

The effect of discarding on estimates
of total removals in the 1980
Division 4Vn winter cod fishery

by

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Abstract

Fishing effort in the 1980 Division 4Vn cod fishery was concentrated in the area of St. Paul's Island where relatively small cod were taken. Data collected through the International Observer Program showed that the modal lengths of kept and discarded cod were 45 cm. and 40 cm. respectively. Two options were used to estimate the total number of discards. Option 1 used the observed discard rate and Option 2 used the highest per-vessel discard rate. The two estimates were 509×10^3 and $2,229 \times 10^3$ by options 1 and 2 respectively. Estimates of total removals were increased by between 6% and 30% by considering the numbers discarded.

Résumé

En 1980, l'effort de pêche durant la pêche hivernale à la morue dans la Division 4Vn était surtout concentrée dans la région de l'île St. Paul. La taille des morues qui y furent capturées était relativement faible. Les données recueillies dans le cadre du programme d'observateurs internationaux indiquent que les longueurs modales des morues conservées et de celles rejetées étaient respectivement de 45 cm et 40 cm. Deux méthodes ont été utilisées pour estimer le nombre total de morues rejetées à la mer. Lorsque le taux moyen de rejet observé fut utilisée, on estima que le nombre total de morue rejetée à la mer fut 509×10^3 alors que lorsque le taux maximal de rejet par bateau fut utilisé l'estimation de la quantité rejetée atteignit $2,229 \times 10^3$. En tenant compte des rejets à la mer, les estimations de la récolte totale (en nombre) ont été majorées d'un pourcentage variant de 6% à 30%.

Introduction

Dumping of small fish may account for a large proportion of the total number of removals in some offshore fisheries. Estimates of discard rates are difficult to obtain due to a) a lack of reporting by fishermen because of stiff penalties against discarding and, b) poor information on the size composition of discards. Thus the estimates of removals are generally low because only the kept portion of the catch is reported.

Direct observations of fishing activities are available from the Department of Fisheries and Oceans International Observer Program. Observers were on 13 vessels during the 1980 Division 4Vn winter cod fishery. These vessels caught 1,597 t (18.7%) of the reported 8,560 t total catch. The observer data is analysed here with regard to the distribution of CPUE, bycatch, length composition and the cod catch and the effect of discarding on estimates of removals.

Methods

While at sea the observer collects set by set information on location, fishing time, catch composition and the proportion of the catch which is discarded. In addition, the observer carries on a routine program of length sampling and otolith collection.

Catch and effort were accumulated by 10' square according to the starting position of each set. Catch per hour was then calculated for each 10' square.

Kept and discard weights of cod and bycatch species were summed. Discard rates were calculated as the ratio of discard weight to kept weight. Bycatch ratios were calculated as the ratio of total bycatch weight to kept weight of cod.

Length frequencies of kept and discarded cod were determined separately. Thirty-four kept and 3 discard length frequencies were taken. Mean weights of kept and discarded cod were determined by applying the following length-weight relationship from the 1978 September 4T research cruise to the respective length frequencies ($\log wt = 2.899 \log (len) - 1.85$). Numbers kept were calculated from the kept mean weight and the reported total 4Vn catch. Two estimates of discard numbers were calculated. Option 1 used the observed discard rate (r_1). Option 2 used the highest per vessel discard rate (r_2) applied to the unobserved portion of the catch plus the observed number of discards. Thus by option 1 the total weight of discards (D_1) calculated as -

$$D_1 = r_1 \times C$$

where C = the reported Division 4Vn catch.

By option 2 the weight of discards (D_2) was calculated as

$$D_2 = d + (r_2 \times (C - k))$$

where d = the observed discard weight

k = the observed kept weight

Estimates of the age composition of the Division 4Vn cod catch were obtained by applying the kept and discard length frequencies to the 1978 Division 4T research cruise cod age length key. Ages were increased by 1 year to be consistent with the ageing conversion of a January 1 birthday.

Results

The distribution of cod catch, effort and CPUE is shown by 10' square in figure 1. The fishery was distributed along the edge of the Laurentian channel from the northern boundary of Division 4Vn to east of Scatarie Island. The highest concentration of effort was around St. Paul's Island in 10' squares 471,600 and 471,601. This was also the area of highest catch rates and yielded over half the observed cod catch. Another area of high effort was between latitudes 46°40' and 47°00'. However, the catch rates in this area were only 1/3 of those around St. Paul's Island.

A summary of bycatch and discards is shown in table 1. The total bycatch was 3.0% of the kept cod weight. The highest bycatch species was pollock which was 1.4% of the kept cod weight. This was followed by haddock, redfish and American plaice. Overall bycatch was low as is normal in the Division 4Vn winter fishery.

A total of 1,551,475 kg of cod were observed to be kept and 45,390 kg were observed to be discarded giving an observed discard rate (r_1) of 0.029. Seventy-three percent of the discards came from 2 vessels. Even with an observer aboard as a deterrent these 2 vessels discarded cod at rates of 15.7% and 9.0%. Thus the option 2 discard rate (r_2) was 0.157.

Length frequencies of kept and discarded cod are shown in figure 2. The kept length frequency has a mode of 45 cm. and is skewed to the left while the discard length frequency has a mode between 39 - 41 cm and is skewed to the right. The skewedness appears to be a result of discarding fish below 40 cm.

The mean weights of kept and discarded cod are shown in table 2 along with the estimated numbers kept and discarded. The numbers kept were estimated as $7,379 \times 10^3$. The numbers discarded were estimated as 509×10^3 and $2,229 \times 10^3$ by options 1 and 2 respectively.

The estimated age composition of the kept and discarded portions of the cod catch are shown in table 3. Ages 5 and 6 contributed approximately 80% of the kept catch and 93% of the discarded catch were ages 4 and 5. When the discard estimates are taken into account the removals at age 3 are between 3.7 - 12.8 times the estimate obtained by considering only the kept portion of the catch. At age 4 consideration of discards increases the estimates of removals between 1.6 - 3.7 times and at age five between 1.1 - 1.3 times.

Discussion and conclusions

Data obtained from the International Observer Program reveals that a high proportion of the effort in the 1980 winter Division 4Vn cod fishery was expended in the area of St. Paul's Island near the northern apex of Division 4Vn. Catch rates in this area were the highest in the fishery, in excess of 3 t per hour. Examination of length frequency data shows that relatively small cod with a modal length of 45 cm dominated the catches.

The small size of cod created discard situations on numerous occasions. Reports by observers state that most companies will pay only fish meal prices for cod under 40 cm which leads many captains to discard small cod.

The presence of observers undoubtedly acts as a deterrent to discarding making option 1 an underestimate of the actual discard rate. On the other hand the highest per-vessel discard rate of 15.7% may be an overestimate due to the nature of that one vessel's catch. However, observer reports indicate that on most vessels a higher rate of discarding would have occurred if the observer was not aboard. A discard rate of 10% would not be unreasonable considering the small size of cod in the 1980 fishery.

The importance of including discards in estimates of catch at age is shown in table 3. The estimates of age 4 removals were from 1.6 to 3.7 times the numbers estimates from the kept portion of the catch alone. Thus in fisheries such as the Division 4Vn winter cod fishery a significant number of removals of young fish may be unaccounted for.

Table 1. Observed catch in the 1980 Division 4Vn winter cod fishery.

| Species | CATCH (kg) | | % Discarded | Bycatch % Directed Species |
|-----------------|------------|---------|-------------|----------------------------------|
| | Kept | Discard | | |
| Cod | 1,551,475 | 45,390 | 2.93 | |
| Pollock | 22,174 | 0 | 0 | 1.39 |
| Haddock | 8,458 | 0 | 0 | 0.53 |
| Redfish | 6,779 | 501 | 7.39 | 0.46 |
| Am. Plaice | 5,582 | 327 | 5.86 | 0.37 |
| Halibut | 1,682 | 0 | 0 | 0.11 |
| Witch | 1,135 | 0 | 0 | 0.07 |
| Winter flounder | 219 | 3 | 1.37 | 0.01 |
| Yellowtail | 108 | 15 | 13.89 | 0.01 |

Table 2. Calculation of total removals in the 1980 4Vn cod fishery.

| | Mean fish Weight (kg) | Total Weight (t) | Numbers $\times 10^{-3}$ | Total Removals $\times 10^{-3}$ |
|---------------------|--------------------------|---------------------|-----------------------------|------------------------------------|
| Kept | 1.16 | 8560 | 7379 | |
| Discard Option 1 | .491 | 250 | 509 | 7788 |
| Discard Option 2 | .491 | 1095 | 2229 | 9608 |

Table 3. Estimates of removals ($\times 10^{-3}$) at age in the kept and discard portions of the 4Vn winter cod fishery.

| AGE | KEPT | DISCARD | | TOTAL | |
|-----|------|----------|----------|----------|----------|
| | | Option 1 | Option 2 | Option 1 | Option 2 |
| 3 | 6 | 16 | 71 | 22 | 77 |
| 4 | 382 | 238 | 1047 | 620 | 1429 |
| 5 | 3445 | 237 | 1041 | 3682 | 4486 |
| 6 | 2491 | 19 | 81 | 2510 | 2572 |
| 7 | 595 | | | 595 | 595 |
| 8 | 297 | 1 | 4 | 298 | 301 |
| 9 | 104 | | | 104 | 104 |
| 10 | 19 | | | 19 | 19 |
| 11 | 21 | | | 21 | 21 |
| 12 | 9 | | | 9 | 9 |
| 13+ | 11 | | | 11 | 11 |

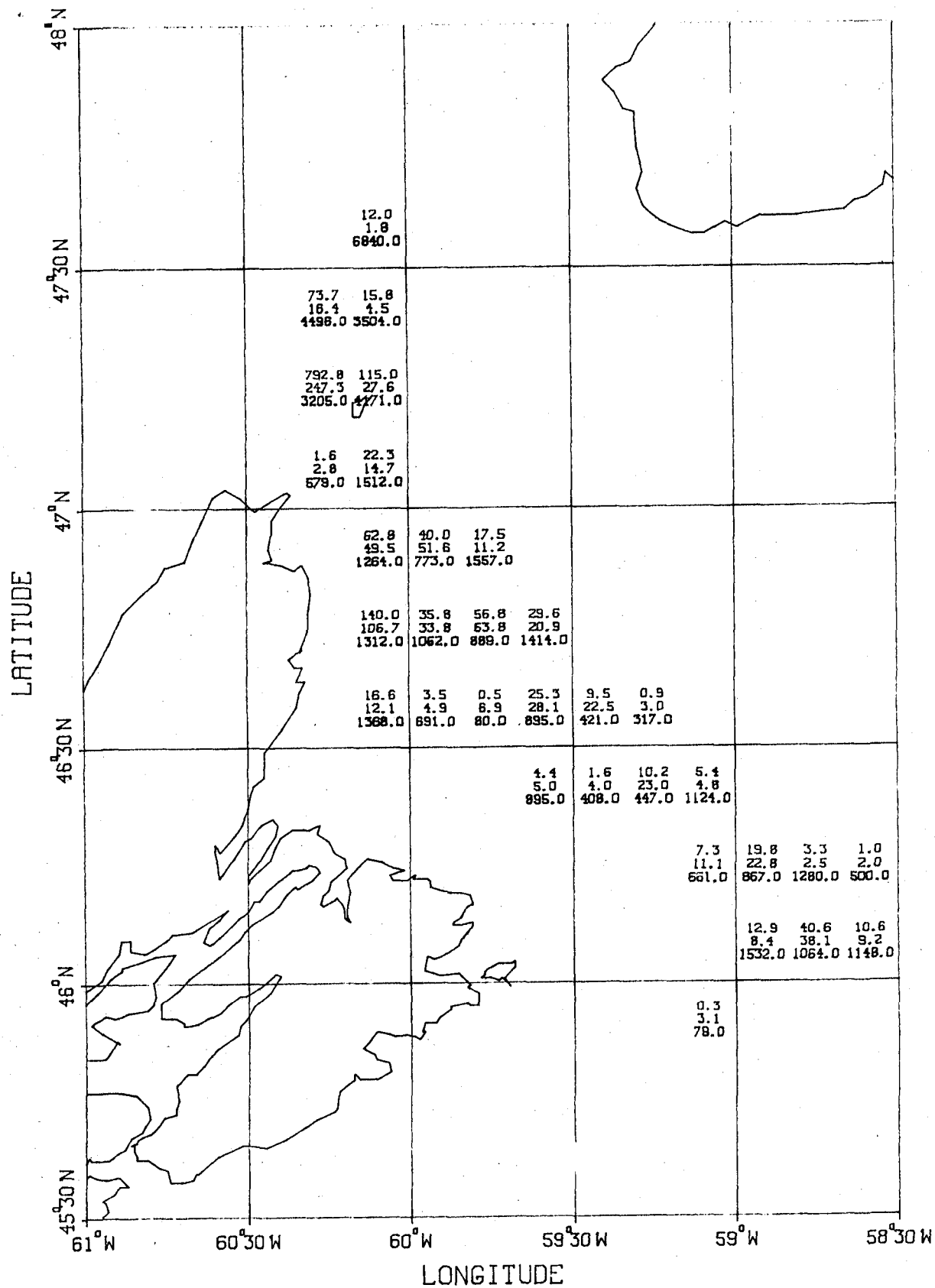


Figure 1. Distribution of cod catch (t), effort (hr), and CPUE (kg/hr) by 10' square in the 1980 Division 4Vn winter fishery.

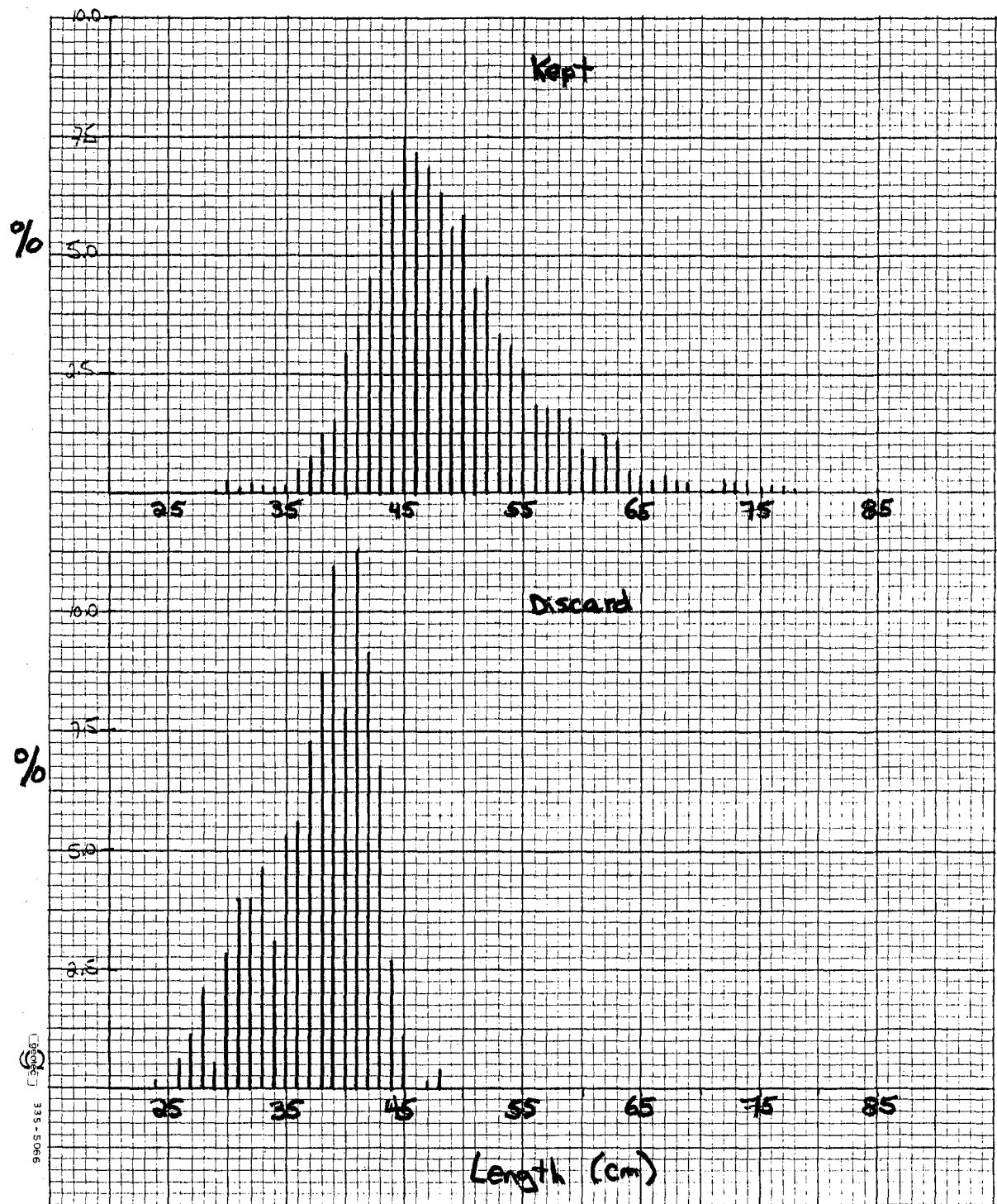


Figure 2. Length frequencies of kept and discarded cod in the 1980 Division 4Vn winter fishery.