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A Preliminary Review of the Status  
of the Subarea 5 Cod Stock

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Abstract

Cod landings for Subarea 5 have increased markedly since 1964 concurrently with increased effort. There is no indication from Albatross IV surveys of an increased population size. Some abundance indices from the commercial fleets indicate a decrease in abundance. There is a slight decrease in mean size of cod captured in the survey cruises since 1963. Yield and yield per recruit studies indicate that overfishing is occurring. Maximum sustained yield is probably no greater than 32000 MT. Landings have exceeded this figure every year since 1965.

Introduction

Cod has been exploited off New England since the seventeenth century. Landings statistics are available since 1893. The recent sharp increase in cod landings is a cause for concern. A review of the fishery is presented herein.

Landings Data

The recent average annual landings of 45-55,000 metric tons rivals that of the late 1800's and early 1900's just after the introduction of the otter trawl (Jensen and Murray, 1965) and exceeds any year since 1910 (Figure 1). Until 1960, the stock was exploited entirely by U.S. vessels. Landings have increased over threefold in the last ten years, due primarily to the entry of nations other than the U.S. (Table 1). Eighty percent of the catch is taken from Division 5Ze.

The historical record indicates that removals above 40,000 tons annually have not been consistently maintained, and raises the question of whether this catch can be supported on a sustained basis.

### Abundance

Landings-per-day-fished have been estimated since 1931 from the catch statistics of the selected set of large otter trawlers fishing out of Boston. These vessels have primarily sought to catch haddock. Thus, the landings-per-day-fished reflects the relative abundance of cod in those areas where haddock were caught. However, these areas encompass the major portion of the cod stock. The availability of haddock may well have influenced the landings of cod, but the fishery was very stable from 1935 to 1960. In recent years, particularly after 1967, the much reduced abundance of haddock has undoubtedly affected the fishing patterns, and, hence, the relationship between abundance and landings-per-day-fished of cod. The landings-per-day are probably biased upwards relative to previous years.

The standard days fished were estimated by dividing total catch by the landings-per-day-fished of the selected vessels. The data are given in Figure 2.

It is evident from these graphs that the increased catch in recent years has resulted primarily from increased effort. Landings-per-day have fluctuated markedly in some short terms of years, but have trended downward over the period from 1932-1967. Landings also decreased steadily from 1932 to 1960 so that effort remained rather steady.

Abundance indices were compiled from data in ICNAF Statistical Bulletin Table 4 for Spanish paired trawlers, Canadian side trawlers of 151-500 GRT, Canadian stern trawlers of 151-500 GRT and Canadian trawlers over 500 GRT. Some of these groups have entered the fishery only recently. The results are presented in Table 2. Overall these data indicate a decrease in abundance since 1966.

The numbers and pounds caught per tow in several survey cruises in Subarea 5 from 1963-69 are plotted on Figures 3 and 4. The former indicates a stable population and the latter perhaps a slight decrease. The high 1963 and 1964 values correspond to the increase in the early 1960's indicated by the commercial abundance indices. The lack of trend in survey abundance index since 1964 supports the hypothesis that the rise in U.S. commercial landings per day between 1963-1970 does not reflect an increase in population size.

### Length Frequency Studies

Examination of length frequency curves derived from samples collected on research vessel survey cruises does not indicate any noticeable trends from 1963 to 1970. A typical curve is shown in Figure 5. The mean lengths of fish in the samples (Table 3) do indicate some decrease in the later years. However, it is difficult to say how meaningful this trend is.

Sample data of length frequencies from U.S. commercial landings are not very representative of the true length frequency composition of landings due to varying market size categories between ports and limited sampling effort. No changes in the frequencies of the first quarter landings were evident in the period 1956-1970. The value for 1970 is given in Figure 6. The mean weight of these samples is presented in Table 4 and no trends are indicated. Samples from other countries are too infrequent to indicate trends. The length at age values given by Schroeder (1930) were applied to these curves and show that the three year olds are the first year class entering the fishery and that 4, 5 and 6 year olds have made up the greatest portion of the catch.

#### Sustainable Yields

Plots of landings-per-day against effort have been fitted with two yield functions in order to estimate the current status of the fishery. The basic data points are given in Figures 7 and 9. However, fitting was done on the set of data points using a four year moving average of effort (Figure 8), with the date referring to the terminal year. The 1968 and 1969 points were ignored for reasons explained above. The effort for these years equivalent to previous years would be about 1.5 times greater than observed.

A curve of yield-per-recruit per unit fishing mortality was taken from the study of Beverton (1965). His technique was utilized to fit this curve to the data in Figure 8. The shape of the curve does not correspond very well to the trend in observed data. A maximum yield of 18,000 MT at  $F$  of about 0.6 (10,000 days) is indicated by the curve. These values are considerably below that operated by the fishery in recent years.

A straight line was also fitted to the data (Figure 8). This provides a better fit, but is more empirical in nature than the Beverton function. Maximum yield of 32,000 MT at 30,000 standard days fished is indicated (Figure 9). Recent removals and fishing effort are about 50 percent greater than this.

Table 1.--Recent cod landings (metric tons x 10<sup>-3</sup>) from Subarea 5

Year	C O U N T R Y					Total
	United States	Canada	Spain	USSR	Poland	
1960	14	-	-	-	-	14
1961	18	-	-	-	-	18
1962	19	2	-	5	-	26
1963	17	8	-	5	-	30
1964	16	7	-	5	-	28
1965	15	11	-	14	2	42
1966	16	16	8	17	-	57
1967	18	8	15	1	-	42
1968	21	9	15	1	3	49
1969*	24	6	14	1	-	45

\*Preliminary

Table 2.--Abundance indices for Subarea 5Z cod

<u>Year</u>	<u>Country</u>	<u>Gear</u>	<u>Catch/day in MT</u>
1966	Spain	Paired trawlers 151-500 MT	19.2
1967			16.2
1968			16.0
1969			13.9
1962	Canada	151-500 MT Side trawler	3.2
1963			4.3
1964			3.2
1965			3.2
1966			3.5
1967			2.1
1968			2.7
1969			2.7
1966			Canada
1967	2.7		
1968	3.5		
1969	2.0		
1966	Canada	500+ Stern trawler	2.4
1967			3.1
1968			4.8
1969			3.7

Literature Cited

- Beverton, R.J.H. 1965. Catch/effort assessment in some ICNAF fisheries. ICNAF Res. Bull. (2):59-72.
- \_\_\_\_\_ and S. J. Holt. 1965. Tables of yield functions for fishery assessments. FAO Fish. Tech. Paper (38) 49 p.
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- Schaefer, M. B. 1957. A study of the fishery for yellowfin tuna in the eastern tropical Pacific Ocean. Inter-Am. Trop. Tuna Comm. Bull. 11(6) 246-285.
- Wise, J. 1962. Cod groups in the New England area. Fish. Bull. 63(1): 189-203.

Table 1.--Ratio of catch per day between 150-501 MT trawlers and other USSR vessels used to estimate standard days fished

<u>Category</u>	<u>Mean Ratio</u>
<u>1800+ Trawlers</u> Standard	2.0
<u>900-1800 MT Trawlers</u> Standard	0.5
<u>500-900 MT Trawlers</u> Standard	1.0
<u>500-900 MT Purse Seiners</u> Standard	2.5
<u>150-500 Purse Seiners</u> Standard	2.0
* <u>150-500 Paired Trawlers</u> Standard	0.7
* <u>150-500 Gill Netters</u> Standard	1.7
* <u>151-900 Pair Trawlers</u> Standard	1.4

\*Vessels of these categories did not fish in 1968-1969

Table 2.--Indices of relative abundance of sea herring

<u>Year</u>	<u>Catch per standard days fished of USSR trawlers with herring catches</u>		<u>Catch per tow on spring surveys of Albatross IV</u>
	<u>more than 10%</u>	<u>more than 50%</u>	
	<u>Division 5Z</u>		
1968	5.90	5.69	120.6
1969	4.67	4.24	45.8
1970	-	-	34.7
	<u>Subarea 6</u>		
1968	6.11	5.42	17.4
1969	3.39	4.24	6.4
1970	-	-	1.2

Table 3.--Catch-per-unit-effort of herring in September in Division 5Ze

<u>Year</u>	<u>1800+ Trawlers</u>	<u>150-500 Trawlers</u>
1966	34.2	-
1967	17.2	8.1
1968	22.3	9.4
1969	10.0	4.3

Table 3.--Mean size of cod captured in research survey cruises in Subarea 5

<u>Year</u>	<u>Country</u>	<u>Mean lengths in mm.</u>			
		<u>Autumn</u>	<u>Winter</u>	<u>Spring</u>	<u>Summer</u>
1963	U.S.	-	-	-	627
1963	U.S.	700	-	-	-
1964	U.S.	-	766	-	-
1964	U.S.	-	-	-	646
1964	U.S.	753	-	-	-
1965	U.S.	-	639	-	-
1965	U.S.	-	-	-	702
1965	U.S.	628	-	-	-
1966	U.S.	-	624	-	-
1966	U.S.	612	-	-	-
1967	U.S.	578	-	-	-
1968	U.S.	-	-	616	-
1968	U.S.	650	-	-	-
1968	USSR	568 <sup>1</sup>	-	-	-
1969	U.S.	-	-	600	-
1969	U.S.	-	-	-	632
1969	U.S.	683	-	-	-
1969	USSR	612	-	-	-
1970	U.S.	-	-	672	672
1970	U.S.	646	-	-	-
1970	U.S.	639	-	-	-

Table 4.--Mean weight of U.S. first quarter cod sample in area 5Z  
U.S. Commercial catch

<u>Year</u>	<u>Weight (kg.)</u>
1957	4.03
1958	2.25
1959	2.12
1960	3.29
1961	2.32
1962	2.80
1963	3.93
1964	3.32
1965	3.75
1966	6.21
1967	2.50
1968	2.91
1969	2.04
1970	4.59

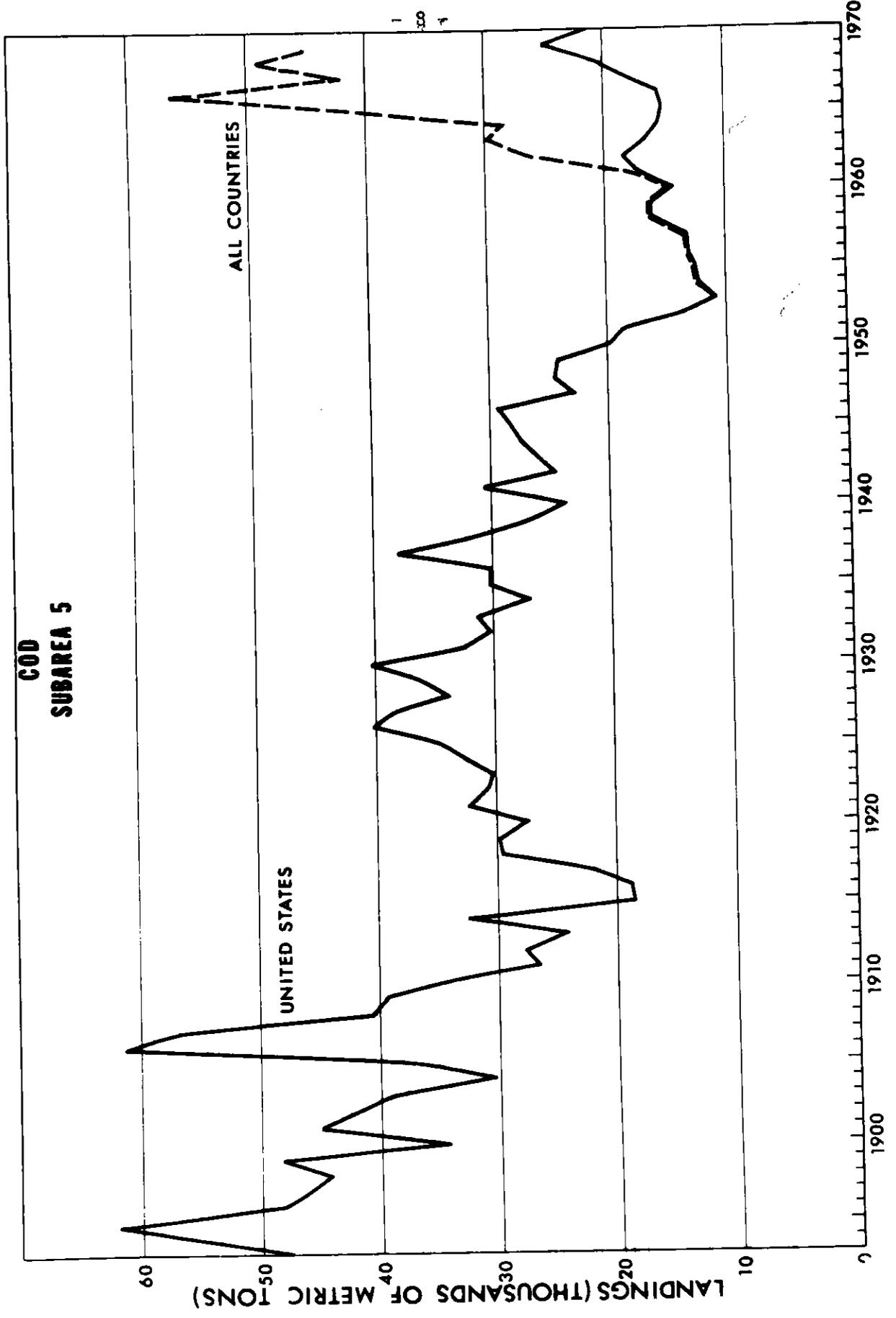


Figure 1.--Landings of Cod since 1893.

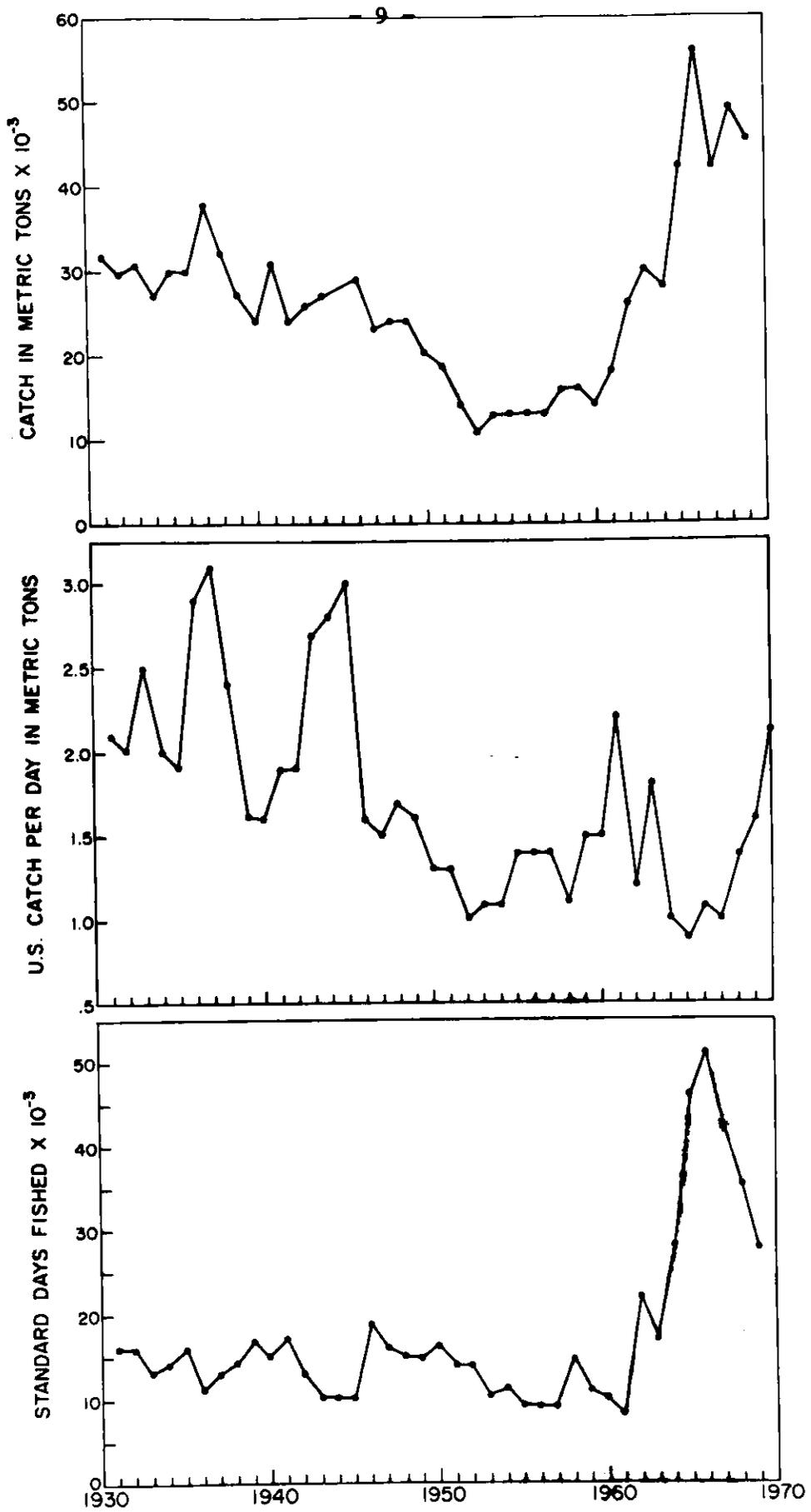


Figure 2.--Landings, catch per day and standard days fished for Subarea 5 cod since 1932.

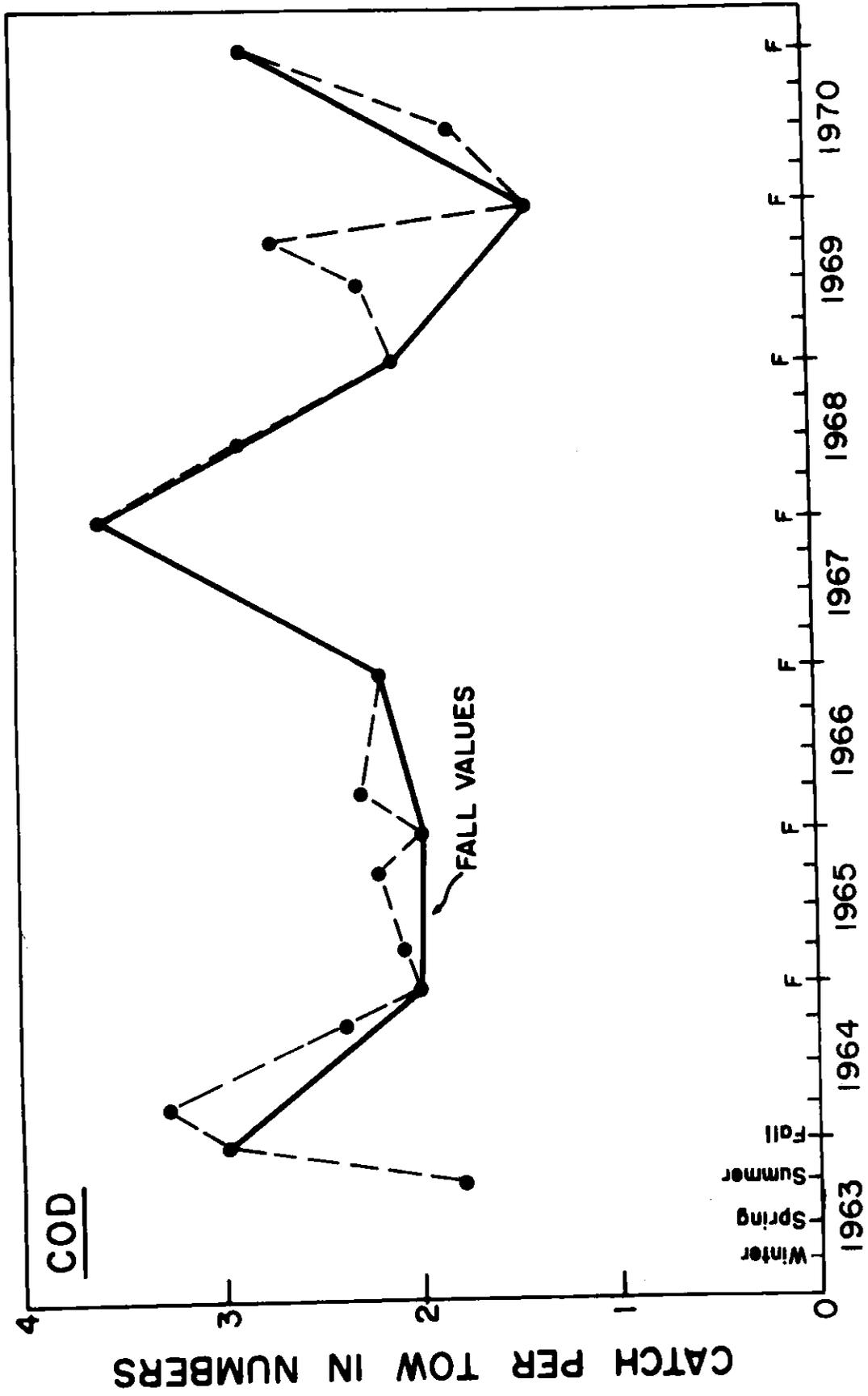


Figure 3.--Numbers per tow of cod from U.S. survey cruises in Subarea 5.

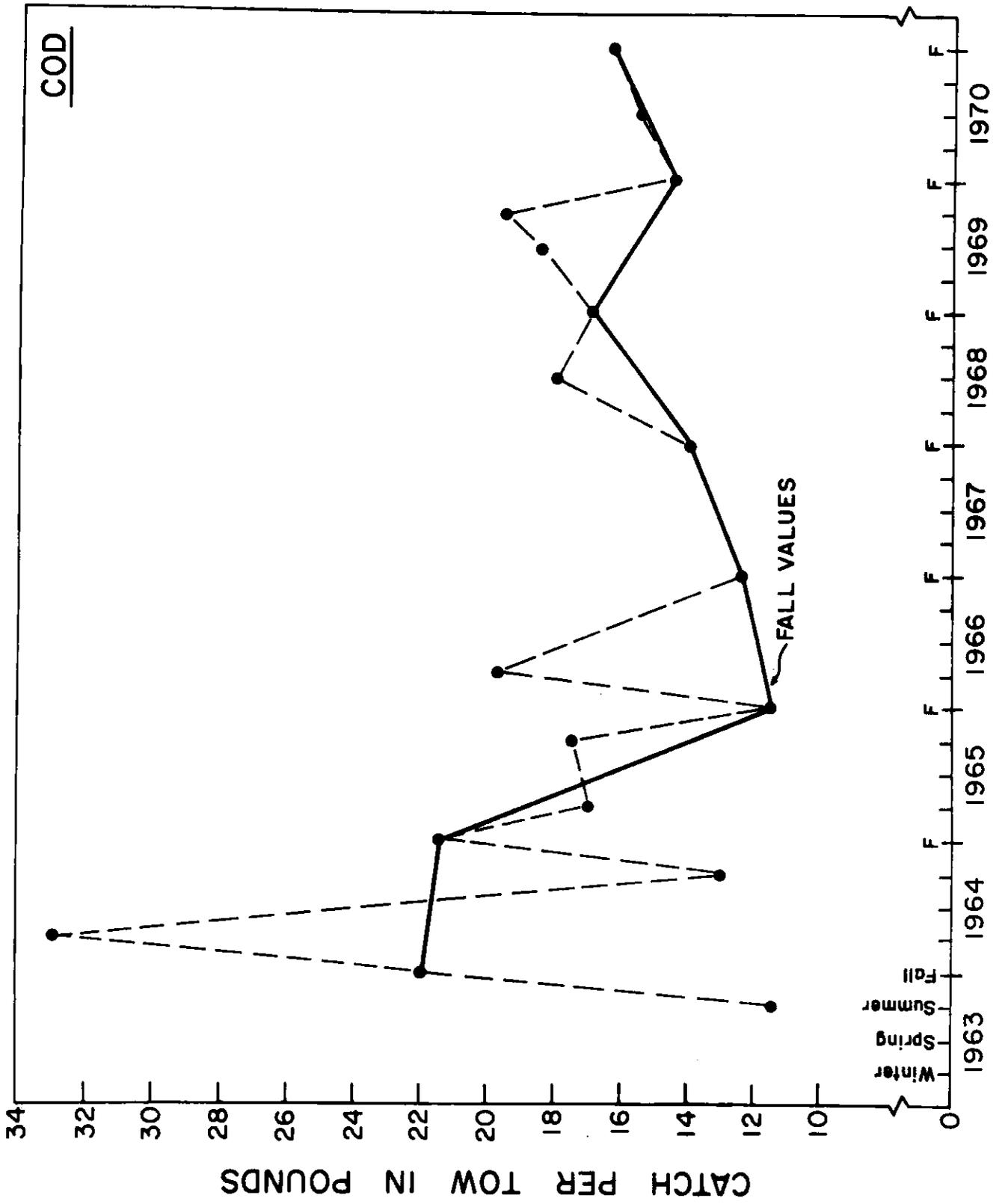


Figure 4.--Pounds per tow of cod from U.S. survey cruises in Subarea 5.

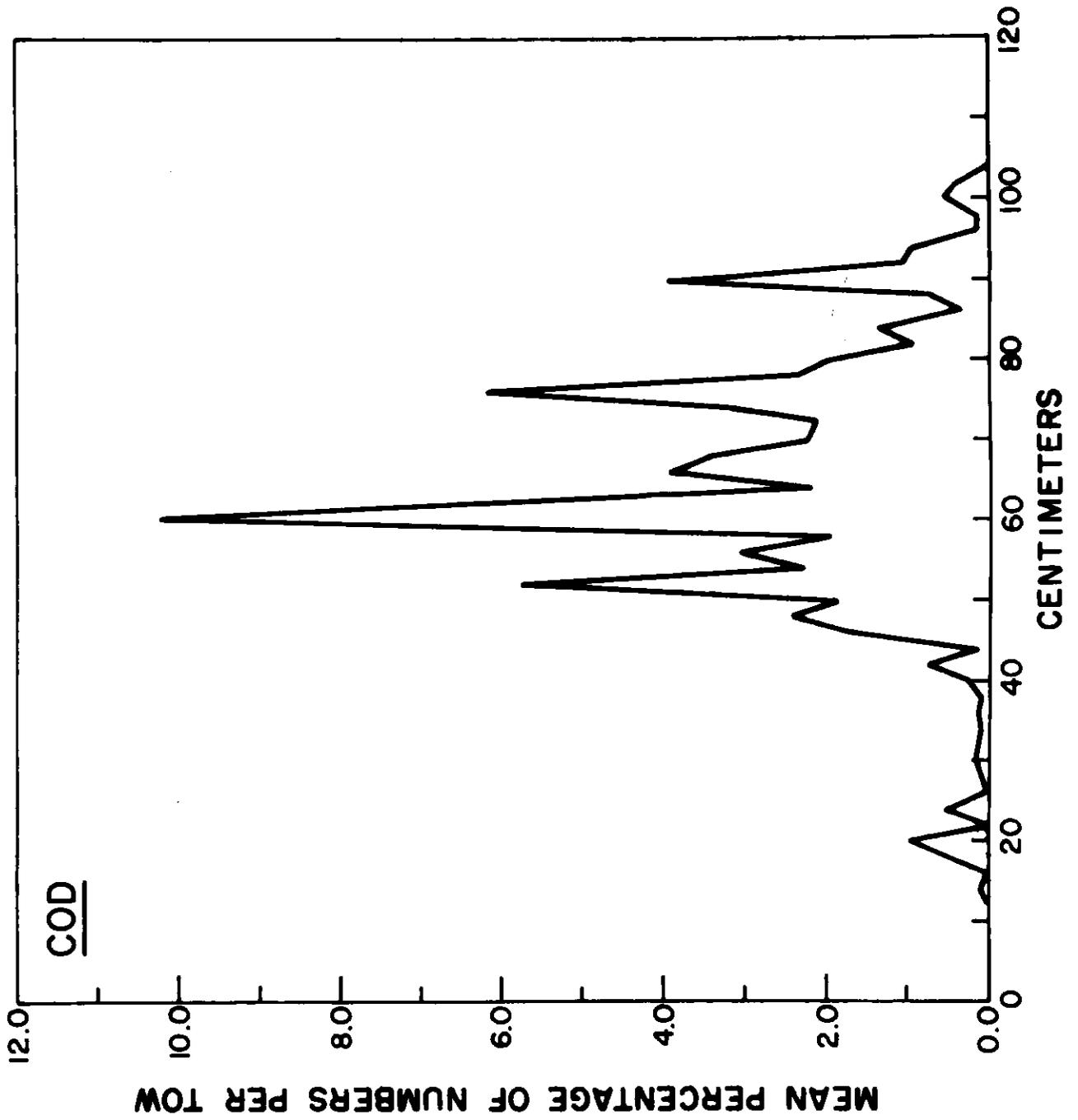


Figure 5.--Mean of strata percent length frequency of cod for Subarea 5 from autumn 1968 U.S. survey cruise.

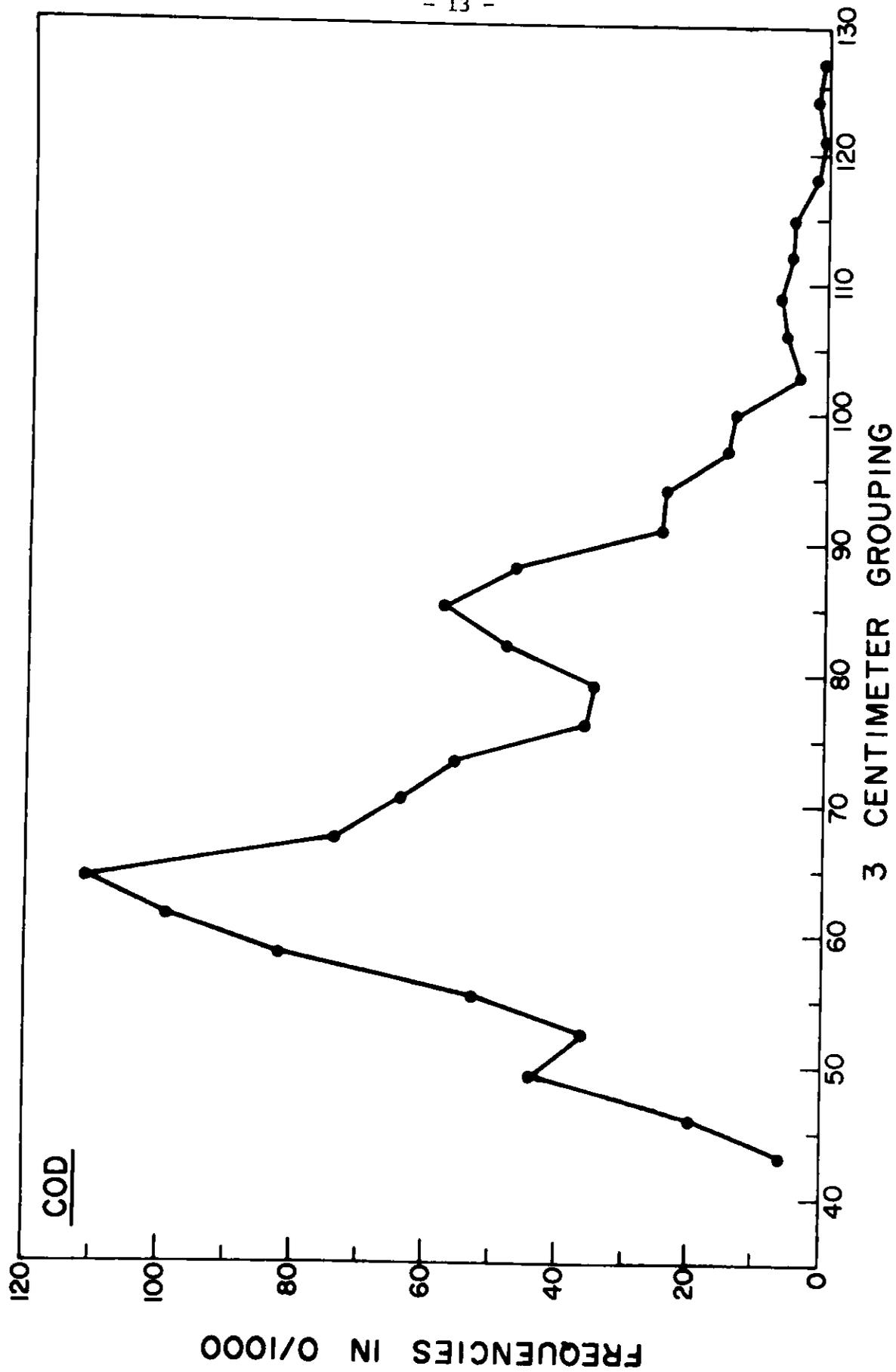


Figure 6.--Length frequency of U.S. commercial cod landings--  
January-March 1971 for Area 5Z.

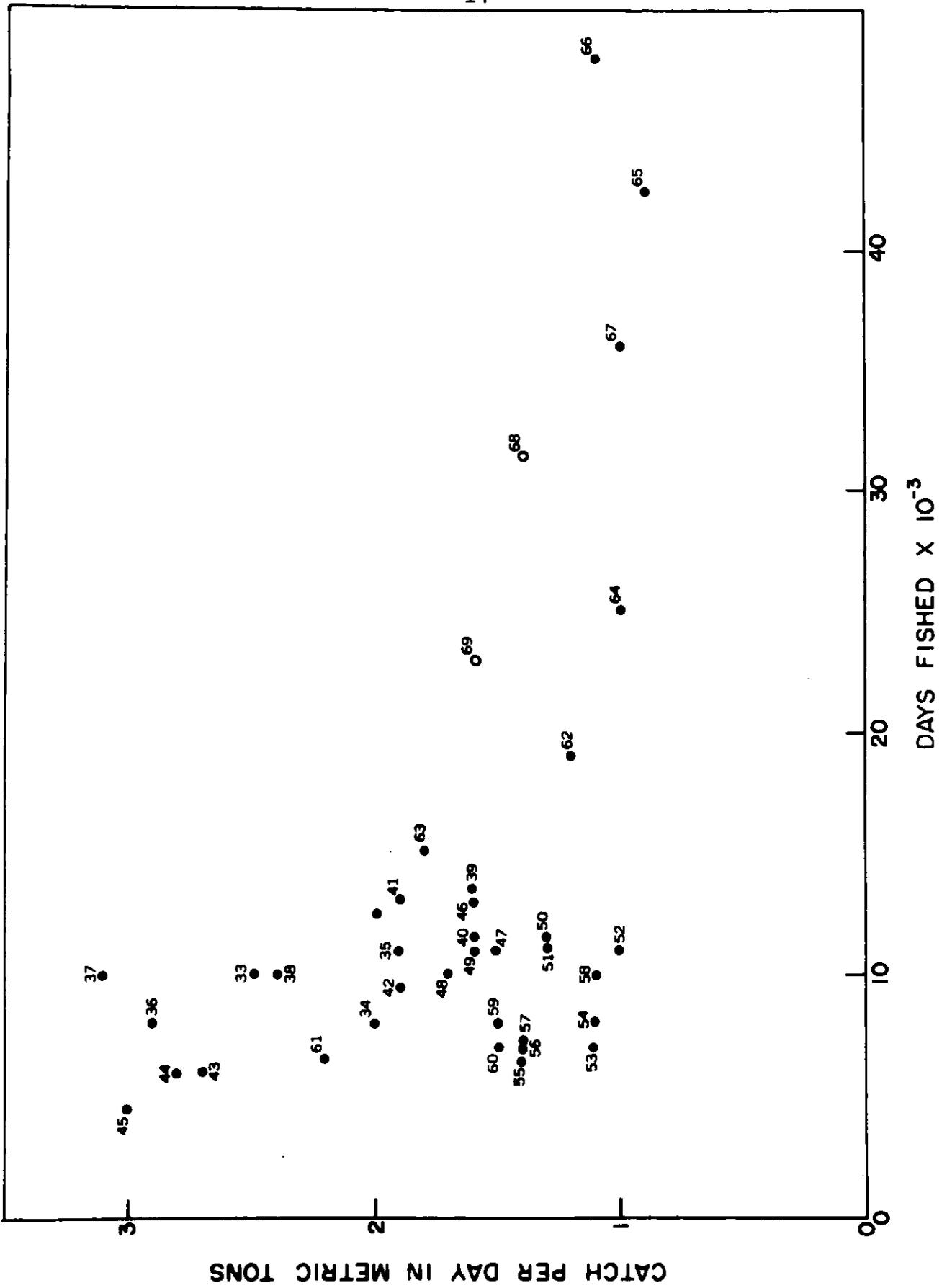


Figure 7.--Catch per unit effort versus days fished for cod in Area 5Z.

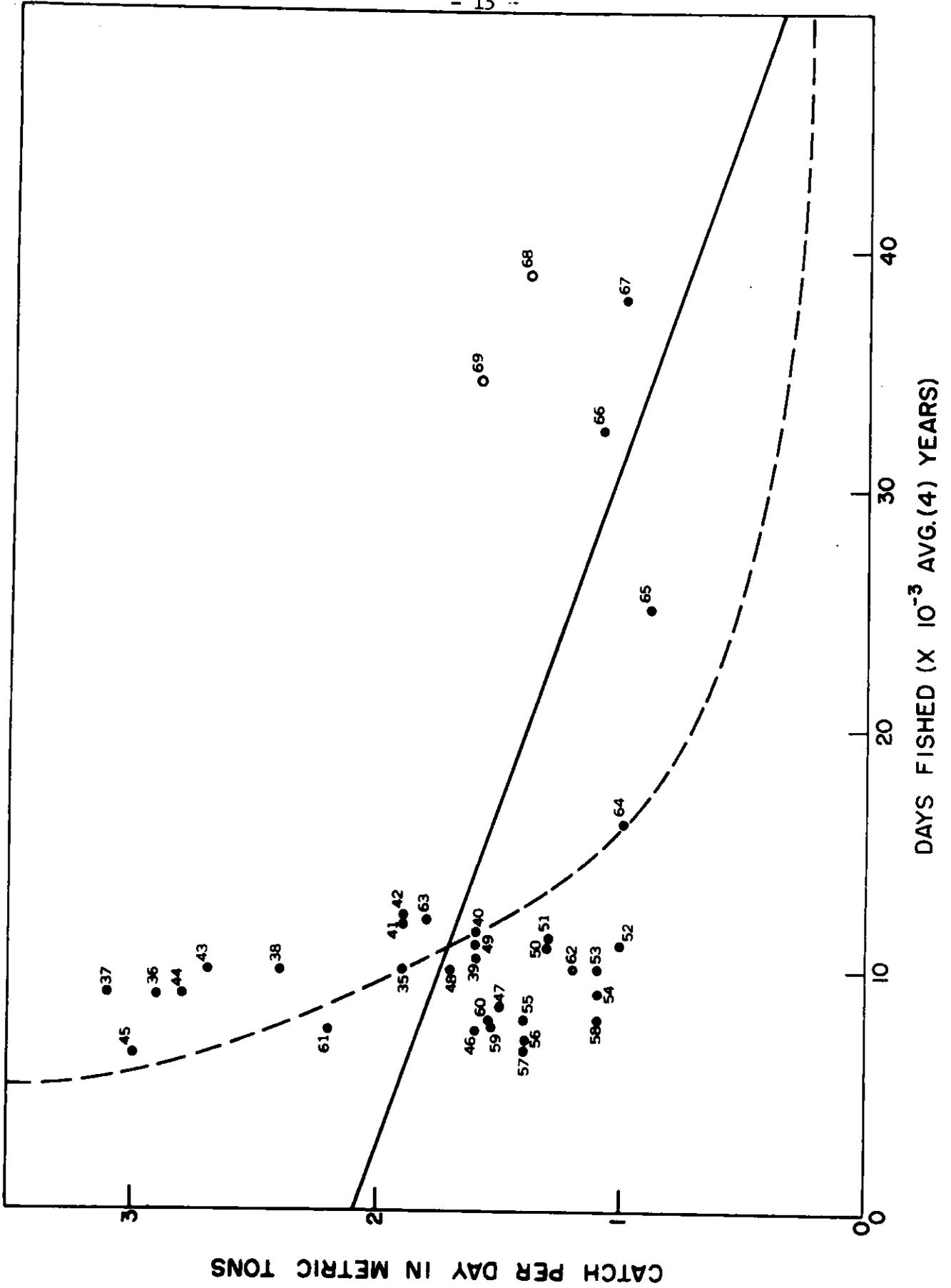


Figure 8.--Catch per unit effort versus days fished (moving average of 4s) for cod in Area 5Z.

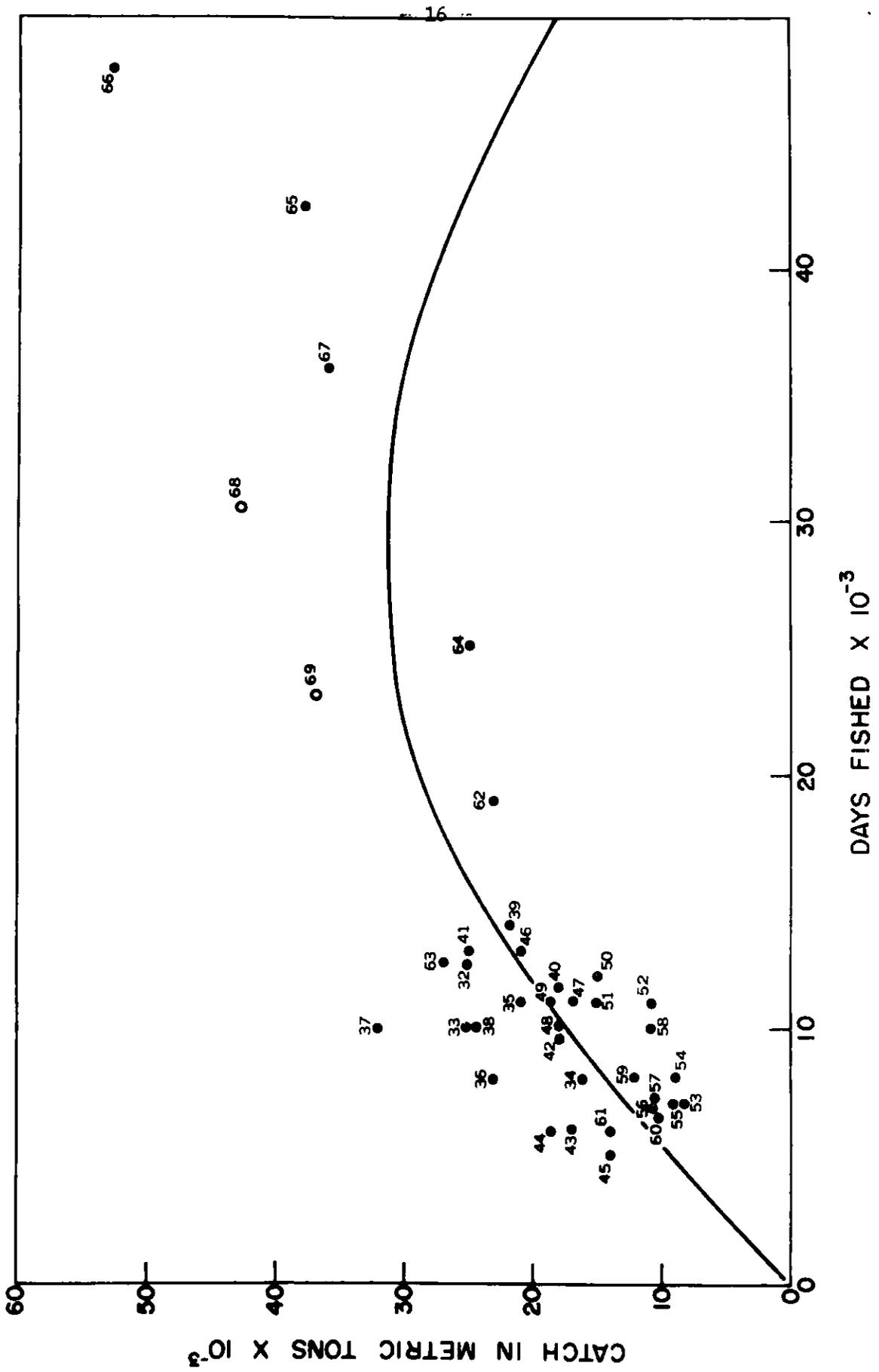


Figure 9.--Catch versus days fished for cod in Area 5Z.