

OVERVIEW OF FISHERIES FOR BILLFISHES IN HAWAII

Heeny S. H. Yuen
Southwest Fisheries Center
National Marine Fisheries Service, NOAA
Honolulu, Hawaii 96812

BILLFISH STOCK ASSESSMENT WORKSHOP

Honolulu, Hawaii, U.S.A.
5-16 December 1977

This is a draft working paper prepared solely for discussions at the Billfish Stock Assessment Workshop. It is not intended for publication in its present form and should not be cited.

OVERVIEW OF FISHERIES FOR BILLFISHES IN HAWAII

Introduction

The species of billfishes caught in Hawaii are blue marlin, Makaira nigricans, striped marlin, Tetrapturus audax, black marlin, Makaira indica, sailfish, Istiophorus platypterus, shortbill spearfish, Tetrapturus angustirostris, and swordfish, Xiphias gladius. Striped marlin and blue marlin are by far the most commonly caught species. The major methods by which billfishes are caught are commercial longliners and recreational trollers. This paper is a review of the catch statistics and the deductions that may be made from certain analyses of these statistics.

Description of Data and Data Sources

Fig. 1 All licensed commercial fishermen in Hawaii are required to file a monthly catch report on a standard form (Figure 1) with the Division of Fish and Game of the State of Hawaii (HFG). Information requested at the top of the form is for the purpose of identifying the licensee and the fishing boat. Other information requested are: day of fishing, area fished, type of fishing gear used, species caught number caught, pounds caught, pounds sold, value of pounds sold, and port of landing. Area of fishing refers to the statistical areas as defined by HFG

Fig. 2 (Figure 2). For this study the HFG areas were grouped into larger units which are also shown in Figure 2. These were called windward Kauai, leeward Kauai, windward Oahu, leeward Oahu, windward Maui, leeward Maui, windward Hawaii, leeward Hawaii, north windward, north leeward, south windward, and south leeward.

HFG data dating back to 1948 are available but only data from 1966 through 1975 are in a format suitable for detailed analysis. HFG data were examined for long-term trends in the annual catch, major fishing areas, and the relative contributions to the total catch by trolling and longlining for each of the billfish species.

Another source of data on billfish catches is the auction records of the United Fishing Agency. The auction records have data on the date of sale, species and weight of each fish, sale price, and seller (name of fisherman or boat). The records do not designate the method of capture. Familiarity with the names of the longline boats, however, make it possible to identify the billfish caught by them. The other billfish listed on the records were for the most part probably caught by recreational fishermen trolling. A few of them may have been caught by incidental trolling by commercial skipjack tuna fishermen or by handlines. The data from the United Fishing Agency from 1958 through 1963 and from 1968 through 1975 were examined to determine seasons and average weight trends. Records for the period 1964-67 were missing.

Data on the catch of recreational fisheries have not been systematically collected by any agency. Although a major effort was made to collect recreational data from varied sources such as fishing clubs and charter boat skippers, in the end the only data suitable for analyses were the records of the Kona Activities Center and the Honolulu Laboratory of the National Marine Fisheries Service. The Kona Activities Center which books 40%-60% of the charter business in the Kona area provided records which listed boat-days of fishing, date of capture,

species, and weight of fish for the period of January 1974–November 1977. The Honolulu Laboratory's records contained similar information for the annual Hawaiian International Billfish Tournament which is held in Kailua-Kona. The data on recreational fishing treated in this study is thus limited to the area of leeward Hawaii. These data provided information on monthly catch per unit effort from which the seasonality of blue marlin, striped marlin, black marlin, and shortbill spearfish were determined.

In June of 1971 a ban on the sale of blue marlin, black marlin, and swordfish was imposed because of new regulations on allowable levels of mercury in fish. The ban resulted in fishermen not reporting their catches of these species. In May of 1973 the ban was eased to permit the sale of individuals of these species that weighed less than 136 kg. The data from HFG and the United Fishing Agency from mid-1971 onward therefore, do not truly reflect the numbers of these species caught nor the weights of all the fish caught.

The Fisheries

Seventeen longline boats are currently active in the State of Hawaii. Two of these are based on Hawaii, the rest on Oahu. Of the 15 on Oahu 3 are newer boats which are larger, have greater range, and can fish more hooks than the older "traditional" boats. The old boats fish 120–180 hooks per set. The new boats fish about 600 hooks per set. In 1976 the longline boat averaged 147 fishing days a year.

The other major billfish catchers are the recreational trollers. The number of boats engaged in this activity is open to conjecture. A summary of boats registered with the Division of Water Transportation Facilities shows about 5,400 boats with the capability of deepwater fishing. A survey of boat owners in the Kona area (unpublished report of Research Associates) indicated that 71% of them used their boats for deepwater fishing. If that rate is projected to the 5,400 boats, 3,800 boats are used for deepwater fishing. Because of the exceptional fishing conditions in Kona, the percentage of Kona boat owners fishing may be too high to apply to the rest of the State. Making an adjustment for that, I think a "ballpark" guess of 3,200 boats in deep-sea recreational fishing is reasonable.

The Kona boat owners average 69 days of fishing a year. That average is also probably higher than the average for the entire State. If one guesses that 50-60 days a year is reasonable, the total fishing days would be 160,000-190,000 days a year.

A professional component in recreational fishing is the corp of charter boats. There are approximately 65 charter boats available for hire in Hawaii. Projection of the 133 charter days per year experienced by the charter boats in Kona (Research Associates, unpublished) to the entire fleet would add 8,600 boat days of fishing.

Besides the longliners and recreational trollers commercial fishermen in other fisheries catch billfish incidentally. Their billfish catches are rare, however, and will not be noted again in this overview.

Striped Marlin

Striped marlin is the most commonly caught billfish in Hawaii. This has not always been the case. Prior to 1962 blue marlin catches usually exceeded striped marlin catches in weight. In 1950 the catch of striped marlin reached a peak of 260 metric tons (MT) (Figure 3). In 1964 it reached another peak of 228 MT after a low of 93 MT in 1954. The catch declined from 156 MT in 1970 to 87 MT in 1971, the first year of the mercury scare. It has since reached a low of 64 MT in 1973 and has risen to 94 MT in 1975.

Fig. 3

Before the last decade striped marlin was caught almost entirely by longlines. Since 1968 the amount caught by trolling has increased steadily (Figure 4). The percentage of the striped marlin catch caught by longlines has decreased from 99% in that year to 32% in 1975. The most productive area by far for striped marlin was leeward Oahu. Leeward Maui and windward Hawaii yielded moderate amounts of striped marlin. Noticeable amounts also came from leeward Hawaii, windward Maui, windward Oahu, windward Kauai, and south windward.

Fig. 4

The seasonality of striped marlin in Hawaii is shown by a plot of the monthly longline catch summed over 14 yr (Figure 5). The highest catches occur in December. This is preceded by an extreme low in August with increasing catches in the intervening months. There appears to be a dip in catches in January which rises to a moderate plateau which extends from February to May. The catches drop from May to the August low. The monthly CPUE of striped marlin in the Kona recreational fishery averaged over the last 4 yr shows the low to be centered in

Fig. 5

October, a couple of months later than the low of the longline fishery. The peak month is June in the Kona fishery. Where the longline season for striped marlin shows a rapid rise from its low point to its high point and a gradual decrease to its low point, the Kona season shows a rapid decline from its peak to its low and a gradual increase.

Fig. 6

The frequency distribution of the weights of striped marlin from the longline fishery (Yoshida 1974) is reproduced here (Figure 6) to illustrate the range of sizes. The mean weight of striped marlin caught by trolling was decidedly greater than those caught on the longlines

Fig. 7

(Figure 7). In the period 1958-63 the average difference in mean weight was 10.7 kg. For the period 1968-75 the difference had been reduced to 2.8 kg on the average. In 1969 and 1971 the longline caught fish were in fact slightly heavier than the troll caught ones. A prominent feature of Figure 6 is the decrease in mean weights. The striped marlin caught by trolling between 1958 and 1963 showed the greatest decrease from 56.6 to 35.9 kg. This amounts to a decrease of 4.1 kg per year. In 1968 when the data is resumed after the years of the data gap the mean weight of the troll caught fish had fallen to 32.2 kg. In the ensuing 7 yr within which there were up and down fluctuations the mean weight showed a net gain of 3.6 kg. The longline caught fish showed a less drastic decrease in mean weight. From 1958 to 1963 there was a 4.5 kg decrease in mean weight; in the 5 yr of the data gap there was no decrease; and in the last 7 yr ending with 1975 there was a 1.7 kg decrease.

Blue Marlin

Fig. 8 The catch of blue marlin reached a high of 366 MT in 1954, and except for 3 yr, had declined until 1972 (Figure 8). The catch was 25 MT in 1974 as the result of an average 19 MT per year decrease over a period of 18 yr. The drop from 120 to 25 MT during 1970-72 was the result of the ban on the sale of blue marlin.

Fig. 9 The relative contributions of the trollers and the longliners to the total catch is presented in Figure 9. The trollers have been catching an increasing percentage of the total catch since 1968. By 1970 the troll catch had exceeded the longline catch. After that the data is meaningless because it is obvious that the longliners did not report their blue marlin catches, as in 1972, or only reported partially.

The lion's share of the troll caught blue marlin came from leeward Hawaii. Leeward Oahu was second in the number of blue marlin caught by trolling. Third was leeward Maui. That the leeward areas are on top of the list probably reflects the preference of these areas by the recreational fishermen for the pursuance of their sport rather than a preference of the blue marlin for these areas. The leeward and windward areas of Hawaii were the best blue marlin areas for longline fishing. Leeward Oahu and the south windward area were next best. Longliners also caught blue marlin in lesser amounts in windward Oahu and the windward and leeward areas of Maui and Kauai.

Fig. 10

The average monthly catches of blue marlin on the longlines (Figure 10) show a season reaching a climax in July and August. The first half of the year shows a rise from a January low and the second half shows a drop to the January low. The average monthly CPUE of the Kona recreational fishery shows a high dome occurring in August and September and a depression from March to May. The blue marlin season in the Kona fishery appears to be later than that for the longline fishery. The seasonal low occurs 2 mo later and the seasonal high occurs 1 mo later. This results in the Kona fishery having a shorter rise period and a longer decline period than the longline fishery.

Fig. 11

The mean weight of blue marlin caught by trolling for the years 1958-63 was smaller than that of their longline caught counterparts (Figure 11). The average yearly difference in size was 12.3 kg. In the same years the mean size of the longline caught blue marlins exhibited wide fluctuations and ended at 111.5 kg for a net decrease of 29.0 kg. The plot of the mean weight of the troll caught fish for the same period was W-shaped that started at 117 kg and ended at 116.3 kg. For the 3 yr after the data gap the fish caught by both methods were about the same size, both fluctuating around 90 kg.

Fig. 12

The weight-frequency distribution of blue marlin (Figure 12) reproduced from Yoshida (1974) shows clearly the differences in sizes and the distribution of sizes between the males and females. That troll caught blue marlin were smaller than those caught on the longline reflects the predominance of males in the recreational fishery. The male to female ratio in the Kona fishery is seldom less than 2:1 and

may be as high as 8:1. The weight-frequency distribution of blue marlin caught in Kona exhibited a dominant mode in the 70-80 kg weight class and a decelerating decline to 430 kg.

Black Marlin

Historically the catch of black marlin in Hawaii has always been small compared to the catches of the blue marlin and striped marlin. In the last 30 yr the best catch of black marlin was 12.3 MT for 1958. Since then the yearly catch has declined precipitously with large up and down fluctuations from year to year (Figure 13). The catch in 1975 added up to half a metric ton.

Fig. 13

From 1967 through 1970, 90% or more of the black marlin were caught with longline gear (Figure 14). Since 1971 the troll catch has exceeded the longline catch in every year but one. The number caught per year from 1972 through 1975, however, has not been more than nine individuals.

Fig. 14

The areas around Hawaii, especially the windward area, was best for black marlin. Almost all of the troll catches were made in leeward Hawaii. Longline catches of black marlin were also made in the leeward and windward sides of the other island areas and in the south windward area.

The longline catch summed over 14 yr and classified by months (Figure 15) indicates that October is the month with the highest catch and January the lowest. The catch in October is only 4 times that of January so the black marlin does not appear to be very seasonal. The

Fig. 15

monthly catch rate of the Kona recreational fishery exhibits a peak in April and a low during the winter months. The reliability of the catch rates is in question, however, because they were calculated from very skimpy data.

Swordfish

With few exceptions all of the swordfish caught in Hawaii were caught on longline gear. From 1948 until the present the annual catch of this species has been on a decline which was interrupted with one moderate rise (Figure 16). The 45.5 MT catch of 1948 dropped to 5.1 MT in 1954, an average drop of 6.7 MT per year. In 1955 the catch rose to 17.1 MT from which point it has gone down to 5.4 MT in 1970, the last year before the mercury crisis. Since then the recorded catch has been negligible.

Windward Hawaii was once the best area for swordfish, but the catch from that area has fallen steadily from 4 MT in 1966 to 0.4 MT in 1970. Another outstanding area was leeward Oahu where 3.1 MT were caught in 1970. Other areas in order of production were south windward, windward Maui, leeward Hawaii, windward Kauai, windward Oahu, leeward Maui, and leeward Kauai.

Sailfish

The annual catch of sailfish, like those of the billfishes mentioned so far, has fallen in the last 30 yr (Figure 17). Most of the decrease occurred between 1948 and 1952. In those 4 yr the sailfish catch plummeted from 79.1 to 9.8 MT. From 1954 to 1959 the

Fig. 16

Fig. 17

annual catch maintained a level between 2 and 9 MT. In 1971 it went to a lower level of 0.5 MT which persisted through 1975.

Up until the annual sailfish catch had dropped to 0.5 MT, longline fishermen caught 96% or more of the catch. In the years 1973-75 the amount caught by trolling increase to 0.2 MT, slightly less than half of the total catch of that period.

The best sailfish areas were leeward Oahu, windward Hawaii, windward Maui, and south windward. Windward Oahu was slightly better than the others. Leeward Hawaii and leeward Maui were also relatively good areas.

In the analysis of monthly catches sailfish and shortbill spearfish data were combined. During the years 1959-63 inclusive the catch was predominantly sailfish. The data of those years were chosen to be examined for the seasonal nature of the sailfish. The monthly totals of those years (Figure 18) indicate a major high and low in April and August, respectively, and a secondary high and low in October and January, respectively.

Fig. 18

Shortbill Spearfish

Fig. 19

The annual catch record of the shortbill spearfish (Figure 19) is the only one among the billfish species that does not exhibit a trend of decline. Neither does it show a trend of increase. It shows extreme fluctuations in the catch. The catch increased from zero in 1951 to 6.2 MT in 1954. The catch of the following year was 0.8 MT. The change in catch from 1968 to 1970 was even more extreme. It went from zero to

10.5 MT in yr. In 1971 the catch was 2.5 MT. From there it went up to 6.5 MT in 1974.

From 1966 to 1971, 99% of the shortbill spearfish catch was by longline. Since then the amount caught by trolling has increased steadily. By 1975 trolling accounted for 38% of the catch.

The best area for shortbill spearfish was definitely south windward. Leeward Oahu was also a very good area. Following those two areas in order of shortbill spearfish yields were: leeward Hawaii, windward Hawaii, leeward Maui, windward Maui, windward Kauai, leeward Kauai, and windward Oahu.

In determining the seasonality of sailfish there was a problem of dealing with data which were a combination of sailfish and shortbill spearfish data. The same problem naturally occurred in determining the seasonality of the shortbill spearfish. The solution was the same. Select those years in which the species of interest was clearly dominant in the catch. For the shortbill spearfish the dominant years were 1973-75 inclusive. February, March, and April were clearly the best months in the plot of monthly totals (Figure 20). May and June were transition months to the off season which occurred from July to November. The catch rose sharply in December followed by a dip in January. The mean monthly CPUE (1974-77) for shortbill spearfish in the Kona recreational fishery shows the same pattern with a month's delay.

Fig. 20

Discussion

The longline catch for the five species for which monthly data were available all showed a dip in January. The lower number of fish caught in January is probably due to reduced fishing effort more than the unavailability of fish. For many reasons, which will not be listed here, January is a good month for longline fishermen to take a vacation.

Four species--striped marlin, blue marlin, shortbill spearfish, and sailfish--demonstrated marked seasons of availability. Data from the Kona recreational fishery available for the first three mentioned species showed comparable seasonal patterns for each of the species. An interesting feature of the Kona seasonal patterns is that they lagged the seasonal patterns of the longline caught fish by about a month in each case. Is the delay the result of migration? If so, with Kona being in the southeast corner of the Hawaiian fishing area, the fish must be moving southward or eastward or along some resultant course which is a combination of those directional components. The predilection of these species to move northward in the spring and southward in the fall conflicts with any lag of the Kona patterns occurring in the early half of the year. The bimodal nature of the sailfish season suggests that the sailfish may be passing the islands in one direction at first and in the opposite direction later. Data on the seasonal occurrence of this species in the Kona area would have been a means of verifying this. Unfortunately, Kona data from those years when sailfish were more common than now are not available.

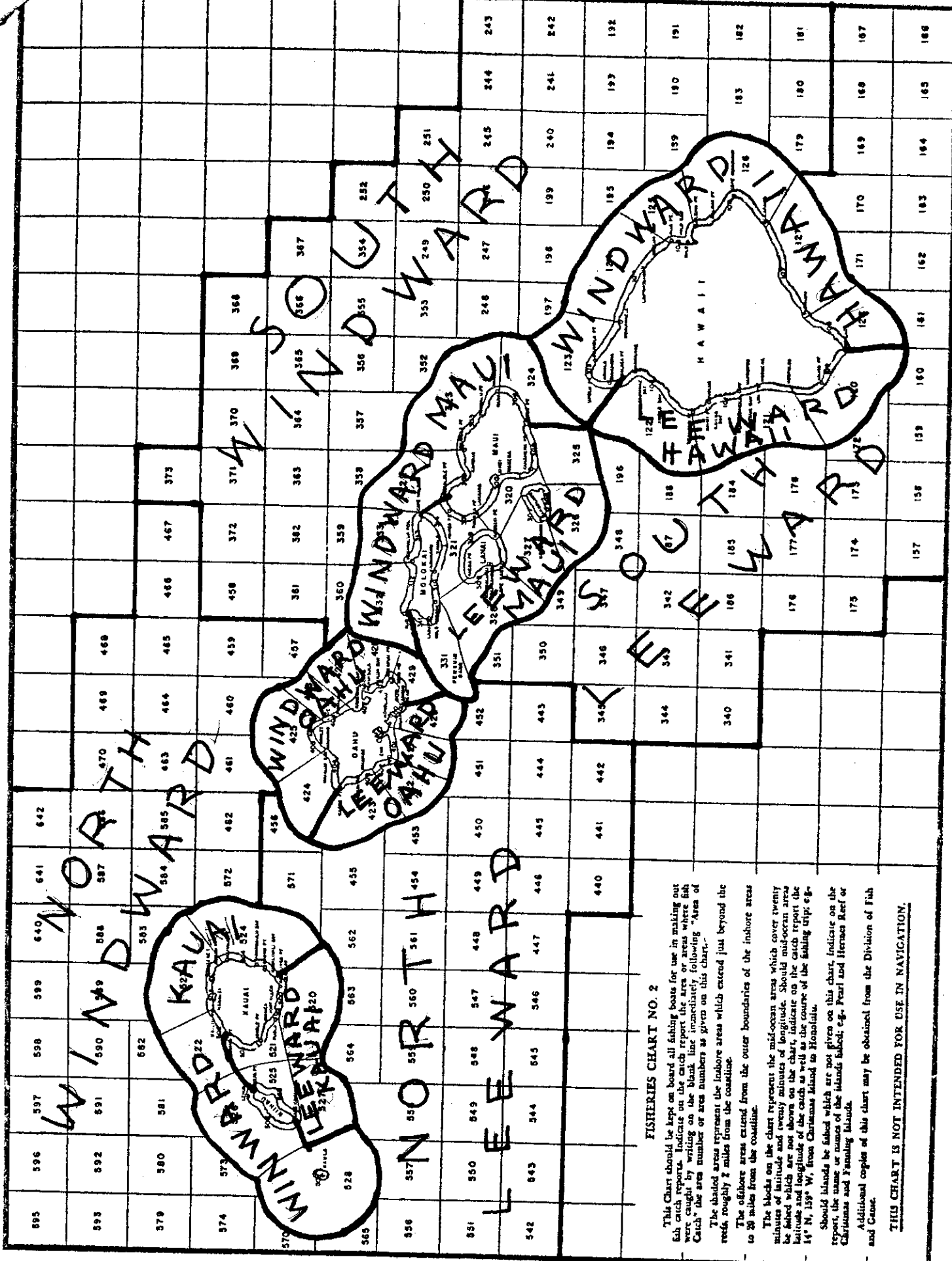
The figure of 160,000-190,000 boat days as an estimate for the total recreational fishing effort was based on a few nebulous assumptions. From data obtained from charter boat skippers (Research Associates, unpublished report) the catch rate of 0.32 kg per boat day for striped marlin for 1976 was calculated. When this rate is divided into the 55 MT of striped marlin caught by trolling in 1976 the result is 171,000 boat days.

Perhaps the most important feature of the data presented in this overview is the drastic drop in catches of five of the six billfish species in Hawaii in the last 15-20 yr. Particularly if the fish caught here come from highly migratory populations, as is implied by their seasonal nature which is possibly lacking in the black marlin, it is important to determine whether the decreases were caused by environmental changes or population changes.

Literature Cited

YOSHIDA, H. O.

1974. Landings of billfishes in the Hawaiian longline fishery. In R. S. Shomura and F. Williams (editors), Proceedings of the International Billfish Symposium, Kailua-Kona, Hawaii, 9-12 August 1972, Part 2. Review and Contributed Papers, p. 297-301. U.S. Dep. Commer., Natl. Mar. Fish. Serv., Spec. Sci. Rep. Fish. 675.



FISHERIES CHART NO. 2

This Chart should be kept on board all fishing boats for use in making out fish catch reports. Indicate on the catch report the area or areas where fish were caught by writing on the blank line immediately following "Area of Catch" the area number or area numbers as given on this chart.

The shaded areas represent the inshore areas which extend just beyond the reefs, roughly 2 miles from the coastline.

The offshore areas extend from the outer boundaries of the inshore areas to 20 miles from the coastline.

The blocks on the chart represent the mid-ocean areas which cover twenty minutes of latitude and twenty minutes of longitude. Should mid-ocean areas be fished which are not shown on the chart, indicate on the catch report the latitude and longitude of the catch as well as the course of the fishing trip; e.g., 14° N, 159° W, from Christmas Island to Honolulu.

Should islands be fished which are not given on this chart, indicate on the report, the name or names of the islands fished; e.g., Pearl and Hermes Reef or Christmas and Fanning Islands.

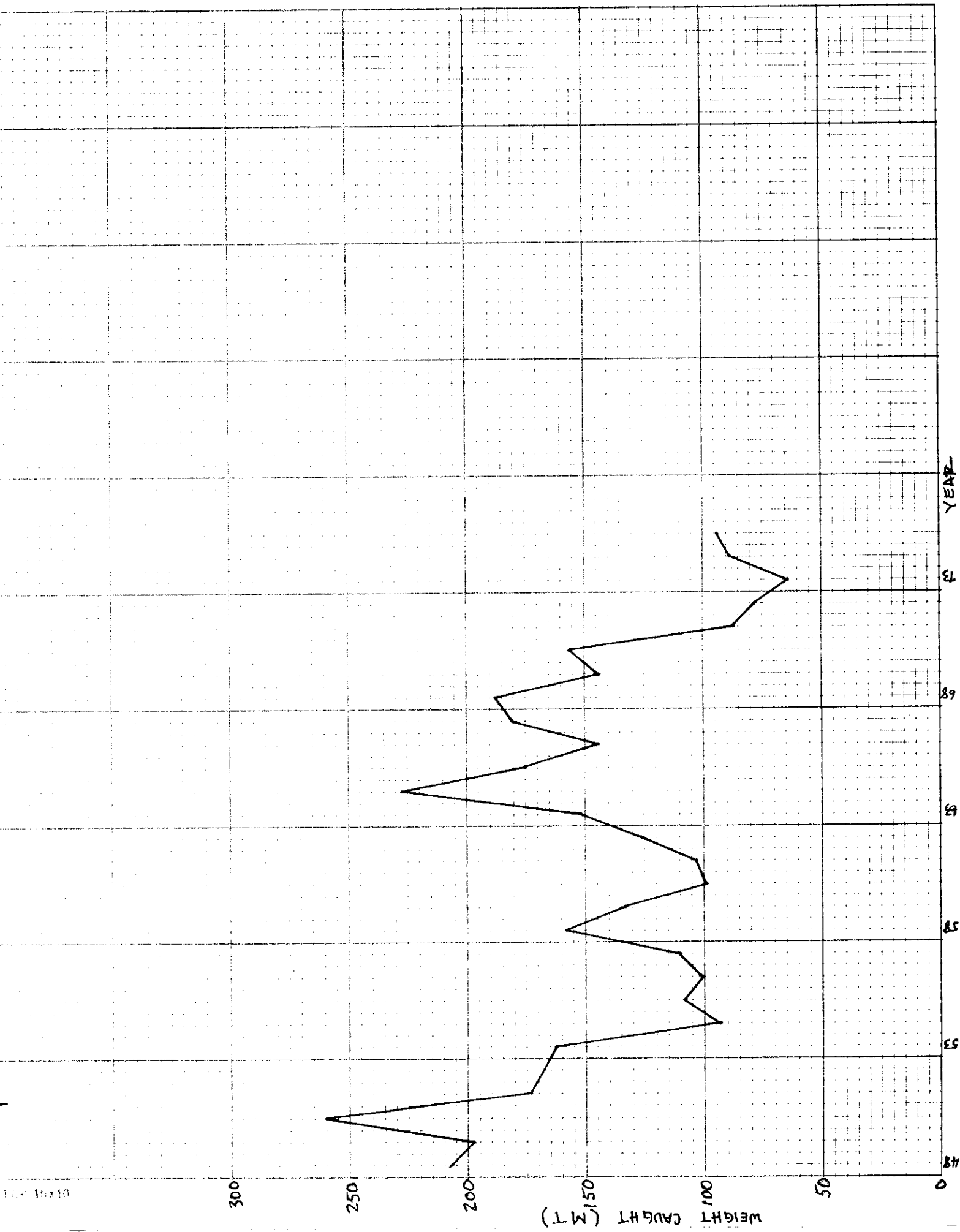
Additional copies of this chart may be obtained from the Division of Fish and Game.

THIS CHART IS NOT INTENDED FOR USE IN NAVIGATION.

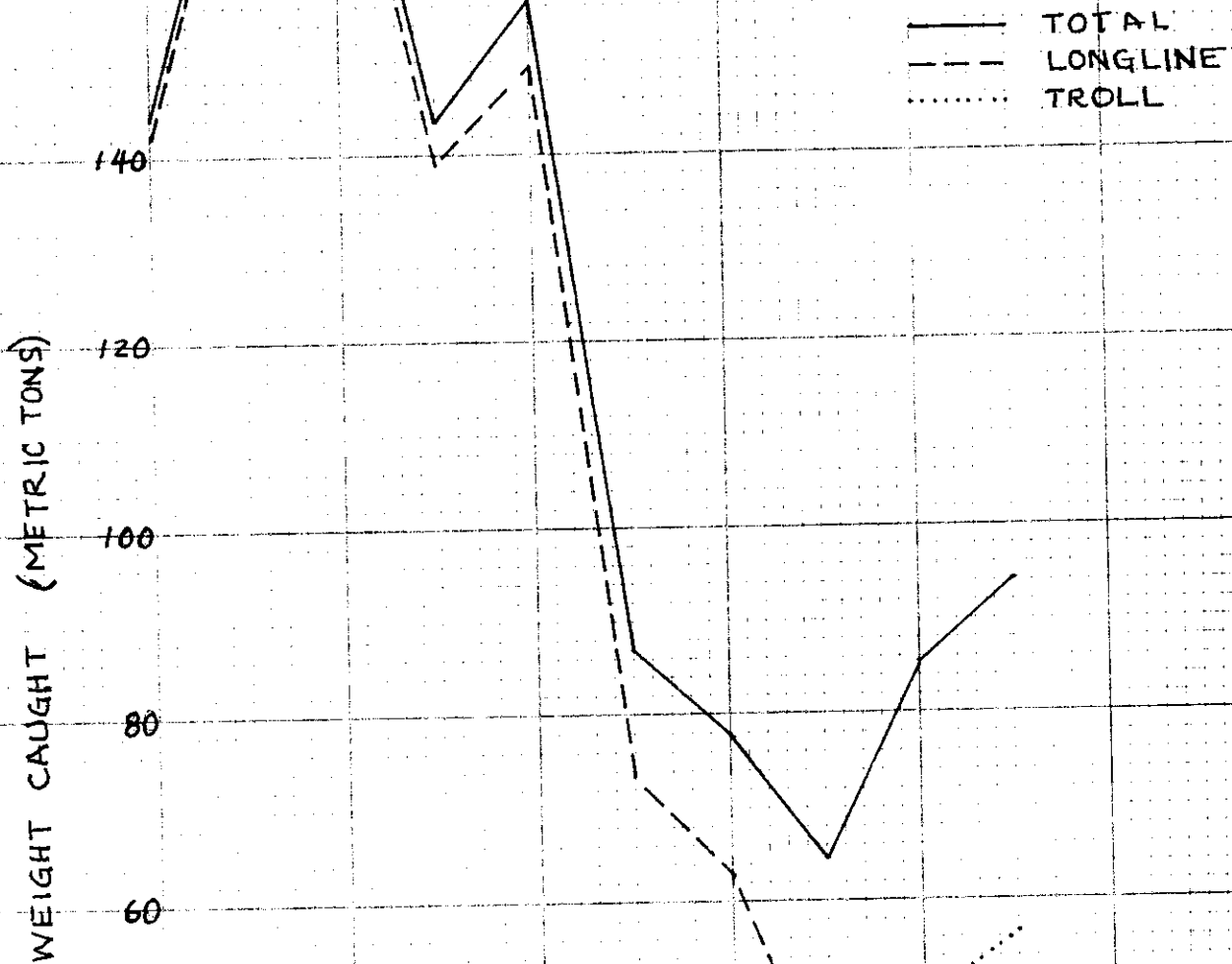
157 156 155 154 153 152 151 150 149 148 147 146 145 144 143 142 141 140 139 138 137 136 135 134 133 132 131 130 129 128 127 126 125 124 123 122 121 120 119 118 117 116 115 114 113 112 111 110 109 108 107 106 105 104 103 102 101 100 99 98 97 96 95 94 93 92 91 90 89 88 87 86 85 84 83 82 81 80 79 78 77 76 75 74 73 72 71 70 69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54 53 52 51 50 49 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

Annual Catch

Striped Marlin



STRIPED MARLIN



Striped Marlin (1958-1963; 1968-1975)

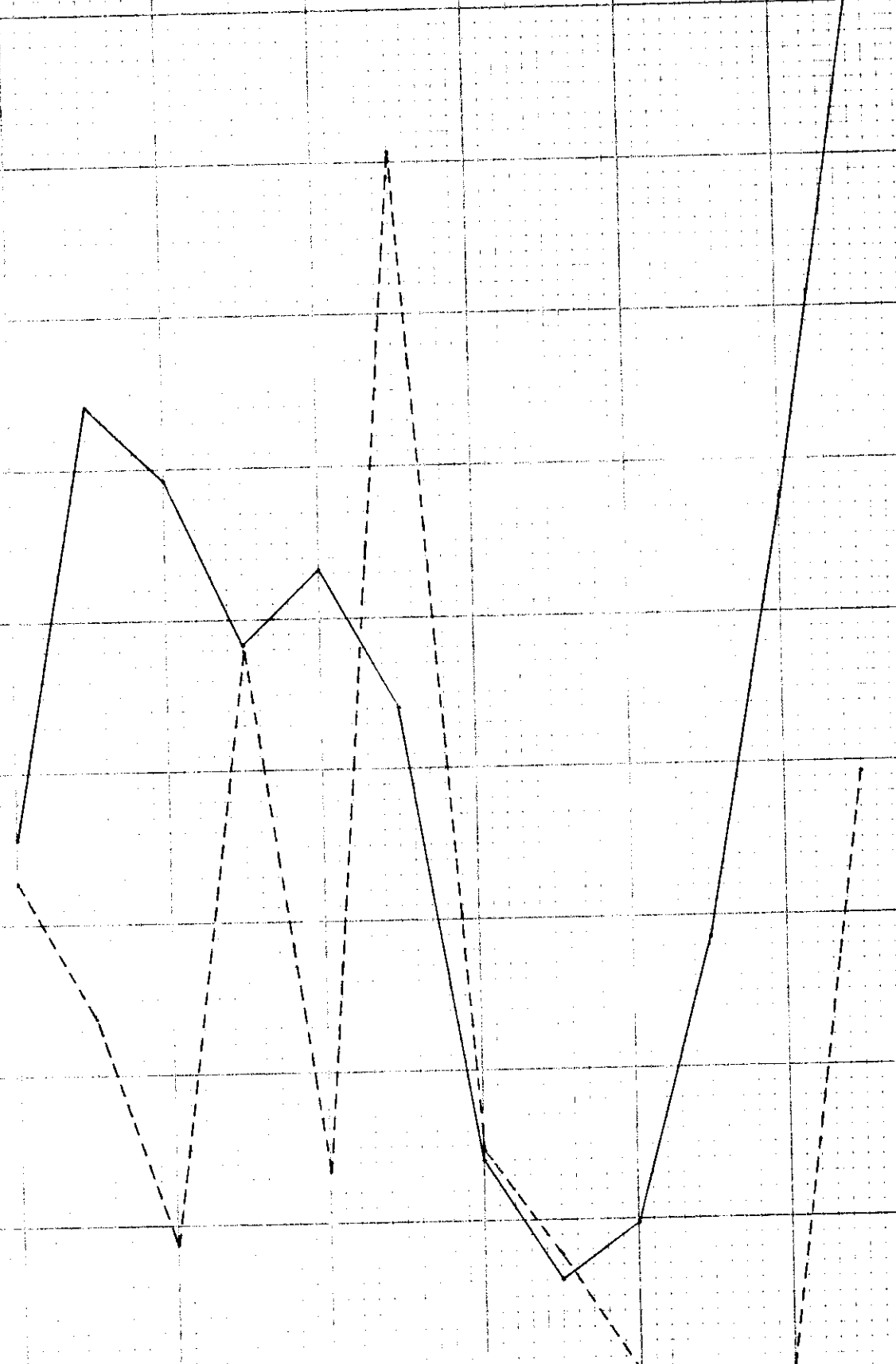
— Hawaiian Longline Total Catch Number
- - - Kona Recreational Fisheries Catch Per Day

NUMBER
10/10/1
00
000
500
800
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
7500
8000
8500
9000
9500
10000

.03
.02
.01
.00

Catch Per Day

Jan. Feb. Mar. Apr. May. Jun. Jul. Aug. Sept. Oct. Nov. Dec.



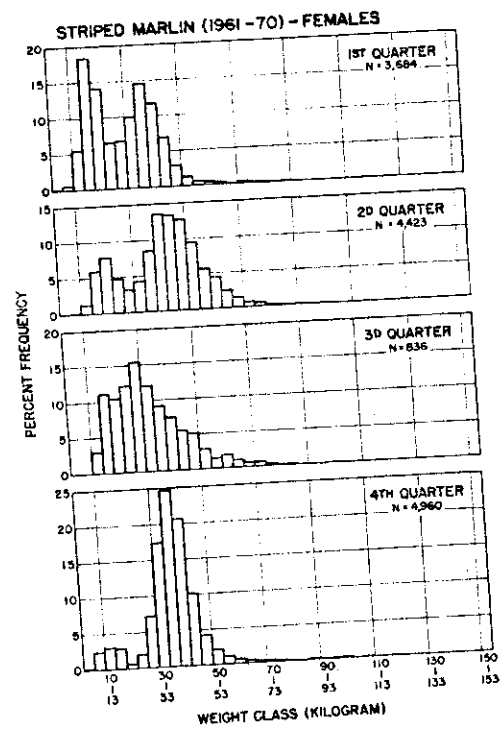
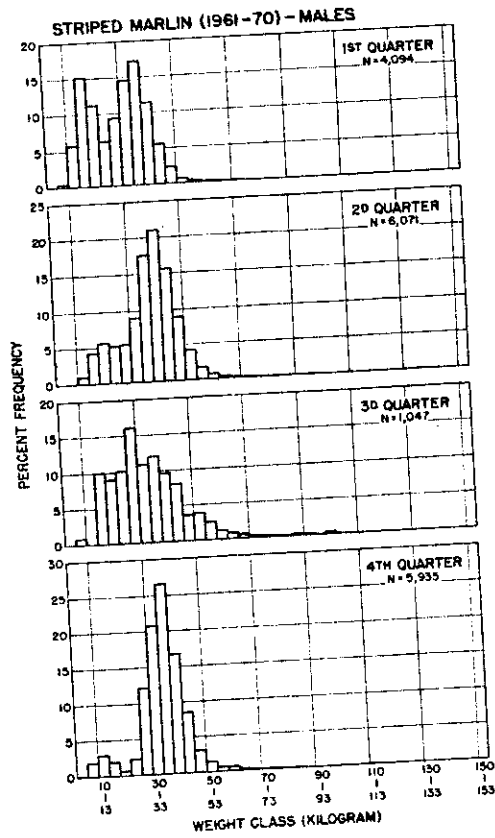
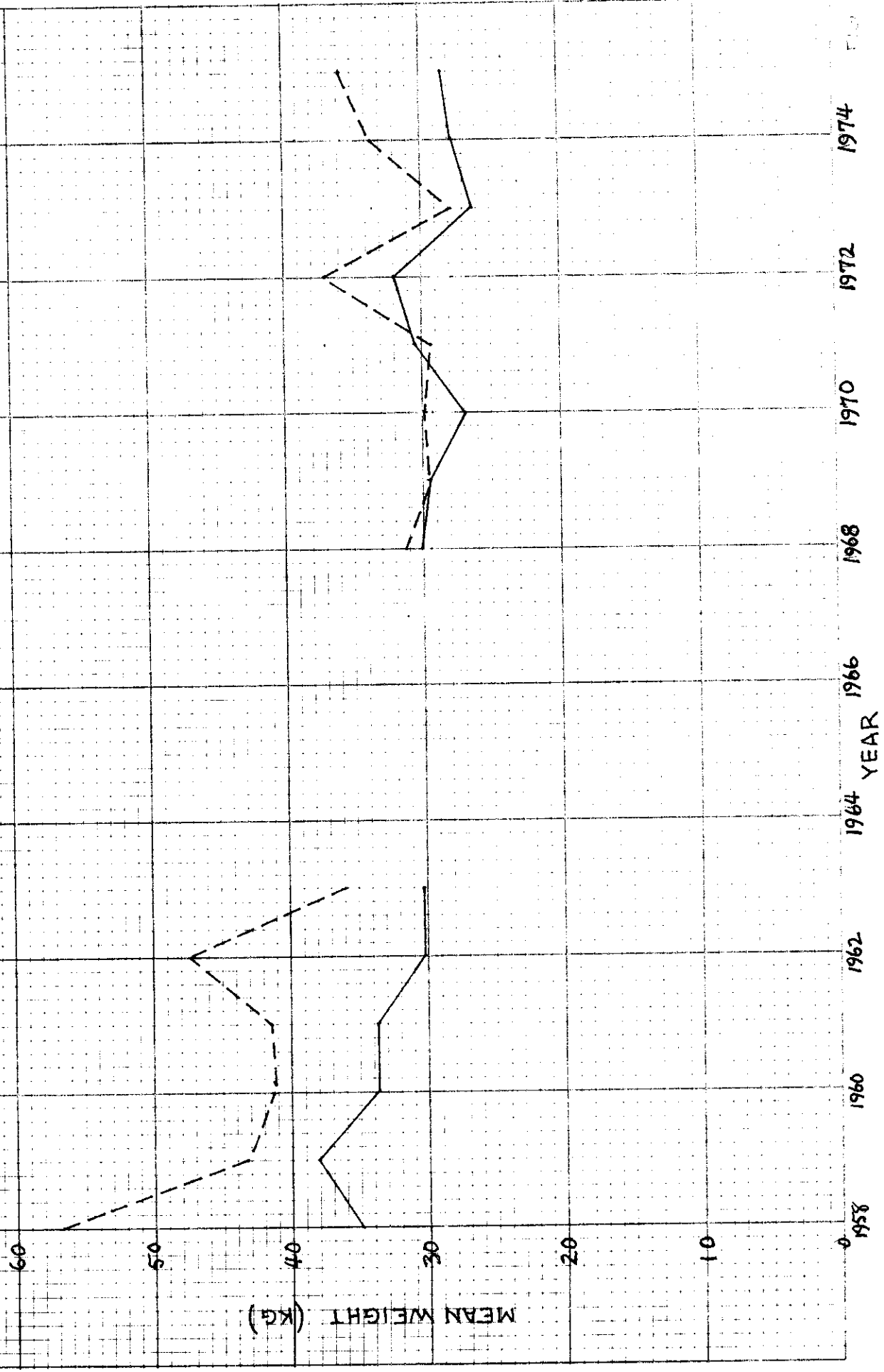


Figure 6.—Weight-frequency distribution of striped marlin.

STRIPED MARLIN

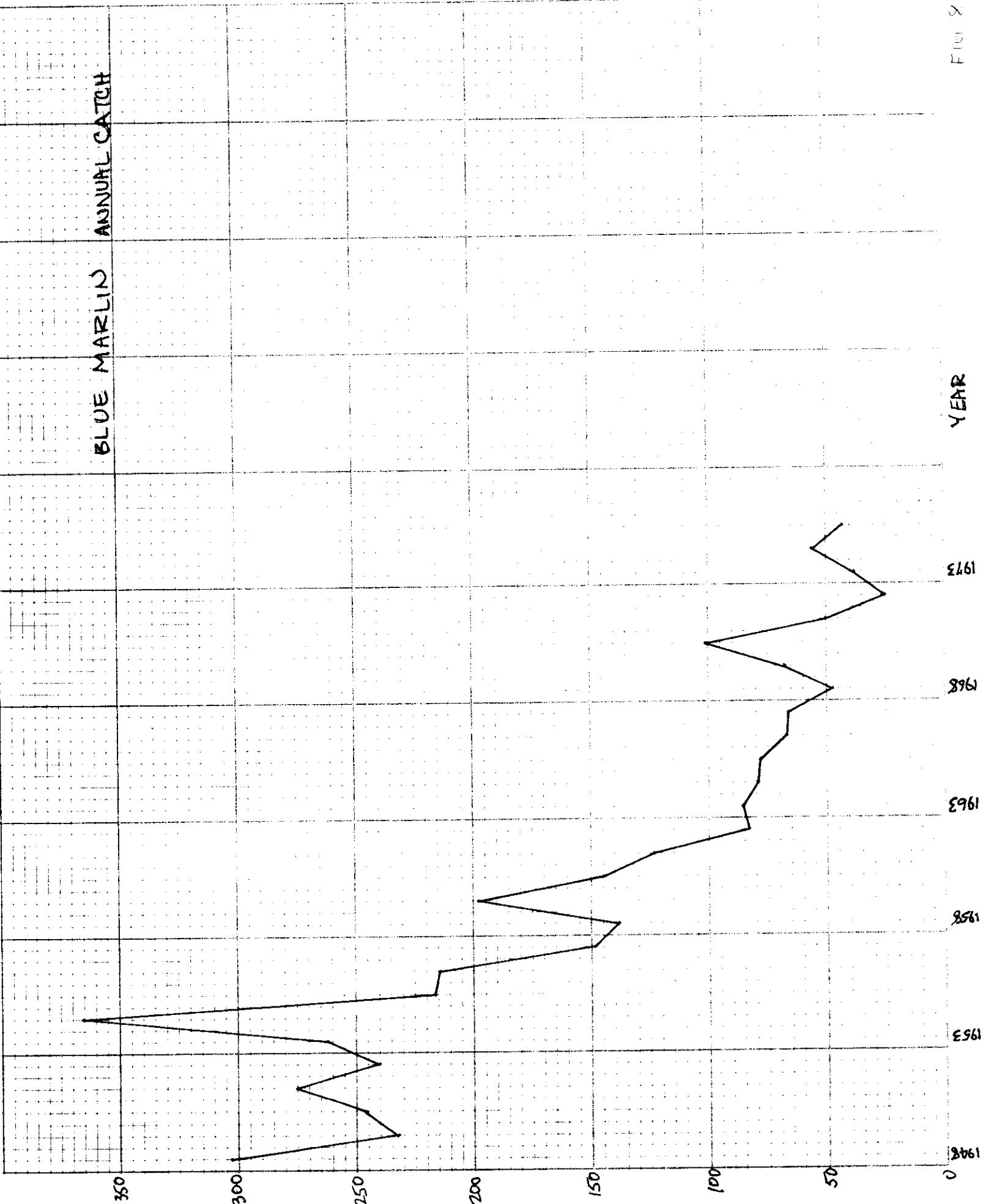
— LONGLINE
- - - OTHER

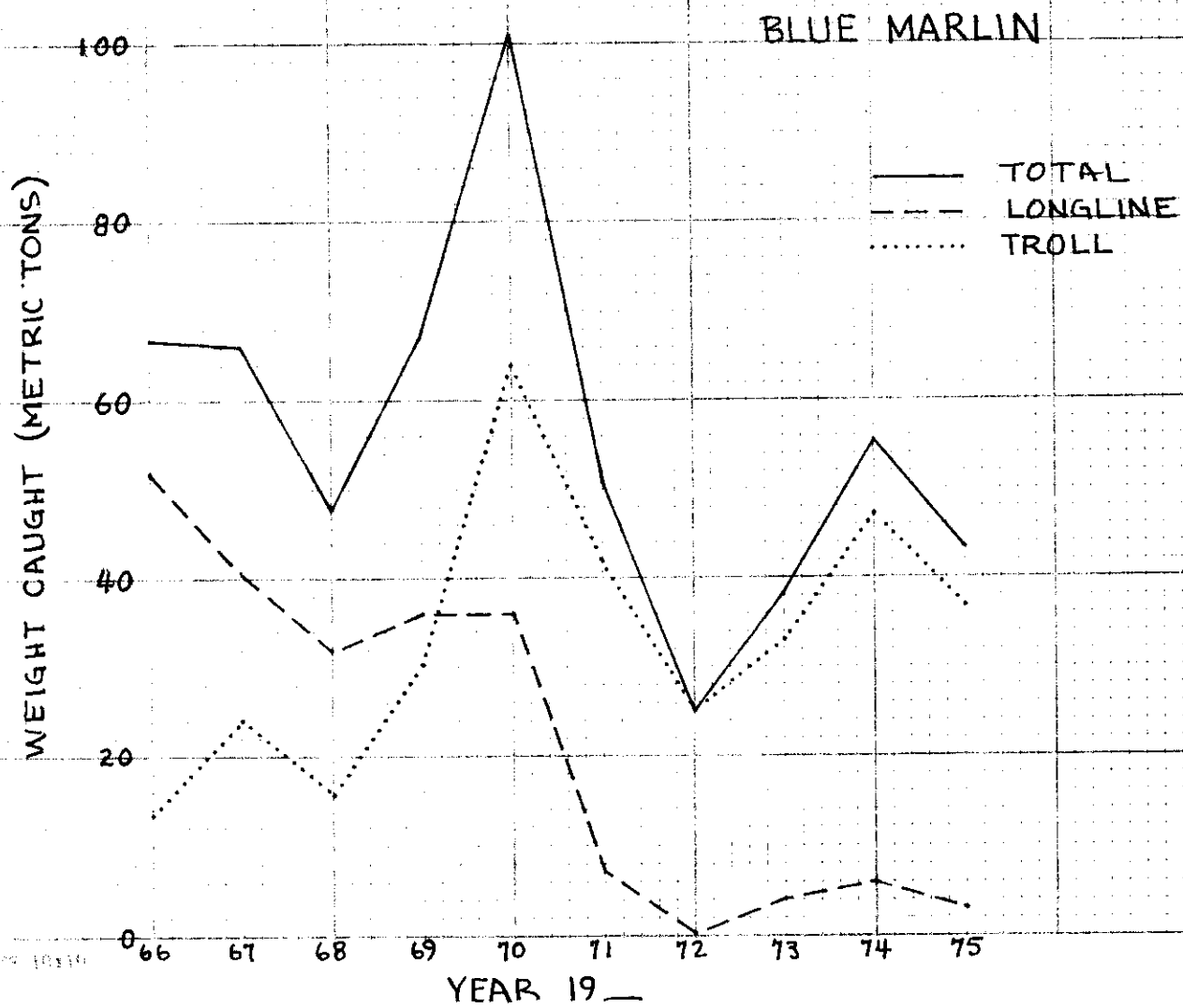


BLUE MARLIN ANNUAL CATCH

YEAR

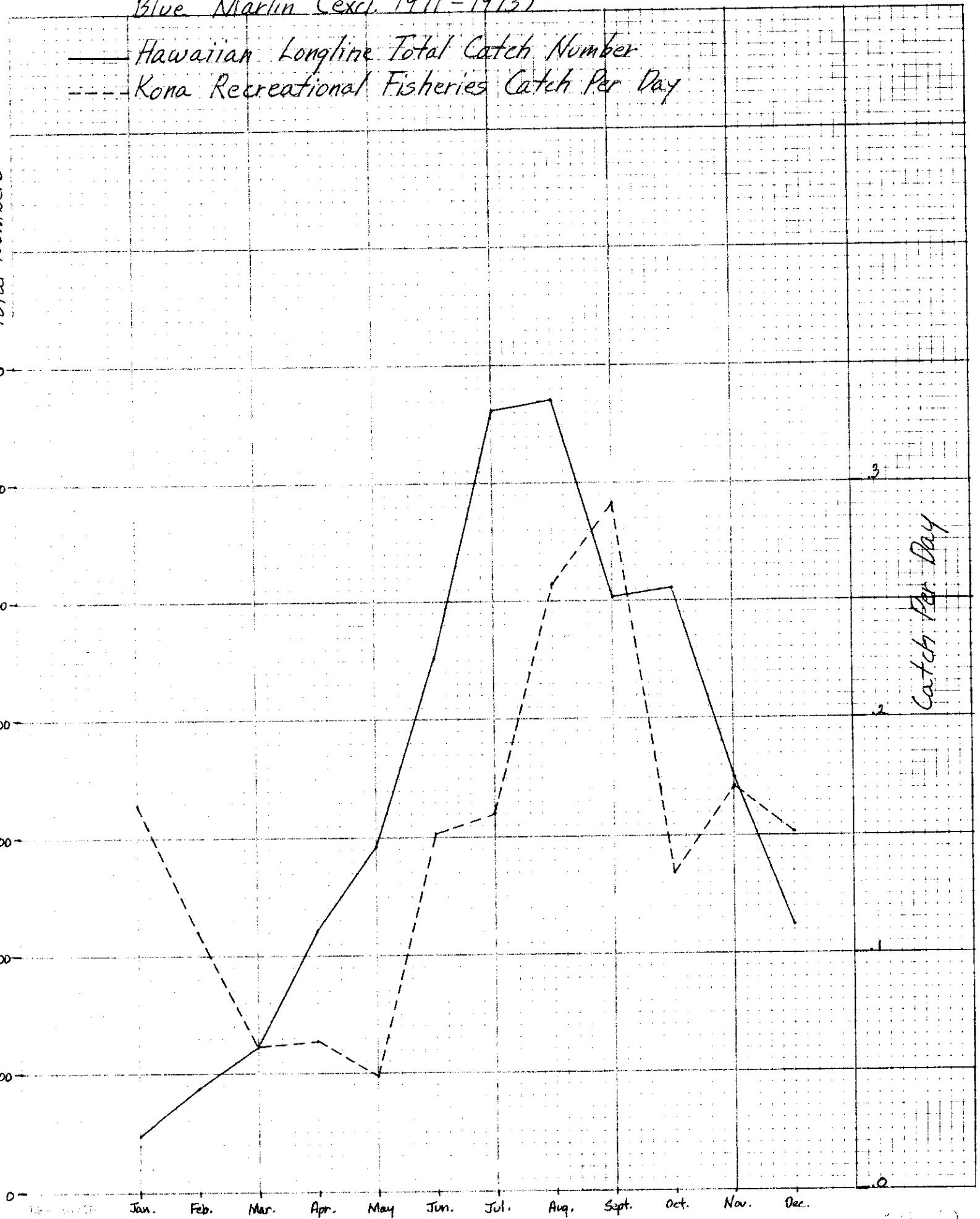
WEIGHT CAUGHT (MT)





Blue Marlin (excl. 1971-1973)

— Hawaiian Longline Total Catch Number
--- Kona Recreational Fisheries Catch Per Day



BLUE MARLIN

— LONGLINE
- - - OTHER

MEAN WEIGHT (KG)

YEAR

160

140

120

100

80

60

1958

1960

1962

1964

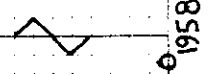
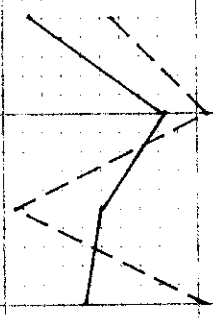
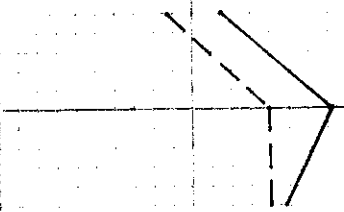
1966

1968

1970

1972

1974



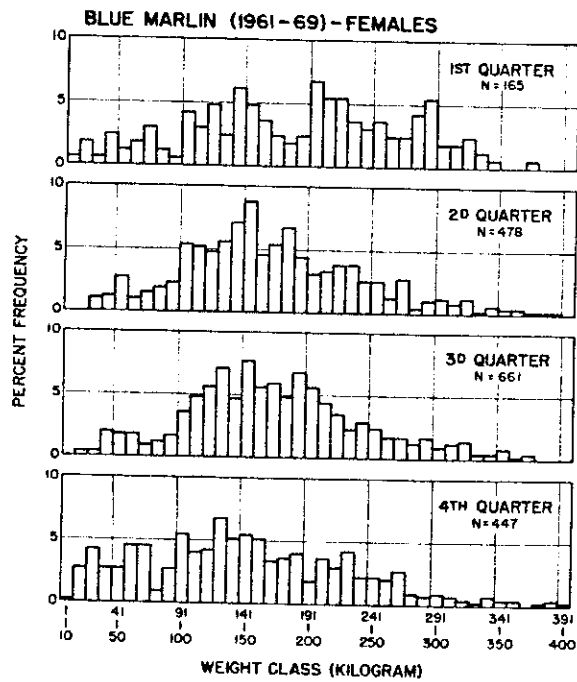
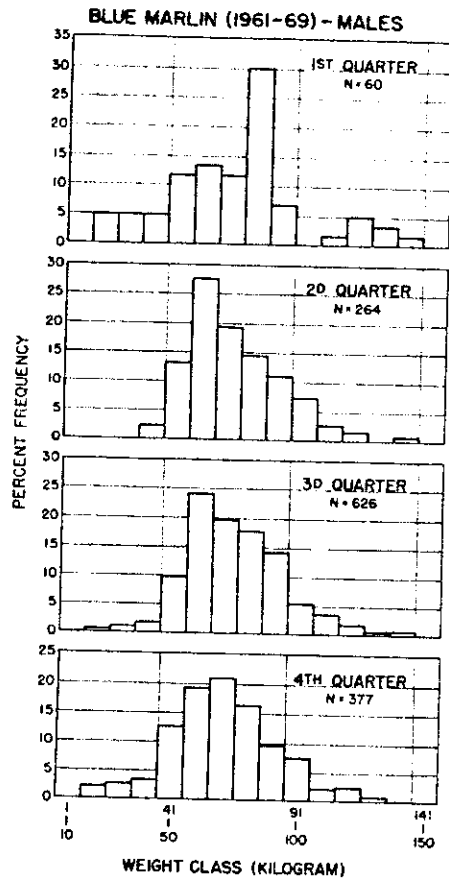
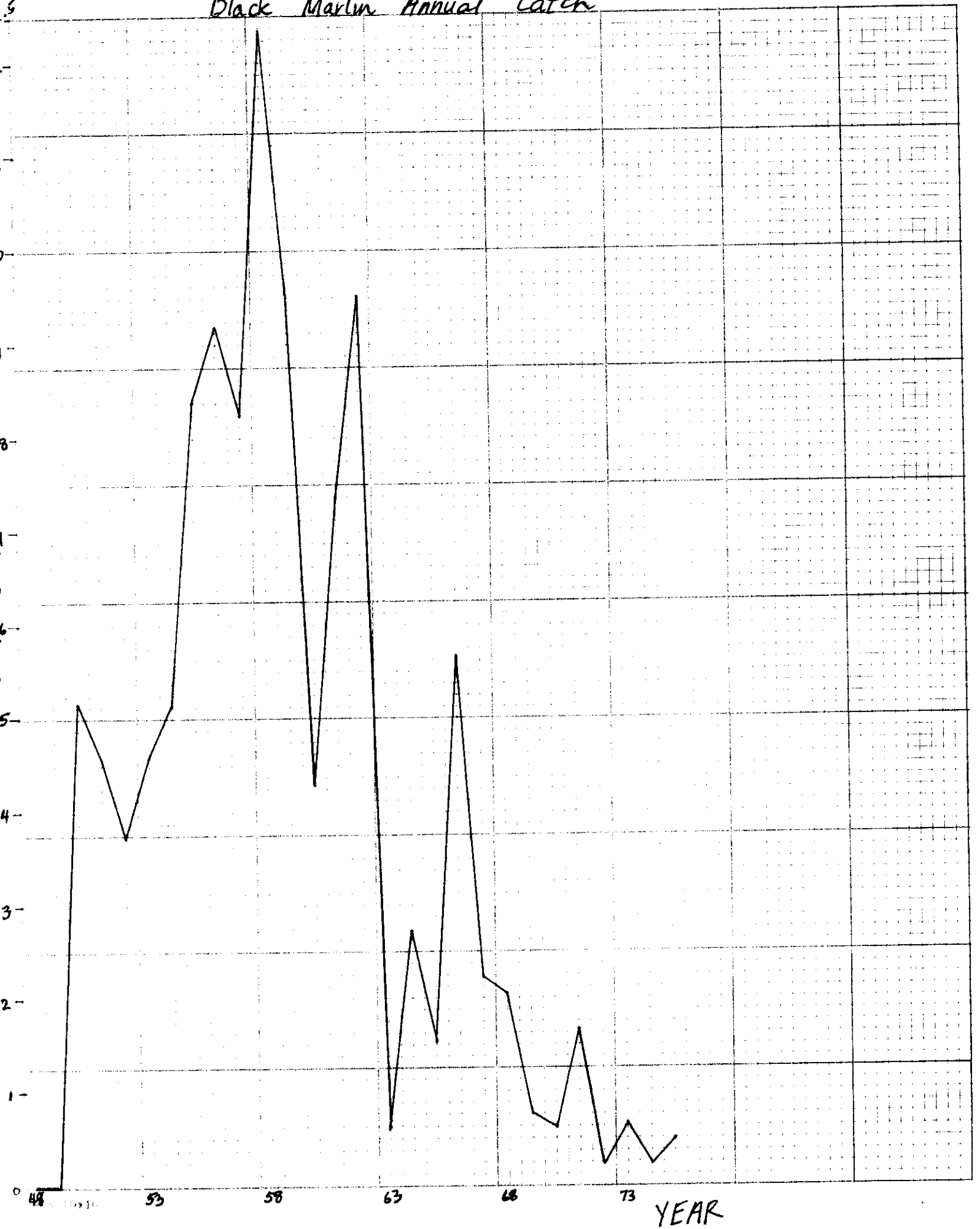


Figure 7.—Weight-frequency distribution of blue marlin.

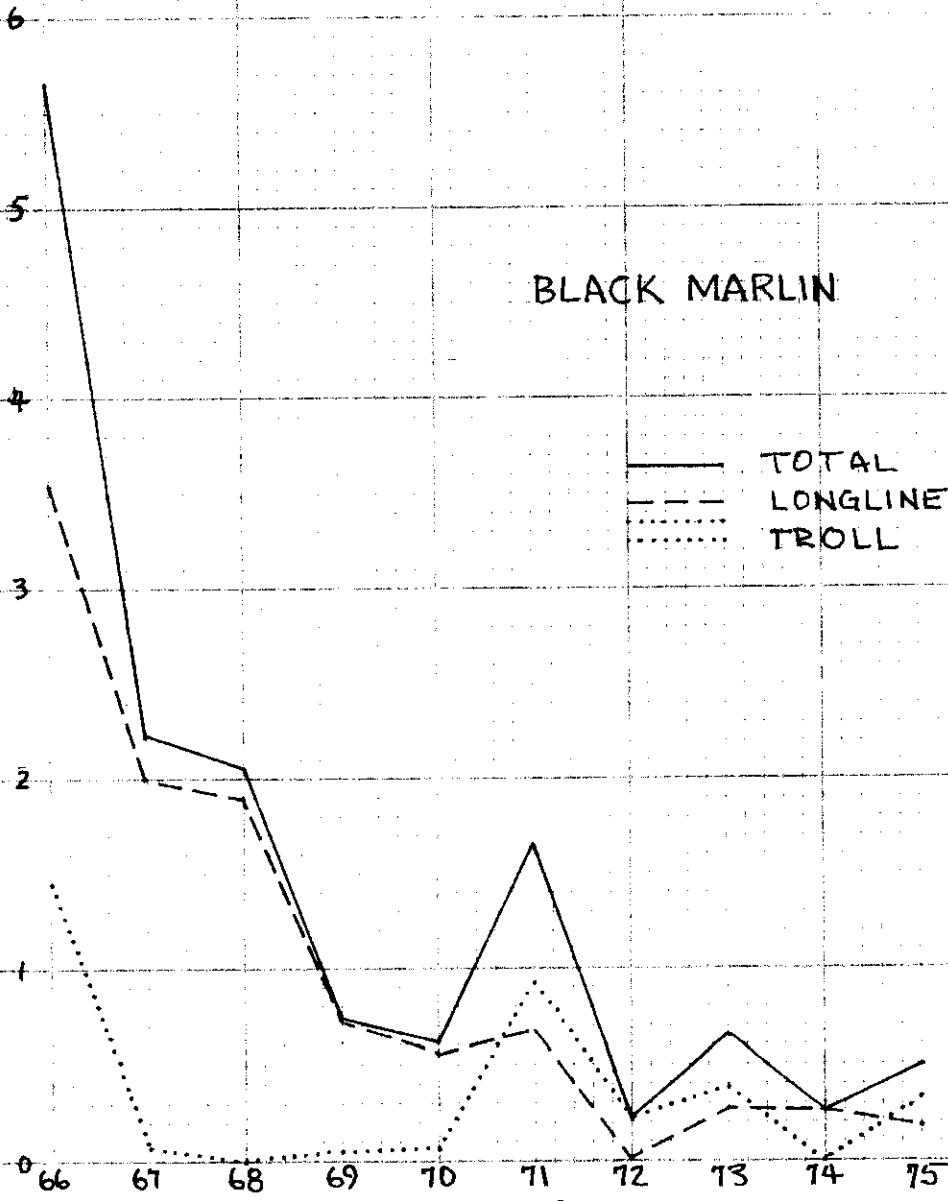
Black Marlin Annual Catch



BLACK MARLIN

WEIGHT CAUGHT (METRIC TONS)

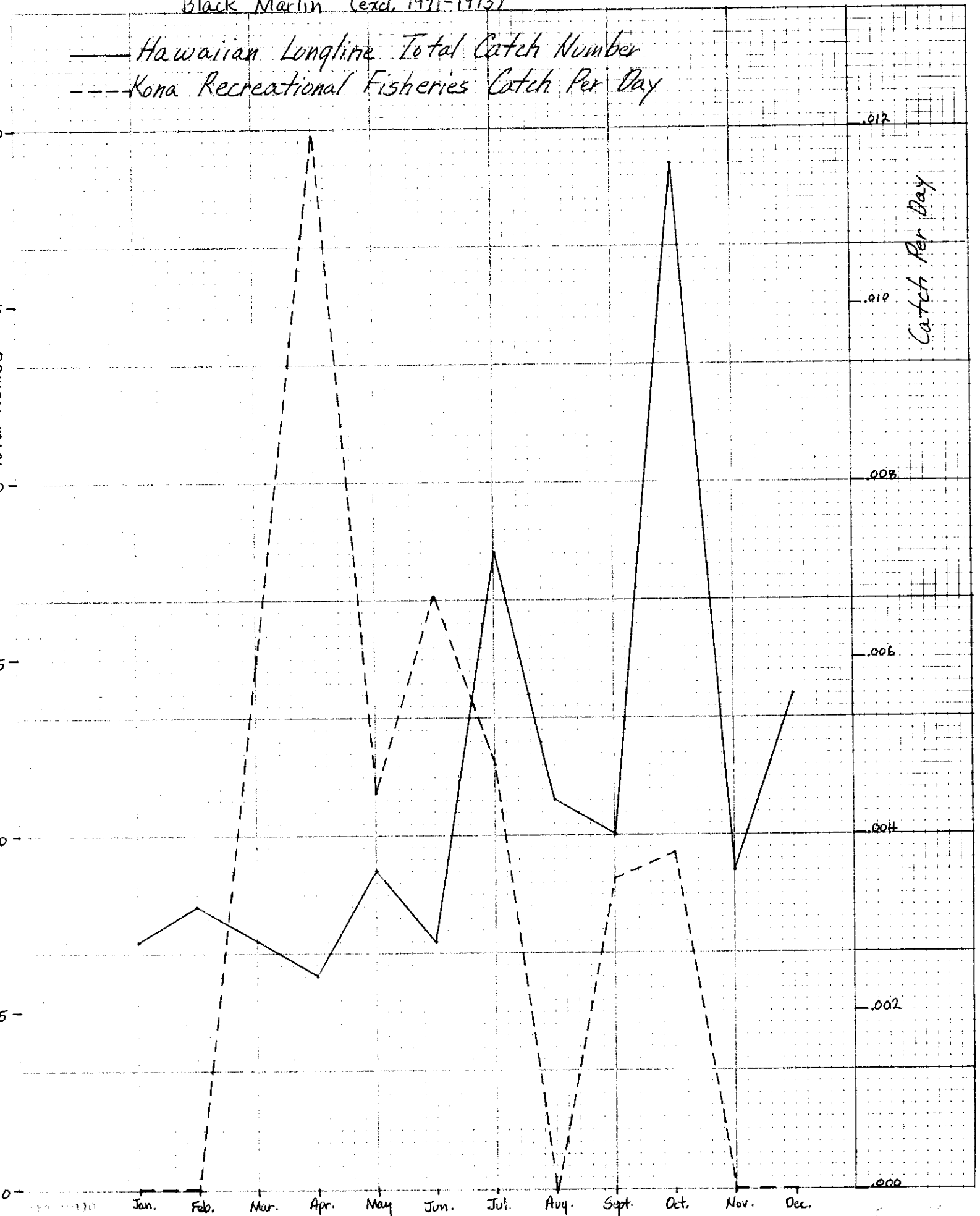
— TOTAL
- - - LONGLINE
... TROLL



YEAR 19__

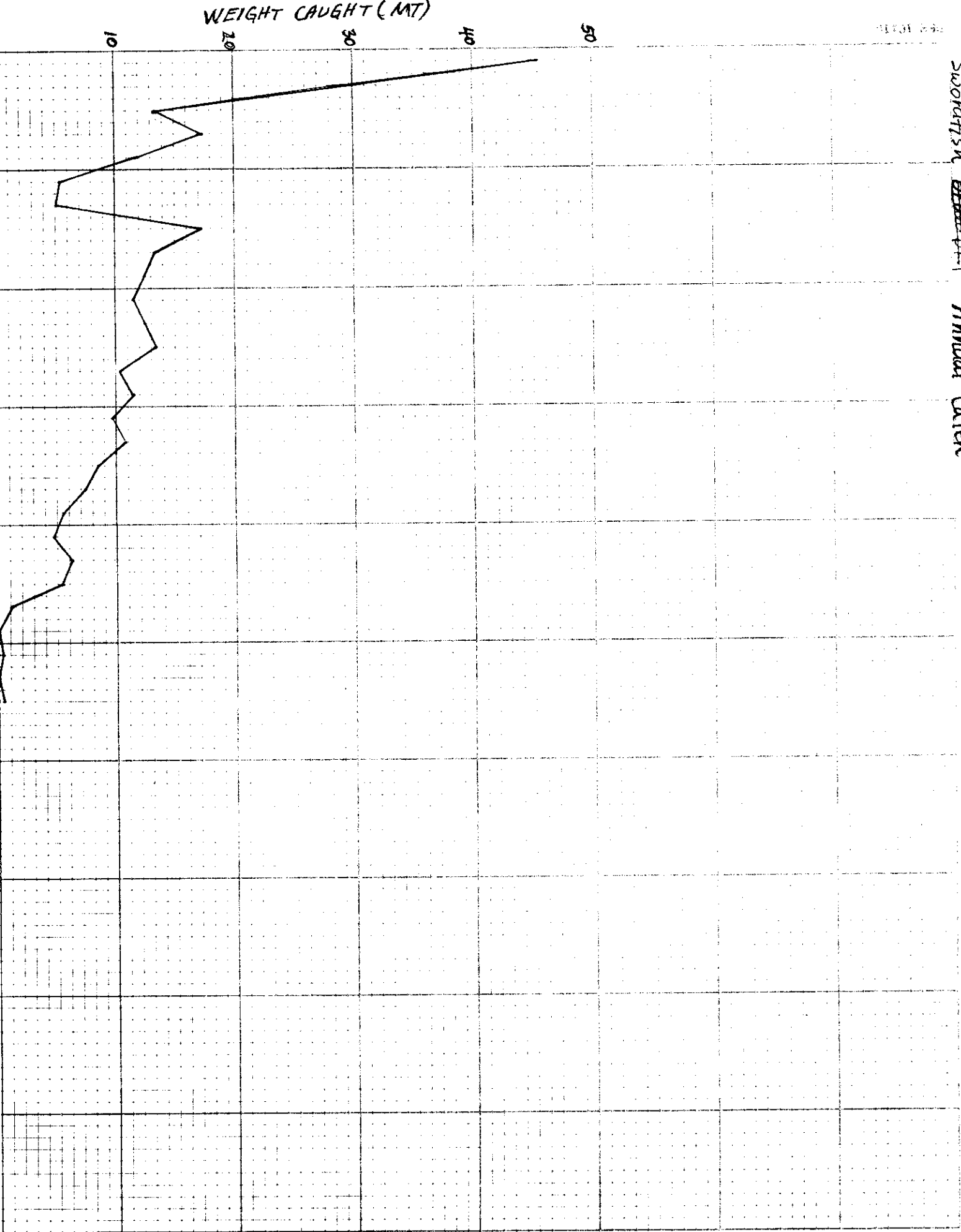
Black Marlin (excl. 1971-1973)

— Hawaiian Longline Total Catch Number
--- Kona Recreational Fisheries Catch Per Day



WEIGHT CAUGHT (MT)

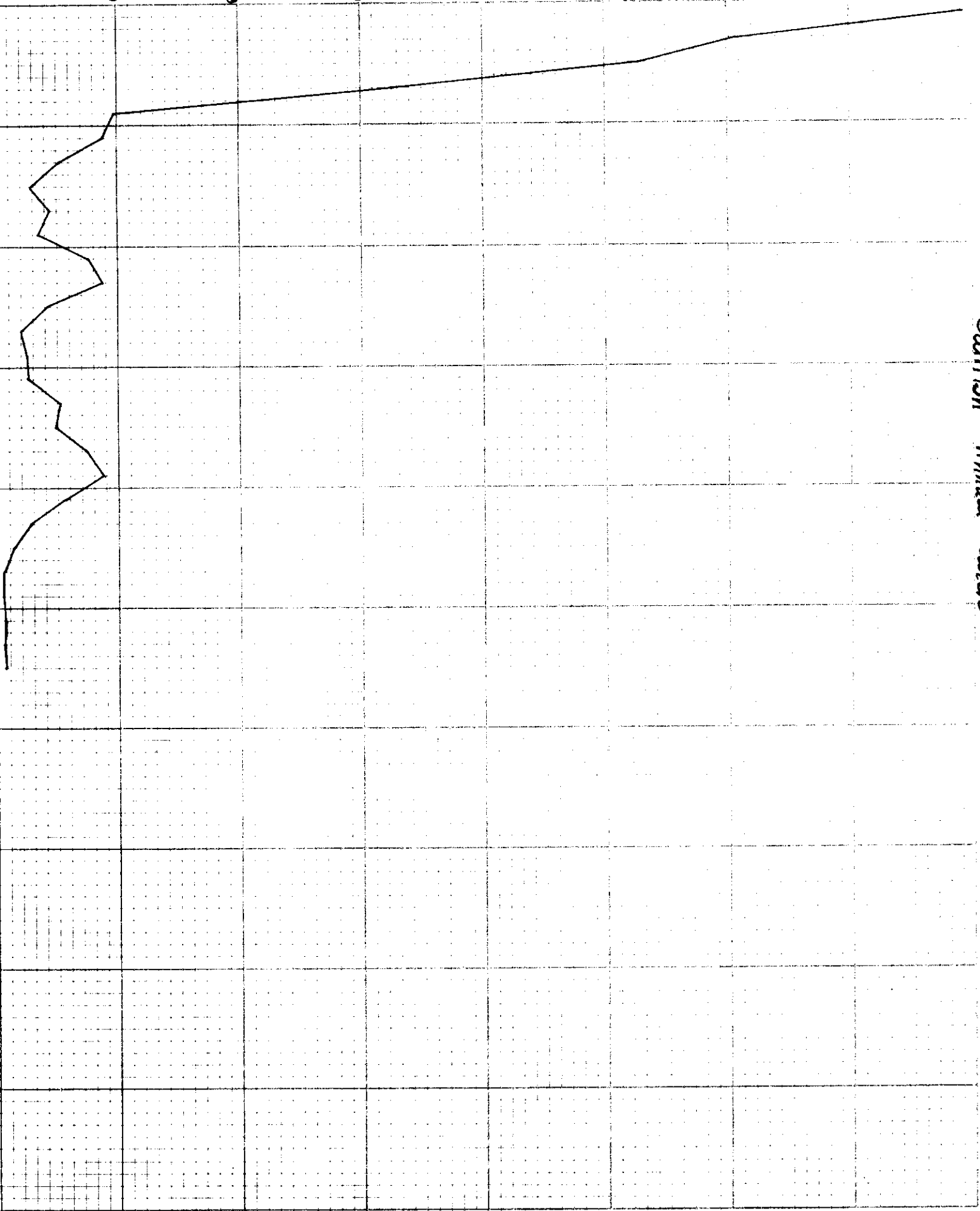
Swordfish ~~Breast~~ Annual Catch

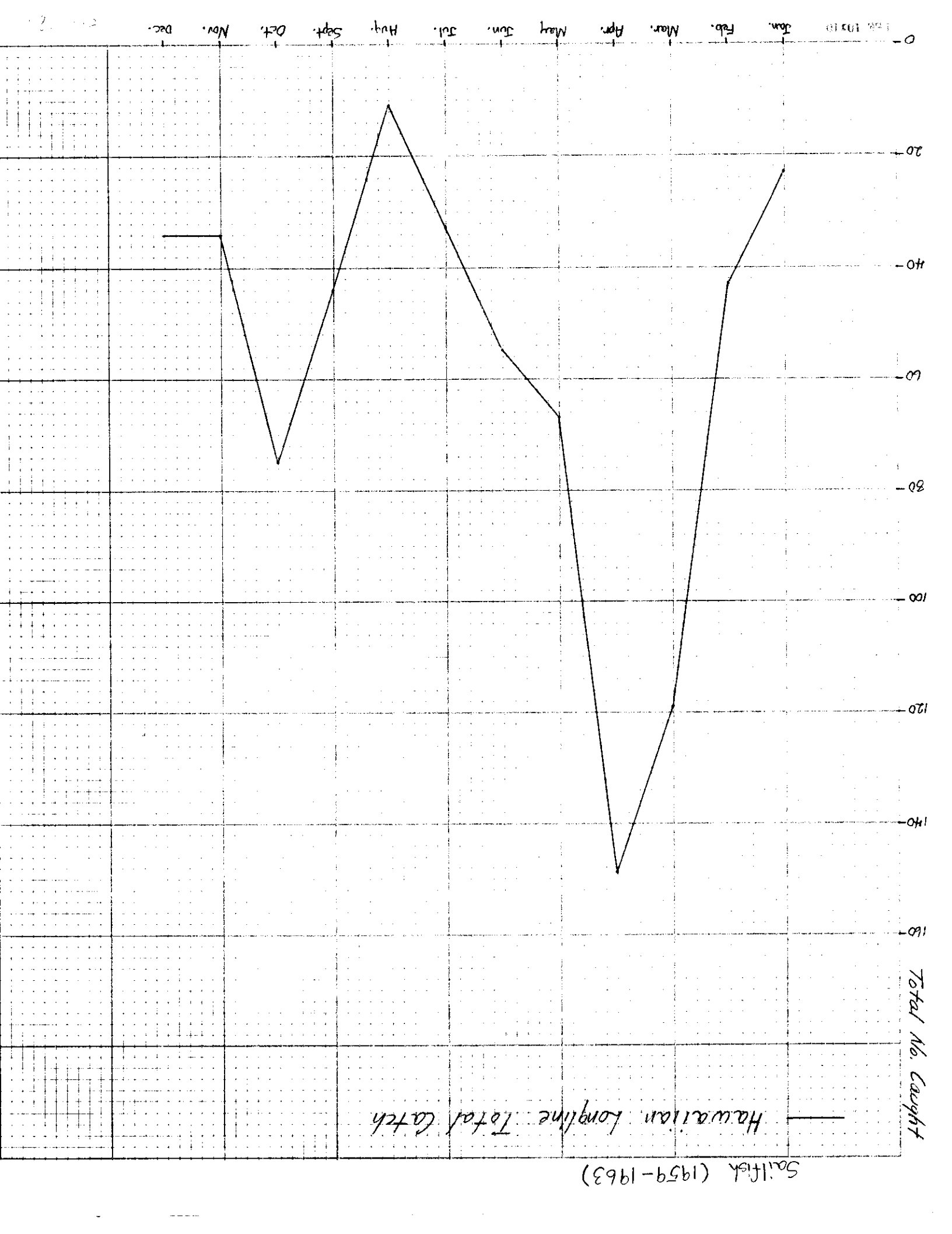


WEIGHT CAUGHT (MT)

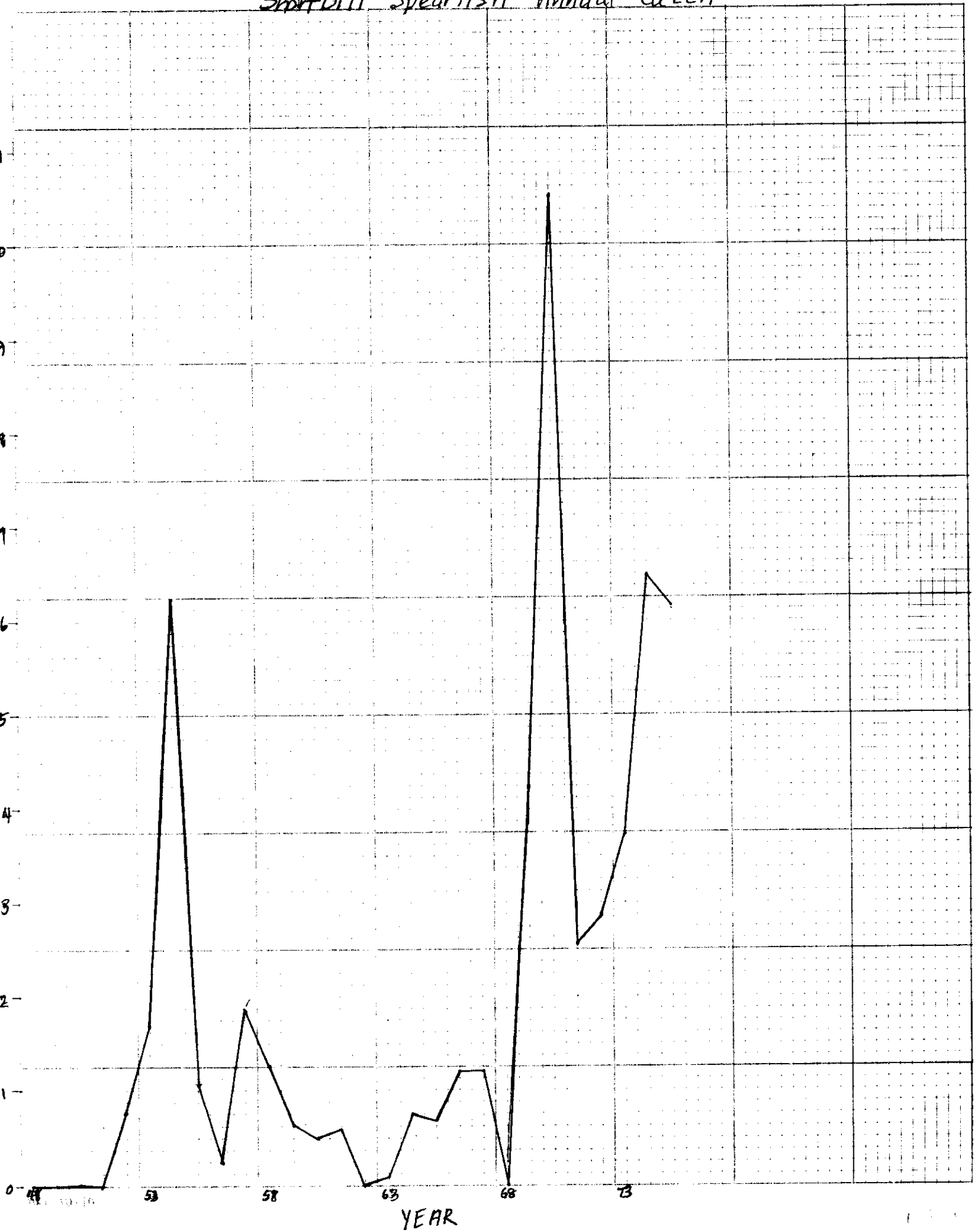
80
70
60
50
40
30
20
10

Sailfish Annual Catch





Shortbill Spearfish Annual Catch



Shortbill Spearfish (1973-1975)

— Hawaiian Longline Total Catch Number
 - - - Kona Recreational Fisheries Catch Per Day

Catch Per Day

Total Number

