Southwest Fisheries Center Administrative Report No. 7H, 1978

HISTORICAL TRENDS IN CATCH, FISHING EFFORT, AND CATCH PER UNIT EFFORT IN THE HAWAIIAN FISHERY FOR SKIPJACK TUNA, *KATSUWONUS PELAMIS*, 1948-76

Robert A. Skillman and Fletcher V. Riggs
Southwest Fisheries Center
National Marine Fisheries Service, NOAA
Honolulu, Hawaii 96812

Prepared for

Indo-Pacific Fishery Commission
Eighteenth Session and Symposium
Manila, Philippines

8-17 March 1978

February 1978

INTRODUCTION

The skipjack tuna fishery continues to be the most important fishery in the State of Hawaii, and the skipjack tuna, Katsuwonus pelamis L., continues to be the most important commercial species landed. In 1976 which was an average year for skipjack tuna landings, skipjack tuna made up 64% of the total fishes landed by weight and 43% by value of landings.

Most of the skipjack tuna landed are captured by the Hawaiian pole-and-line fleet that fishes mostly within a day's run of the main Hawaiian Islands. The number of full time vessels in the fleet now numbers 14. Most are aku sampans, which are generally made of wood and range from 27 to 77 gross tons, and there is a single modern, refrigerated vessel of 136 gross tons. There are also other vessels that fish only during the peak of the season. The anchovy, Stolephorus purpureus Fowler, is used as the primary bait species and its lack of hardiness limits trip length generally to 1 day and not more than 3 days. The abundance or availability of the bait often limits fishing activities, especially when skipjack tuna is most abundant.

Catch Trends

From 1928 to 1936, the mean annual catch of skipjack tuna was 2,400 metric tons (MT), and from 1937 to 1940, the mean rose to 5,000 MT. While fishing ceased during World War II (Uchida 1966), normal fishing activities were resumed by 1948.

From 1948 through 1976, the annual landing of skipjack tuna has averaged 4,400 MT (Table 1), which is somewhat less than the 1937-40 average. There seems to be no indication of an increase or decrease in the annual landings or of any other long-term trend though there is considerable year-to-year fluctuation (Figure 1). The largest catch (7,329 MT) occurred in 1965, and the smallest (2,293 MT) in 1975.

While there is no discernible long-term trend in the catches, there is of course a marked seasonal pattern. Averaged over 1948-76, the mean trend reaches its lowest point in February, rises to a peak in July, and then falls steadily to a low in December (Figure 2). The best year in the history of the fishery, 1965, followed essentially the same pattern but with the season peaking in May and persisting through September. The poorest year, 1975, actually started out better than the average, but the summer season catches never materialized.

Fishing Effort and Catch Per Unit Effort

Several attempts have been made to estimate the abundance of skipjack tuna using data from the Hawaiian fishery. Yamashita (1958) and Shippen (1961) both used uncorrected measures of fishing effort in terms of productive or effective trips. Uchida (1967) standardized fishing effort in terms of effective days fished by Class 2 vessels, where vessel classes were based on carrying capacities of the baitwells. In his latest analysis of the fishery Uchida (1976) standardized fishing effort in terms of days fished (effective days plus days of zero-catch) by Class 2 vessels, where vessel classes were based on gross tonnage. The data presented here follow the computational procedures presented by Uchida (1976).

The catch per days fished by Class 1 and 2 vessels and their relative efficiency factors for both inshore and offshore zones are presented in Table 2. The inshore zone extends from just outside the reef to 37 km from shore, and the offshore zone extends outward of 37 km. While the catch per day fished is higher in the offshore zone, the relative efficiency factors are not statistically different ($t = 0.337$ with d.f. = 28), nor is there a correlation between the annual fluctuations for inshore and offshore zones ($r^2 = 0.0048$, $n = 29$). The annual geometric mean efficiency factor fluctuates considerably, but no discernible trend is apparent (Figure 3).

The apparent abundance of skipjack tuna was estimated using the formula

$$C/SDF = \frac{TC_1 + TC_2}{(EF)(DF_1) + DF_2}$$

where TC_1 = total catch of Class 1 vessels,

TC_2 = total catch of Class 2 vessels,

EF = efficiency factor,

DF_1 = days fished among Class 1 vessels, and

DF_2 = days fished among Class 2 vessels.

The relative fishing intensity for all skipjack tuna catches was estimated using

$$\text{Relative fishing intensity} = \frac{TC_S}{C/SDF}$$

where TC_S = total state catch.

Estimates from these formulas are given in Table 1.

As can be seen from Figure 1, C/SDF follows the same annual trend as does the total catch but with less variation. Figure 4 shows the data from the viewpoint of the catch generated by the fishery being dependent on the relative abundance of the stock. The regression line shown in the figure has a correlation coefficient of 0.919 with $n = 29$.

As is typical of most skipjack tuna fisheries, no effect of the fishery on the stock can be demonstrated. Figure 5 shows the relationship between C/SDF and the relative fishing intensity and lags of 1 or 2 years or averaging of the relative fishing intensity over a 2-year period did not result in any significant improvement in the relationship.

LITERATURE CITED

SHIPPEN, H. H.
1961. Distribution and abundance of skipjack in the Hawaii fishery, 1952-53. U.S. Fish Wildl. Serv., Fish. Bull. 61:281-300.

UCHIDA, R. N.
1966. The skipjack tuna fishery in Hawaii. *In* T. A. Manar (editor), Proceedings, Governor's Conference on Central Pacific Fishery Resources, State of Hawaii, p. 147-159.

1967. Catch and estimates of fishing effort and apparent abundance in the fishery for skipjack tuna (*Katsuwonus pelamis*) in Hawaiian waters, 1952-62. U.S. Fish Wildl. Serv., Fish. Bull. 66:181-194.

1976. Reevaluation of fishing effort and apparent abundance in the Hawaiian fishery for skipjack tuna, *Katsuwonus pelamis*, 1948-70. Fish. Bull., U.S. 74:59-69.

YAMASHITA, D. T.
1958. Analysis of catch statistics of the Hawaiian skipjack fishery. U.S. Fish Wildl. Serv., Fish. Bull. 58:253-278.

Table 1.--Total Hawaii landings of skipjack tuna from all fisheries and estimated statistics for catch per standard day fished, relative fishing intensity, catch per standard effective trip, and relative effective fishing intensity, 1948-76.[1]

Year	Total catch (MT)	Catch per standard day fished (MT/SDF)	Relative fishing intensity (Class 2 days fished)	Catch per standard effective trip (MT/trip)	Relative effective fishing intensity (Class 2 trips)
1948	3,802.96	2.01	1,891	2.30	1,653
1949	4,488.23	2.53	1,773	2.85	1,575
1950	4,314.38	1.99	2,161	2.31	1,868
1951	5,863.37	2.93	2,001	3.28	1,788
1952	3,307.58	1.83	1,806	2.15	1,538
1953	5,470.15	2.14	2,552	2.46	2,224
1954	6,360.13	2.81	2,256	3.16	2,013
1955	4,397.43	1.95	2,248	2.26	1,946
1956	5,049.58	2.59	1,946	2.91	1,735
1957	2,780.66	1.61	1,726	1.90	1,464
1958	3,100.15	1.87	1,652	2.18	1,422
1959	5,630.65	2.93	1,919	3.26	1,727
1960	3,338.46	1.99	1,673	2.30	1,452
1961	4,941.66	2.69	1,835	3.01	1,642
1962	4,270.81	2.56	1,665	2.88	1,483
1963	3,673.86	2.15	1,712	2.48	1,481
1964	4,093.10	1.98	2,065	2.29	1,787
1965	7,328.96	3.29	2,221	3.54	2,070
1966	4,256.82	2.24	1,896	2.52	1,689
1967	3,646.80	1.99	1,832	2.30	1,586
1968	4,227.41	2.04	2,067	2.32	1,822
1969	2,704.94	1.63	1,658	2.02	1,339
1970	3,334.46	1.89	1,760	2.19	1,523
1971	6,051.39	3.07	1,971	3.33	1,815
1972	4,952.12	2.67	1,852	2.94	1,685
1973	4,876.71	2.59	1,880	2.94	1,661
1974	3,373.04	1.74	1,942	1.98	1,702
1975	2,292.57	1.16	1,969	1.48	1,551
1976	4,443.55	2.37	1,877	2.67	1,667

[1]Data from 1948 to 1970 from Uchida (1976).

Table 2.--Catch per day fished and vessel efficiency factors by inshore and offshore areas by vessel classes 1 and 2, and the geometric mean vessel efficiency factor for each year, 1948-76.[1]

	Inshore			Offshore			
Year	Class 1	Class 2	Efficiency factors	Class 1	Class 2	Efficiency factors	Geometric mean
1948	1.33	1.78	0.747	2.07	3.46	0.598	0.668
1949	1.56	2.24	0.696	2.54	4.12	0.616	0.655
1950	1.34	1.74	0.770	2.10	3.38	0.621	0.692
1951	1.64	2.59	0.633	2.60	3.58	0.726	0.678
1952	1.31	1.66	0.789	1.31	2.19	0.598	0.687
1953	1.53	1.98	0.773	2.37	2.69	0.881	0.825
1954	1.36	2.54	0.535	2.89	3.80	0.760	0.638
1955	1.39	1.99	0.698	2.08	2.32	0.896	0.791
1956	1.90	2.36	0.805	2.30	3.27	0.703	0.752
1957	1.18	1.63	0.724	1.28	1.61	0.795	0.759
1958	1.17	1.87	0.626	1.79	2.36	0.758	0.689
1959	1.97	3.03	0.650	2.37	2.91	0.814	0.728
1960	1.32	2.02	0.653	1.94	2.40	0.803	0.727
1961	1.82	2.37	0.768	2.42	4.05	0.598	0.677
1962	1.49	2.45	0.608	2.22	3.43	0.647	0.627
1963	1.17	1.77	0.661	1.87	3.55	0.527	0.590
1964	1.40	1.69	0.828	2.07	2.90	0.714	0.769
1965	2.39	2.90	0.824	3.32	4.01	0.828	0.826
1966	1.54	1.82	0.846	1.93	2.91	0.663	0.749
1967	1.47	1.84	0.799	1.65	2.31	0.714	0.755
1968	1.57	1.68	0.934	2.04	2.93	0.696	0.807
1969	1.12	1.43	0.783	1.58	2.26	0.699	0.740
1970	1.32	1.74	0.759	1.30	2.36	0.551	0.646
1971	2.38	2.98	0.800	3.03	3.49	0.867	0.833
1972	1.49	2.28	0.651	2.55	3.74	0.681	0.666
1973	1.16	2.30	0.506	2.42	3.37	0.719	0.603
1974	1.15	1.64	0.699	1.57	2.10	0.749	0.724
1975	0.88	1.10	0.804	1.08	1.45	0.741	0.772
1976	1.44	2.37	0.607	2.00	2.65	0.755	0.677

[1]Data from 1948 to 1970 from Uchida (1976).

Figure 1. Historical trend in total catch and catch per standard day fished for skipjack tuna in Hawaii, 1948-76.

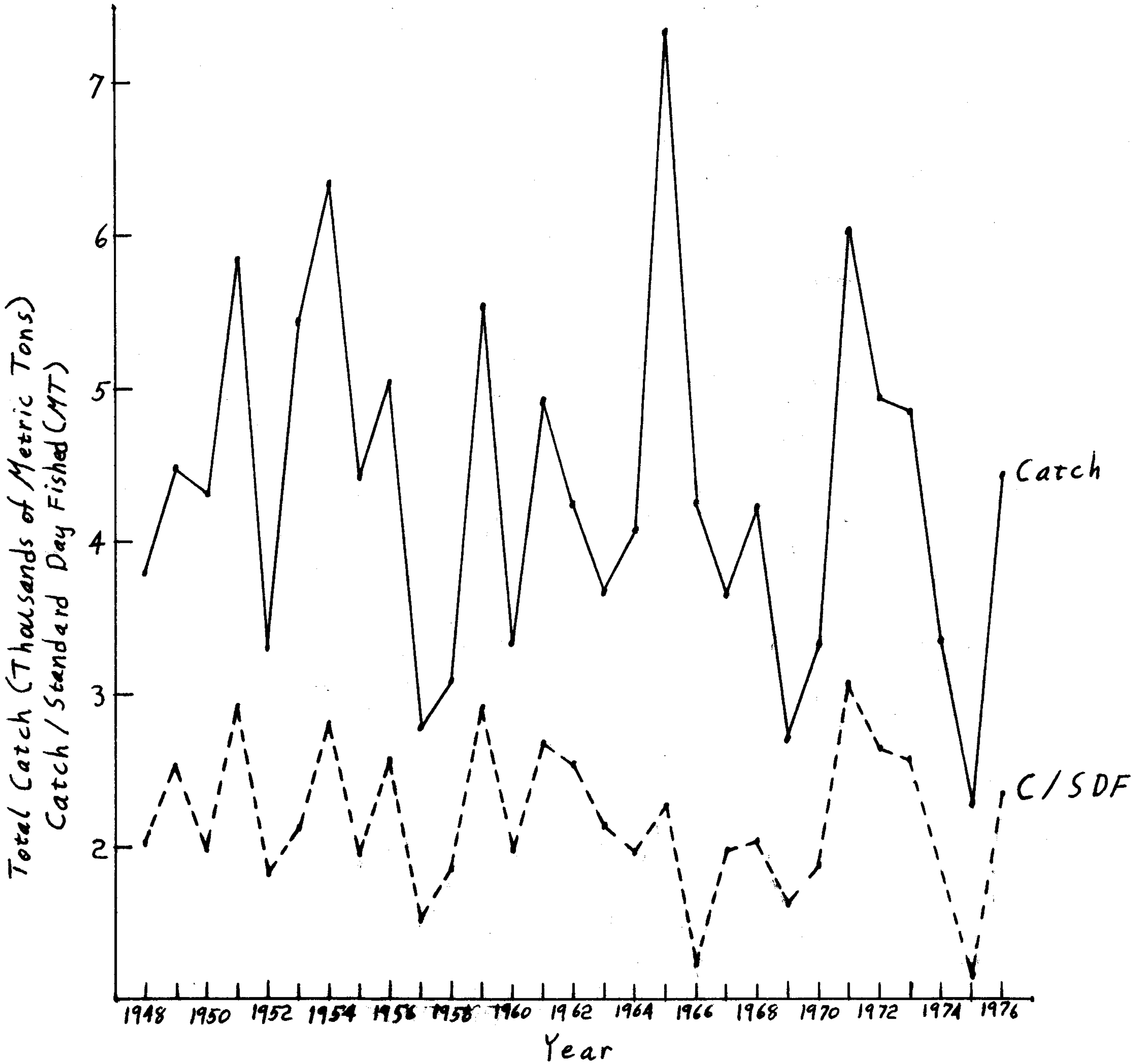

Figure 2. Seasonal trends of skipjack tuna catches in Hawaii for the long-term mean over 1948-76, the best year 1965, and the poorest year 1975.

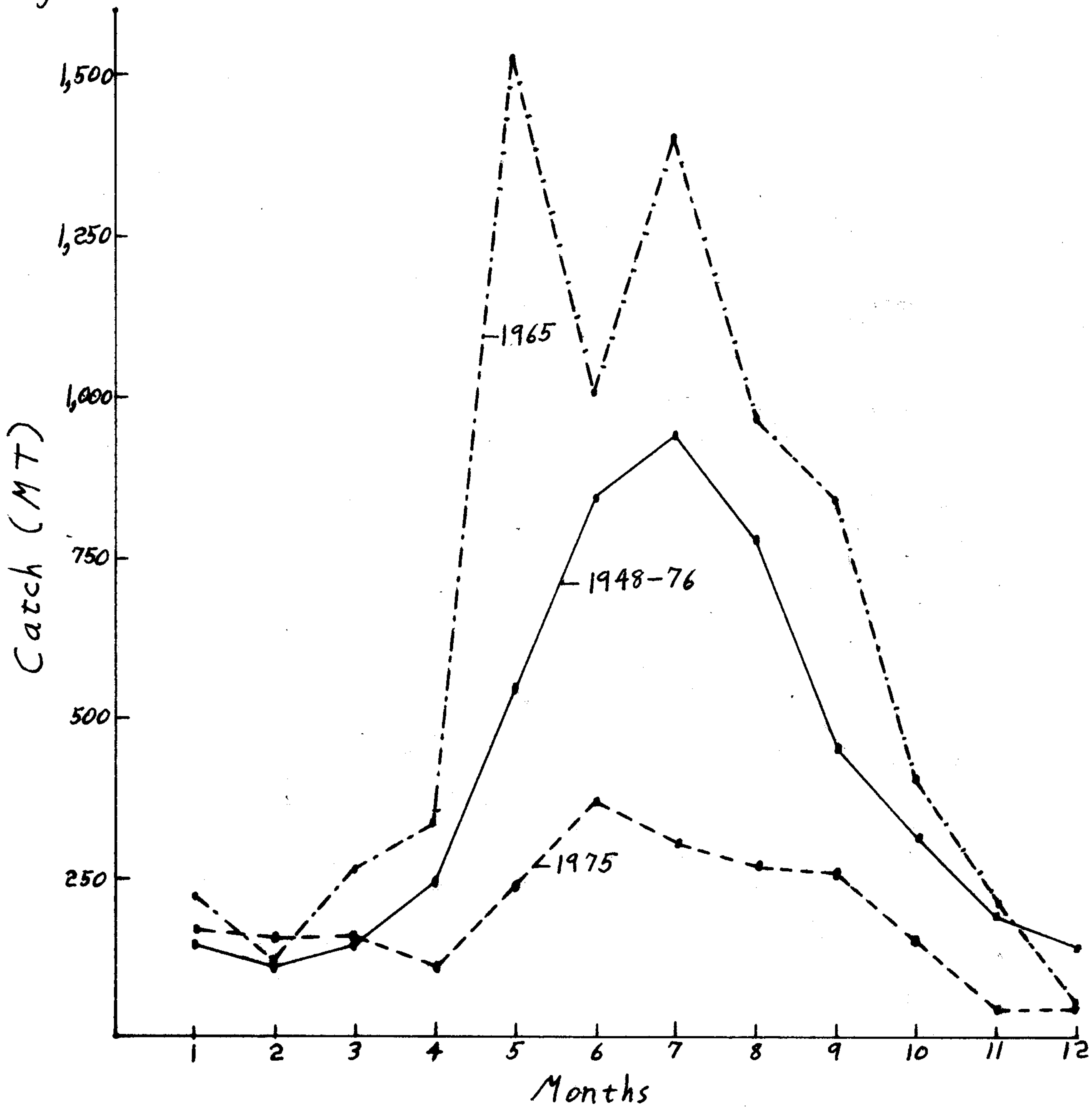

Figure 3. Annual geometric mean of the vessel effeciency factors, 1948-76.

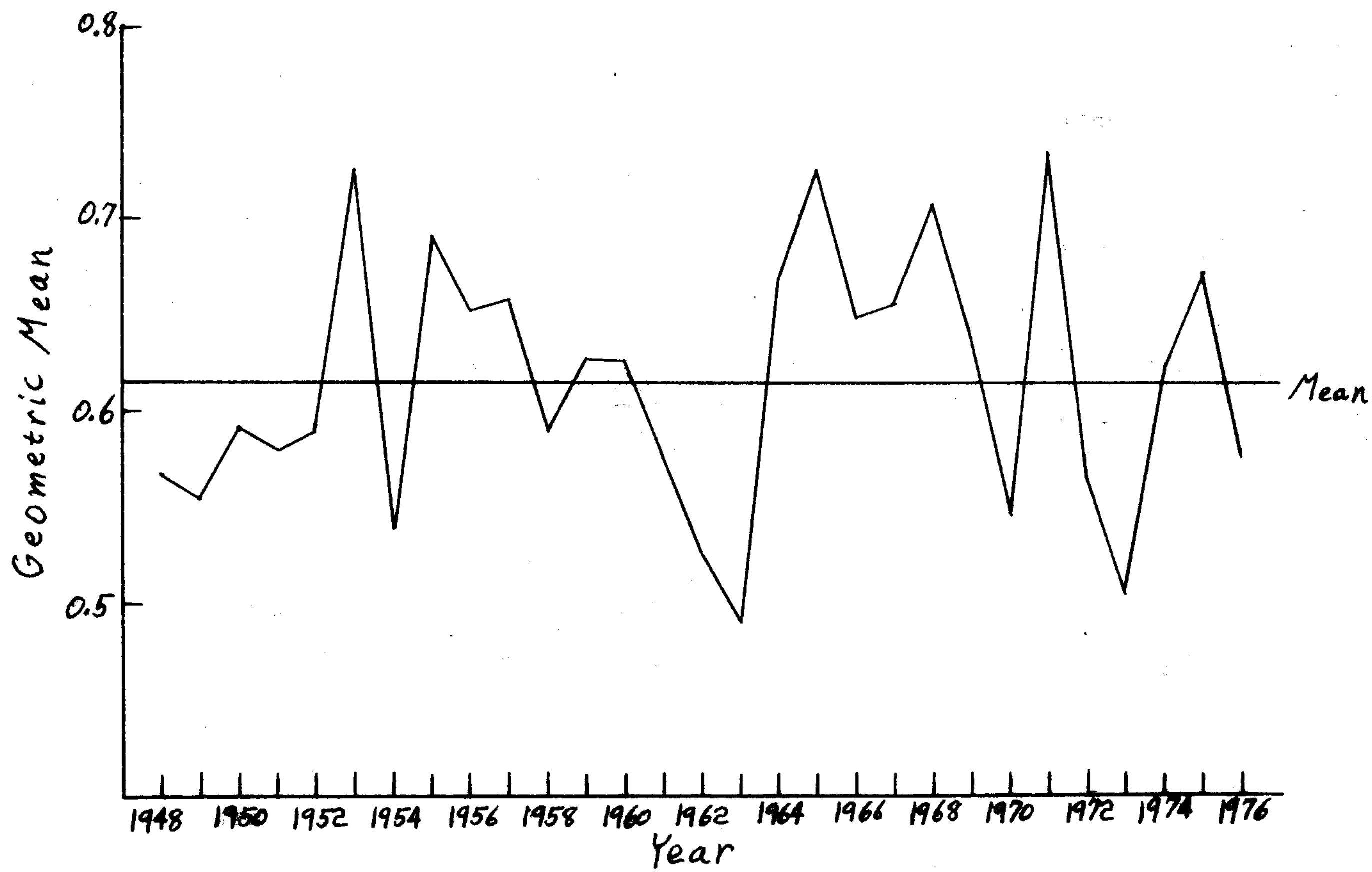

Figure 4. Relationship between catch and catch per standard day fished for skipjack tuna in Hawaii, 1948–76.

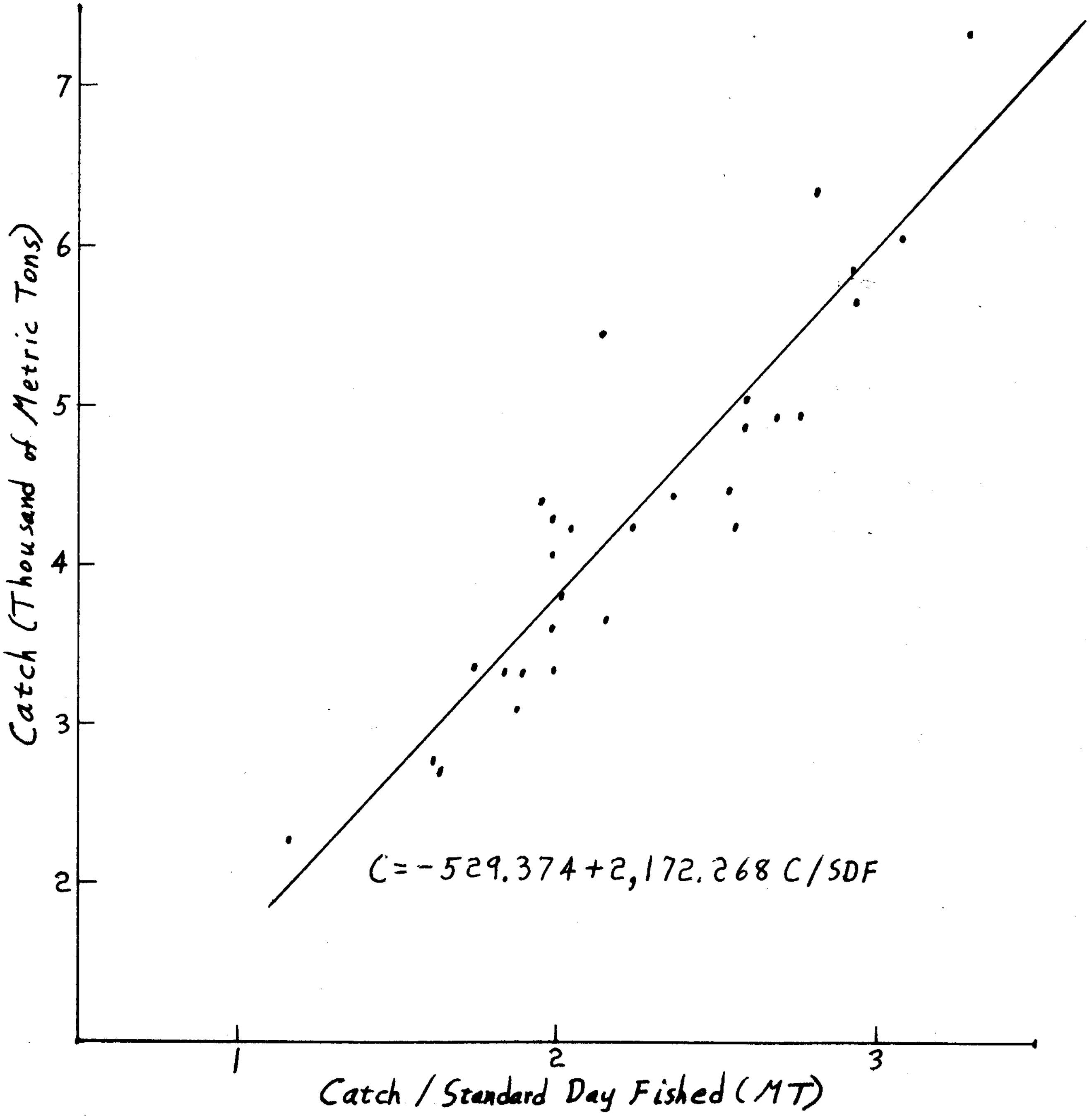

Figure 5. Relationship between measure of abundance and fishing intensity within same year for skipjack tuna, 1948-76.