. It had a reputation as being a steady producer, if salmon were in the area at all. Spots 2 and 3 were seen as the next most productive, though they were more dangerous to fish due to nearby rocks. Spot 4 was viewed as the least attractive spot to set. A shoal ran off the corner of Red Point, and it was open to winds from the straits. Fishing this location was seen by many captains as one of the most dangerous in the Johnstone Strait area.

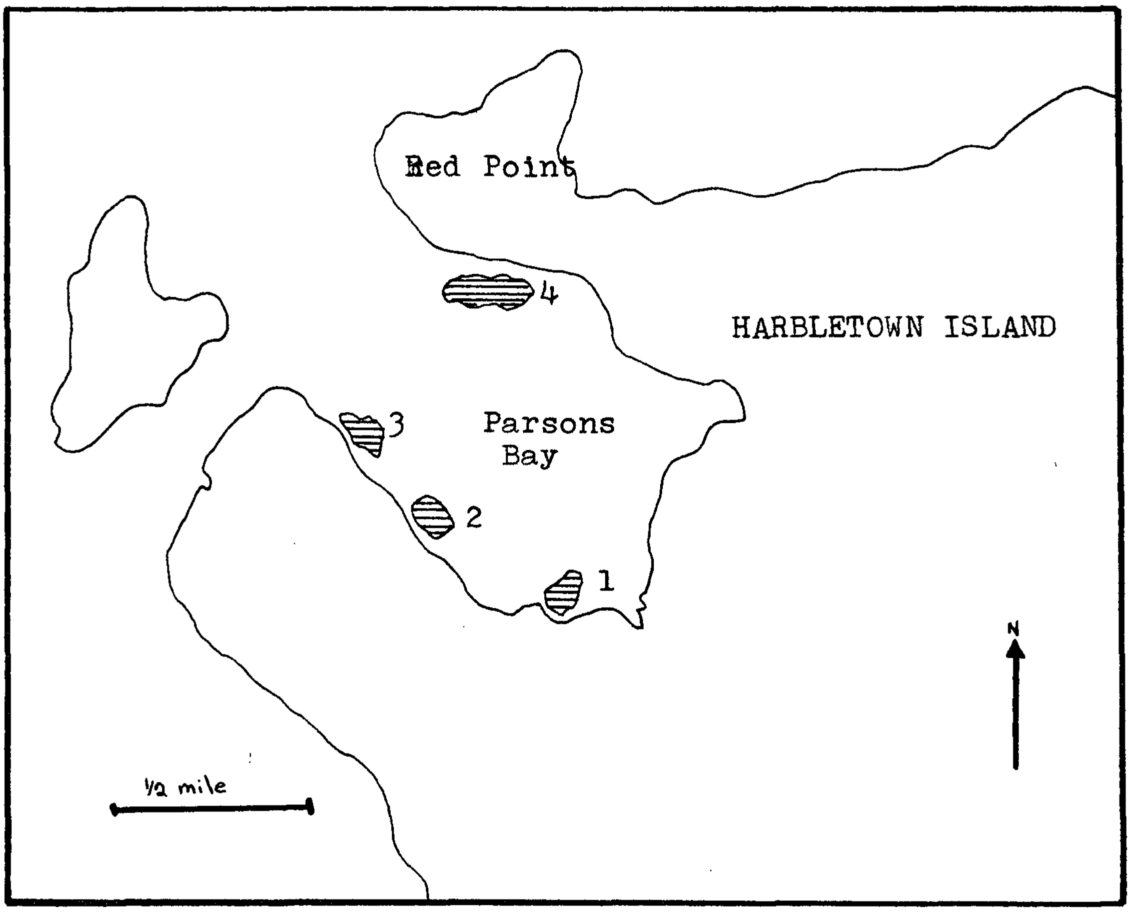

Figure 6: Parsons Bay and productive spots.

Without competition, spot 1 would be every captain's first choice. With the exception of three Alert Bay captains, none of the others that I observed would fish any other spot if they came into the bay.

The high risk captain would only fish in spot 1 if there were less than three other boats taking turns. When there were more, he would move to another spot and fish until spot 1 was free again. Since only one boat could set at a time, each boat had to wait its turn. With three boats in line to set, there would be approximately one hour between sets. Time between turns was totally non-productive since moving out of line meant losing one's place.

On one occasion, a newcomer to spot 1 had his turn after the high risk captain. To make the spot seem unattractive, he would make a set as far down on the spot as possible. This meant that whoever followed would have to set in the kelp when his turn came up. After two such sets the newcomer left because each set fouled his net with kelp and was non-productive.

Another time, the high risk captain consciously restricted access to information for other captains. A newcomer will generally watch other boats taking in to determine the yield of a spot without having to wait for a turn. Twice, the high risk captain positioned his boat so that the newcomers could not see how much was being caught. He was able to discourage both newcomers from staying around, arguing that they were not willing to wait an hour before they could set and find out if the spot was any good.

Whenever there were more than three boats in spot 1, and it looked as if they planned to stay, he would move to one of the other locations. Since 'the old man's home' was popular, it meant that we made over half our sets in one of the other locations.

The captain argued that movement to a more dangerous and less productive location made sense because we did not have to wait for a turn to set. Even though catch per set was lower, overall intake would most likely be higher. Also, he felt that sitting around and waiting for a turn to set was frustrating, "I can't stand sitting around like this. I'd rather be setting every half hour and catching less, than sitting here doing nothing. The week is so short that I want to highball every minute that we can." As with many other captains, he felt that the short fishing times were a major limitation on performance and income.

The government regulations resulted in commercial fishermen having to earn enough for a year out of four months of fishing. Many were forced to go deepsea fishing in the winter months, or work in logging camps in poor performance years.

Spot 4 presented an interesting case in risk-taking. The captain knew that the chances of gear damage were high, "I've fished that spot more than anyone here, and I think I'm lucky if we get one set out of four without something going wrong." At the beginning of the season, he had made sets there to learn how the seine should be arced to handle the currents and avoid the reef. He even kept a log of each set, giving the tides, direction of currents and winds, the seine's arc, and total catch.

On our second day in Parsons Bay, we were fishing spot 3. There were gale force winds in the straits, but the captain still kept looking over to spot 4. Finally, he said, "Damn it I know there are fish over there. The tide is right, so they have to be moving by the point." He was able to convince another captain to take his boat over - "We've got some insurance now. If anything goes wrong we can help each other. The only thing I don't like is that I'll have to show him how to set."

As it turned out, both of us got into trouble. The other captain set first, but could not close his seine due to the winds. We finally had to throw their skiff a line, and tow them to the seiner. When we set, the same thing happened. We were able to close the net, but the current forced our boat into the net so that we could not take in. Our captain decided to make another set even after the other boat had gone. His skiffman refused to go out at first, but was finally convinced to make one more set. The same thing happened again, although we were able to clear ourselves without assistance. Our captain wanted to make a third set, but the crew refused so we went back to spot 3.

Another kind of high risk-taking occurred on closing day. Fishing was poor that afternoon, and many of the seiners had returned to Alert Bay. Our captain decided to stay, and we shared spot 1 with two other boats. As he said, "I'd rather stay here and get three fish a set than to go back early and get nothing."

Around five p.m., fishing improved and the boats in spot 1 were catching forty salmon per set. We had last set approximately forty-five minutes before closing time. The other two seiners left, assuming that neither would have time to set before the 'gun' was fired. When we finished our set, there was twenty minutes left in the fishing week.

Instead of leaving, our captain decided to make one last set. This was a high risk decision, in that fishing even one minute after closing meant a violation of Fisheries' regulations. Any boat caught with a net in the water after closing would automatically lose its catch on board, and probably would receive a fine. By deciding to set again, the captain was risking over two hundred salmon for a chance of catching forty more. Even under optimal conditions, it is difficult to make a set in less than half an hour. A single mistake or a broken line could extend the time considerably. As it turned out, we finished taking in two minutes before closing. Five minutes later, a patrol plane flew over Parsons Bay looking for violations of closure time.

This captain seemed to be a high risk-taker, both in attitudes and behavior. His fishing strategy reflected a concern with maximizing performance regardless of costs. If he thought we could catch more in the long run, he would set in spots that were dangerous to gear. His attitude can best be summed up by one of his own comments, "If you're going to be a highliner, you've got to fish. You go where the fish are and stay as long as you can. Fishing is a gamble. I love the competition and the chances you have to take. If it wasn't for the gamble, I don't think I'd want to be a fisherman."

2. A low risk captain

The second captain was a Kwakiutl fisherman who had fished commercially for over forty years. During this time, he had worked from canoes, gillnetters, and all types of seiners. His background led to a reputation as one of the most knowledgable captains in Alert Bay.

From the stories that I heard about him, he had 'discovered' many of the best fishing spots in the Alert Bay area. When he was younger, he had a reputation as a real gambler. He would try out new spots just to see if they were productive, and try out ways of setting which might be successful.

At the time that I met him, his earlier reputation had changed. He was known as a cautious skipper, one who did not take any chances if he did not have to. After spending four days on his boat, I concluded that his new reputation was deserved. Virtually all of his choices were low risk alternatives.

He owned his own seiner, and had refitted it in 1968. The modifications included the latest hydraulic drum, a high speed marine engine, and a radar set. After investing twenty thousand dollars in his boat, it was the best outfitted in the company fleet.

Verbally, he was against these changes. "I think the Fisheries people should not have allowed drum fishing. You catch too many fish with it, so they have to cut down on fishing days. I don't think any of us are really better off." Most of the Alert Bay seiners already had drums, and he was one of the last to convert.

In addition to his own seiner, he owned one other which was captained by one of his sons, and had half share in another. Also, he did test fishing for the Department of Fisheries - giving him another source of income. Many of the local fishermen were irritated by him receiving the contract. They felt that he needed it least of all, and had got it through favouritism.

During the week that I spent with him, we fished in Johnstone Strait - about twelve miles north of Alert Bay. In the sub-area that he selected, there were two possible spots to set, as shown in Figure 7.

Spot 1, directly off Soldier's Point was a safe area. The point gave protection from currents, and the bottom was sandy. Spot 2, which was a larger area in the middle of the strait was more dangerous, and had more fluxuation in yield. The currents through the strait often made sets difficult. The main channel was also used by a large number of larger boats and barges. The amount of traffic often meant that sets had to be taken in quickly, and there was a danger of nets being run over.

During that whole week (four days), the captain did not leave spot 1 expect on two occasions. Since the spot was seen as a 'safe' location, we had to share it with a number of boats. For two afternoons, the number was up to six, and never dropped below four. Frequently, the waiting periods were two hours between sets, and I overheard one crewman say, "I don't mind a break once in awhile, but all this is is a picnic." The impression I got from the crew was that they stayed with the boat because it meant easy money. The contract with the Department of Fisheries gave them a weekly income regardless of catch.

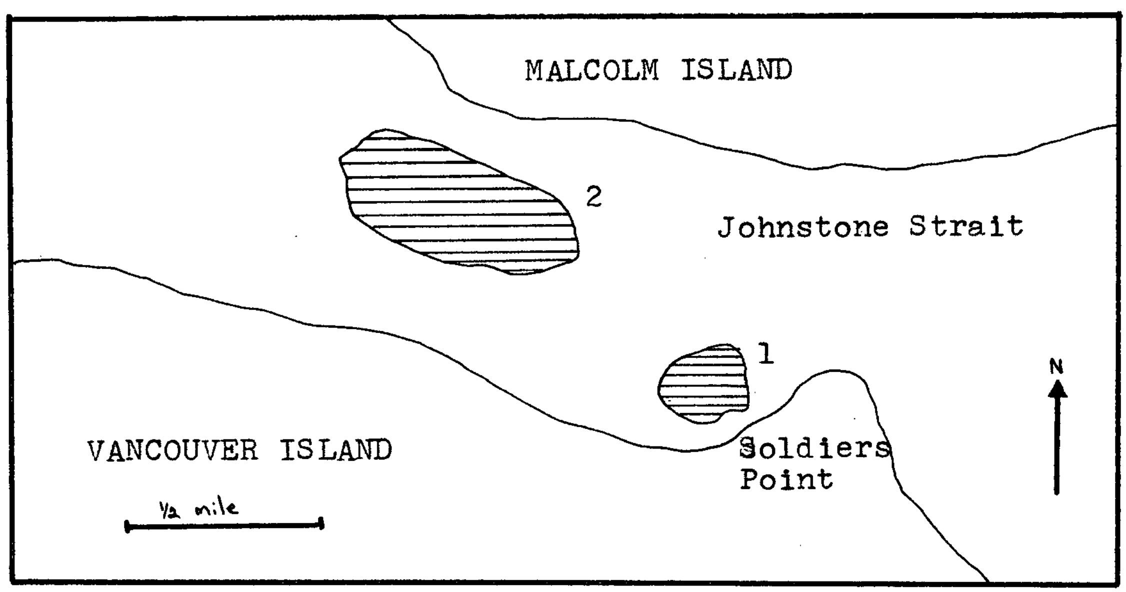

Figure 7: Fishing spots in the Soldier's Point sub-area.

Even in the relative safety of the point, we took lower risks than other boats. When the tide was strong, the captain made 'half' sets which kept us within the shelter of the point. By only letting out half of the seine before towing the arc, the net would not extend beyond the point.

In comparison to one of his sons who fished in spot 2, we made less than one-third the number of sets per day. His son averaged twenty sets per day, while we made six. Our catch, though, was only twenty percent lower than his sons for the same time period. This indicated that the yield for spot 1 was much greater than spot 2 - the difference in performance being a function of the number of sets made.

The only deviation from a low risk strategy occurred when our captain spotted 'jumpers'. The first time was when we were returning from unloading fish at a company packer. Although we were in spot 2, the captain decided to made a set. Ironically, our catch was three salmon - the number of jumpers spotted.

The second time, one of the crew spotted a jumper while we were waiting for a turn in spot 1. We went out, and caught thirty salmon, though we had to be towed free from the net by another boat. When I asked the captain about how good an indication jumpers were, he said, "Its the only one you see. You know something is out there so you go. Any other time, and you just guess where they'll be."

A final instance of his relative lack of concern about performance was the fact that we left the fishing grounds four hours before closure. The captain said he preferred getting back early to avoid waiting in line to unload. The best description of his fishing strategy during the 1969 season was a comment by another captain, "He doesn't have to take chances now. He has a good boat and so do his sons. Why should he run around? He knows all the good safe spots, and doesn't do too badly."

3. High risk/low risk

The final example to be discussed is interesting because it points out the effects of differences in fishing contexts on risk-taking. The captain concerned had just made a mortgage agreement with one of the companies for a boat. He wanted to have a good year in order to make payments, keep up his boat and gear, and have enough left over to do modifications after the season closed. With low expected runs for the season, he knew this would be problematic - "I really won't be my own boss until I get the boat paid for. If I'd been smart, I would have waited for next year. This season I'll be lucky to make expenses."

In the commercial fishing context, he used a high risk strategy much the same as the captain in the first example. He fished in spot three when we were in Parsons Bay, and avoided spot 1 because there were too many boats taking turns. Similarly, he never stopped fishing even when the water was slack. Other boats would be anchored during slack tide, but he still made sets. When I asked him why we were the only ones fishing in that area, he said, "I guess they can afford to sit around. Maybe they know more about salmon than I do. You never know when they will come by."

Two days after a closure, he applied for a food fishing permit from the Department of Fisheries. The permit is issued to Indian fishermen as a traditional right. The fish cannot be marketed, and is supposed to be used for food only. The normal practice in Alert Bay is for one boat to go out each week and fish for a band. The catch is distributed, and is generally either smoked or canned.

On the food fishing trip, we made six sets and all of these were in relatively low risk locations as far as potential for gear damage was concerned. Much of the trip was spent cruising around looking for jumpers. The crew brought beer with them and everyone drank while we made our sets. The captain kidded around with everyone and even went out on the skiff for one set. His wife and children came out with us, which he would not allow when commercial fishing.

The marked difference in his fishing strategies in the two contexts indicates that different sets of constraints were involved. He saw food fishing more as a duty to his band than as a means of achieving any particular goals. A food fishing catch does not provide income, security or prestige. Since he only kept a few fish for himself, which he could do when commercial fishing, it could not even be viewed as a major source of food.

In the commercial context, the constraints differed. Catch was important in that it meant income, prestige, and keeping his boat, as well as crew commitment. In so far as catch was important, he was motivated to use his boat in a different way while commercial fishing - as indicated by his high risk strategy.

C. The Testing of Predictions About Risk-Taking

In the previous sections, an attempt was made to determine if the specific relations between components given in the Fortune model were applicable to the Alert Bay context. The components were: (1) Information: The primary sources of information about yields of different locations were 'jumpers', and observing the performance of other boats. The environment/resource provided some information which seemed to be a common body of knowledge among captains - when particular areas would be most productive, what times should be most productive, and which spots were dangerous or safe. Differences in level of information about actual fish location referred to spotting jumpers, or if one could see the catch made by another boat. For the risk-taking problem, this means that a captain could be operating under different levels of information - high level of information when he knew that fish were in a spot, and low level of information when he could see neither jumpers nor other boats' catches.

(2) Performance (landed catch): As in deepsea fishing, performance is a result of strategy and type of boat. The type of boat (drum or powerblock seiner) determines the capability for catching fish, and strategy determines how the capability will be used. The example of the low

risk captain is a case in point. Although he had a drum seiner, and his son a powerblock, the son outperformed by making more sets in the same period of time. His decision not to fish in a spot requiring taking turns meant that he could catch more even though his boat had much lower capability.

(3) Evaluation: Evaluation both by companies and fishermen, was primarily by relative performance measured in landed catch. Captains' reputations generally referred to how much they caught, with temperment and ability to get along with a crew being secondary. The presence of the highliner system is indicative of the emphasis placed on relative performance within a company fleet.

(4) Rewards: With the highliner system of evaluation, captains were differentially rewarded. Income was based solely on landed value of catch, as was prestige. For company owned boats, job security and boat assignment were determined by relative standing in the fleet. Crew evaluation of captains, which influenced which boats they went on, was primarily in terms of relative performance. With the exception of differences in size of crews on drum and powerblock seiners, going out on a high performance boat means higher crew shares.

The reward system, and differences in boat ownership should have implications on motivation. An owner/captain will receive a higher income (given equivalent catch) than a mortgage captain or a company captain. Income for a mortgage captain should be more important than for a company or owner captain since it must be used for mortgage payments as well as keeping up the boat and gear. Regardless of performance, owner/captains and mortgage captains have similar job security as the high performance company captain. Differences then, in relative standing and boat ownership, should lead to differences in the importance assigned to performance. A comparison of the high and low risk captains shows that the low risk captain was not as concerned with maximizing catch. He owned his boat, and had additional income from shares in two others and a government contract. The high risk captain had to prove himself to the company, wanted a better boat, and was worried about crewing. Motivationally, this should mean that some captains will take higher risks than others, depending on their position in the fleet and ownership of boat.

(5) Capability: The type of seiner influences a captain's ability to catch fish. The drum seiner allows for much faster workcycles than a powerblock seiner, hence greater catching potential. Since there are three company fleets, differences in capability should be determined relative to membership in a single fleet. The company fleet constitutes the primary reference group for comparison of performance, identity, and assignment of certain rewards such as prestige. Two of the companies had roughly equal numbers of drum and powerblock seiners. In the two fleets, captains with drum seiners can be regarded as having higher capability than captains with powerblock seiners. In the third fleet, only twenty percent of the seiners were powerblock. In this case,

it seems more reasonable to classify captains with drum seiners as having equivalent capabilities, while those with power-block seiners having lower capabilities.

1. The Alert Bay combinations

From the above, we can determine which of the Fortune transformations have empirical referents in Alert Bay. The six which were isolated provide testing situations for the predictions about risk-taking. Captains were classified as being in one of the combinations generated from the Fortune model by using: (1) Level of information: A captain can be classified as operating with high information if there were 'jumpers' or he could see the catches of other boats in different spots. If neither of these information sources were available, then he is operating with low information. Since some captains argued that knowledge of the fishing areas and spots was common to all captains, no differentiation was done on the basis of experience or reputation.

(2) Motivation: Relative standing in a company fleet, and boat ownership can be used to determine expected motivation. If a captain owned his boat, then he should be less motivated towards high performance than non-owner captains (mortgaged boats or company boats). Among company captains, relative standing should be important. A captain with high standing should be less motivated to increase his standing than a low performance captain.

(3) Capability: Capability is relative to type of seiner in the context of a company fleet. In two of the fleets, captaincy of a drum seiner means higher capability than captaincy of a powerblock seiner. In one fleet, drum seiners represent equal capabilities, while powerblock seiners are lower capabilities.

Combining the states of each component gives us the following six transformations, which could be isolated in Alert Bay:

TABLE 3

TESTING SITUATIONS IN ALERT BAY

Combination	Level of Information	Level of Motivation	Capability	Predicted Risk
2	High	High	Equal	High
3	High	High	Low	High
4	High	Low	High	Low
8	Low	High	Equal	----
9	Low	High	Low	High
10	Low	Low	High	Low

2. The tests

Out of the population of thirty-four seiner captains, I was able to classify and make observations on twenty-four.[9]

[9]See Appendix F for discussion of classification and determination of risk-taking.

Rather than using captains as the units of analysis, I decided to use the decisions themselves. Classifying captains as high or low risk takers would mean referring to their decision-making, and using an arbitrary cut-off on the proportions of high and low risk-taking. The propositions refer to propensity towards risk-taking with certain combinations of factors, hence should apply regardless of the captains concerned. Finally, the limited sample size in each transformation, if captains were used, would preclude statistical treatment and interpretation of results.

Two tests were performed on the Alert Bay data. The first was testing the particular predictions made about risk-taking under each of the transformations. The second refers to the implicit ranking of the transformations as to their risk inducing tendencies. For both tests, non-parametric techniques were used since there was no reason for assuming a normal distribution of decision-making.

a. <u>Within Transformation Test</u>

Each of the six transformations predicts a propensity towards either high or low risk-taking. One way of viewing the problem is to say that the total number of decisions observed constitutes a population with two discrete classes - high and low risk. The transformations constitute criteria for selecting samples from that population. The proportion of high and low risks in each 'sample' can be compared with the proportions in the total population of observed decisions. If the two proportions (sample and population) are significantly different, and the difference is in the predicted direction, then it can be assumed that the transformation tells us more than could be learned by just looking at the total population of decisions.

The proportion of high and low risk-taking under each of the transformations are shown below:[10]

TABLE 4

DISTRIBUTION OF RISK-TAKING BY TRANSFORMATION

Combination	Number Observed Decisions	Number High Risk	Number Low Risk
2	55	42	13
3	41	36	5
4	189	140	49
8	106	45	61
9	262	174	88
10	643	230	413

Since the classes of decisions are discrete, and direction of risk-taking predicted, a binominal test was used, with a one-tailed z score to determine if the differences in proportions between the population and 'sample' was significant

[10]See Appendix G for population breakdowns.

(Siegel,1956:41-42). The computation formula is:

$$z = \frac{(x \pm .5) - NP}{\sqrt{NPQ}}$$

with x= the number of high risks
N= total number of observed decisions
P= .51 (proportion of high risks taken in the population)
Q= .49 (proportion of low risks taken in the population)

The results of this test were:

TABLE 5

TEST OF PREDICTED RISK-TAKING IN THE TRANSFORMATIONS

Combination	Prediction	P	p	z	Significance
2	$P < p$	.51	.76	3.5	$< .002$
3	$P < p$	.51	.88	4.5	$< .001$
4	$P > p$	.51	.74	-6.1	$< .001$
8	$P \approx p$	.51	.43	-.06	$> .05$
9	$P < p$	.51	.66	4.9	$< .001$
10	$P > p$	.51	.36	4.4	$< .001$

The results indicate that all of the predictions, excepting combination 4, can be accepted. The difference in the proportion of high risk-taking in combination 4 compared to the proportion in the population was significant, but in the wrong direction.

b. Ranking of Transformations

Implicit in the set of transformations derived from the Fortune model was the assumption that the greater the number of high risk inducing components, the greater the proportion of high risk-taking. This means that the transformations can be ordered in terms of their risk inducing propensity. Using the total scores given in Table 2 for each combination, the six transformations can be ranked for expected proportions of high risk-taking. The expected ranking can then be compared with the actual ranking, determined by the actual proportion of high risks taken under each transformation as shown in Table 5.

The test used to determine if the expected and observed rankings were significantly different was the Wilconon Matched-Pairs Signed-Ranks Test (Siegel,1956:75-79). The test is useful in that it tests for relative magnitude as well as direction of difference.

The T=3 does not allow us to reject the null hypothesis that expected and actual rankings are the same. If combination 4 is removed, then the ranking is in fact the same. The results imply that the set of transformations tell us something about differences in propensity for high risk as well as direction of risk-taking.

TABLE 6

EXPECTED AND ACTUAL RANKING OF TRANSFORMATIONS

Combination	Expected Rank	Actual Rank	d	Rank of d	Rank with less frequent sign
2	5	5	0	-	-
3	6	6	0	-	-
4	2	4	+2	+3	3
8	3	2	-1	-1.5	-
9	4	3	-1	-1.5	-
10	1	1	0	-	- (T=3)

CHAPTER IV

CONCLUSIONS

The Alert Bay field test indicates that the Fortune model and transformations do have explanatory and predictive value. The results, however, are in no way conclusive. In order to accept the findings, the sampling and classification of risks must be validated.

There is no reason for assuming that the decisions observed are representative of the total number of choices made by Alert Bay captains about how and where to use their equipment and labour. The fact that I could only get on certain boats for short periods of time, and could only visit certain areas near Alert Bay means that the sample is probably biased. Disconfirmation of the prediction from combination 4 appears to be due to sampling, in that I can think of no other reason for the higher proportion of high risk-taking.

Similarly, my classification of decisions into high and low risk was problematic. The risks taken are in no sense discrete, but rather differ in degree. Only in an area like Parsons Bay was I able to rank the alternatives in degree of risk, and even then changes in fish yield and weather did effect rankings over time.

The indicators used to determine if a location were high or low risk were derived from the captains themselves. Although there appeared to be agreement as to the meaning of the indicators by all of the captains that I talked to, they still are subjective rather than objective evaluations of risk. As much as possible, I tried to validate the classifications by using actual yields, damage to gear, and crew attitudes. It may be, however, that the model is more concerned with accounting for captains' conceptualizations of environment and risk, than with actual states of environment and risk.

The field test is suggestive though, not only for accountability of risk-taking, but for many assumptions underlying the model and approach to the problem. It is in these areas that the Alert Bay case has the most implications.

1. Type of explanation

The Fortune model and its transformations was built on the assumption that situational factors could be used to account for variations in risk-taking. Clearly, there are other types of explanation that could have been used. Aronoff (1967) uses personality variables to explain social organization of fishing in the West Indies. Similarly, many decision theorists regard risk-taking as a personality component.

The usefulness of social rather than psychological variables was borne out by the test results, and also by the fact that the same captains were observed under different combinations of factors. Transformations 3 and 9, 2 and 8, 4 and 10 differed only in level of information. Observations of decision-making by captains under varying levels of information allowed a partial test of the influence of information on risk-taking.

The results shown in Table 7 suggest that variations in level of information do influence risk-taking as expected. Predictions could be made holding capability and motivation constant for each pair, and determining expected differences in risk-taking due to level of information.

TABLE 7

DIFFERENCES IN RISK WITH CHANGES IN LEVEL OF INFORMATION

Predicted Differences	Actual Differences
3 > 9	3 > 9 (.88 > .66)
2 > 8	2 > 8 (.76 > .43)
4 > 10	4 > 10 (.74 > .36)

Although the results imply that variation in level of information influences risk-taking, it cannot be inferred that the transformations can account for all of the variation in risk-taking. A technique suggested by Coleman (1964:189-240) shows that the transformations' components account for 52 percent of the variation in observed risk-taking.

Coleman's technique is designed for data which is ordinal and attributional. It is assumed that one state of each component variable will induce high risk-taking, and the absence of that state can be treated as if the variable were not present. The transformations can be converted into a set of equations by adding those components in each transformation which should induce high risk-taking. In the equations, a_1 refers to high level of information, a_2 to high level of motivation, and a_3 to low or equal capability. Any variation not accounted for by a_1, a_2, a_3 can be regarded as r, an error factor.

The set of equations representing the six transformations are:

TABLE 8

TRANSFORMATIONS AND THEIR EQUATIONS

Combination	Equation
2	$P_{12} = a_1+a_2+r$
3	$P_{123} = a_1+a_2+a_3+r$
4	$P_1 = a_1+r$
8	$P_2 = a_2+r$
9	$P_{23} = a_2+a_2+r$
10	$P = r$

In order to determine the proportion of variation in risk-taking accounted for by the transformations, the above equations must be converted into specific equations for each component. Using a sum of least squares method, the above can be re-stated as four simultaneous equations whose values are the proportions of high risk found in Table 5 for each combination:[11]

$$(1)\quad 6a_1+4a_2+2a_3+6r = 4.76$$

$$(2)\quad 4a_1+8a_2+4a_3+8r = 5.66$$

$$(3)\quad 2a_1+4a_2+4a_3+4r = 3.28$$

$$(4)\quad 6a_1+8a_2+4a_3+12r = 7.92$$

Solving for the equations provides a means of determining the proportion of variation in risk-taking accounted for by each component:

TABLE 9

PERCENT OF VARIATION IN RISK ACCOUNTED FOR BY COMPONENTS

Component	Per cent of Variation in Risk-taking
Level of Information	27
Level of Motivation	5
Capability	20
Error	48

[11] See Appendix H for derivation of equations, and solution.

The 48 percent error factor indicates that the Fortune model and transformations in themselves are not sufficient for handling variations in risk-taking. Other factors besides information, motivation, and capability, as used in the study, must be brought in. It may be that there is a risk-taking component in a captain's personality which should be taken into account. The example of the new captain is a case in point. His attitude that fishing was a gamble which he enjoyed, especially competition with others, may reflect a personality type. The example of the low risk captain suggests that age in itself may be an important influence on propensity to take risks. The change in that captain's reputation from 'pioneer' to 'cautious' indicates that strategies should be studied over time to determine if there are stages based on age as well as the external factors mentioned.

2. Limits on choice

From the Fortune research, it was assumed that a captain could take all high or all low risks if he so wanted. The Alert Bay data does not support this assumption. The lowest proportion of high risks observed was 36 percent (combination 4), and none of the captains took no high risks. A breakdown of the error factor indicated that 42 percent of the error was in the high risk direction, and 6 percent in the low.

It would seem from the above, that captains could not operate on a pure low risk strategy. This conclusion is supported by observations made on the boats about damage to gear. Changes in weather frequently led to taking high risks, although the alternative selected was safe at the time. Drifting into the seine, for example, was often a result of changes in currents rather than the decisions made by captains.

If the interpretation here is correct, it may be that the particular combination of environment/technology required that high risks be taken. If so, then the Fortune model and transformations apply only to risks in which there actually is a 'choice' on part of the captains. Application of the Fortune model to a range of empirical situations may therefore result in considerable variation in predictive power. Further refinement of the model would have to include other kinds of information besides fish location.

3. The additive assumption

The results of the Coleman test indicate that the assumption about equal weighting was invalid. Intuitively, the low weighting of level of motivation seems inaccurate. Coleman (1964:224-229) suggests that interaction effects among the components may be masking the influences to some degree. This would imply that the additive assumption in the model was invalid.

Although there was not sufficient data to determine what all the interactions might be, it was possible to make one set of comparisons to check for possible interactions between high motivation, low capability, and high information. Such a check seems reasonable given that the model does specify feedbacks.

Interaction effects can be determined by comparing the proportion of high risk-taking in combinations 3,8 and 9. The computation formula given by Coleman is:

$$a_2 = \frac{\frac{(a_1)(a_2)(a_3)}{r}}{\frac{(a_2)(a_3)}{r}}$$

$$= \frac{\frac{P_{123}-P_2}{P_2}}{\frac{P_{23}-P_2}{P_2}}$$

$$= \frac{.88-.43/.43}{.66-.43/.43}$$

$$= \frac{1.0}{.56}$$

$$= 1.7$$

It appears that, at least for high motivation on low capability and high information, an intensifier effect does exist. Given further comparative research, it might be possible to determine what the interaction effects are, and thereby modify the relations between components.

As an indication of how taking into account interaction effects would improve prediction, a new expected proportion of high risk-taking can be generated for combination 3. The new value can be compared with the expected proportion of high risk-taking derived from adding $a_1+a_2+a_3+r$. The actual proportion of high risk was .88 in this combination, compared to .94 which would be expected given the additive assumption. Using Coleman's calculations, the new expected proportion of high risk-taking is:

$$P_{123} = \frac{(a_1)(a_2)(a_3) + E_1}{(a_1)(a_2)(a_3) + E_1 + E_2}$$

$$= \frac{(1.0) + 1.0}{(1.0) + 1.0 + .30}$$

$$= .87$$

As can be seen the new expected combination 3 has a much closer fit than the original - a difference of .01 rather than .06.

Even with the interaction effects uncontrolled, the additive assumption can be used to generate more precise predictions about risk-taking in combinations not found in Alert Bay. The predictions can be generated by adding the proportions found in Table 9, as they apply to the other combinations.

Although the new predictions are not even theoretically accurate, given interaction effects and possible limits on risk-taking due to environment and technology, they are still more specific than those from the original model.

TABLE 10

EXPECTED PROPORTIONS OF HIGH RISK

Combination	Equation	Expected Proportion of High Risk-taking
1	a_1+a_2+r	.74
5	a_1+r	.69
6	a_1+a_3+r	.89
7	a_2+r	.47
11	r	.42
12	a_3+r	.62

In conclusion, the results of this research can only be seen as suggestive. The data does not support rejecting the Fortune model and its transformations, though at the same time, there are no grounds for totally accepting it. The problems of sampling, classification or risk-taking, and non-support of certain underlying assumptions weakened the results.

Further research into the general problem of risk-taking would benefit from taking these problems into account. It would seem that laboratory experimentation would be a better context for testing models of risk-taking than a field situation such as fishing. Controls could be more readily introduced, and more precise measurement made. Following Levi-Strauss (1967), movement from laboratory to field would probably allow for the development of more rigorous models.

The above does not imply that fishing contexts should not be used for such research. The range of technology and environments in which fishing occurs, coupled with the necessity for short term planning, makes fishing a useful area for comparative research on decision-making.

Clearly, further research in fishing contexts would benefit from focussing on less complex situations. Research in locations where boats are individually owned, and no crews needed, for example, would cut down on sampling and classification problems. Similarly, interdisciplinary work with marine biologists and geographers would aid in making objective evaluations of risk-taking. Clarification of sampling and classification problems would allow for realistic analyses of production strategies, and external/internal factors affecting them. Such knowledge could be used to increase our understanding of decision-making in general, and the types of constraints involved.

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APPENDIX A

SAMPLE OF SOCIETIES WITH FISHING ECONOMIES

I. ASIA

Korea
South China
Malaya
Thailand
Burma
Southwest China
India
Andaman
Gond

II. AFRICA

Tiv
Twi
Nupe
Luo
Bemba
Mbunda
Ila
Ganda
Nuer
Azande

III. SOUTH AMERICA

Mataco
Talamanca
Cuna
Jivaro
Cayapa
Yahgan
Choroti
Tupinambu
Aymara
Carib

IV. OCEANIA

Iban
Central Bisyan
Ifugao
Apayo
Tiwi
Murngin
Samoa
Tikopia
Philipines
Lau

V. EUROPE AND RUSSIA

Czechoslovakia
Poland
Greece
Malta
Ireland
Scotland
England
Lapp
Ukraine
Chukchee

VI. NORTH AMERICA

Bellacoola
Nahane
Tlinglit
Aleut
Copper Eskimo
Iroquois
Ojibwa
Micmac
Nootka
Cree

APPENDIX B

DIFFERENCES IN ACTUAL TOTALS, HAILS, AND PLANT ESTIMATES

ONE TRIP OF A STERN TRAWLER

	Day # 1	2	3	4	5	6
Actual 1,000s lbs.	67	120	180	210	300	320
Hail	0	50	170	190	230	250
Plant Estimate	30	100	220	240	280	250
Difference between actual and hail	-67	-70	-10	-20	-70	-70
Difference between actual and plant estimate	-47	-20	+40	+30	-20	0

ONE TRIP OF A SIDE TRAWLER

	Day # 1	2	3	4	5	6
Actual 1,000s lbs.	0	75	120	205	270	280
Hail	0	25	80	130	200	280
Plant Estimate	0	50	100	180	250	280
Difference between actual and hail	0	-50	-40	-75	-70	0
Difference between actual and estimate	0	-25	-20	-25	-20	0

APPENDIX C

EARNINGS OF FISHERMEN ON FORTUNE TRAWLERS IN 1962

	Boat A	B	C	D	E
Captain	$16,477.	$12,818.	$8,723.	$8,744.	$9,314.
Mate	8,884.	6,185.	5,054.	Unknown	3,936.
Chief Engineer	9,682.	7,279.	6,421.	4,978.	Unknown
Deckhand	5,297.	4,197.	2,314.	2,235.	2,343.

APPENDIX D

TRAWLER PERFORMANCE FOR TEN TRIPS IN 1968

A STERN TRAWLER

Trip Number	Days Fished	Total Catch in 1,000s of pounds	$\overline{X}$ per Day in 1,000s of pounds	$\overline{X}$ per Set in 1,000s of pounds
1	7	275	39	3.9
2	8	124	32	3.2
3	7	253	58	5.8
4	10	410	42	4.2
5	9	416	47	4.7
6	6	440	23	2.3
7	9	140	44	4.4
8	8	400	29	2.9
9	9	233	37	3.7
10	5	124	28	2.8
	T= 78 days	T=32029	$\overline{X}$= 37.0	$\overline{X}$= 3.7

A SIDE TRAWLER

Trip Number	Days Fished	Total Catch in 1,000s of pounds	$\bar{X}$ per Day in 1,000s of pounds	$\bar{X}$ per Set in 1,000s of pounds
1	5	248	49.6	6.2
2	9	300	33.6	4.1
3	6	187	31.0	3.8
4	6	128	21.0	2.6
5	7	227	32.4	4.0
6	4	193	48.0	6.0
7	10	309	30.9	3.8
8	6	122	20.3	2.5
9	5	134	26.8	3.3
10	4	102	25.5	3.2
	T= 63 days	T= 1950	$\bar{X}$= 31.6	$\bar{X}$= 3.9

APPENDIX E

SUPPLEMENTARY AGREEMENT FOR SALMON VESSELS: SHARE BASIS AND FISHING CONDITIONS (1967-1968)

This agreement made and entered into this day of July, 1967, between the Fisheries Association of B.C., herein referred to as the OPERATORS, and the United Fishermen and Allied Worker's Union, hereinafter referred to as the UNION.

ARTICLE I - DIVISION OF CATCH

From the gross value of the catch will be deducted the cost of fuel and lubricating oil. The resultant balance is to be divided on the basis of eleven (11) shares, four (4) shares to the boat and net, and seven (7) shares to the crew. From the seven (7) shares shall be deducted the cost of all provisions and the balance divided equally among members of the crew.

ARTICLE II - CONDITION OF VESSELS

Section 1: It is agreed that at the start of the season all boats shall be in seaworthy condition in accordance with rules and regulations established by the Department of Transport.

Section 2: Proper fire fighting and life-saving equipment shall be provided for each vessel.

Section 3: Crew's quarters, galley and toilet accomodation shall be in first class sanitary condition and the crew shall extend 100 percent co-operation in maintaining such cleanliness.

Section 4: In vessels where there is no toilet accomodation, same shall be installed if convenient and practicable before vessel leaves for the fishing grounds.

Section 5: The crew shall keep the fish hold and deck in sanitary and neat condition throughout the season.

Section 6: It is agreed that at the beginning ofeach season vessels shall be fully equipped with adequate crockery dishes and proper cooking utensils. At the end of each season the crew shall be responsible for the replacement of broken crockery and damaged utensils.

Section 7: A medicine chest shall be furnished to each vessel in accordance with requirements of the Workmen's Compensation Board. The Operators agree to maintain adequate replacement supplies at all fishing stations, and the responsibility for the upkeep of a vessel's First Aid Chest shall be upon the Boat Delegate elected by the crew.

ARTICLE III - BOAT DELEGATE

Section 1: A Boat Delegate, duly elected by the crew, shall be recognized by the Captain and the owner as the Union representative.

Section 2: The duties of the Boat Delegate shall be as follows: (a) To ensure that correct tallies and records are kept;
(b) To ensure that settlements made with all or any members of the crew are fairly and correctly made. Each member of the crew shall receive a copy of the full settlement.

Section 3: The Boat Delegate, duly elected by the crew, shall be fully recognized by the Operators to this Agreement as the representative of the crew and the Union on all matters connected with the weighing of fish. In order to facilitate the election of suitable representatives for this purpose, the Operators shall, if requested by the Union, make available a list of crew members on boats fishing for them.

ARTICLE IV - SETTLEMENTS

Section 1: When a crew member quits before the end of a season, he is entitled to his proportionate share of the catch.

Section 2: Settlements are to be made as quickly as possible at the conclusion of each season.

ARTICLE V - CAPTAIN'S RIGHTS

Section 1: The Operators agree that seine boat captains shall have the right to hire and discharge their crew members.

Section 2: In all matters pertaining to the operation of the boat, it is agreed and understood that the Captain's decision shall be final, subject only to instructions from the Operator or his representative.

Section 3: It is understood that the Captain has the right to apply the following conditions subject only to the approval of the crew if specifically provided for: (a) When a man is engaged it is for the balance of the salmon season, unless he suffers an accident or illness or is granted compassionate leave by agreement with the crew or has been specifically engaged for a lesser period or has clearly informed the Captain and boat delegate, if any, that he will leave the vessel at a specific date;

(b) If a man is discharged or quits, notice must be given on the last fishing day of the week. One week is to be considered proper notice but if a replacement is obtained sooner the notice period shall terminate at that time;

(c) When a man is discharged by any Operator or his agent, the company shall be responsible for his fare to his port of hiring. The Operator agrees to furnish steamer or scheduled airline transportation back to the port of hiring as well as the fare for his replacement when such fare is actually used;

(d) When a man quits, he shall be responsible for his fare to port of hiring. If his quitting is in violation of sub-section (a) above, he shall be responsible for the fare for his replacement when such fare is actually used;

(e) When a man fails to give proper notice for quitting, he shall be subject to a $100.00 penalty;

(f) The penalty shall be paid to the remainder of the crew except that, if every effort to obtain a replacement is not made, the penalty will be paid to the Salmon Welfare Fund;

(g) When, in the opinion of the skipper and a majority of the crew, intoxication impairs a man's ability to perform his work, no notice of discharge need be given and sub-section (c) may be waived with respect to his transportation to the port of hiring.

Section 4: It is understood that the Operators shall not be responsible for penalties and fares uncollected.

ARTICLE VI - ILLEGAL FISHING

There shall be no illegal fishing and if any is done the Captain and crew shall be jointly responsible for any fines and penalties imposed.

ARTICLE VII - FUEL

Fuel tanks and lub-tanks will be filled by the Operator at the start of each season and will be returned by the crew in similar condition at the close of each season.

ARTICLE VIII - HOLE BILLS

Section 1: It is agreed and understood that hole bills shall not be collectable under the following circumstances:

(a) When men are discharged and it is definitely proven that such discharge was not due to any fault of their own;
(b) When the vessel goes into some other trade or other type of fishing;
(c) When crew members are discharged by the Captain for reasons other than the regular reasons;
(d) When the vessel is a total wreck;
(e) When an accident has occurred and the crew is not required after repairs are completed.

Section 2: <u>Definition</u>: It is understood that hole bills as referred to in this Agreement shall denote a condition where the crew share of the landed catch at the time referred to in Section 1(a), (b),(c),(d), or (e) is not sufficient to cover the cost of fuel, lubricating oil and provisions as set out in Article II of this Agreement.

ARTICLE IX - LIMITING CATCH

The Operators agree that should it be necessary to place a limit on fish deliveries, such limit will be set on a per-man basis.

ARTICLE X - CHARTER BOATS

It is agreed that all boats chartered by the Operators for the 1967 and 1968 salmon season and operated by members of the Union shall come under the terms and conditions of this Agreement.

ARTICLE XI - NET WORK

Section 1: The Union recognizes the responsibility of the seine crews to give proper care to the seine throughout and to the end of the fishing season, including necessary repairs, washing, and bluestoning, in accordance with management's instructions.

It being understood and agreed that if it is not management's intention to strip the seine, that it shall be returned in the same condition as received, reasonable wear excepted. Crews shall not be required to alter dimensions of the seine, or to effect major repairs, when the vessel concerned is terminating the season.

Any crew member who does not adequately participate in the maintenance of the seine on weekends during the fishing season, unless his absence is mutually agreed upon, shall be charged for each absence at regular netman's rates.

If there is no replacement this sum shall be equally divided among the seine crew members who do the work. The Captain must advise the company promptly of any such charge to be made.

Section 2: Loading or unloading of seines shall not be considered network and on arrival in port at the end of any season or for a lay-up, or to change over to another type of fishing, it shall be the crew's responsibility to bluestone, wash and unload the seine within a ten day period. In the event that the net is bluestoned on the day of arrival in port, the crew may be called out to wash and unload the seiner on a day to be specified during the next ten days.

Any crew member who fails to appear on the day specified unless his absence has been mutually agreed upon, shall be charged for eight hour's work at the regular net man's rates which sum shall be paid to the man taking his place. If there is not replacement, then the sum shall be equally divided amongst the seine crew members who perform the work.

Section 3: The Union recognizes the responsibility of the seine crew to deepen, shallow or shorten the seine during the fishing season in accordance with the Captain's instructions. It shall also be the crew's responsibility to lengthen the seine provided that the extension which is to be added is made up beforehand. If the extension is not made up, and the crew is called to do this work, then they shall be paid in accordance with the terms of the current agreement on network.

Section 4: Work done by members of the crew in preparing nets for each season and in stripping, washing stripped web, and storing nets at the end of each season, shall be paid for by the owner of the net, in accordance with the terms of the current Union agreement on network.

Section 5: The owners agree that should a seine, or seines, be put out which has not been relaced or rehung since the previous season and it becomes necessary for the crew to relace or rehang the seine within two weeks of the commencement of the net being fished, members of the crew who work on the seine shall be paid for such work at the rates set out in the Networker's Agreement.

Section 6: The owners agree that if, at the time of taking the seine, it is necessary for the crew to make up purselines or brailers, payment shall be made for such work at the straight time rates set out in the Networker's Agreement. It is understood that putting such gear aboard is part of the regular operation and no extra payments be made.

Section 7: The company shall provide the seine crew members who are working on seines including the loading, unloading, washing, bluestoning of same, or working on brailers, purselines or other fishing gear, with Workmen's Compensation and Unemployment Insurance coverage for such work for which payment is made under the foregoing sections.

Section 8: In the performance of such work and the responsibility for the same under the foregoing sections, the Captain shall participate along with other crew members.

ARTICLE XII - CERTIFIED ENGINEER'S BONUS

It is agreed that all engineers holding Department of Transport 1st, 2nd, 3rd or 4th Class Marine Engineers' Certificates engaged as engineers on salmon seine boats shall receive a bonus of $25.00 per month during the fishing seasons of 1967 and 1968, said bonus to be paid by the Operators.

ARTICLE XIII - RADIO TELEPHONE

(a) Where radio telephones are installed on seine boats, it is agreed that the crew will not be required to pay for any installation or rental charge. Where crew members use the radio telephone for personal calls, excepting emergency calls, the Operator shall have the right to impose and collect a surcharge of 15 percent over and above the actual cost of such calls.

(b) It is further understood and agreed that the Operators shall have the right when settlements are being made to withhold the sum of $15.00 per man as a deposit, for a period not to exceed six weeks, to cover each crew member's personal calls.

ARTICLE XIV - FAIR PRACTICES

During the term of this Agreement, no crew member shall be asked to make written or verbal agreements with the Operator covering rental of boat equipment or charges to gross stock unless such written or verbal agreement is approved by the General Executive Board of the Union.

ARTICLE XV - NEW MEN

If any crew member is going seining for the first time he may, at the discretion of the Captain and crew, receive half the normal fisherman's share for the first 14 consecutive calendar days, the half share remaining shall be divided among the balance of the crew. This condition shall be drawn to the attention of the crew man at the time he joins the vessel.

ARTICLE XVI - GRIEVANCE PROCEEDURE

All disputes that cannot be settled on board the vessel must be referred to the Operator or Operators concerned and the Union for adjustment.

THIS SUPPLEMENTARY AGREEMENT IS SIGNED IN CONJUNCTION WITH THE SALMON PRICE AGREEMENT AND IS RECOGNIZED AS PART OF THE SAME.

APPENDIX F

FIELD RESEARCH IN THE ALERT BAY FISHERIES

Field work in Alert Bay was done during the summer of 1969, and followed up by three return trips in the Fall of 1969 and Spring of 1970. Since the major purpose of the study was to test the validity of the relations and predictions from the Fortune model and transformations, a variety of research techniques were used.

Before going out on the boats to observe the actual decision-making of seiner captains, I attempted to do a general study of the community and the fisheries. This was done primarily by interviewing various members of the community, with special emphasis on people engaged in commercial fishing - Fisheries Department Officers, company managers, union representatives, fishermen and their families.

With a background sketch of wider context, the first stage of actual research was classification of captains into appropriate transformations. Using company records and interviews with management and fishermen, I was able to classify captains in terms of capability and motivation given the assumptions from the model.

The interviews all indicated that the drum seiner was superior in catching ability to the powerblock seiner. The factors of number of sets per day, speed of seine retrieval, fewer crew, and greater ability to get out of possible trouble were the criteria used by fishermen and management. Using company records, I was able to classify captains as having high, equal, or low capability in comparison to other members of the same fleet. The breakdown by company was:

Company	High	Equal	Low
Nelson Brothers	7		4
B.C. Packers		15	3
Canada Fish	3		2

The only exception to the rule that drum seiner meant high capability was for the B.C. Packers fleet. The rationale for regarding it as equal capability was that over 80 percent of the fleet was drum seiners.

Motivation was determined by looking at boat ownership and fleet standing based on past performance. It was assumed that low motivation best fitted high performance standing company captains and owner captains. Low performance company captains and mortgaged captains were seen as being more highly motivated. For company captains, I used company records for the 1968 season to determine standings. A cut-off of the top three performers in every fleet was used to separate high and low levels of motivation. Twelve captains had low motivation - three owners and nine company high performers. Twenty-two were given low motivational status -

thirteen being low performance company captains, and nine being mortgage captains. Combining motivation and capability gave me the following distribution of captains in the Alert Bay seiner fleet:

Capability		Motivation: High	Motivation: Low
	High	1	9
	Equal	13	2
	Low	8	1

Ideally, at this point, I should have drawn a samole of captains from each combination and observed their decision-making under different levels of information. Unfortunately, going out on a boat was more of a problem than anticipated. Some captains refued to take me out, and others stalled about making a definite commitment. By the end of the summer, I was able to get out on six different seiners- two in each of high motivation/equal capability, high motivation/low capability, and low motivation/high capability. Although I was able to observe other boats as well, I restricted data collection to categories that I had experience with.

Before going out on the seiners, I made two trips on gillnetters in order to determine the kinds of information that might be relevant. Although the technology differs, both seiners and gillnetters fish for the same species in the same general area. It was on the basis of the two trips that I decided that 'jumpers' and visibility of catches by other boats were the two major sources of high information. I classified a captain as operating under high information if either of these sources were visible, and under low information if neither were. The criteria used were confirmed by the captains themselves, when talking about fishing 'blind' when no jumpers were visible. There was, however, some variation on the use of other boats' catches as a source of information. All of the captains that took me out used other boats as indicators of location yield, but they differed in the importance that they placed on it.

My greatest problem was classifying decisions into high and low risk. Data on captains' decision-making was gathered by observation on the fishing grounds. Five of my trips were primarily as a non-participant observer, and one was as a deckhand.

From my experience on Fortune trawlers, and readings on the problem of risk-taking, I started with the assumption that risk can best be calculated in terms of costs (both real and opportunity). Real costs refer to factors such as gear damage and loss of time, while opportunity costs refer to what is lost by rejecting an alternative having a higher pay-off than the one accepted.

In order to determine what the costs might be in the

Alert Bay context, I repeatedly questioned the captains I was with about their evaluations of different locations, and the way they saw the problem of choice. I found that all of the captains that I went with, and others interviewed on shore, agreed on the risks involved with particular locations. The two major factors that they used were variation in yield, and possibility of getting into trouble.

The agreement on evaluation of risk for different locations allowed me to assume that other captains that I did not go out with could be classed as making the same sort of decisions if they fished in the same locations in the same time period. I also asked the captains I went with to try and explain the fishing strategies used by other captains who were making different choices. This acted as one form of check on evaluations of possible locations, and the criteria used. On very few occasions did a captain classify the decision-making of others as 'stupid'. Generally, factors such as safety and yield were used - with explanations of why different choices made sense. Fishing a high risk spot would be explained by a low risk captain as a gamble, but one that might really pay off. Similarly, a high risk captain might explain the choices of a low risk captain as "he'll do alright, but he'll never make a fortune."

By restricting myself to generalizing to captains in the same motivational/capability category as those I had experience with, I was able to collect data on twenty-four captains in total. For some captains, I had observations for all six trips, while for others only part of one trip. Again, sampling was a matter of opportunity rather than design.

After two trips on gillnetters, and two on seiners, I was able to isolate a number of indicators which could be used to determine risk. For the most part, the indicators were ones used by the captains themselves. Given their experience and agreement on the meaning of such indicators, it seemed to be a reasonable basis for evaluation. As much as possible, I attempted to cross-check the indicators with 'objective' data, such as actual damage and ranges of yield.

The indicators that I used were:

(a) Traffic: Fishing in the straits rather than near the shore meant high risks in real costs. Traffic moving through the straits frequently meant taking in early, thereby loosing fishing time, and occasionally damaging nets.

(b) Other Boats: Fishing alone rather than with other boats involved two types of risk. First, it did not provide avenuess for legitimating the decisions made (a crew commitment cost). Second, other boats can provide aid if a boat gets into trouble.

(c) Currents: Fishing in areas with strong currents is a high risk. There is more of a chance for drifting into nets which can result in lost time and gear damage.

(d) Tide: All the captains agreed that salmon only run when the tide is moving. Fishing during slack tides meant real and opportunity costs. Time spent fishing could be used to move to a new area, do repairs, or relax. Real costs of fuel and potential gear damage plus crew commitment are also relatively high for slack tide fishing.

(e) Reefs and Rocks: Making sets near known reefs or rocks meant high risks. A seine can easily drift into such obstacles thereby damaging gear.

(f) Knowledge: Although there was a general pool of knowledge about where to fish, it was distributed differentially due to experience. Fishing in unknown spots, or in spots not fished before involves high risks.

(g) Non-marketable Fish Locations: Many spots in the Alert Bay area were known to have concentrations of 'trash' or non-marketable fish. Fishing in these spots often meant taking a chance of wasting time and possible net damage if 'trash' fish were caught.

(h) Corking: Setting inside another boat's net is a high risk. This form of deviance will generally lead to retaliation by other boats.

(i) Violation of Regulations: Purposeful violation of Department of Fisheries' regulations is a high risk decision. If caught, then loss of catch and fines can occur.

(j) Range of Yield: Some spots have the reputation as steady producers, while others have wide ranges of yields. Fishing in spots where past experience has shown wide ranges of catch can be assumed to be a high risk choice.

Classification of observed decisions was made using the above indicators. If a captain selected a spot which was high risk on any of the indicators, then the decision was classed as high in risk. Clearly, combinations of high risk did occur at times, and some risks are higher in terms of costs. Due to lack of time and difficulty in ranking alternatives, I did little more than fit the decisions into the two categories irrespective of degree of risk.

It can be concluded that the field situation placed many restrictions on the validity of the data collected. The inability to sample either captains or their decisions in any systematic sense raises questions as to the representativeness of the decisions observed. Similarly, the weakness of the risk classification based on the captains' model of the alternatives means that the data may have no relation to 'objective' measures of risk.

APPENDIX G

RISK-TAKING UNDER DIFFERENT SITUATIONS IN ALERT BAY

COMBINATION 8

Captain	Total Number Decisions Observed	Number High Risk Decisions	Number Low Risk Decisions
a	40	18	22
b	33	12	21
c	18	10	8
d	15	5	10
	T= 106	45	61

COMBINATION 9

Captain	Total Number Decisions Observed	Number High Risk Decisions	Number Low Risk Decisions
e	45	39	6
f	38	21	17
g	30	18	12
h	30	16	14
i	29	21	7
j	29	26	3
k	28	12	16
l	24	17	7
m	9	3	6
	T= 262	174	88

COMBINATION 10

Captain	Total Number Decisions Observed	Number High Risk Decisions	Number Low Risk Decisions
n	104	38	66
o	90	26	64
p	88	48	40
q	83	27	56
r	70	25	45
s	44	14	30
t	40	3	37
u	40	17	23
v	33	12	21
w	31	9	22
x	20	11	9
	T= 643	230	413

COMBINATION 2

Captain	Total Number Decisions Observed	Number High Risk Decisions	Number Low Risk Decisions
a	21	16	5
b	17	14	3
c	14	9	5
d	3	3	0
	T= 55	42	13

COMBINATION 3

Captain	Total Number Decisions Observed	Number High Risk Decisions	Number Low Risk Decisions
e	10	9	1
f	8	7	1
g	7	5	2
h	5	5	0
j	5	5	0
k	4	3	1
m	2	2	0
	T= 41	36	5

COMBINATION 4

Captain	Total Number Decisions Observed	Number High Risk Decisions	Number Low Risk Decisions
o	40	32	8
p	33	22	11
q	28	23	5
r	25	19	6
t	18	9	9
u	17	16	1
v	15	8	7
w	12	10	2
x	1	1	0
	T= 189	140	49

APPENDIX H

DERIVATION AND SOLUTION OF COMPONENT EFFECT EQUATIONS

(1) $P^* = r$

$P_1{}^* = a_1 + r$

$P_2{}^* = a_2 + r$

$P_{23}{}^* = a_2 + a_3 + r$

$P_{13}{}^* = a_1 + a_3 + r$

$P_{123}{}^* = a_1 + a_2 + r$

(2) $f(a_1, a_2, a_3, r) = (P_i - P_i{}^*)$

$$= (.36-r)^2 + (.74-a_1-r)^2 + (.43-a_2-r)^2 + (.66 - a_2 - a_3 - r)^2 + (.76-a_1-a_2-r)^2 + (.88-a_1-a_2-a_3-r)^2$$

(3) $$\frac{\partial \quad K}{a_1} = (-2)(.74-a_1-r) + (-2)(.76-a_1-a_2-r) + (-2)(.88-a_1-a_2-a_3-r)$$

$$= 6a_1 + 4a_2 + 2a_3 + 6r - 4.76$$

$$\frac{\partial K}{a_2} = (-2)(.43-a_2-r) + (-2)(.66-a_2-a_3-r) + (-2)(.76-a_1-a_2-r) + (-2)(.88-a_1-a_2-a_3-r)$$

$$= 4a_1 + 8a_2 + 4a_3 + 8_r - 5.66$$

$$\frac{\partial K}{a_3} = (-2)(.66-a_2-a_3-r) + (-2)(.88-a_1-a_2-a_3-r)$$

$$= 2a_1 + 4a_2 + 4a_3 + 4r - 3.28$$

$$\frac{\partial K}{r} = (-2)(.36-r) + (-2)(.74-a_1-r) + (-2)(.43-a_2-r) + (-2)(.66-a_2-a_3-r) + (-2)(.76-a_1-a_2-r) + (-2)(.88-a_1-a_2-a_3-r)$$

$$= 6a_1 + 8a_2 + 4a_3 + 12r - 7.92$$

(4) $6a_1 + 4a_2 + 2a_3 + 6r = 4.76$

$4a_1 + 8a_2 + 4a_3 + 8r = 5.66$

$2a_1 + 4a_2 + 4a_3 + 4r = 3.28$

$6a_1 + 8a_2 + 4a_3 + 12r = 7.92$

(5)
$$\begin{bmatrix} 6 & 4 & 2 & 6 \\ 4 & 8 & 4 & 8 \\ 2 & 4 & 4 & 4 \\ 6 & 8 & 4 & 12 \end{bmatrix} \begin{bmatrix} a_1 \\ a_2 \\ a_3 \\ r \end{bmatrix} = \begin{bmatrix} 4.76 \\ 5.66 \\ 3.28 \\ 7.92 \end{bmatrix}$$

(6)
$$\begin{bmatrix} 3 & 2 & 1 & 3 \\ 2 & 4 & 2 & 4 \\ 1 & 2 & 2 & 2 \\ 3 & 4 & 2 & 6 \end{bmatrix} \begin{bmatrix} a_1 \\ a_2 \\ a_3 \\ r \end{bmatrix} = \begin{bmatrix} 2.38 \\ 2.83 \\ 1.63 \\ 3.96 \end{bmatrix}$$

(7)
$$\begin{bmatrix} 3 & 2 & 1 & 3 \\ 2 & 4 & 2 & 4 \\ 1 & 2 & 2 & 2 \\ 3 & 4 & 2 & 6 \end{bmatrix} \begin{bmatrix} .27 \\ .05 \\ .20 \\ .42 \end{bmatrix} = \begin{bmatrix} 2.38 \\ 2.83 \\ 1.63 \\ 3.96 \end{bmatrix}$$

(8) $a_1 = .27$

$a_2 = .05$

$a_3 = .20$

$r = .42 + .06 = .48$