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Effect of Offshore Fishing on the Inshore Labrador Cod Fishery

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Abstract

Recent trends in the offshore and inshore Labrador cod fisheries are described. Offshore fishing began in the early 1950's and landings reached an average level of over 200 thousand tons annually during 1961-64. Inshore landings declined from the mid-1940's to 1956, with a subsequent increase to an average level of over 20,000 tons annually during 1961-64. Catch per unit effort has increased in the offshore fishery, but has markedly declined inshore, apparently as a result of the increased offshore landings. Recent estimates of various population parameters suggest that the present fishing intensity may be at or beyond that giving maximum sustained yield.

Introduction

The Labrador coast is known to have been fished by French vessels at least as early as the early 1700's (Black, 1960). These were replaced by English vessels during the late 1700's and the latter replaced by vessels based in Newfoundland in the early 1800's. By this time a shore-based fishery was also established. The fishery grew rapidly until the early 1900's and three categories of fishermen were recognized:

- (1) Livyers - resident fishermen,
- (2) Stationers - those who came from Newfoundland each summer and operated from shore bases,
- (3) Floaters - Newfoundland fishermen who operated from fishing schooners.

Each group fished from small open boats, the schooners being used only for storage of the catch and accommodation. No catch statistics are available for this early period, but on the basis of figures given by Black (1960) for number of ships in the floater fishery, catches must have been substantial even by recent standards. By 1908 the number of schooners fishing along the coast had reached 1,400. Catch per ship in the 1940's was of the order of 200 tons (metric, round fresh) annually. On this basis the total annual catch in the early 1900's must have approached 300 thousand tons.

For economic reasons the inshore fisheries experienced a rapid decline to the mid-1950's, particularly the floater fishery which disappeared in 1955. There has since been a gradual buildup, with a tripling of the

catch from 1956 to 1965, and a minor revival of the floater fishery (59 vessels in 1965). This has been accompanied by the development of a large European offshore fishery, beginning about 1952, and reaching a peak of 246 thousand tons in 1961.

Cod from the Labrador area are part of a stock complex extending from northern Labrador to the northern Grand Bank (Templeman, 1962). Spawning occurs in spring in deep water far offshore and is followed by a post-spawning shoreward migration (Templeman and May, 1965). The cod are fished for a few months in summer in the coastal fisheries, and for the remainder of the year by the offshore fleets. The present study examines the effects on the inshore Labrador fishery of the recent large expansion in offshore fishing.

Development of the Offshore Fishery

Offshore fishing first began in the early 1950's, and reached a level of almost 1/4 million tons annually in 1961 and 1962, or 10 times the amount taken in the inshore fishery in those years (Fig. 1). Between 1954 and 1961 the fishery as a whole increased twelvefold. Offshore landings fell below 200 thousand tons in 1963 and 1964. From 1960 to 1964 15-20% of the annual northwest Atlantic cod catch has come from Labrador (Fig. 1).

In the past the inshore fishery was carried on along the entire coast. Recently only the southern one-third of the coast (Division 2J) has been fished to any great extent. The offshore fishery also is almost entirely based on Hamilton Inlet Bank, directly east of the southern part of the coast. Thus more than 90% of the annual cod catch is taken in Division 2J (Fig. 2A). Virtually all the offshore catch is taken by France, Portugal, Spain and the USSR (Fig. 2B).

The offshore fishery originally developed (1954-58) as a relatively small autumn fishery. A spring fishery began in 1959 and fishing was extended throughout the year. The autumn fishery increased and the new spring fishery quickly reached major proportions (Fig. 3). The latter appears to be based largely on spawning and post-spawning concentrations on the southeastern edge of Hamilton Inlet Bank. By June the concentrations break up and begin to move inshore where they are fished in July and August,

when the offshore fishery is at a minimum (Fig. 3). The autumn offshore fishery builds up as fish move away from shore toward the spawning area. Trawl landings per effort declined from 1954 to 1958, but increased from about 1 ton per hour in 1958 to over 2 tons per hour in 1962 as a result of development of the spring fishery (Hodder, 1965).

Trends in Inshore Catch and Effort

In view of the recent large expansion of the offshore fishery, and the fact that it operates on the same stock of fish later fished inshore, it is of interest to examine inshore catches in relation to effort expended to determine whether the large offshore fishery is having any effect. Unfortunately it is difficult to get a good measure of effort in the inshore fishery. At least 4 gears of varying efficiency are in wide use (codtrap, handline, longline and gillnet) and the fishery is effectively decentralized. The catch of each fishing crew (often by several gears) is salted and disposed of at the end of the season. The greater part of the catch is probably taken by codtraps but actual quantities taken by each gear are unknown. However numbers of men employed in fishing are known from the 1930's onward. Catch per man is not a good measure of effort since it does not take into account varying fishing practices and changes in fishing efficiency over the years. However if shore-based and ship-based fishermen are treated separately such changes may be regarded as minimal in Labrador over the period considered.

Statistics of the inshore fishery were obtained from the Annual Reports of the Newfoundland Fisheries Board from 1937 to 1948, and from files of the Canada Department of Fisheries (at St. John's, Nfld.) after 1948. Data for shore-based and ship-based fishermen are separable. Shore-based fishermen here include both those resident on the coast and summer migrants from the island of Newfoundland, and for convenience are labelled together as stationers. Unfortunately the data are not directly comparable over the whole period. The area covered from 1937 to 1953 included the North Shore of the Strait of Belle Isle (part of Division 4R) as well as the coast of Labrador proper. The effect is not serious as recent statistics indicate that landings from the former area account for less than 15% of the total. However the early figures are reported as "equivalents, light salted dry cure" in quintals (1 qtl = 112 lb). Most cod production from this area is "heavy salted wet cure". Conversion factors from one to the other have

altered over the years and it is not certain which of several was used from 1937 to 1953. For rough comparability with recent data the landings in equivalent light salted dry quintals were converted to metric tons, round fresh weight, by applying the following modern standard conversions:

- (1) quintals to lb x 112
- (2) light salted dry to round fresh x 4.88
- (3) lb to metric tons x 1/2,204.6

Since cod from the Quebec North Shore and the Strait of Belle Isle belong to a different stock than those fished along the Labrador coast (Templeman, 1962) it is desirable to separate statistics of the 2 fisheries. Landings have been reported separately since 1954 (ICNAF Statistical Bulletins, Vols. 3-14), and these were used in analysis of the fishery from that time.

Numbers of fishermen and total landings declined sharply during the early years of the Second World War (Fig. 4). There was a brief recovery in 1943 and 1944 as the number of stationers increased, with a coincident increase in catch per man of both floaters and stationers. The number of floaters remained about the same during the mid-forties while stationers increased, but low catches per man from 1945 to 1947, and decreasing numbers of men after 1946 resulted in an overall downward trend in landings from 1945 to 1953. There is a general correspondence in the trends in catch per man of floaters and stationers. The low periods of 1940-41 and 1945-47 may be indicative of declined stock abundance, or simply lessened availability to the inshore fishery because of anomalies in fish distribution due to hydrographic conditions.

The 1954-64 period must be considered separately for reasons previously outlined. Thus the high levels of catch per man in the mid-fifties are not directly comparable with earlier data because of different area coverage and probable differences in conversion factors to round fresh landings. Landings and numbers of men reached their lowest levels in 1956 (Fig. 4). The floater fishery temporarily disappeared. Numbers of floaters were so low during the period 1954-59 (less than 50 men) that figures for catch per man have no meaning. The number of stationers has doubled since 1959 but their landings exhibit a downward trend from that time. Increased total landings in 1962 and 1963 were due to renewed participation in the

fishery by floaters. The very pronounced decline in catch per man of stationers since 1959 and floaters since 1961 coincides exactly with the period of great increase in offshore fishing (Fig. 1).

Discussion and Conclusions

It was previously noted that some of the variation in catch per man was possibly due to decreased availability to the inshore fishing areas. Thus catch per man was abnormally low in 1958, but cod catches and catch per unit effort were low in this year throughout the Newfoundland and Labrador areas (Hodder, 1965). This has been considered to be due to unusually warm temperatures and lack of cold water barriers, allowing cod to be less concentrated and thus less easily fished than normally (Hodder, 1965). A difference in availability, rather than a decline in abundance, is indicated.

On the other hand increased fishing will result in proportional increases in catch only as long as there are reserves of stock to draw from. At higher effort levels catch per unit effort will decline due to a real decline in stock abundance as a result of fishing. Prior to 1951 the inshore fishery alone was responsible for removals from the available stock (Fig. 1). Using catch per unit effort as a relative measure of abundance the data were examined to determine the relation of effort to catch per effort for this period. It is obvious (Fig. 4) that numbers of men cannot be used directly as a measure of effort since floaters fish more efficiently, probably due to their greater mobility and extensive use of traps rather than less efficient gears. A plot of catch per floater against catch per stationer (Fig. 5A) revealed that floaters were on the average twice as efficient. Total effort was thus estimated in stationer units by applying this factor, i.e.

$$\text{Total effort (stationer units)} = \text{number of stationers} + 2 (\text{number of floaters}).$$

Dividing these values into annual catch gave catch per stationer unit for each year. A plot of catch per stationer unit against number of units (Fig. 5B) showed no significant correlation for the period 1937-53 ($r = -0.16$, $.50 > P > .40$). It may be concluded that even at the highest levels of effort during this period the inshore fishery had little or no effect on overall

stock abundance, and that variations in abundance were due to "natural" causes.

The pattern for 1954-64 is quite different (Fig. 5B), producing a significant negative correlation ($r = -0.90$, $P < .01$). In view of the foregoing it is most unlikely that this is a real effect of increased inshore effort. In fact three of the cluster of four high values are for the years 1955-57; the four lowest values are for 1961-64. It is most likely that the increase in offshore fishing since 1959 has resulted in decreased stock abundance, reflected as a much lower catch per man inshore. A similar pattern of decline in catch per man inshore on the east and northeast coasts of Newfoundland, coincident with increased participation in the fisheries by trawlers, has been reported by Hodder (1965).

Beverton (1965) observes that fairly intense fishing would be necessary to attain maximum sustained yield in the Labrador area. This conclusion is based on values of parameters for Divisions 2H and 2J combined as follows:

L_c (mean selection length)	=	50 cm
L_∞ (average "final" length in population)	=	65-70 cm
k (rate of change in length increment)	=	0.3,

giving a range of 0.71 to 0.77 for L_c/L_∞ , and assuming a range of 0.5 to 1.0 for M/k . Growth has recently increased in Division 2J (but not in Division 2H) for those ages taken in quantity by the fishery. Values of L_∞ and k for Division 2J in 1963 were 74 cm and 0.2 respectively (May, MS, 1966a). The value of M (natural mortality) appears to be about 0.2 (May, MS, 1966b). Assuming mesh sizes of 110 to 120 mm, L_c lies between 38 and 42 cm (Hodder and May, 1965). This gives a range of 0.51 to 0.57 for the ratio L_c/L_∞ , and 1.0 for M/k . The effect of these changes is to modify Beverton's (1965) conclusion, to an extent depending on the as yet uncertain value of the ratio F/M . If this ratio were as low as 3, and inserting the recent values for other parameters in Beverton's (1965) Figure 1, it would be concluded that such a level of fishing is at or beyond that giving maximum sustained yield.

Catch per unit effort more than doubled in the offshore fishery from 1958 to 1963 (Hodder, 1965) as the fleets became increasingly familiar

with seasonal cod distribution and devoted increasing effort to the spring spawning concentrations. There was a slight decline in catch per unit effort for the autumn period. The inshore fishery continues to expand in spite of reduction in catch per man.

References

- Beverton, R.J.H. 1965. Catch/effort assessment in some ICNAF fisheries. Res. Bull. int. Comm. Northw. Atlant. Fish., No. 2, p. 59-72.
- Black, W. A. 1960. The Labrador floater codfishery. Annals Assoc. Amer. Geographers, 50(3): 267-293.
- Hodder, V. M. 1965. Trends in the cod fishery off the east coast of Newfoundland and Labrador. Res. Bull. int. Comm. Northw. Atlant. Fish., No. 2, p. 31-41.
- May, A. W. MS, 1966a. Increase in growth of Labrador cod. Ann. Meet. int. Comm. Northw. Atlant. Fish., 1966, Doc. No. _____, (mimeo.).
- MS, 1966b. A note on natural mortality in Labrador cod. Ann. Meet. int. Comm. Northw. Atlant. Fish., 1966, Doc. No. _____, (mimeo.).
- Templeman, W. 1962. Divisions of cod stocks in the Northwest Atlantic. Int. Comm. Northw. Atlant. Fish., Redbook 1962, Part 3, p. 79-123.
- Templeman, W. and A. W. May. 1965. Research vessel catches of cod in the Hamilton Inlet Bank area in relation to depth and temperature. Spec. Publ. int. Comm. Northw. Atlant. Fish., No. 6 (in press), p. 149-166.

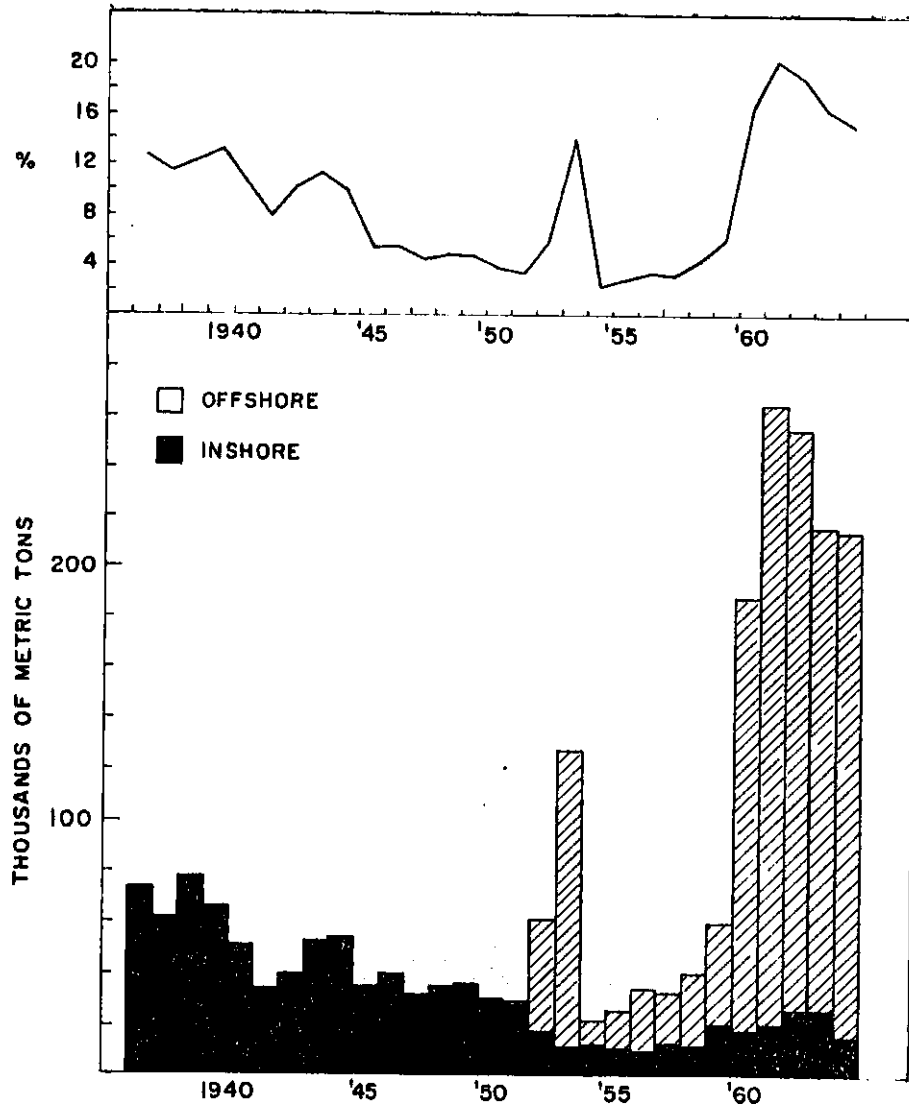


Fig. 1. Top. Relative contribution of cod landings from Labrador to total cod landings for the ICNAF area.

Bottom. Inshore and offshore Subarea 2 landings, 1936-64.

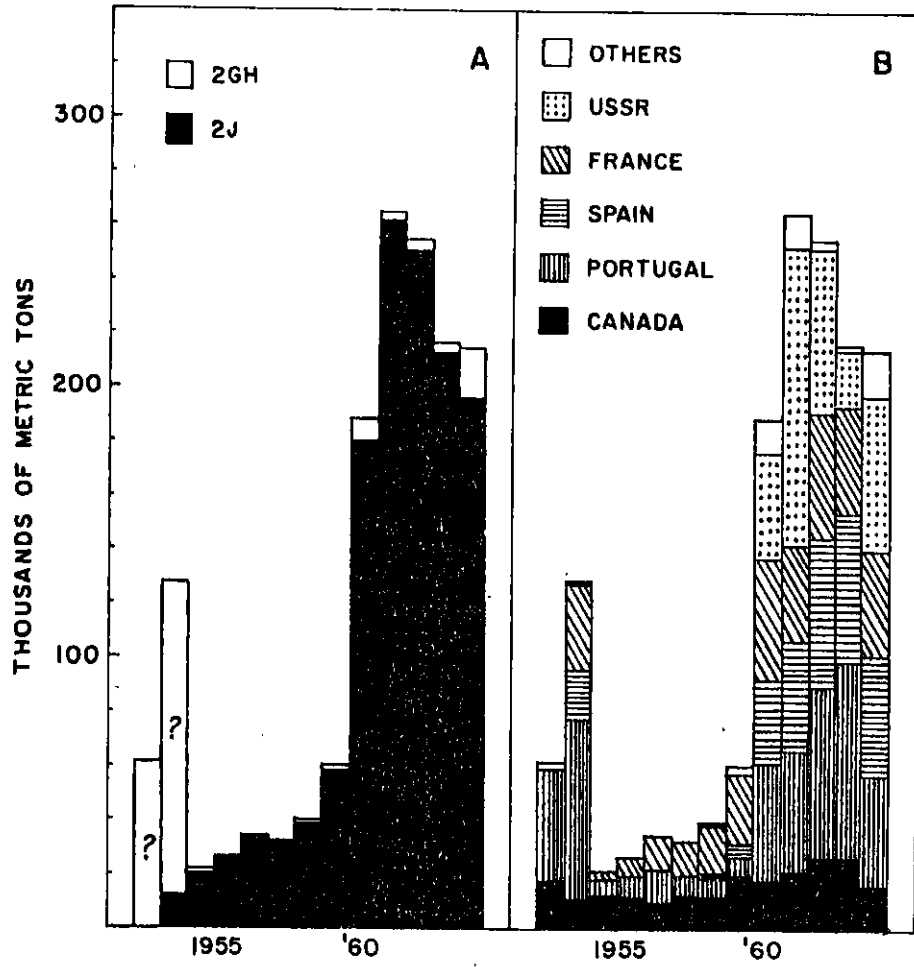


Fig. 2. Subarea 2 cod landings by ICNAF Division (A) and country (B), 1952-64.

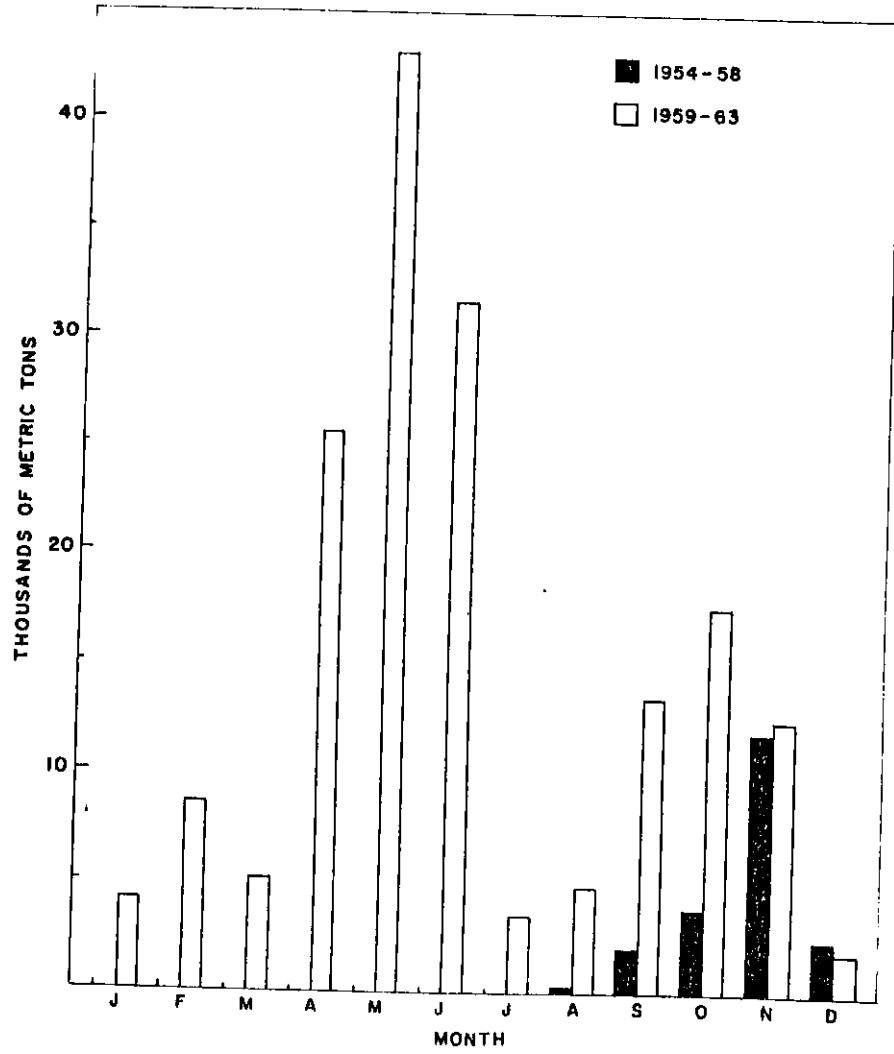


Fig. 3. Monthly landings from the offshore fishery in Division 2J averaged for 1954-58 and 1959-63.

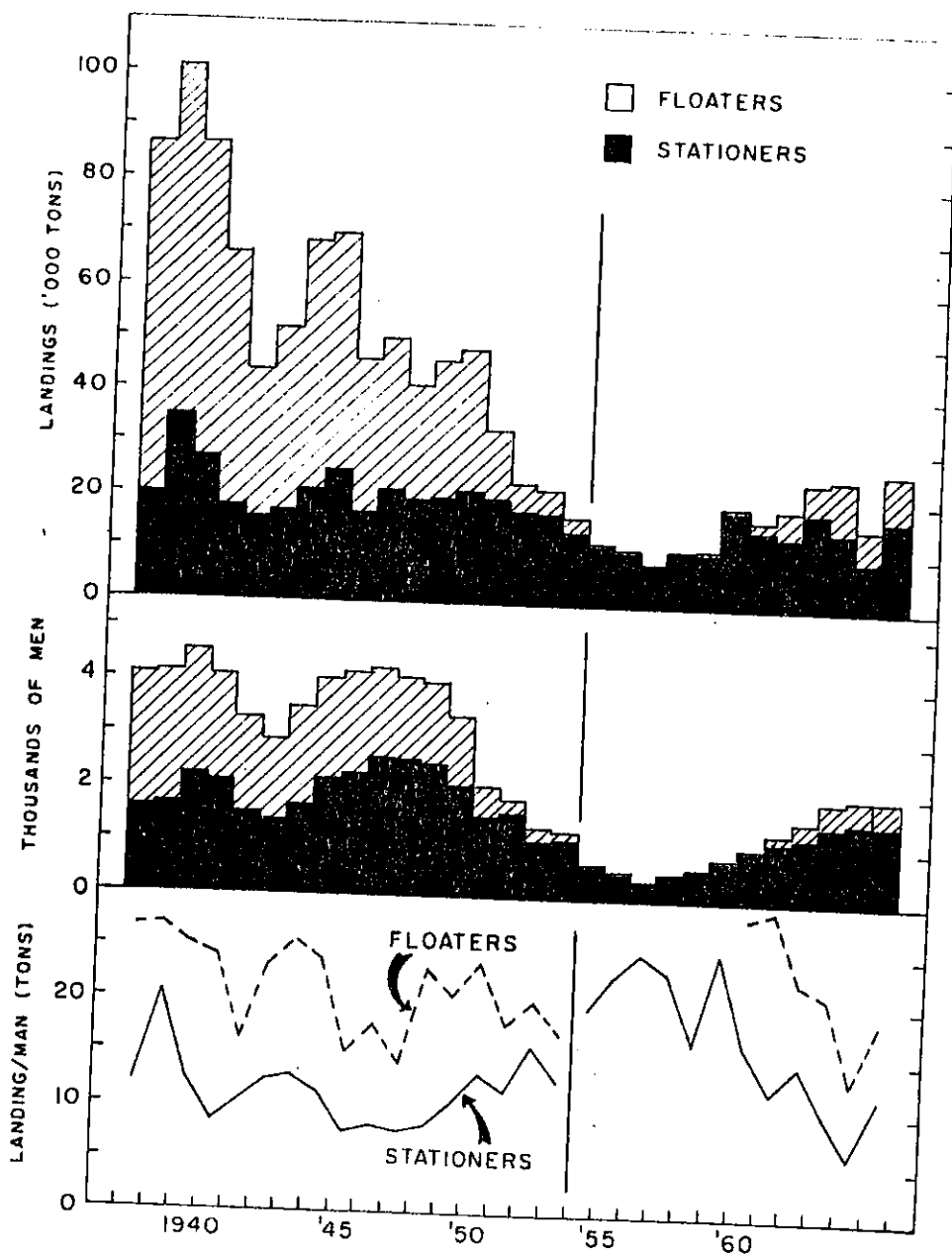


Fig. 4. Landings, effort and landing per unit effort in the inshore fishery, 1937-65.

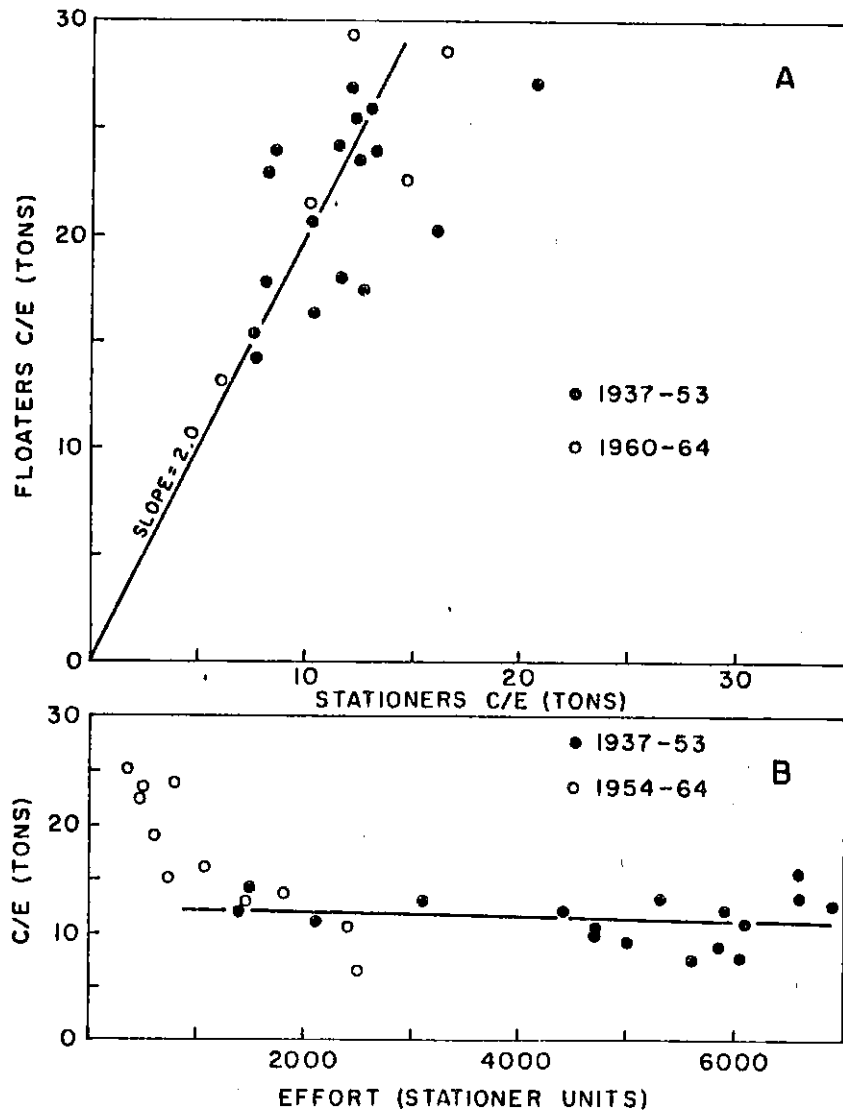


Fig. 5. A. Relation between catch per man of floaters and stationers^{er}. B. Catch per unit effort versus effort in the inshore Labrador cod fishery.