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Summary of Observations Made in an Analysis of Groundfish Landings and Effort Statistics

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Collection of landings and effort statistics for biological fisheries studies rests on the notion that landings of a species are related to abundance of the species, and that this relationship can be obtained by a combined study of discards at sea, statistics on the operation of the fishing fleet, and some knowledge of the ecology and behaviour of the species.

A good deal has been written about the difficulties connected with the attempts to relate the catches and catches per effort to abundance, for example, the several papers presented at the joint ICES, ICNAF, and FAO meeting in Lisbon 1957 on this subject. In this report we will not concern ourselves with the question in general, rather we wish to illustrate some of the specific problems met with in our attempts to analyze Canadian Subarea 4 statistics. Most of the results used are taken from a study of the 1956 Canadian statistics from Subarea 4 by Mr. D. Brown.

Classification of Boats According to Fishing Power

The published ICNAF statistics classify groundfish vessels by gross tonnage in groups of 0-25, 26-50, 51-150, 151-500, etc. However, lacking specific information, it could be argued that the fishing power (catch per hour dragged from the average stock density) of a boat is related primarily to the size of its net and to its towing speed since these two things determine the area covered by the net at different depths.

The classification of boats should be such that the groups are as uniform as possible with respect to their fishing power.

In Table I we have listed for each gross tonnage classification the different types of nets used. In Table II the boats have been classified by net type, and the range of gross tonnage is tabulated for each net type.

Table I. Net types used in different gross tonnage classes.

Gross tonnage class	Net types
0-25	Yankee 3/4 35, and flounder net
26-50	Yankee 3/4 35, 35, and flounder net
51-150	Yankee 35, 36, 41A, 41, and Peter Carey
151-	Yankee 36, 41A, 41, Peter Carey, and 1½ Iceland

Table II. Range of gross tonnage for different nets for boats fishing 4V and 4W in 1956.

Net type	Gross tonnage range
Yankee 35	35-70
36	110-160
41A	140-190
41	130-400
Peter Carey	130-195
1¼ Iceland	195-400

From Tables I and II it is obvious both that gross tonnage classes are heterogeneous with respect to gross tonnage. 1/

For boats using a similar net size the catches per effort were plotted against the gross tonnage. One such graph is reproduced in Figure 1, which gives the average catch per effort, Subdivision 4W (1956) for individual boats using Iceland 1¼ net. Despite the fact that gross tonnage varies from 220 to 400, no relation between catch per effort and gross tonnage was found. The same held true for all other net sizes as well. It appears, therefore, that gross tonnage alone without net size may not be an indication of fishing power.

In Figure 2 the boats have been grouped both by net size and gross tonnage. The graph shows the average total catch per trip for different sizes within different gross tonnage classes. There seems to be only small differences in average total catch among boats over 151 gross tons, while (e.g.) in the 50-150 gross tonnage class two distinct groups can be separated, the boats using Yankee 35 net and the boats using Yankee 36 nets.

From this analysis using total catch figures it would appear that gross tonnage in the 151-500 class is not indicative of difference in fishing power, although it has meaning below 150 gross tons in its relation to net size. It was found however that there were statistically significant differences in the species composition of catches between different net sizes. If these differences are affirmed and made clear by further study, it becomes necessary to classify boats by net size, not only because a net size is a measure of its fishing power but because it also plays a part in determining the species composition of catch.

Classification of Trips

To obtain the effort expended toward each major species the trips (or parts of trips) by different classes of fishing vessels should ideally be classified as cod, haddock, etc. trips. In practice, however, the intention of the skipper is not so well defined, nor do we have any information on it. The present practice is to classify a trip as cod, haddock or flounder trips if more than 40% (sometimes 50%) of the total is of that species. To find out if any such distinction did in fact represent a classification of fishing trips and effort, the following analysis was carried out: The percentages

1/ Apart from the Yankee 41 class the net size classes seem somewhat more homogeneous with respect to gross tonnage than gross tonnage classes with respect to net size. In recent years, however, the larger boats in Yankee 41 class have changed to Iceland 1¼, bringing the upper gross tonnage limit down from 400 to 190.

of cod, haddock, and flounders in otter-trawl landings from Subdivisions 4V and 4W were compiled separately by areas and by boats, using Yankee 35 and Iceland 1½ nets. The data were plotted as histogram frequencies. The resulting frequency curves were rather smooth with only small difference in the magnitude of adjacent classes. In not a single case could we separate a particular group or groups of trips as cod, haddock or flounder trips.

This apparent impossibility of classifying trips as cod, haddock, etc. trips has important consequences for the interpretation of our data. If we continue to use an arbitrary criterion such as "the trip is a cod trip if more than 50% of the total is cod", our calculations will tend to stabilize the catch per effort and convert what may be a major part of the fluctuations in abundance to apparent shifts in the applications of fishing effort to another species. It is evident that we require some alternative method of compiling catch figures if we are to be able to measure mortality rates or abundance. One such possible alternative would be to study the species composition of catches in terms of frequencies of weights of catches of at least the major species, and the yearly changes in such frequencies. The yearly changes in the frequencies would have to be compared with abundance indices obtained by research vessel operations and by market demands for that species to learn how these three variables are connected.

Measures of Effort

Two different units of effort (hours dragged and days fished) were examined to see which measure of effort is more closely correlated with catch. In all cases studied it was found that the measure of relative accuracy was greater for hours dragged than for days fished. The difference was quite small (less than 5%) however, and because of the greater ease of employing catch per day fished, it may be preferable.

Increase in Efficiency of Boats

In Figure 3 the average catch per boat of Gloucester class draggers built before 1949, operating in Subdivision 4T, is plotted for 1948-56 against the average catch per week of the same class boats built in 1949 or after. The first group includes 10 boats which have been fishing regularly since 1948; the latter group consists of only 6 boats in 1949 but upward of 30 in 1956. All these boats are in the 25-50 gross tonnage class. Beginning in 1952 the newer boats have been consistently more efficient, catching about 7% more than the older ones.

Summary and Recommendations

1. The study of the 1956 Canadian Subarea 4 statistics shows that the net size may be as important as the gross tonnage in determining fishing power and species composition.

2. The relative fishing power of different vessels is determined reliably by comparative fishing experiments. An alternative or complementary and at the same time considerably cheaper approach to measuring the relative fishing power of vessels would be a special study of the area covered at standard towing speeds by different sizes of nets.

3. It is desirable to add to statistics describing fishing vessels information on net size and average towing speed.

4. More than one year's Canadian statistics should be analyzed and the results compared with European data, particularly with reference to fishing power and trip classification or related to species composition.

5. Studies indicate that the catch per day may be as good a measure of effort as the number of hours dragged. This conclusion should be checked using more than one year's statistics for different areas.

6. In Subdivision 4T the fishing efficiency of the fleet has been changing upwards since 1945. A similar study should be conducted for all other subdivisions as well, and for all major classes of boats fishing in the ICNAF area.

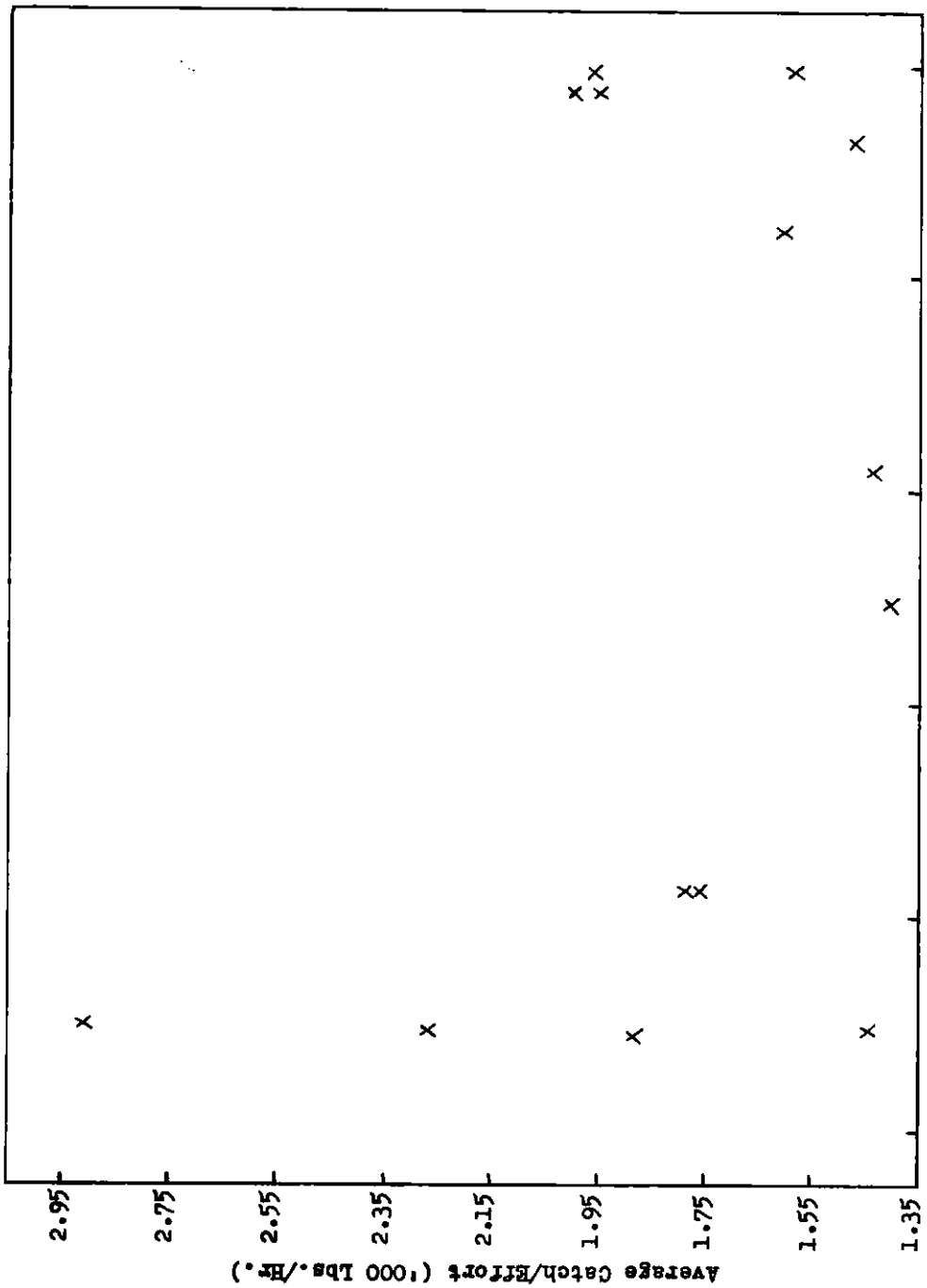

Figure 1. Average catch per effort, Subdivision 4W (1956), Iceland 1½ net.

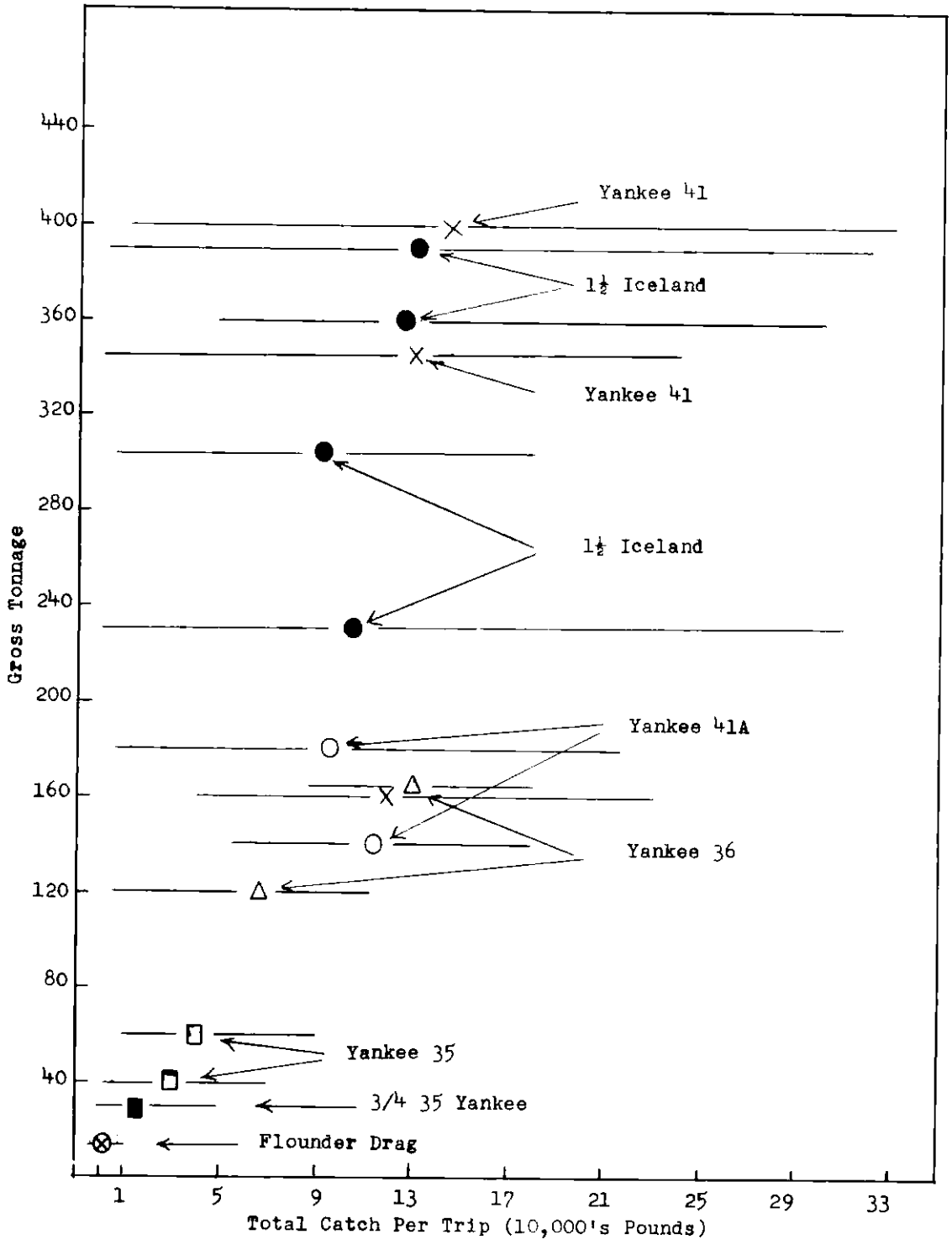

Figure 2. Average total catch and the range in relation to gross tonnage and net size, Subarea 4 (1956).

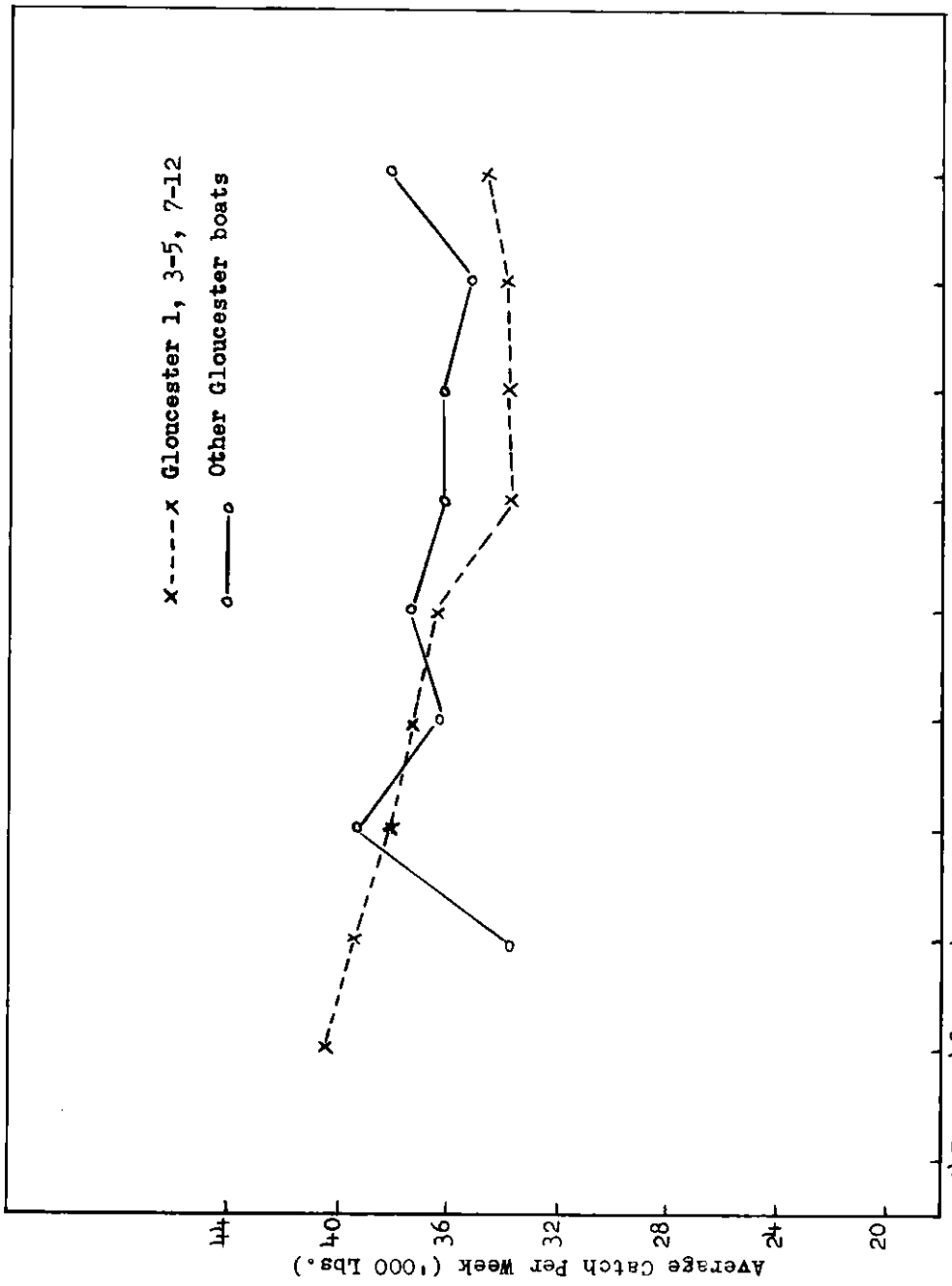

Figure 3. Catch per week of Gloucester class draggers fishing in Subdivision 4T.