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JULY 1990

SUMMARY OF THE 1989 NORTH AND SOUTH PACIFIC ALBACORE FISHERIES DATA

By

Atilio L. Coan, Jr., Gary M. Rensink
Christina H. Perrin and Forrest R. Miller

ADMINISTRATIVE REPORT LJ-90-21

ERRATA SHEET

At the top of page 3, delete the first line which reads:

"from those in 1988 (46 fish per day fished). Highest areas of catch per effort in 1989, from"

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INTRODUCTION

During the 1989 north Pacific (July-October) and 1988-89 south Pacific (December-April) fishing seasons, over 400 logbooks were distributed to U.S. albacore fishermen for voluntary record keeping. Completed logbooks were collected, and landings were sampled for sizes of fish, by representatives from the California Department of Fish and Game (CF&G), Washington Department of Fisheries (WDF), Oregon Department of Fish and Wildlife (OF&W), and the NMFS Southwest Regional office in American Samoa. Interested scientists in Fiji, Tahiti, and New Zealand also sampled catches from vessels landing in those countries.

This report is a summary of data for the 1989 fishing season. Available data from foreign fisheries are also presented for comparison.

COVERAGE RATES

Samplers collect catch and effort statistics from vessel logbooks and length measurements of individual fish (length- frequency) from landed catches. Coverage rates for catch and effort and length-frequency statistics were calculated as the ratio of sampled landings in weight to total landings.

Catch and effort and length-frequency statistics from the U.S. north Pacific fishery were collected at landing ports throughout California, Oregon and Washington. The majority of the landings were from jigboats, with lesser quantities from baitboats, gillnets and vessels using a combination of bait and jig fishing gears (Table 1a). The overall sampling coverage for catch and effort increased from 32% in 1988 to 42% in 1989 and increased slightly from 3% in 1988 to 4% in 1989 for length-frequency sampling (Tables 2a-2b). While the majority of the 1989 landings occurred in California, catch and effort sampling coverage in California was the lowest of the three states. In general, sampling coverage at all ports increased over those recorded in 1988.

Catch and effort and length-frequency statistics from the 1988-89, U.S. south Pacific fishery were collected mainly from jigboats landing in American Samoa, with lesser quantities in Fiji and Tahiti (Tables 1b & 2a). Catch and effort coverage increased from 20% in the 1987-88 fishery to 42% in 1988-89, and length-frequency coverage increased from less than 1% in 1987-88 to 3% in 1988-89.

TOTAL CATCH AND EFFORT

The 1989, U.S. north Pacific albacore fishery started in early July and went through mid-October. The fishing fleet expended an estimated 8,856 days fishing (sampled days fishing times 1/coverage rate) compared to 7,494 days fishing in 1988. In 1989, catches were highest in August, and mostly made within 300 miles of the northern tip of Vancouver Island (Figures 1a-f). Catches from the fishery continued a downward trend and reached a record low of 1,600 mt (Table 3), a decrease of 67% from 1988 catches. Sport catches were estimated at 160 mt landed in California.

Japanese gillnet and baitboat catches also show the same decreasing trend (Figure 2, Table 3). The baitboat catches have dropped from a high of 85,000 mt in 1976 to a low of 6,200 mt in 1988. Gillnet catches have dropped from 20,000 mt in 1985 to 8,500 mt in 1988. Longline catches seem stable at 14,000 mt.

The 1988-89, U.S. south Pacific albacore fishery started in December, 1988 and continued through April, 1989. The number of U.S. jigboats participating in the fishery increased from 43 during the 1987-88 season to 46 in the 1988-89 season. An estimated 2,364 days fishing were expended in 1988-89. Catches were highest in January and concentrated in a narrow area east of New Zealand and south of French Polynesia (Figures 3a-f). Catches from the 1988-89 season continued an upward trend for the fishery, reaching 3,810 mt, a slight increase from 1987-88 catches of 3,527 mt (Table 4).

Foreign countries fishing in the south Pacific also show increasing trends in surface catches of albacore (Table 4). Gillnet catches for Japan and Taiwan show the largest increases, reaching a combined total of almost 42,000 mt in 1989, a 400% increase over 1988 catches. Jigboat catches from New Zealand have also shown substantial increases in 1989. Longline catches, as in the northern Pacific, remain relatively stable.

CATCH PER EFFORT

Estimates of catch-per-effort (number of fish caught per standard days fishing) for jigboats in the U.S. north Pacific fishery presented in past reports showed an increasing trend (Majors et al 1989). Those estimates were found biased and were recalculated. Previous estimates were standardized based on vessel size. The new estimates are independent of vessel size and are the ratio of catch to effort in each 1° square and month. Annual estimates are an average of all months and 1° squares. The new estimates show a gradually decreasing trend. Catch rates in 1989 (27 fish per day fished) decreased 45% from those in 1988 (46 fish per day fished). Highest areas of catch per effort in 1989, from

from those in 1988 (46 fish per day fished). Highest areas of catch per effort in 1989, from 120 to 260 fish per day fished, were located 325 miles west of northern California and Oregon in late July (Figures 5a-f), compared to catch rates of 120 to 150 fish per day in the same areas from mid-July to late August in 1988.

Estimates of catch per effort for jigboats in the U.S. south Pacific fishery decreased 8% from 242 fish per day fished in 1987-88 to 223 fish per day fished in 1988-89 (Figure 4). The highest catch rates were in March.

LENGTH FREQUENCY

Over 10,500 fish were measured for fork length (tip of mandible to fork of the tail) from the landings of vessels participating in the 1989, U.S. north Pacific fishery (Table 1a). The average sizes of fish measured decreased slightly from 65.6 cm (12.8 lbs) in 1988 to 65.1 cm (12.6 lbs) in 1989 (Figure 6). Fish ranged in size from 46 to 117 cm (Figure 7). The dominant mode of fish sizes for jigboat catches was 61 to 70 cm, although 75-81 cm fish were predominant north of 50°N (Figures 8a-c). The majority of the baitboat catches were in two modes, 61 to 70 cm and 73 to 85 cm, with fish getting larger as one goes north. In general, there were fewer large fish (>85 cm) caught in 1989 than in 1988.

Over 17,500 fish were measured for fork length from landings of vessels participating in the 1988-89, U.S. south Pacific fishery. The average size of fish landed remained virtually the same in 1988-89 (68.9 cm, 15.0 lbs) as in 1987-88 (69.0 cm, 15.2 lbs) (Figure 6). Fish sizes ranged from 42 cm to 108 cm. in the 1988-89 fishery and were mainly in three modes (Figure 7). In general, fewer large fish (>85 cm) and more small fish (<58 cm) were caught in the 1988-89 fishery than in the 1987-88 fishery.

SEA SURFACE TEMPERATURE

Sea-surface temperatures (SSTs) recorded by commercial transport vessels, fishing boats and research vessels were compiled into monthly means and plotted on charts with 1° latitude-longitude resolution. Analyses of mean SSTs on these charts show the distribution of SST contours (isotherms) and the location of surface ocean fronts. Areas fished successfully in 1989 by the U.S. north Pacific albacore fleet are shaded on the SST charts to show the relationship among areas of fishing, surface ocean fronts and SST isotherm patterns (Figures 9a-e).

During the 1989 albacore season SSTs were near normal except in the coastal region between Vancouver Island and Point Conception. Here SSTs were 1° to 2°C (1.8° to 3.6°F) below normal from July through October due to persistent coastal upwelling which caused sharp temperature edges (frontal boundaries) to form out 60 to 150 from the U.S. and British Columbia coasts (Figures 9b-e). From August to October the strongest SST fronts existed off the coast from Monterey Bay to Vancouver Island.

In southern California waters there were the typical frontal boundaries south of Point Conception with SSTs ranging from 15° to 17°C (59° to 62.5°F). Most of the unsuccessful effort occurred along the western boundary of the SST fronts during the first half of the albacore season. There were no unusual features in the SST pattern that might have caused albacore to avoid the southern California area during 1989. The most successful fishing in 1989 occurred north of the Monterey Bay along the warm (western) side of the frontal boundaries where SSTs were greater than 15°C (Figures 9b-d). During the last half of the albacore season the more pronounced SST fronts were found offshore between Cape Mendocino and Vancouver Island.

SUMMARY

Highlights for the 1989 U.S. north Pacific albacore fishery include, 1) record low catches of 1,600 mt, 2) continued decreasing trends in catch and catch per effort, 3) fewer large fish in landings, and 4) successful fishing north of Monterey Bay along the warm side of the frontal boundaries where SSTs were greater than 15°C (59°F). The record low catches can be explained, in part, by continued good catches in U.S. salmon fisheries (many U.S. albacore fishery participants start the year fishing for salmon and convert to albacore as soon as albacore become available). However, the continued decreasing trends in catches and catch per effort for U.S. fisheries combined with corresponding decreases in Japanese surface fisheries may indicate a low recruitment to the north Pacific albacore stock.

Highlights for the 1988-1989 U.S. south Pacific albacore fishery include, 1) continued increasing catches, 2) relatively high catch per effort and 3) fewer large fish and more small fish in landings. The number of vessels participating in the 1989-90 fishing season increased to 49 and catches are expected to exceed 5,000 mt.

Increasing catches by foreign gillnet fisheries that fish some of the same areas as the U.S. fishery are a growing concern. New logbooks will be distributed to U.S. fishermen during the 1989-90, south Pacific season and the 1991 north Pacific season. The new logbooks will attempt to quantify the number of gillnet marked fish in U.S. jigboat and baitboat catches, and the number of foreign gillnet vessels operating in the same areas. Information gathered from these new logbooks will help in understanding interactions between foreign gillnet fisheries and U.S. jig and baitboat fisheries.

ACKNOWLEDGEMENTS

We thank the captains and crews of the U.S. north and south Pacific albacore fishing fleets, and William Perkins of the Western Fishboat Owners Association for their cooperation and continuing support of this program. We also thank Mary Larson of CDFG, Larry Hreha of ODFW, Brian Culver of WDF, Russ Porter of PMFC, Gordon Yamasaki of the American Samoa Laboratory of the NMFS Southwest Region, and members of their staffs for distributing logbooks and collecting albacore fishing information during the fishing seasons.

Norman Bartoo and Gary Sakagawa of the SWFSC reviewed drafts of this report and provided useful comments. Roy Allen and Henry Orr illustrated the maps and figures. Karen Handschuh typed the final draft of the manuscript.

LITERATURE CITED

Majors et al 1989. Summary of the 1988 North and South Pacific Albacore Fisheries Data. SWFC Admin. Rep. LJ-89-19, 53 p.

Table 1a. Sampling of the U.S. North Pacific albacore landings by gear and year.

Vessel Gear Type Used	1989 Effort (days)	1989 Catch (number)	1989 No. Fish Measured	1988 Effort (days)	1988 Catch (number)	1988 No.Fish Measured
1. Pole & Line	30	3,559	756	108	34,598	550
2. Jig	2,094	113,900	9353	2,039	237,761	19,023
3. Both (1&2)	31	3,691	428	11	4,026	1,708
4. Gillnet	90	242	53	240	921	526
99. Unknown	589	0	0	0	0	0
Total	2,834	121,392	10,590	2,398	277,306	21,807

Table 1b. Sampling of the U.S. South Pacific albacore landings by gear and year.

Vessel Gear Type Used	1989 Effort (days)	1989 Catch (number)	1989 No. Fish Measured	1988 Effort (days)	1988 Catch (number)	1988 No.Fish Measured
2. Jig	975	233,933	17,582	437	105,805	4,642
3. Both	1	74	0	0	0	0
99. Unknown	17	0	0	0	0	0
Total	993	234,007	17,582	437	105,805	4,642

Table 2a. Sampling coverage for the 1989 U.S. north and south Pacific albacore fisheries by landing location.

State/Nation Where Fish Landed	Total Landings (lbs.)	Landings Sampled (lbs.)	Coverage (percent)	Number of Landings	Sampled Landings
		Catch and Effort			
North Pacific:					
California	1,288,209	409,475	32%	491	94
Oregon	1,049,914	486,977	46%	205	115
Washington	1,189,659	593,725	60%	143	38
Total	3,527,782	1,490,177	42%	839	247
South Pacific:					
California	540,133	88,978	16%	1	1
Am. Samoa	5,483,997	3,281,600	60%	53	34
Fiji	715,973	144,207	20%	7	1
Tahiti	1,659,507	0	0%	0	
Total	8,399,619	3,514,785	42%	61	36
		Length Frequency			
North Pacific:					
California	1,288,209	67,883	5%	491	72
Oregon	1,049,914	34,225	3%	205	44
Washington	1,189,659	29,871	3%	143	19
Total	3,527,782	131,989	4%	839	135
South Pacific:					
California	540,133	0	0%	1	0
Am. Samoa	5,483,997	193,578	4%	53	46
Fiji	715,973	0	0%	7	0
Tahiti	1,659,507	70,504	4%	21	
Total	8,399,619	264,082	3%	61	67

Table 2b. Sampling coverage for the 1988 U.S. north and south Pacific albacore fisheries by landing location.

State/Nation Where Fish Landed	Total Landings (lbs.)	Landings Sampled (lbs.)	Coverage (percent)	Number of Landings	Sampled Landings
		Catch and Effort			
North Pacific:					
California	2,611,532	274,040	10%	643	87
Oregon	3,952,453	1,461,700	37%	467	80
Washington	4,073,683	1,702,855	42%	419	101
Total	10,637,667	3,438,595	32%	1,529	268
South Pacific:					
Am. Samoa	3,776,577	1,587,075	42%	31	15
Fiji	200,000	-	-	-	-
Tahiti	3,800,000	-	-	27	-
Total	7,776,577	1,587,075	20%	58	15
		Length Frequency			
North Pacific:					
California	2,611,532	34,571	1%	643	96
Oregon	3,952,453	104,458	3%	467	62
Washington	4,073,683	131,378	3%	419	90
Total	10,637,667	270,407	3%	1,529	248
South Pacific:					
Am. Samoa	3,776,577	22,440	<1%	31	31
Fiji	200,000	-	-	-	-
Tahiti	3,800,000	47,190	1%	27	27
Total	7,776,577	69,630	<1%	58	58

Table 3. Catches of north Pacific albacore in metric tons by fisheries, 1952 - 1989.

	JAPAN					TAIWAN		KOREA		UNITED STATES					CANADA	
YEAR	BAIT	LONG LINE	GILL NET	OTHER GEAR	TOTAL	LONG LINE	GILL NET	LONG LINE	BAIT	JIG	SPORT	GILL NET	PURSE SEINE	TOTAL	JIG	GRAND TOTAL
1952	41,786	26,687		237	68,710					23,843	1,373			25,216	71	93,997
1953	32,921	27,777		132	60,830					15,740	171			15,911	5	76,746
1954	28,069	20,958		38	49,065					12,246	147			12,393		61,458
1955	24,236	16,277		136	40,649					13,264	577			13,841		54,490
1956	42,810	14,341		57	57,208					18,751	482			19,233	17	76,458
1957	49,500	21,053		151	70,704					21,165	304			21,469	8	92,181
1958	22,175	18,432		124	40,731					14,855	48			14,903	74	55,708
1959	14,252	15,802		67	30,121					20,990	0			20,990	212	51,323
1960	25,156	17,369		76	42,601					20,100	557			20,657	5	63,263
1961	18,636	17,437		268	36,341				2,837	12,061	1,355			16,253	4	52,598
1962	8,729	15,764		191	24,684				1,085	19,760	1,681			22,526	1	47,211
1963	26,420	13,464		218	40,102				2,432	25,147	1,161			28,740	5	68,847
1964	23,858	15,458		319	39,635	26			3,411	18,392	824			22,627	3	62,291
1965	41,491	13,701		121	55,313	261			417	16,545	731			17,693	15	73,282
1966	22,830	25,050		585	48,465	271			1,600	15,342	588			17,530	44	66,310
1967	30,481	28,869		520	59,870	305			4,113	17,826	707			22,646	161	82,982
1968	16,597	23,961		1,109	41,667	482			4,906	20,444	951			26,301	1,028	69,478
1969	32,107	18,006		1,480	51,593	569			2,996	18,839	358			22,193	1,365	75,720
1970	24,376	15,372		956	40,704	1,482			4,416	21,041	822			26,279	354	68,819
1971	53,198	11,035		1,262	65,495	1,739			2,071	20,537	1,175			23,783	1,587	92,604
1972	60,762	12,649	1	921	74,333	2,904			3,750	23,608	637			27,995	3,558	108,790
1973	69,811	16,059	39	1,883	87,792	128			2,236	15,667	84			17,987	1,270	107,177
1974	73,576	13,053	224	1,065	87,918	84			4,777	20,187	94			25,058	1,207	114,267
1975	52,157	10,060	166	402	62,785	254		319	3,243	18,975	640			22,858	101	86,317
1976	85,336	15,896	1,070	1,394	103,696	565		971	2,700	15,932	713			19,345	252	124,829
1977	31,934	15,737	688	1,039	49,398	301		65	1,497	10,005	537			12,039	53	61,856
1978	59,877	13,061	4,029	3,209	80,176	278		174	950	16,682	810			18,442	23	99,093
1979	44,662	14,249	2,856	1,280	63,047	106		27	303	6,801	74			7,178	521	70,879
1980	46,743	14,743	2,986	1,516	65,988	39		15	382	7,574	168			8,124	212	74,378
1981	27,426	18,020	16,825	959	63,230	163		600	748	12,694	195			13,637	200	77,830
1982	29,615	16,762	17,217	1,054	64,648	521		1,070	425	6,661	257			7,343	104	73,686
1983	21,098	15,103	9,514	471	46,186	512		1,233	607	9,512	87			10,206	225	58,362
1984	26,015	15,111	13,177	3,898	58,201	471		1,041	1,030	9,378	1,427		3,728	15,563	50	75,326
1985	20,714	14,320	20,199	1,940	57,173	109		2,169	1,498	6,431	1,176	2		9,107	56	68,614
1986	16,096	12,945	9,670	2,192	40,903				432	4,708	196	3		5,339	30	46,272
1987	19,091	14,642	9,900	1,394	45,027				158	2,766	74	5		3,003	104	48,134
1988	6,216		8,555	1,208	15,979	38	11,366		598	4,212	64	15		4,889	155	32,061
1989	9,800				9,800				48	1,549	160	3		1,760	200	11,760

1. Figures for 1987-88 are preliminary.
2. Japanese longline catches for 1952-60 exclude minor amounts taken by vessels under 20 tons. Longline catches in weight are estimated by multiplying annual number of fish caught by average weight statistics.
3. Japanese baitboat catches include fish caught by research vessels.
4. Japanese longline catches from 1958-68 were readjusted in 1988.
5. U.S. Jigboat catches from 1952-60 include fish caught by baitboats, from 1961-85 include fish landed in Hawaii.
6. Japan gillnet catches include south Pacific catches.
7. Korean longline catches calculated from FAO statistics and Korean catch/effort data.
8. Korean and Taiwan gillnet catches are missing at this time.

Table 4. Catches of south Pacific albacore in metric tons by fisheries, 1952 - 1989.

	JAPAN			TAIWAN		KOREA		USA	AUSTRALIA		NEW ZEALAND	NEW CALEDONIA	TONGA	
YEAR	LONG LINE	GILL NET	TOTAL	LONG LINE	GILL NET	LONG LINE	GILL NET	JIG	SPORT	LONG LINE	JIG	LONGLINE	LONG LINE	GRAND TOTAL
1952	210		210											210
1953	1,091		1,091											1,091
1954	10,200		10,200											10,200
1955	8,420		8,420											8,420
1956	6,220		6,220											6,220
1957	9,764		9,764											9,764
1958	21,558		21,558			146								21,704
1959	19,344		19,344			456								19,800
1960	23,756		23,756			610								24,366
1961	25,628		25,628			330								25,958
1962	38,880		38,880			599								39,479
1963	33,500		33,500			1,367								34,867
1964	21,435		21,435			2,911								24,346
1965	19,305		19,305			6,405								25,710
1966	23,401		23,401			10,817								34,218
1967	16,640		16,640	11,751		13,717								42,108
1968	7,707		7,707	12,424		10,138								30,269
1969	5,559		5,559	9,595		9,963								25,117
1970	6,560		6,560	14,689		11,599			500					33,348
1971	4,339		4,339	15,887		14,482			500					35,208
1972	2,796		2,796	16,814		14,439			500					34,549
1973	2,381		2,381	17,742		17,452			500					38,075
1974	1,847		1,847	17,283		12,194			500		898			32,722
1975	1,045		1,045	17,071		9,015			500		646			28,277
1976	1,906		1,906	13,700		12,212			500		25			28,343
1977	2,240		2,240	21,932		13,176			500		621			38,469
1978	2,520		2,520	20,942		10,989			500		1,686			36,637
1979	2,350		2,350	15,086		8,682			500		814			27,432
1980	2,488		2,488	18,180		10,852			500		1,468			33,488
1981	4,856		4,856	14,595		14,793			500		2,085			36,829
1982	4,900		4,900	12,689		12,586			500		2,434			33,109
1983	4,928		4,928	12,119		6,669			500		744			24,960
1984	3,607	1,563	5,170	11,155		5,730			300		2,773			25,128
1985	3,746	1,905	5,651	9,601		14,267			300		3,253			33,072
1986	4,466	1,919	6,385	11,913		18,799		100	300	15	1,911	185		39,608
1987	4,085	587	4,672	15,009		8,646		750	300	94	1,227	563	227	31,488
1988	4,100	4,801	8,901	17,120	1,000	6,896		3,600	300	78	330	567	221	39,013
1989		13,160	13,160		28,500		184	3,700	300		5,161			51,005

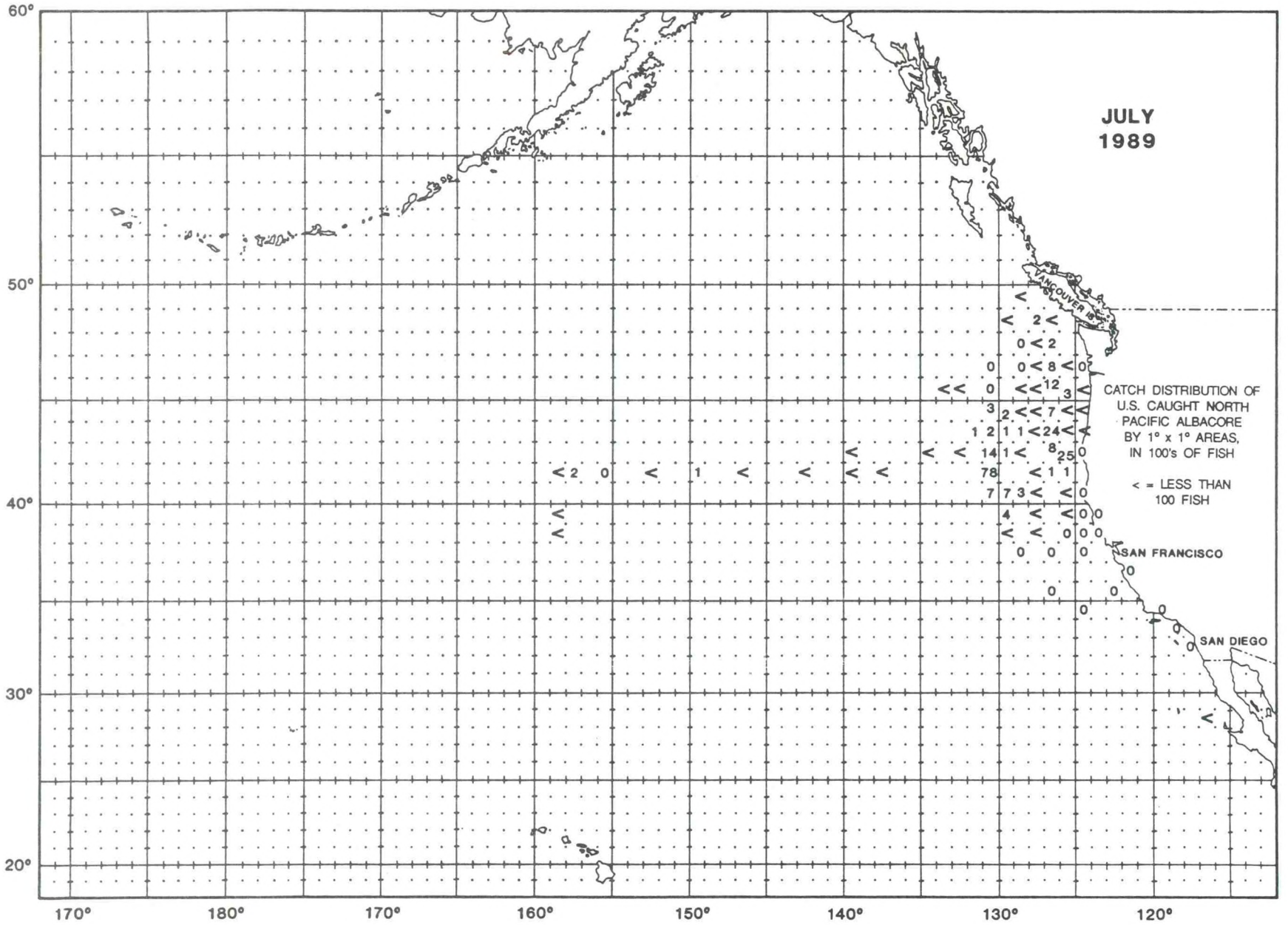

Figure 1a. Albacore catch (numbers of fish) by all vessels by 1^{o} quadrangle in the north Pacific, July 1989.

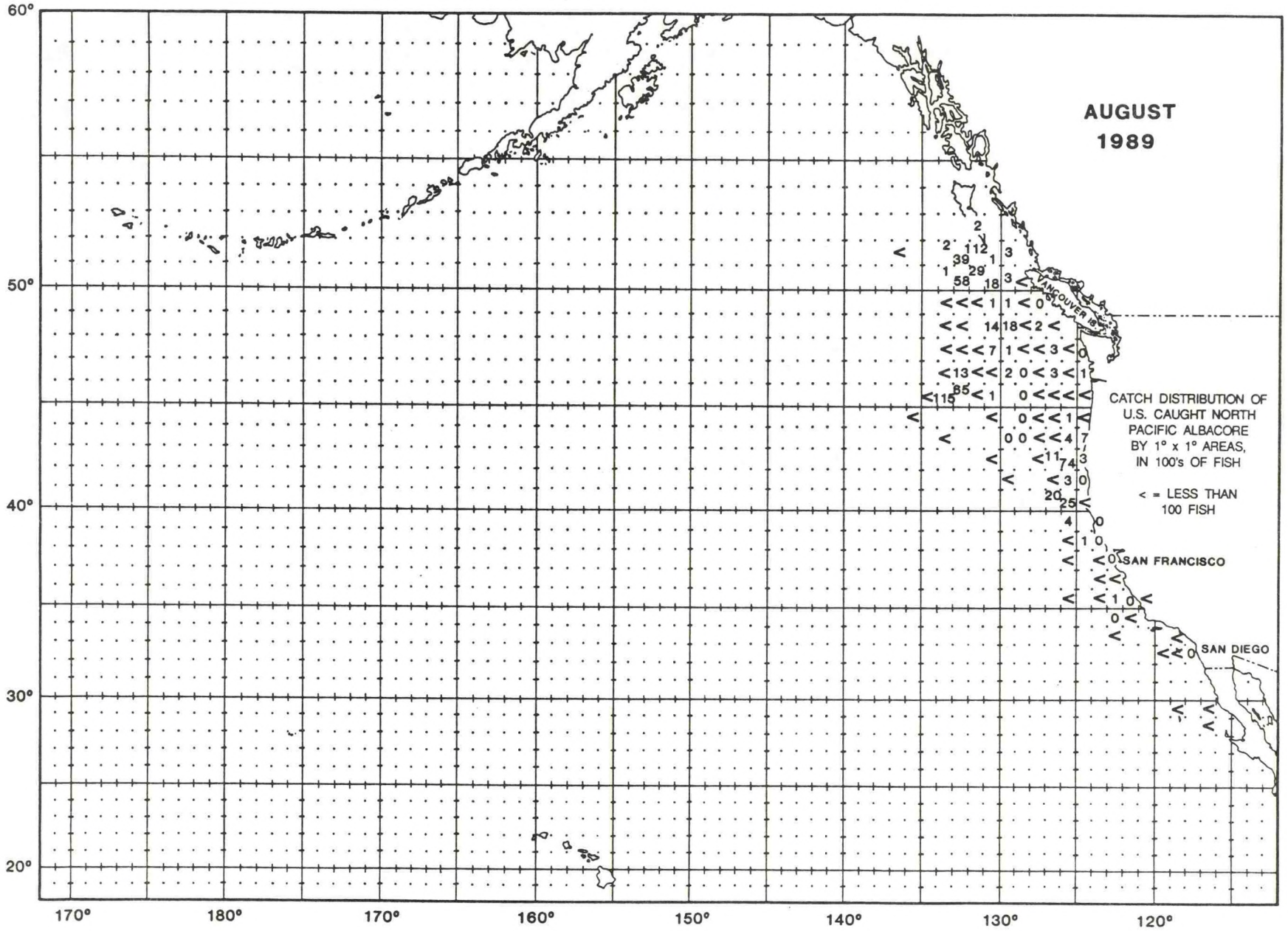

Figure 1b. Albacore catch (numbers of fish) by all vessels by 1^{o} quadrangle in the north Pacific, August 1989.

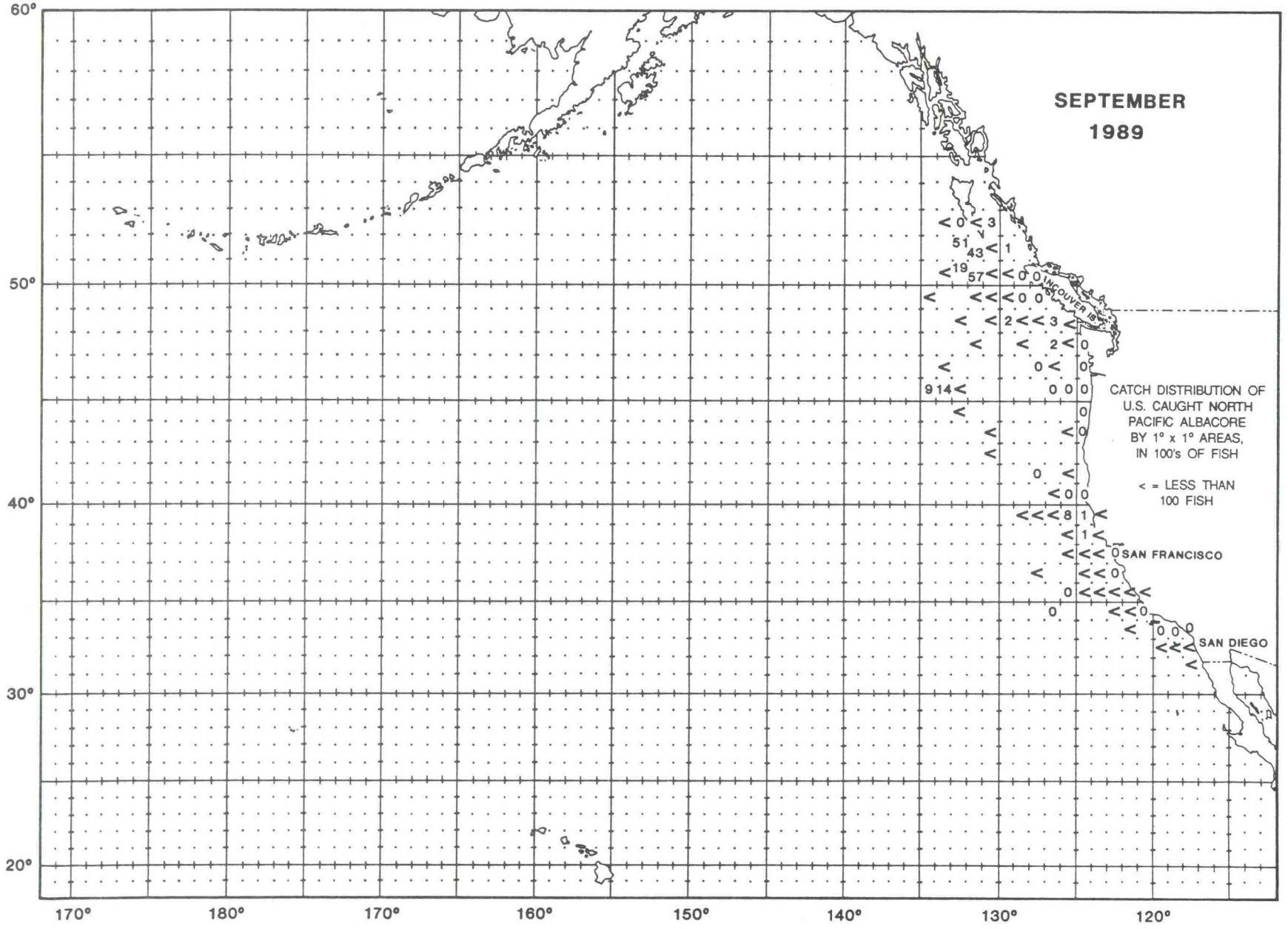

Figure 1c. Albacore catch (numbers of fish) by all vessels by 1^{o} quadrangle in the north Pacific, September 1989.

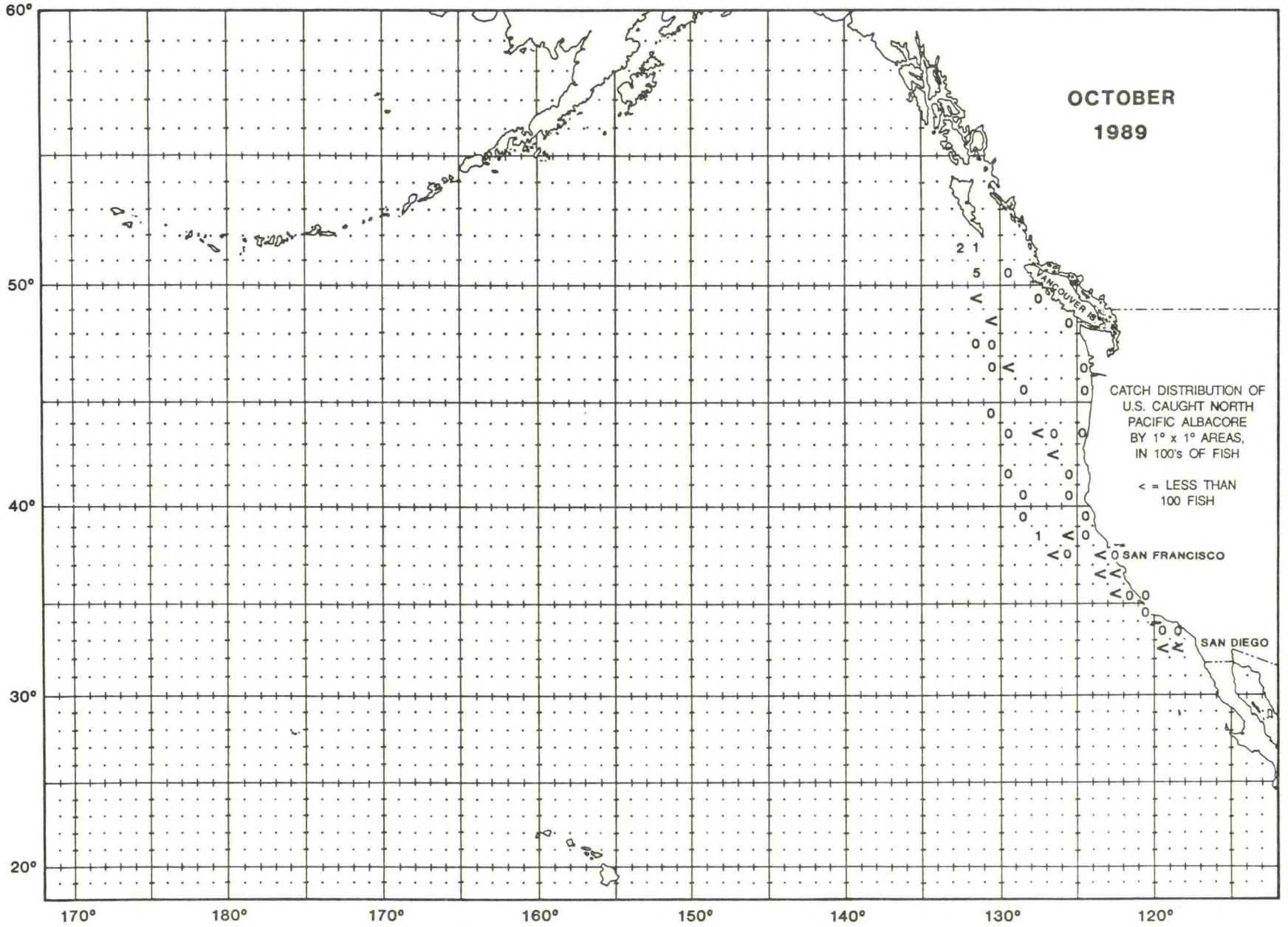

Figure 1d. Albacore catch (numbers of fish) by all vessels by 1^0 quadrangle in the north Pacific, October 1989.

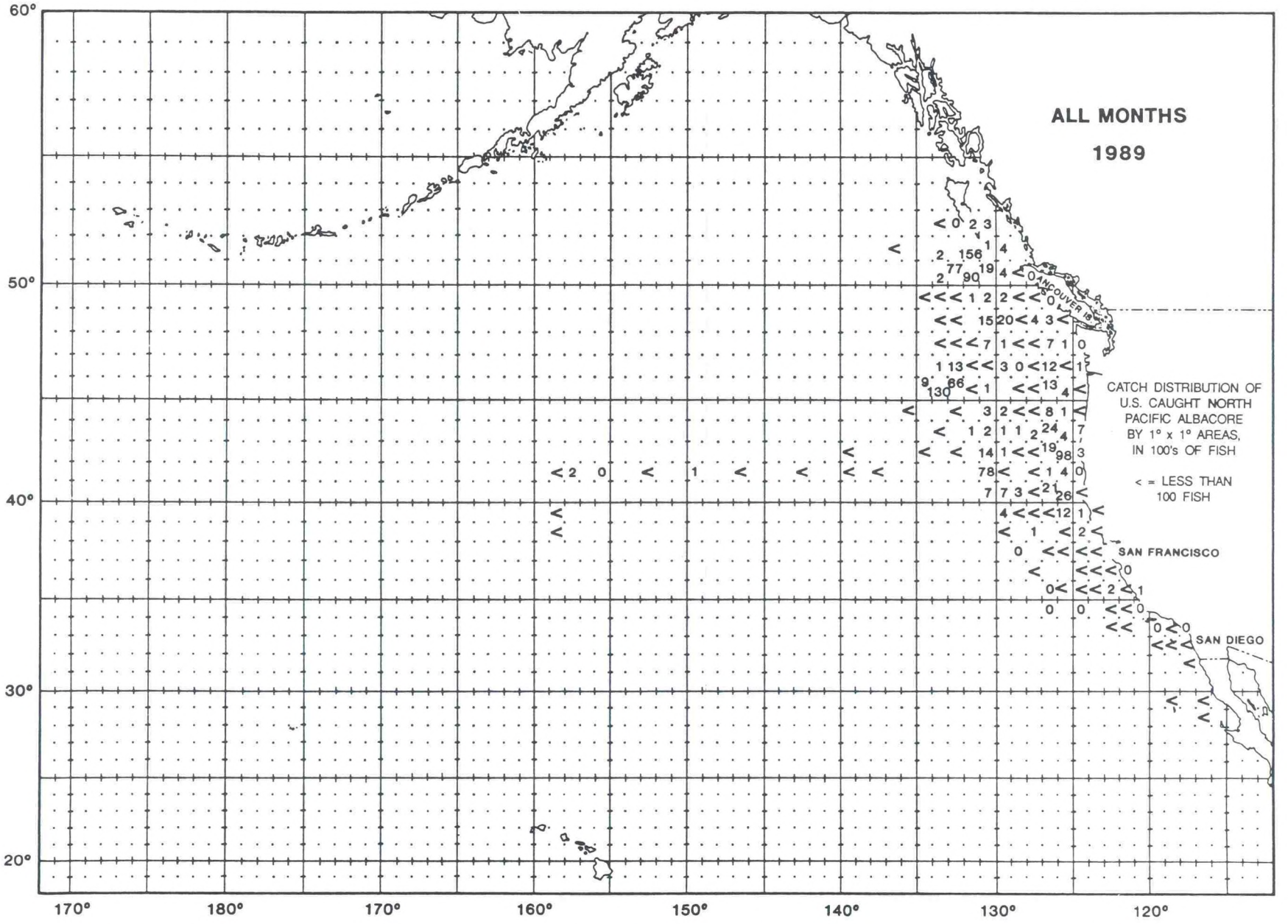

Figure 1e. Annual albacore catch (numbers of fish) by all vessels by 1^{o} quadrangle in the north Pacific, 1989.

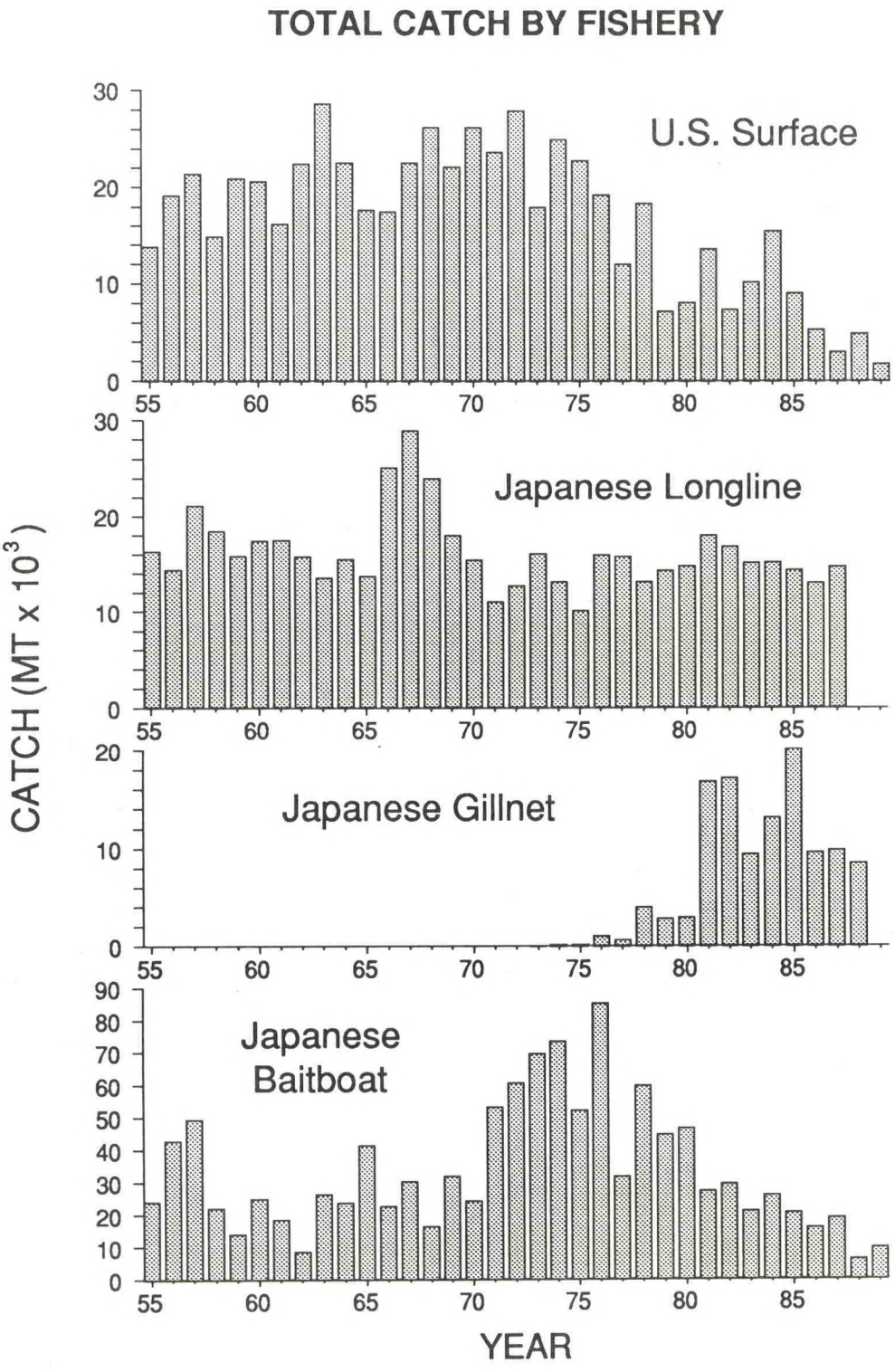

Figure 2. Total albacore catch in metric tons by fishery and gear for the north Pacific, 1955 - 1989.

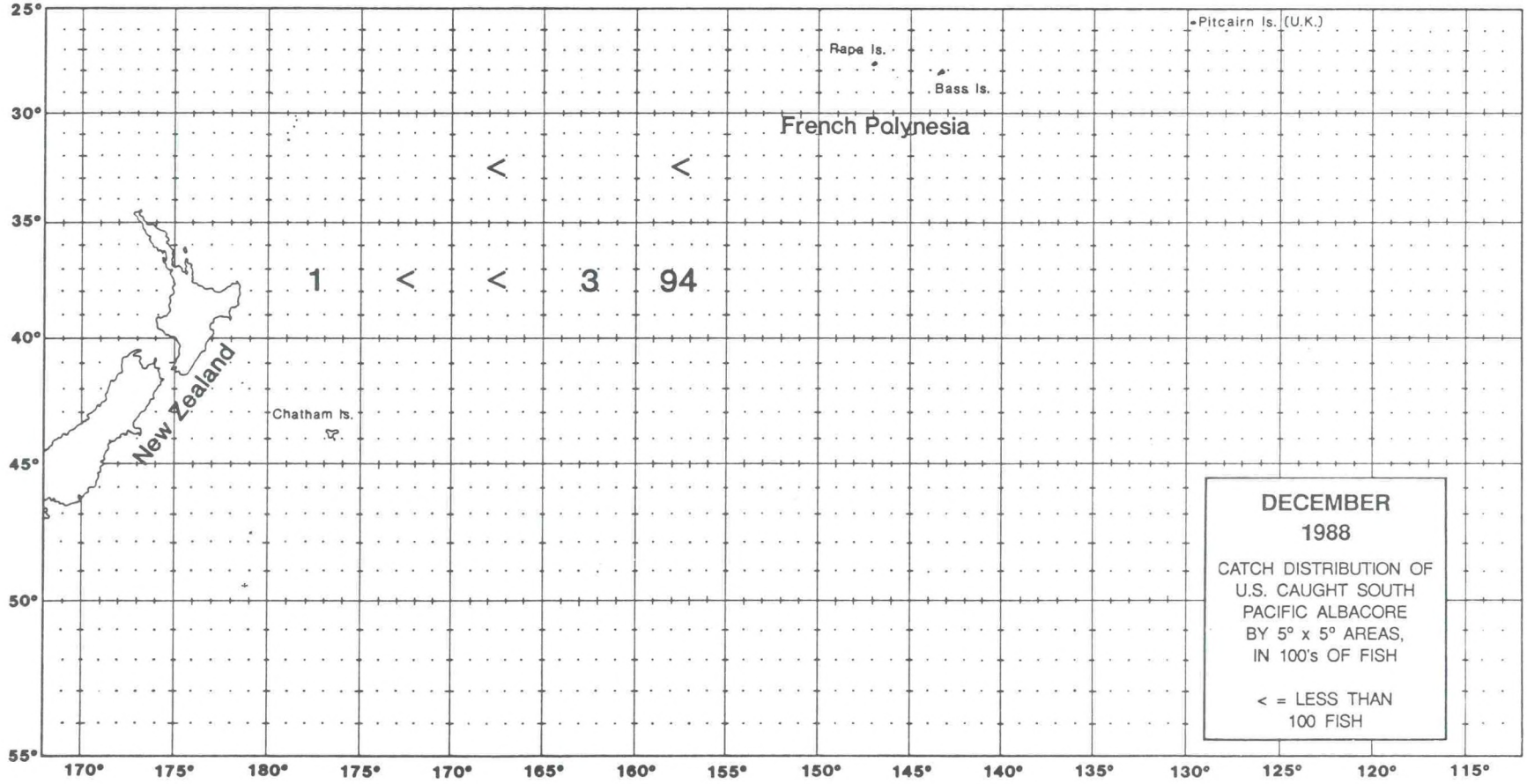

Figure 3a. Albacore catch (numbers of fish) by jigboats by 5^{o} quadrangle in the south Pacific, December 1988.

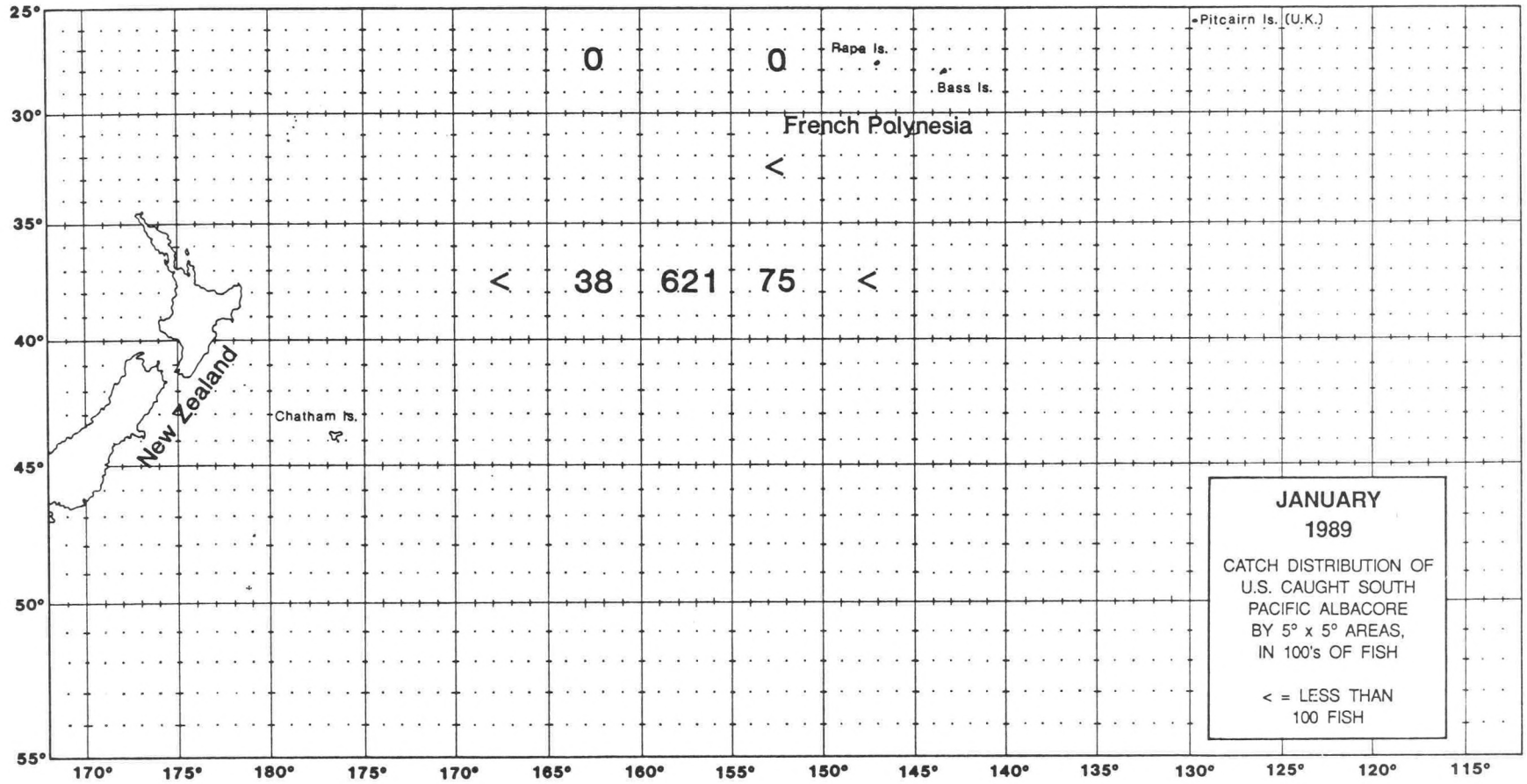

Figure 3b. Albacore catch (numbers of fish) by jigboats by 5° quadrangle in the south Pacific, January 1989.

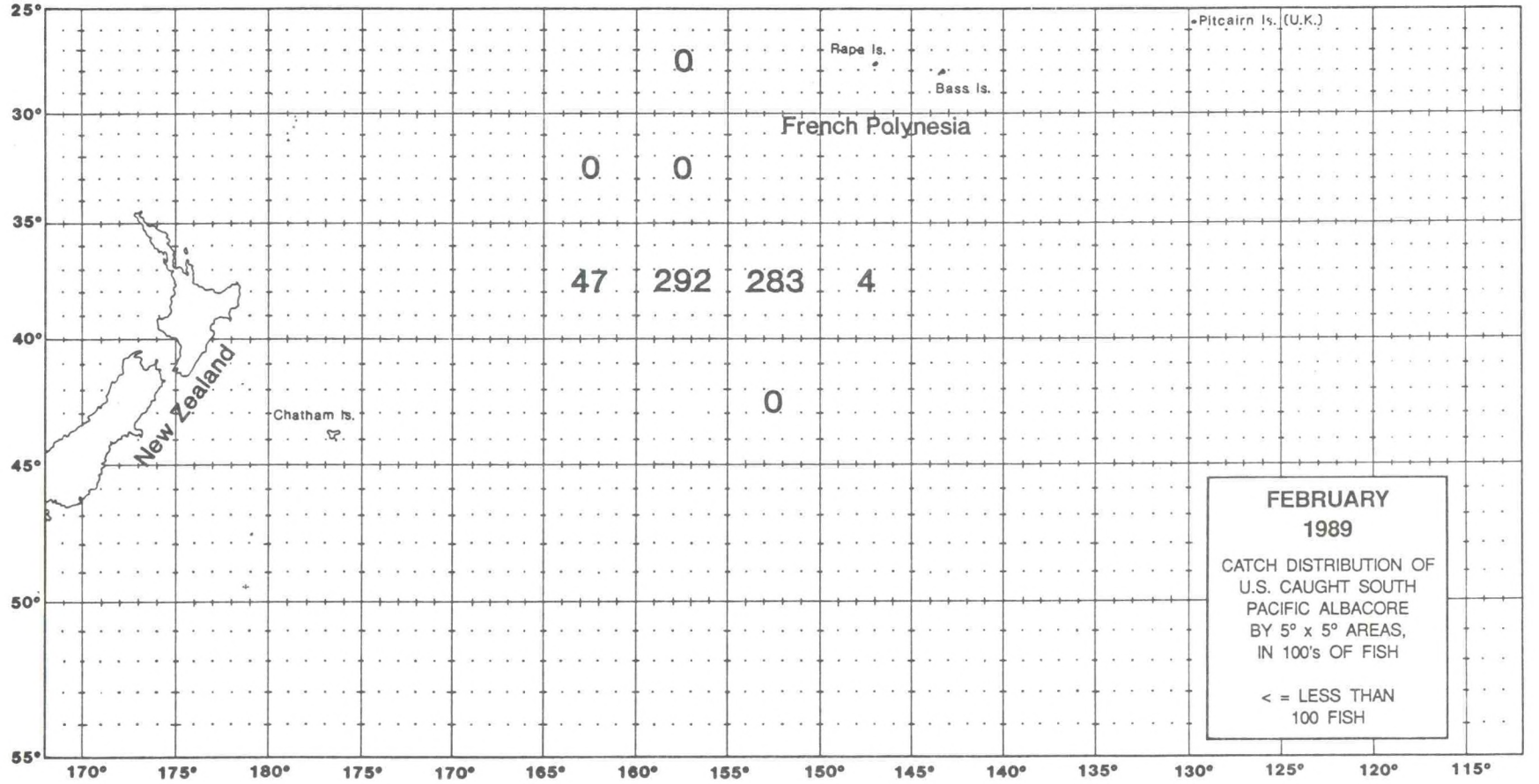

Figure 3c. Albacore catch (numbers of fish) by jigboats by 5° quadrangle in the south Pacific, February 1989.

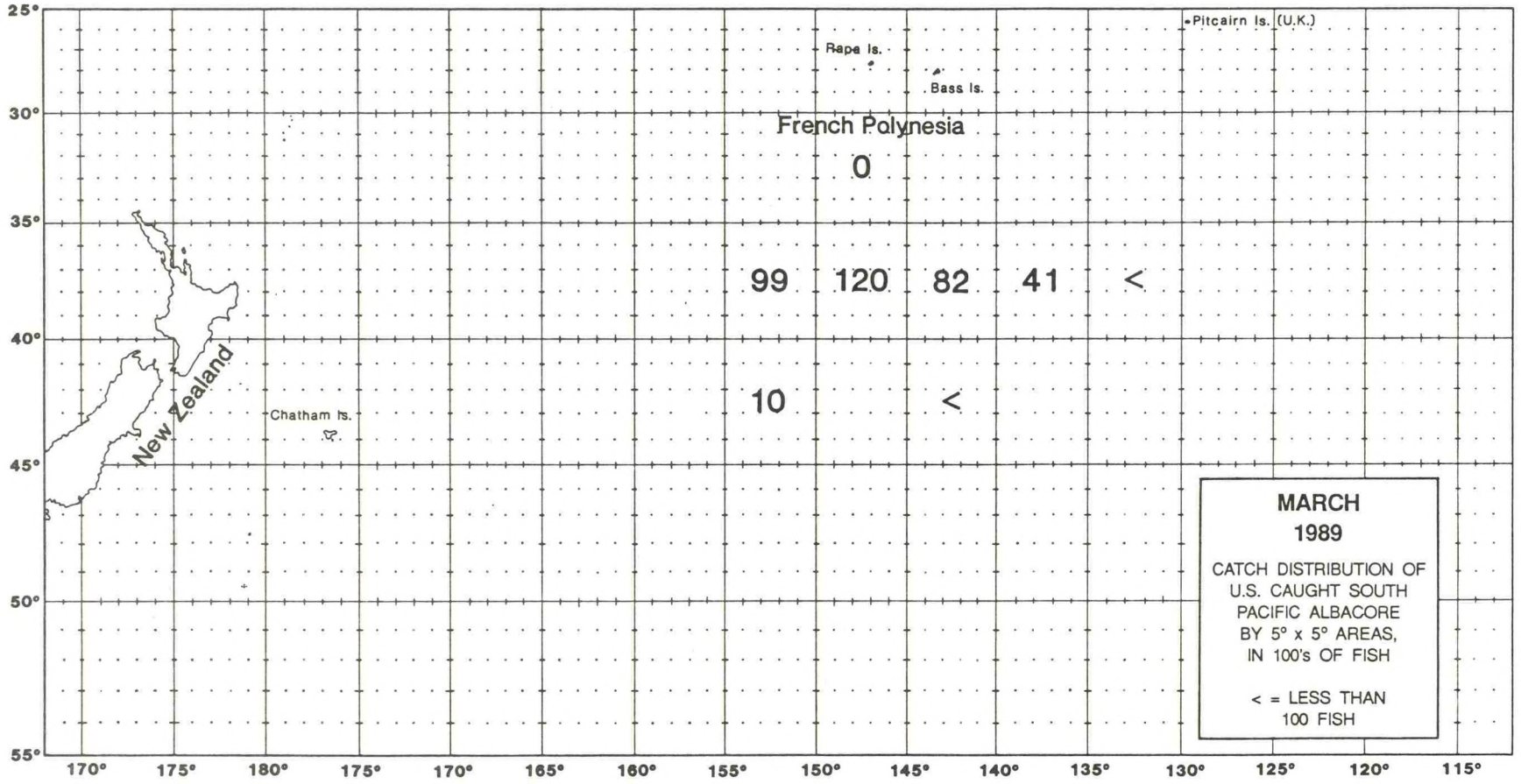

Figure 3d. Albacore catch (numbers of fish) by jigboats by 5^{0} quadrangle in the south Pacific, March 1989.

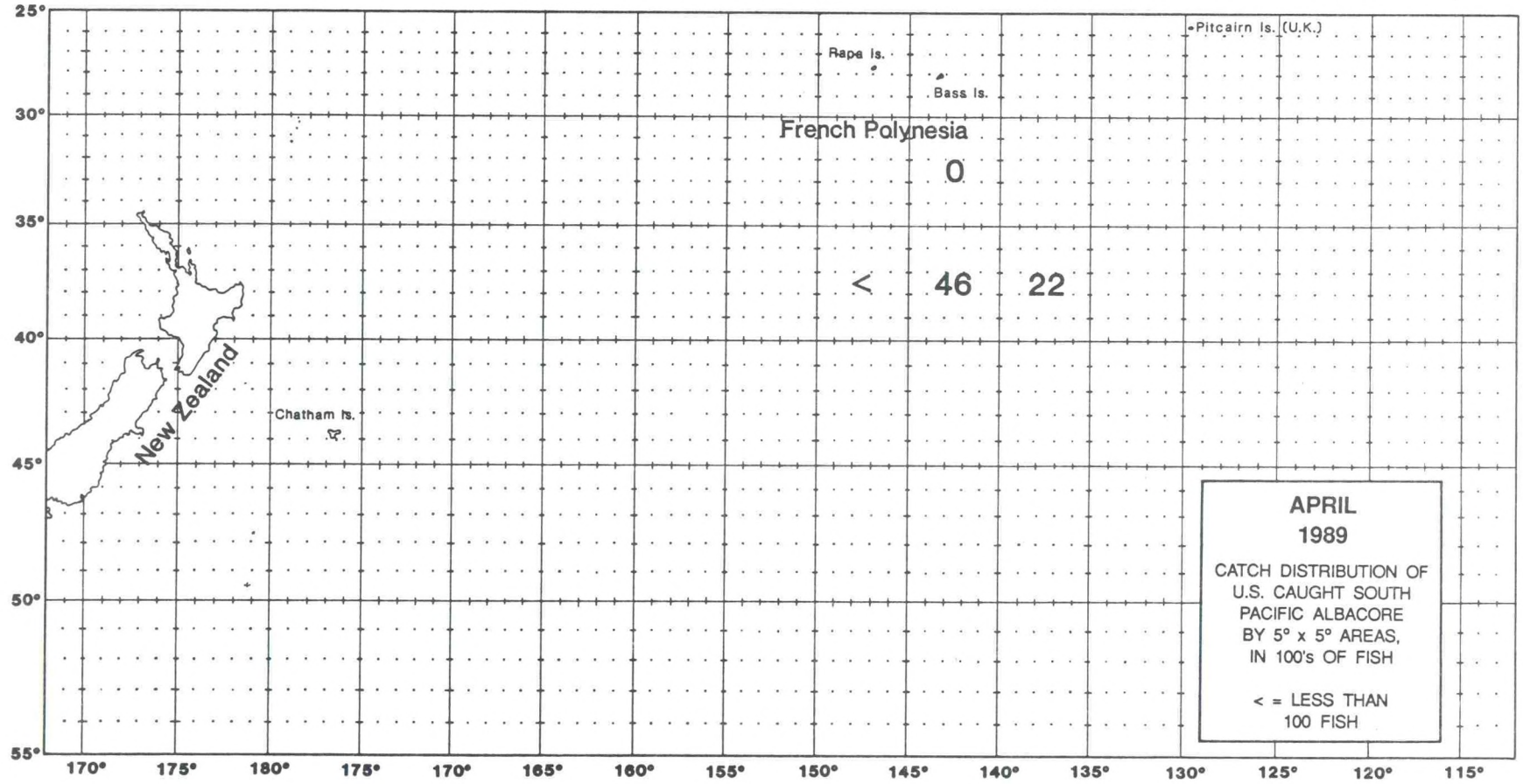

Figure 3e. Albacore catch (numbers of fish) by jigboats by 5^{o} quadrangle in the south Pacific, April 1989.

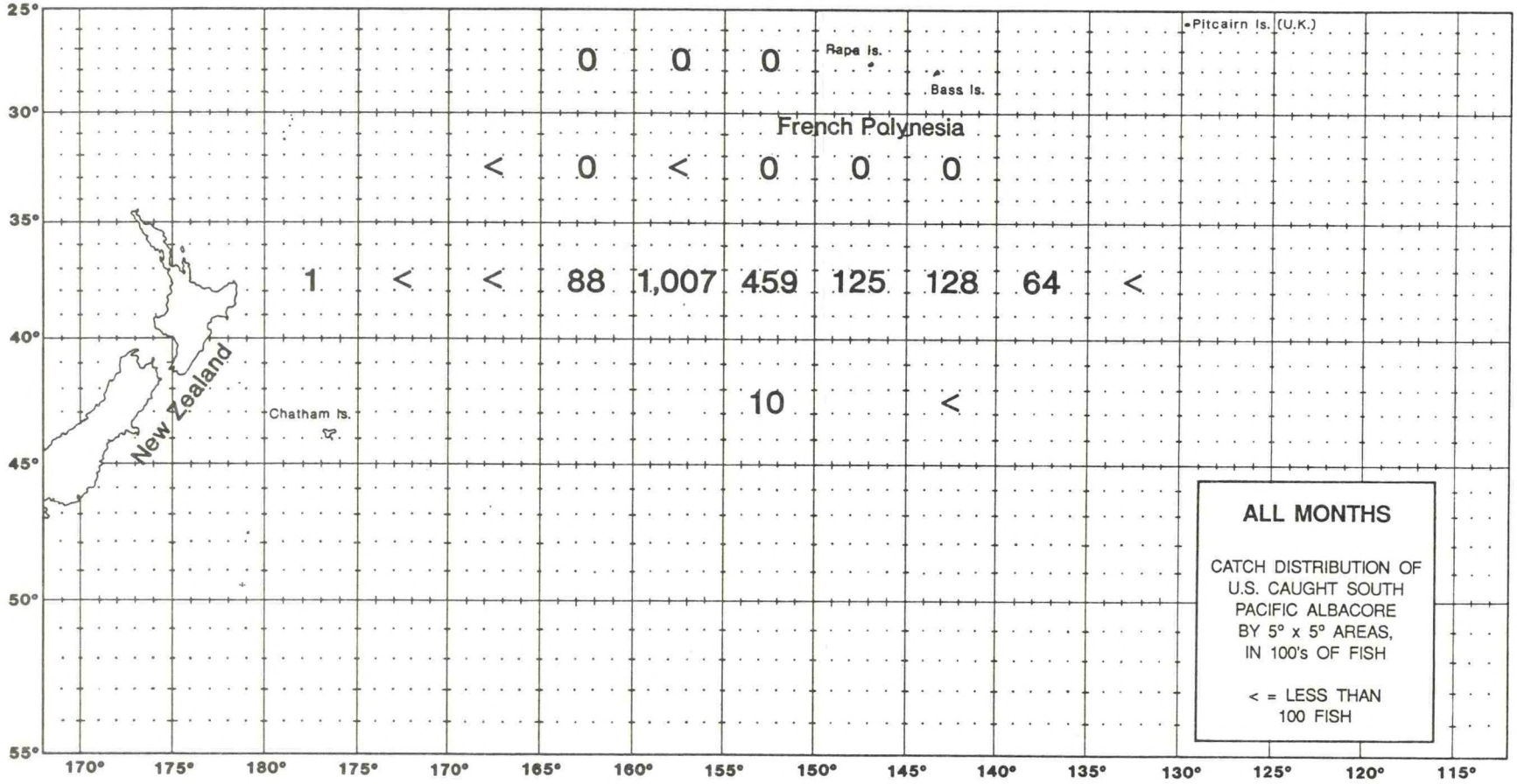

Figure 3f. Annual albacore catch (numbers of fish) by jigboats by 5° quadrangle in the south Pacific, 1988-89.

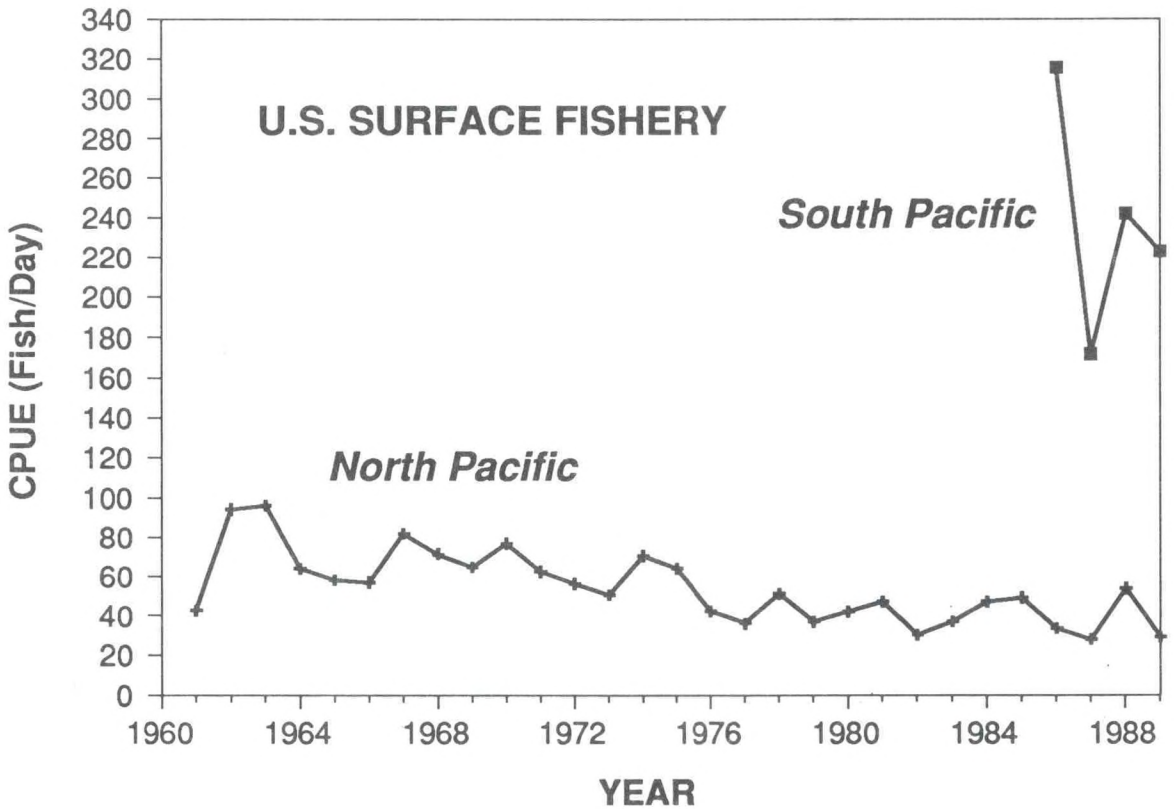

Figure 4. U.S. north and south Pacific albacore catch-per-effort, 1961 - 1989.

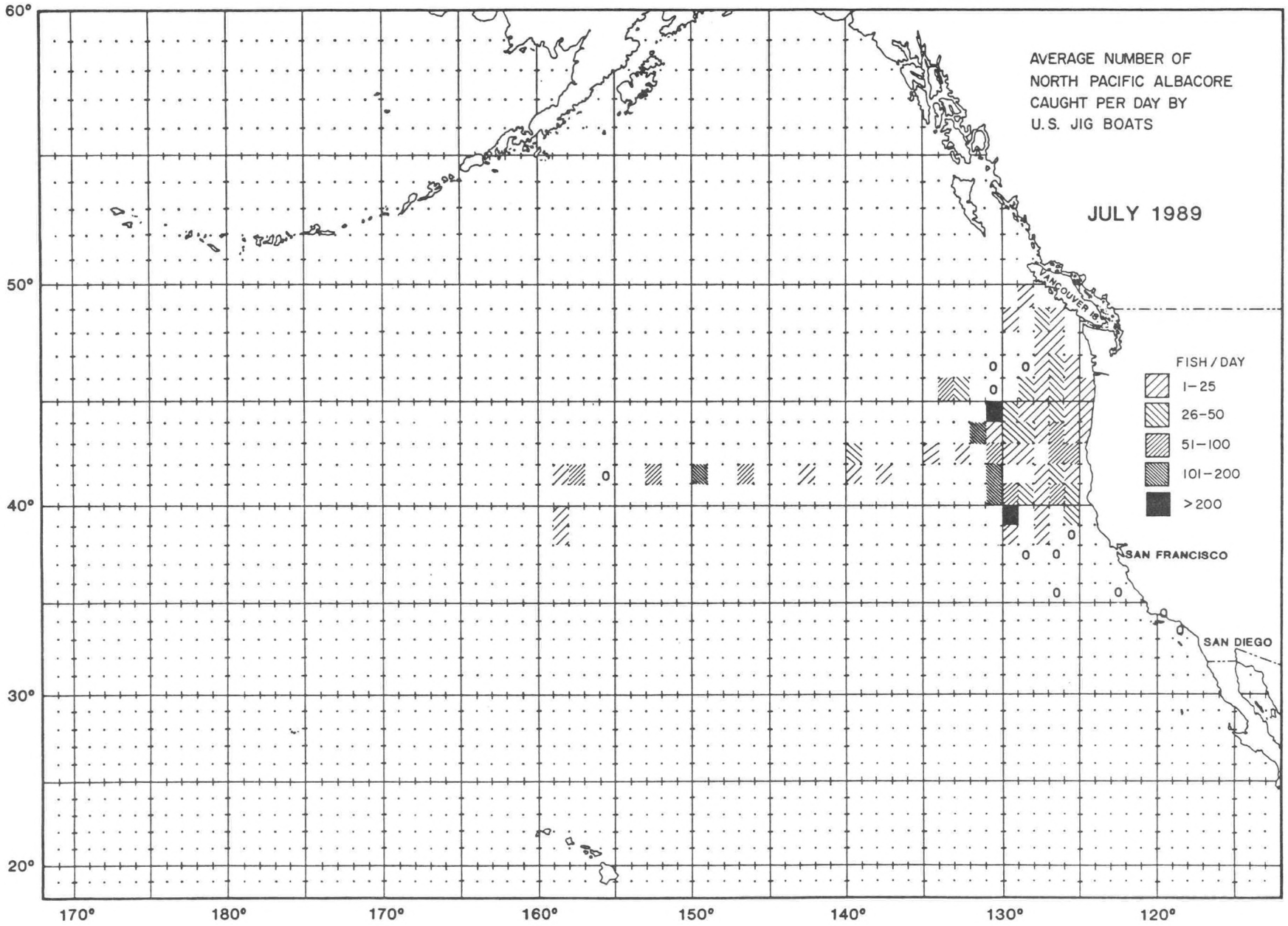

Figure 5a. Jigboat catch-per-standard-day of fishing by 1^{o} quadrangle for July, 1989.

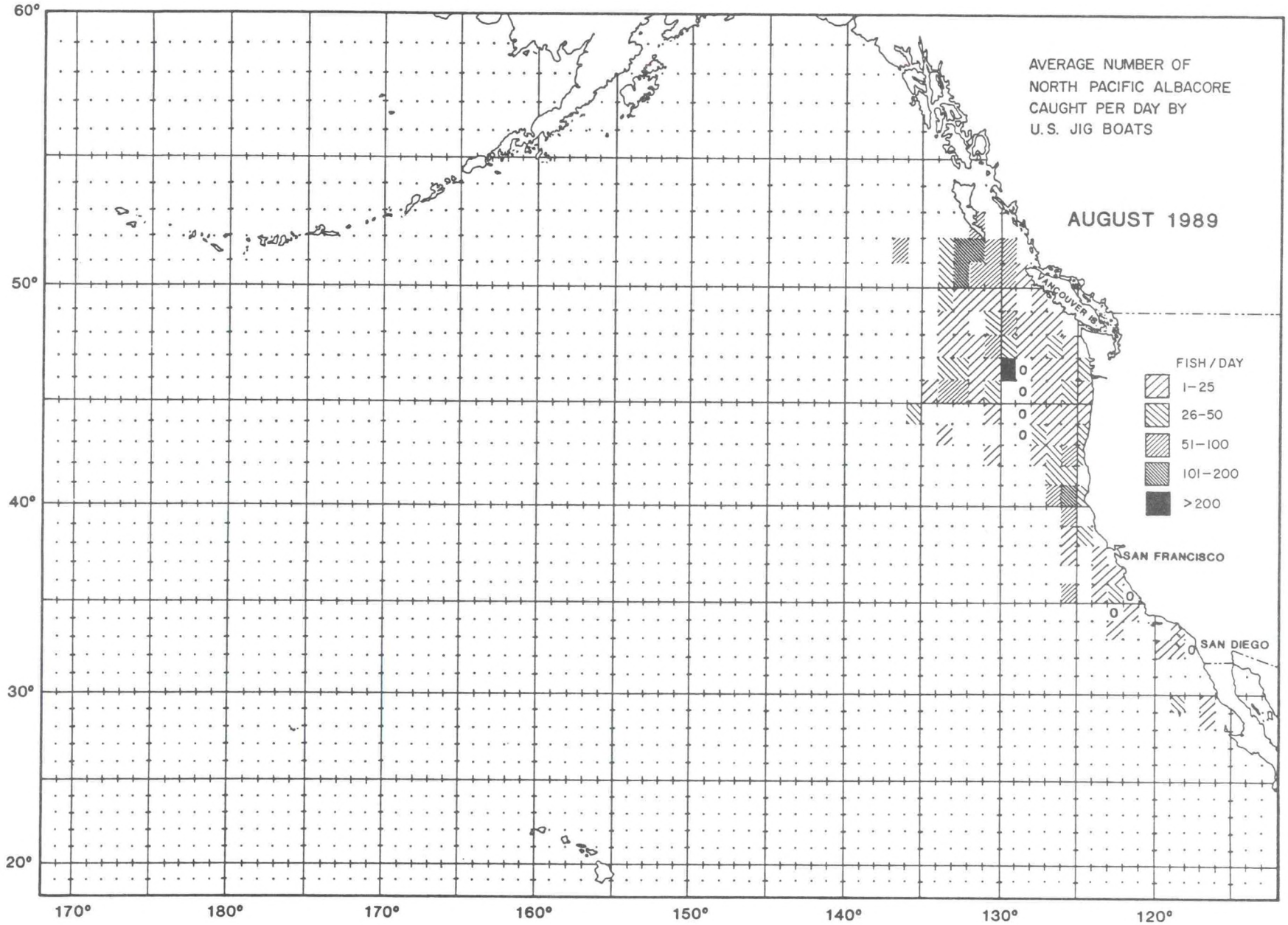

Figure 5b. Jigboat catch-per-standard-day of fishing by 1^{o} quadrangle for August, 1989.

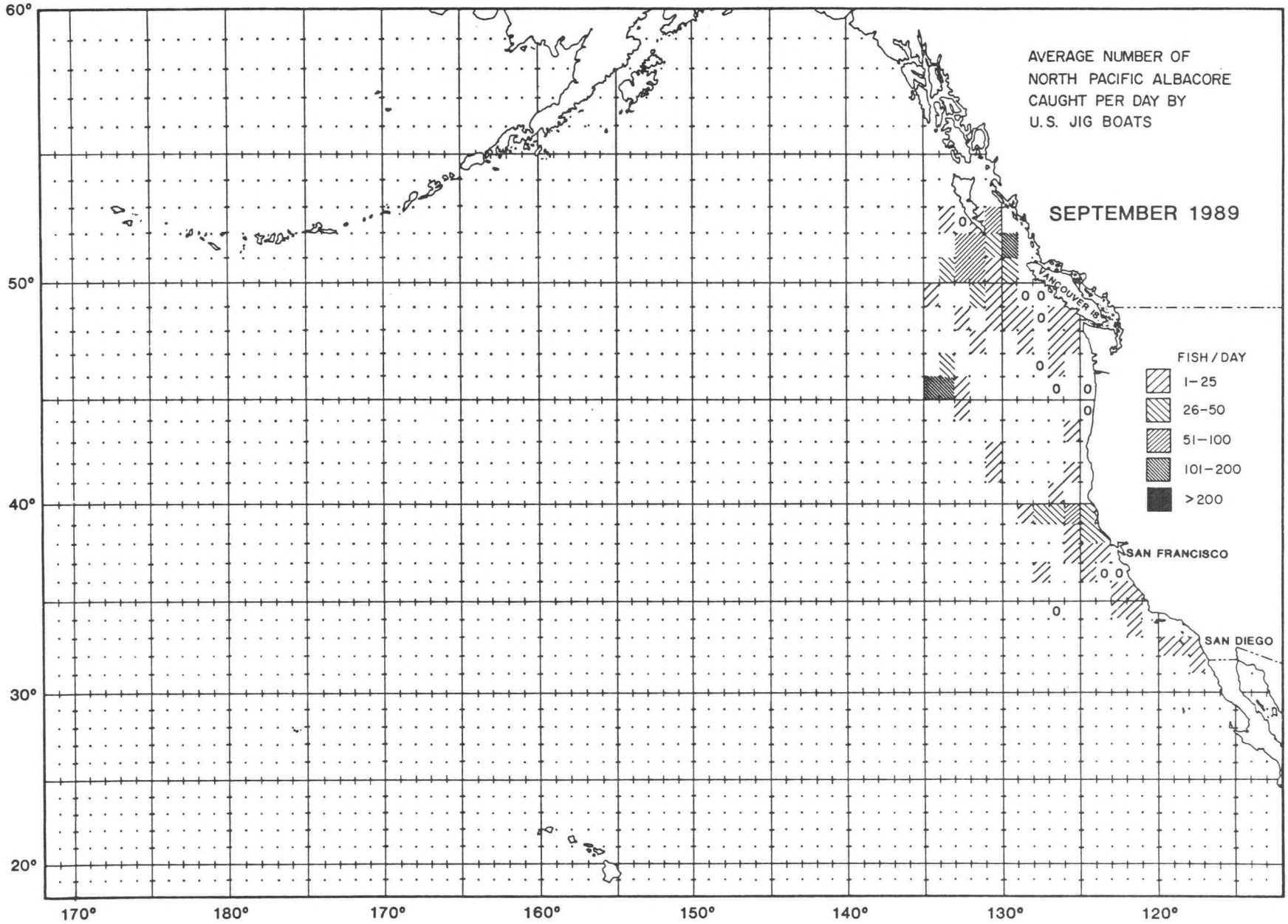

Figure 5c. Jigboat catch-per-standard-day of fishing by 1^{o} quadrangle for September, 1989.

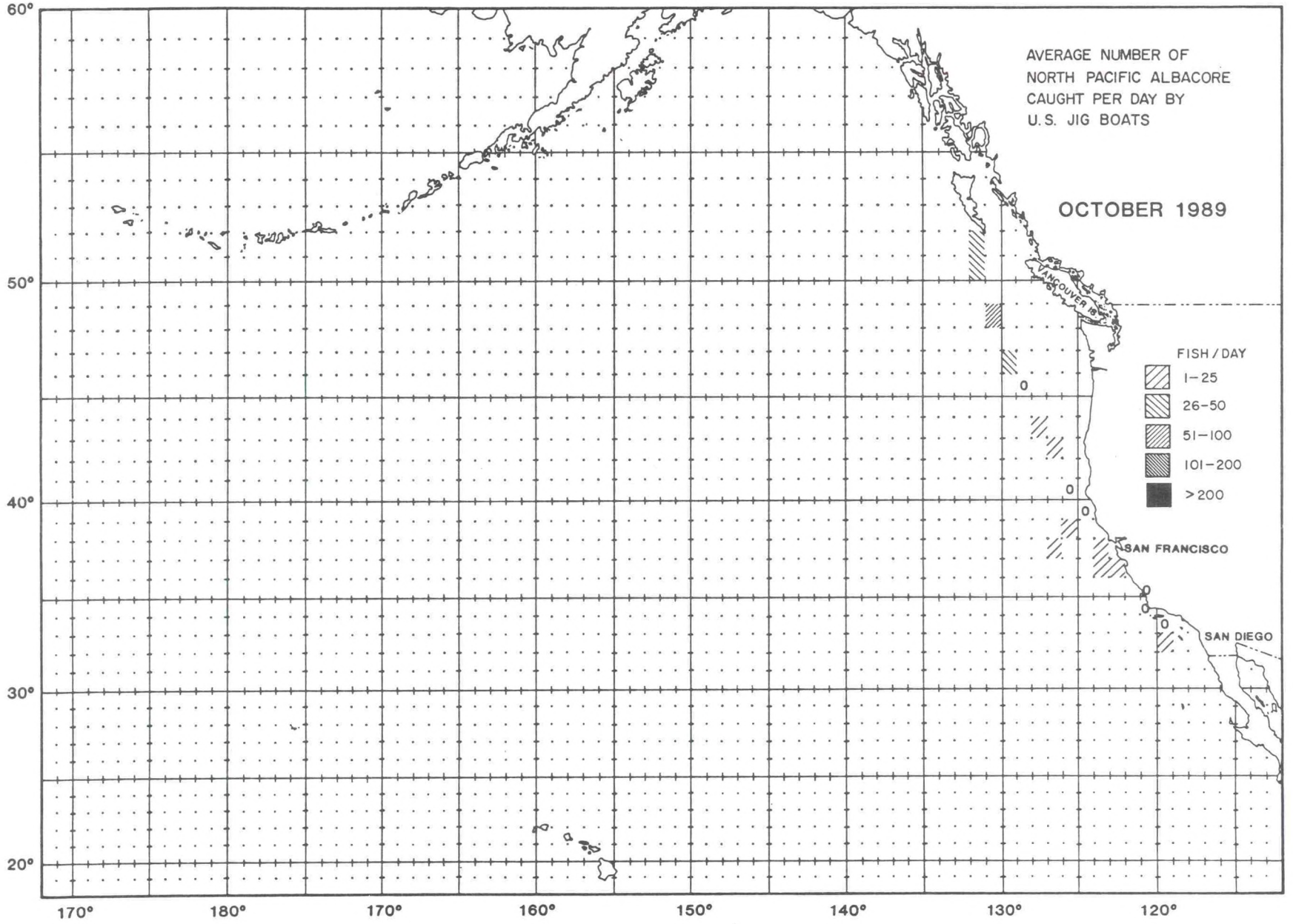

Figure 5d. Jigboat catch-per-standard-day of fishing by 1^{o} quadrangle for October, 1989.

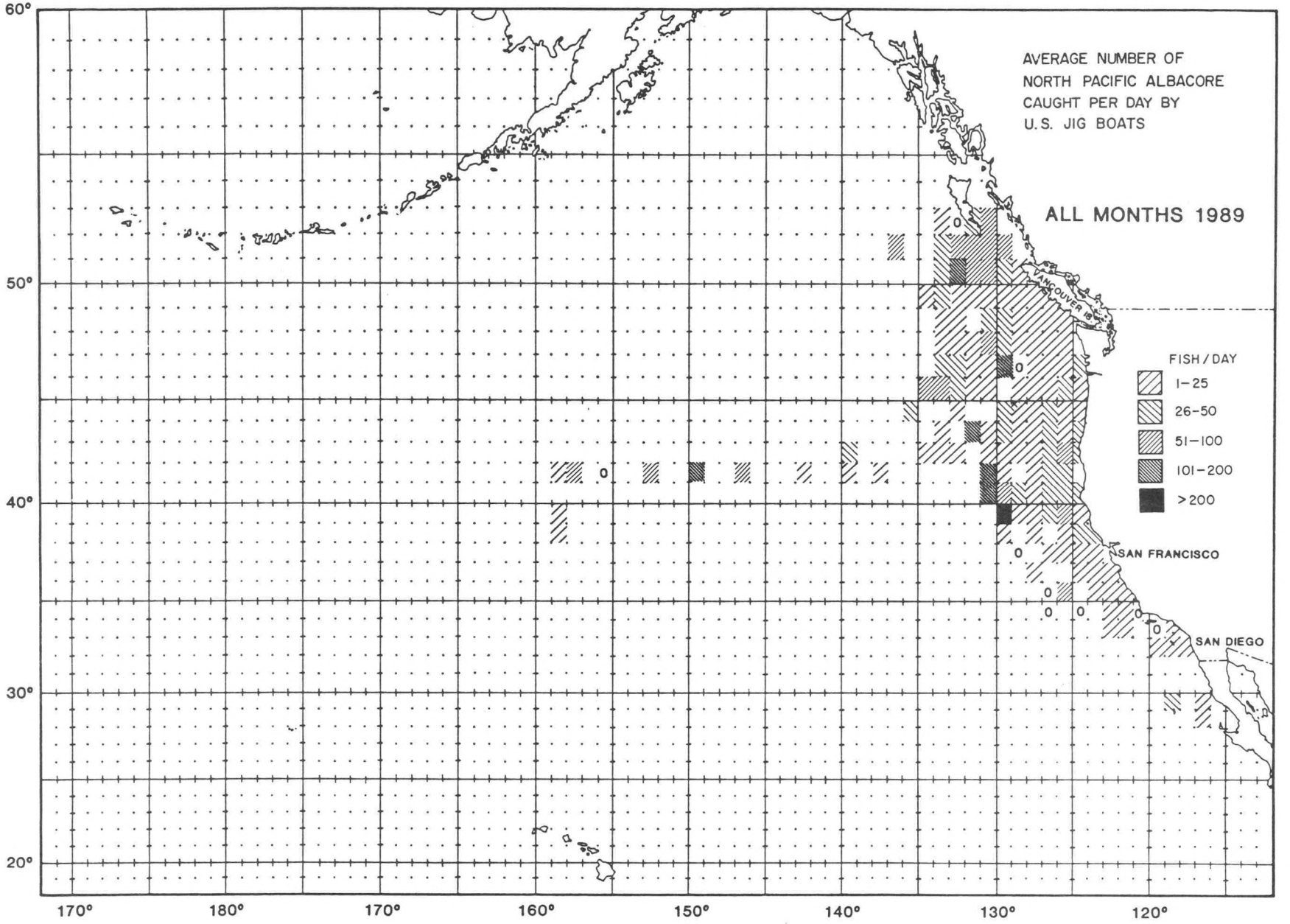

Figure 5e. Jigboat catch-per-standard-day of fishing by 1^{o} quadrangle and year, 1989.

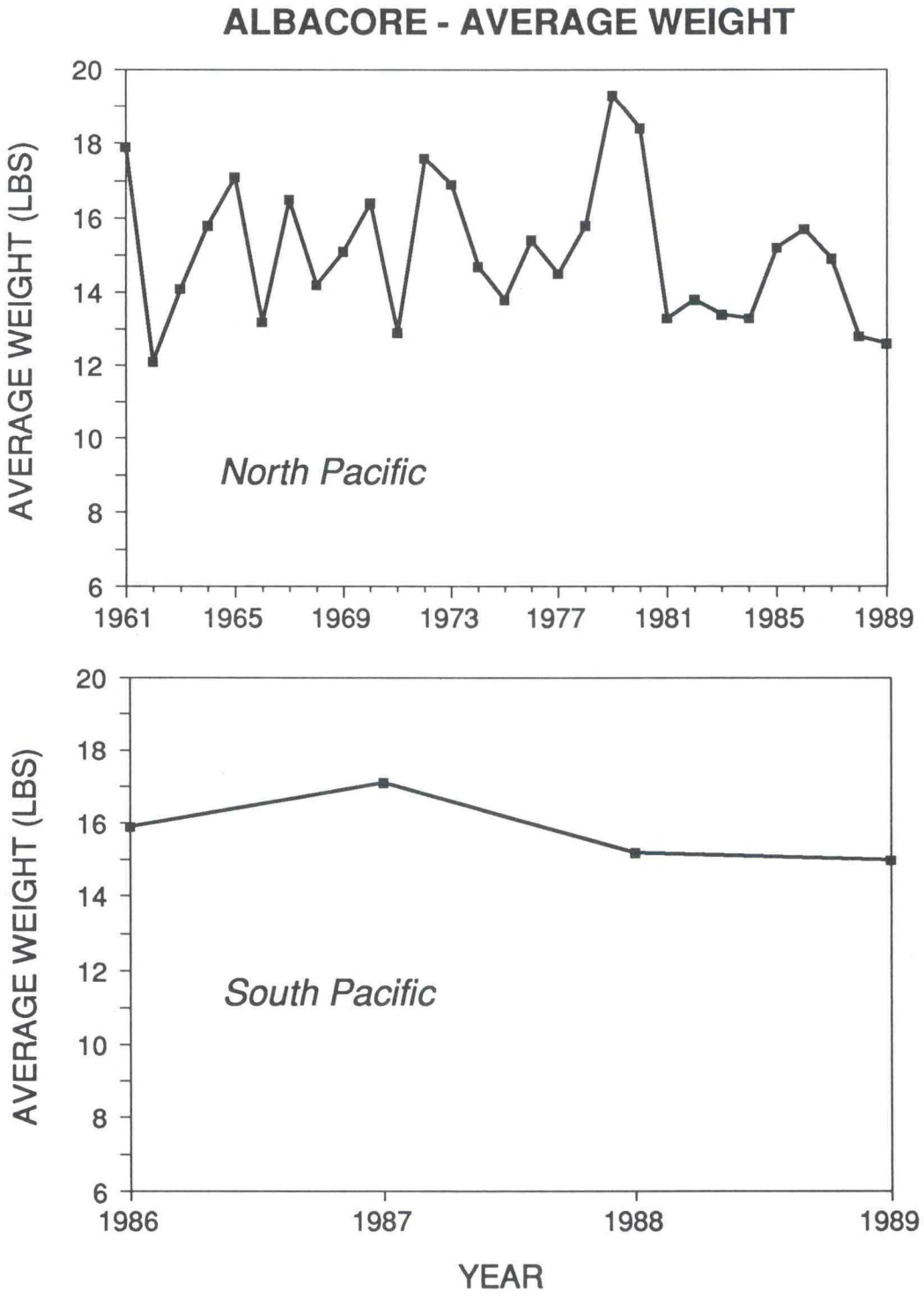

Figure 6. U.S. north and south Pacific albacore average weight (pounds), 1961 - 1989.

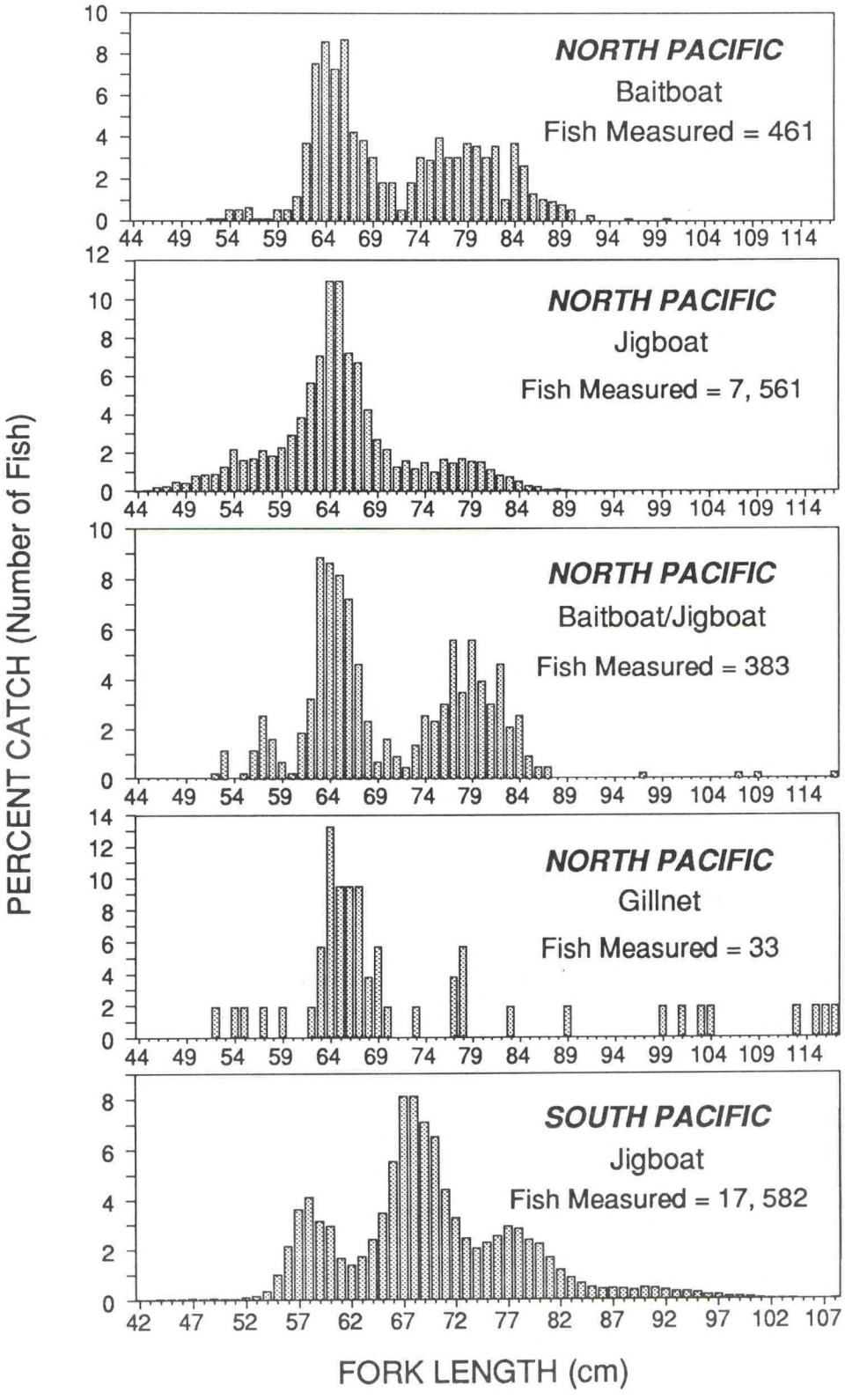

Figure 7. Size compositions of fish caught by the U.S. north and south Pacific albacore fleets in 1988-89 by gear.

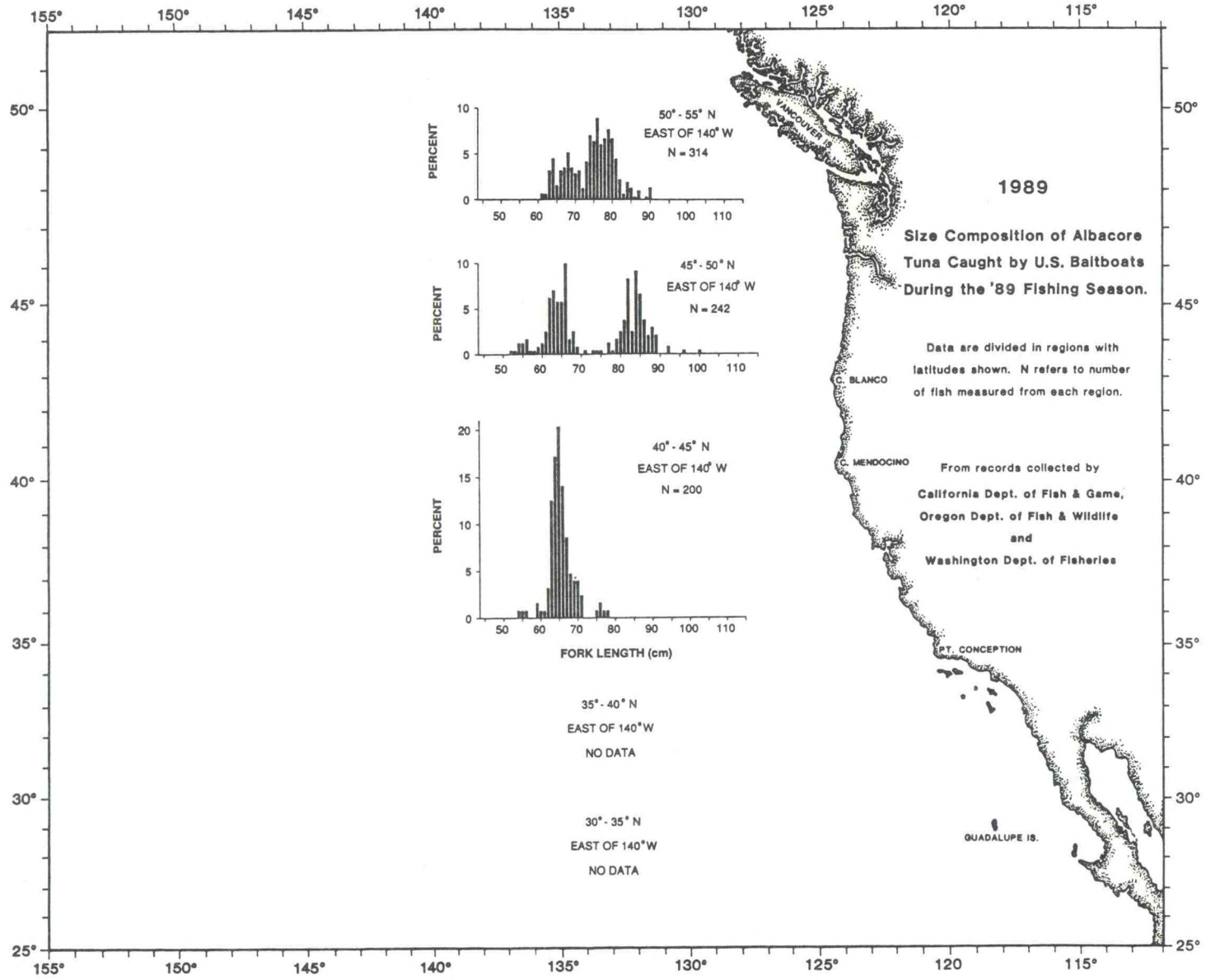

Figure 8a. Length-frequency histograms of albacore caught by the U.S. baitboat fishery in the north Pacific, 1989.

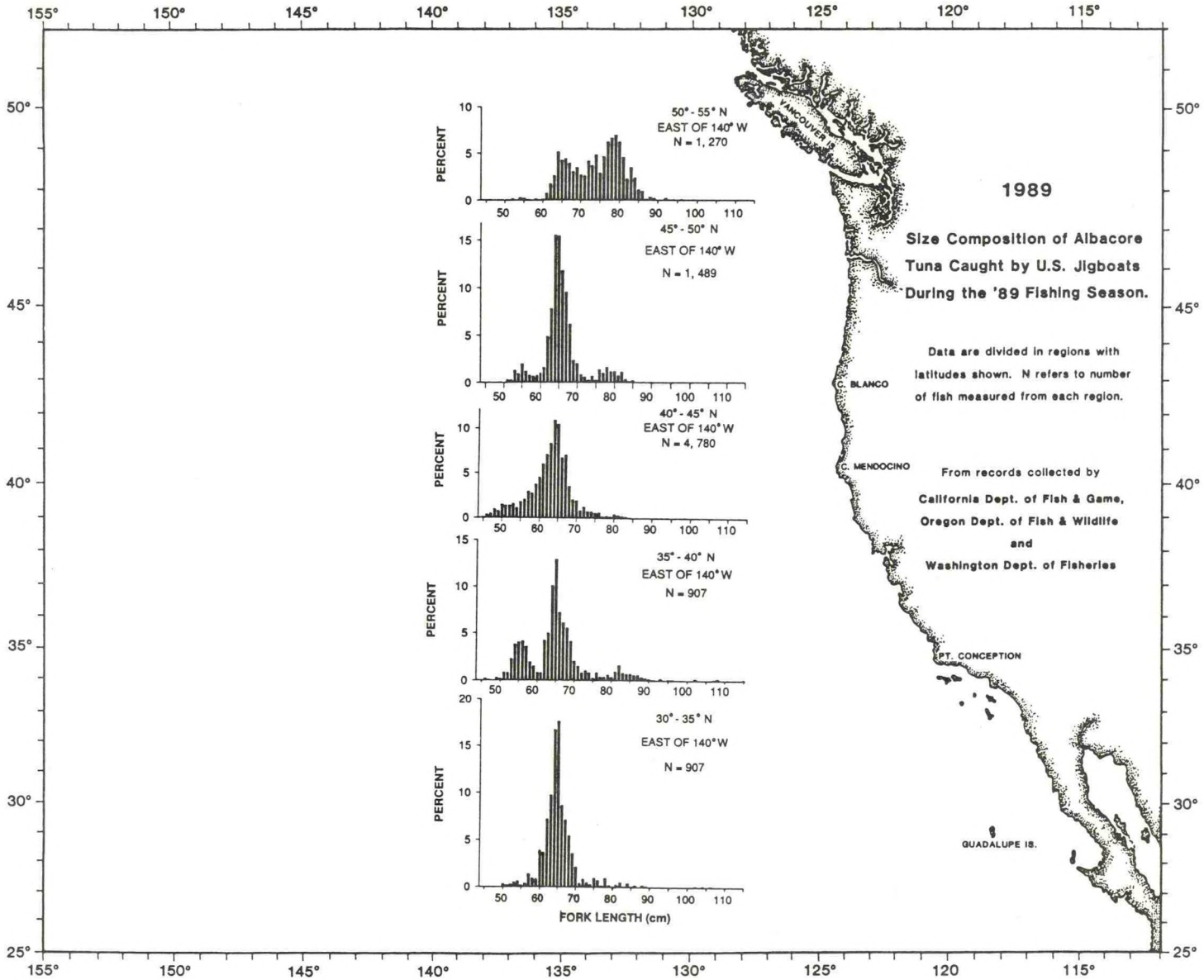

Figure 8b. Length-frequency histograms of albacore caught by the U.S. jigboat fishery in the north Pacific, 1989.

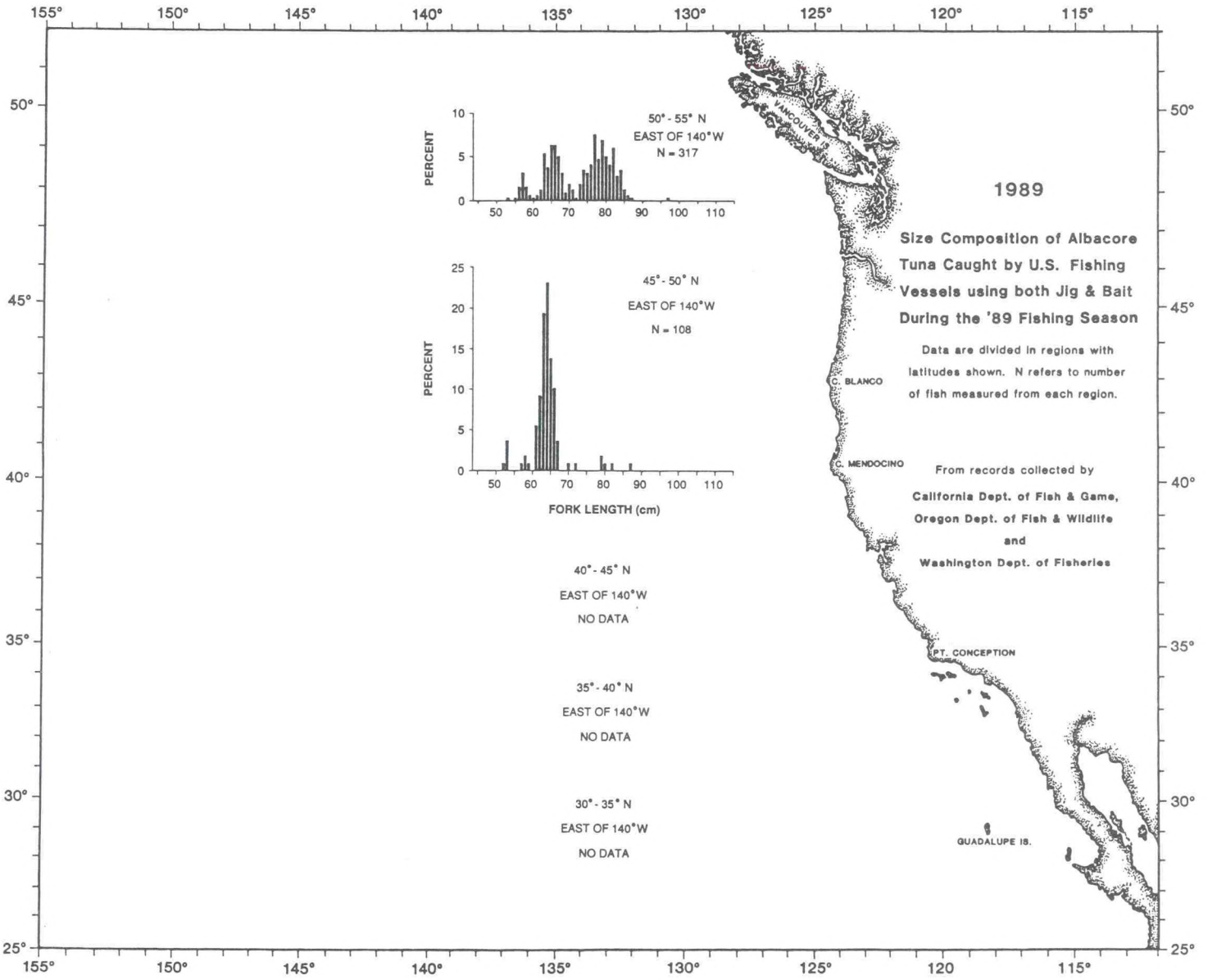

Figure 8c. Length-frequency histograms of albacore caught by vessels using bait and jig in the north Pacific, 1989.

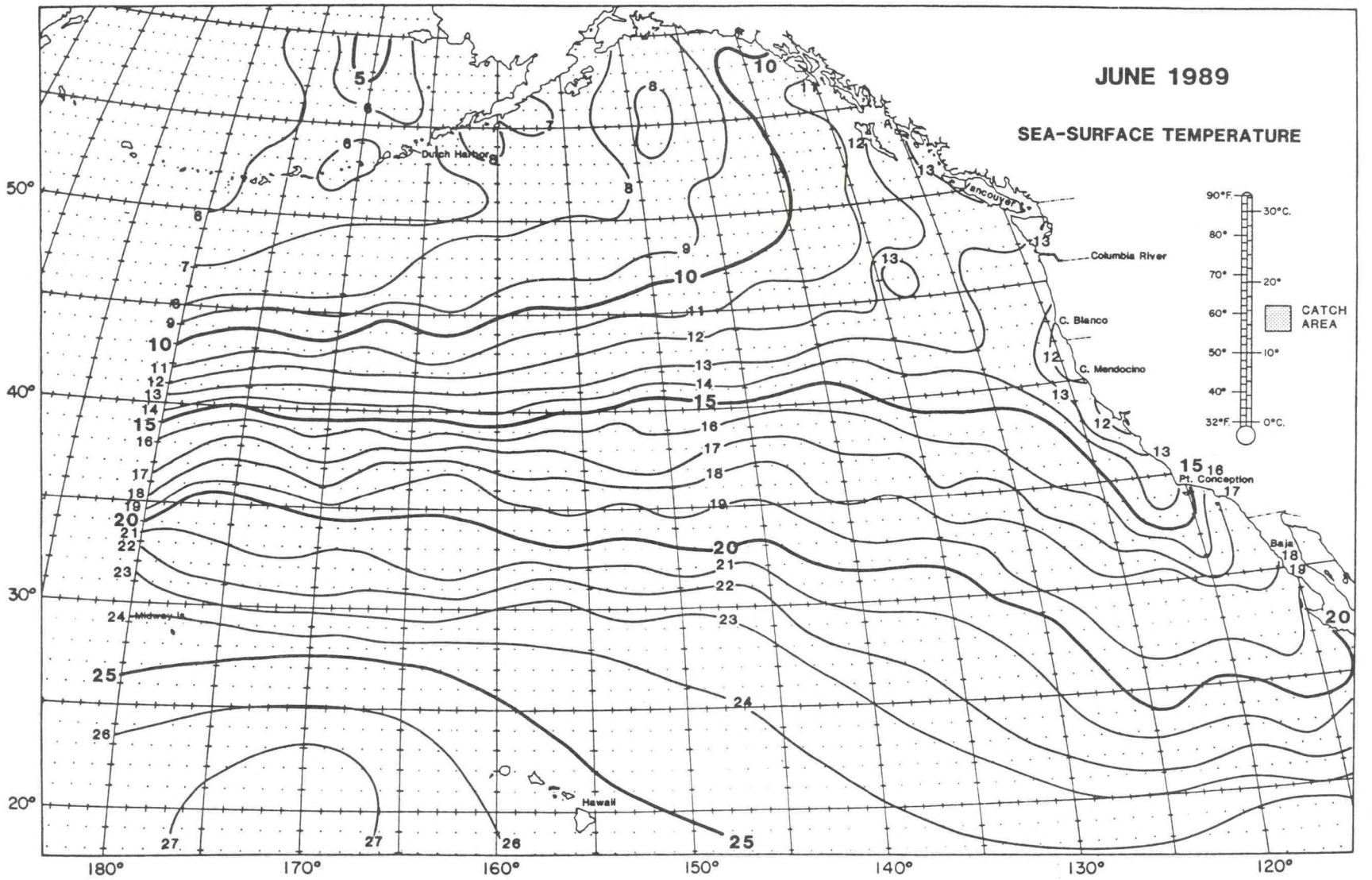

Figure 9a. Average sea-surface temperature (SST) isopleths (°C) and albacore catch area for the north Pacific, June 1989.

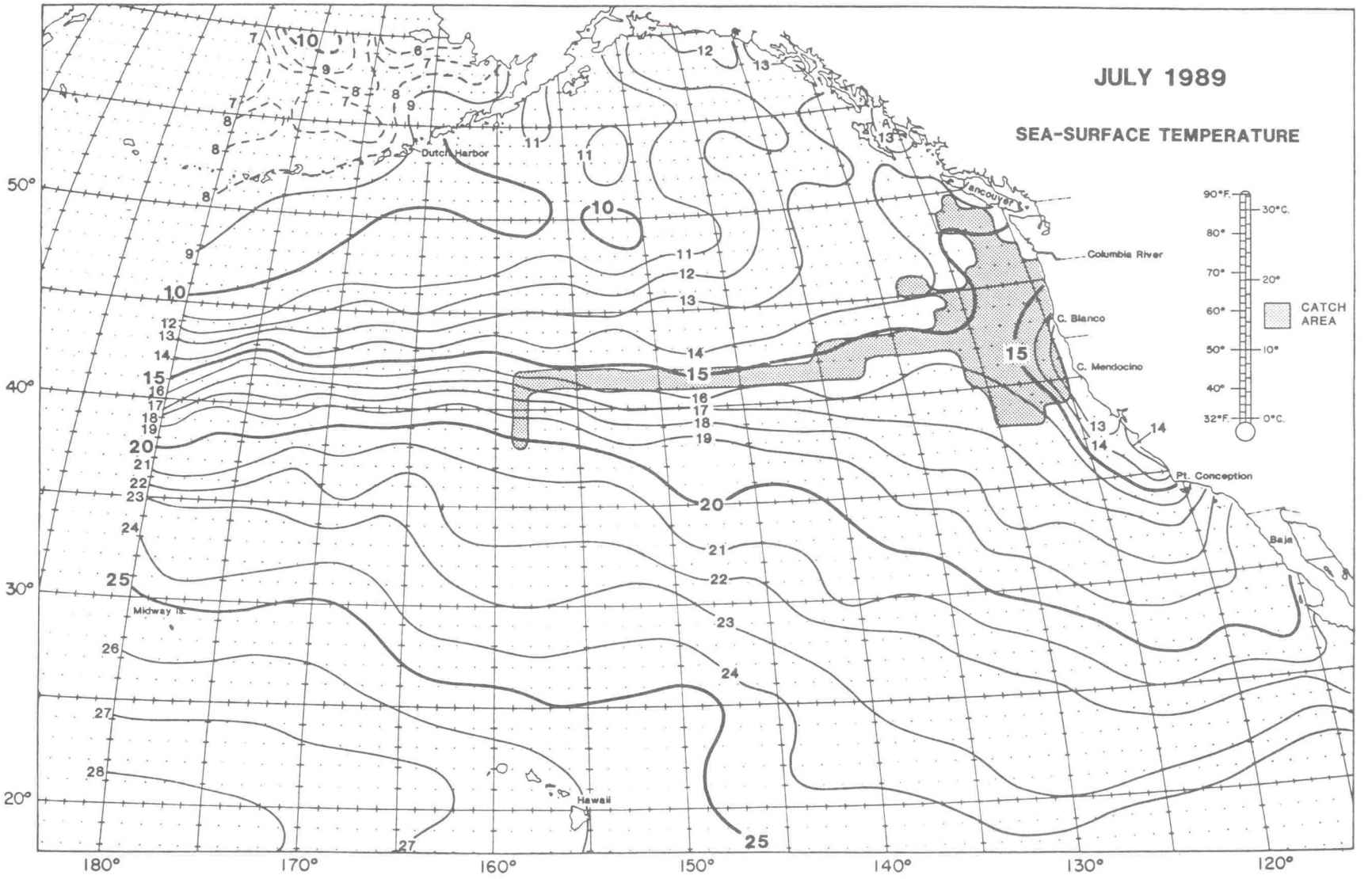

Figure 9b. Average sea-surface temperature (SST) isopleths (°C) and albacore catch area for the north Pacific, July 1989.

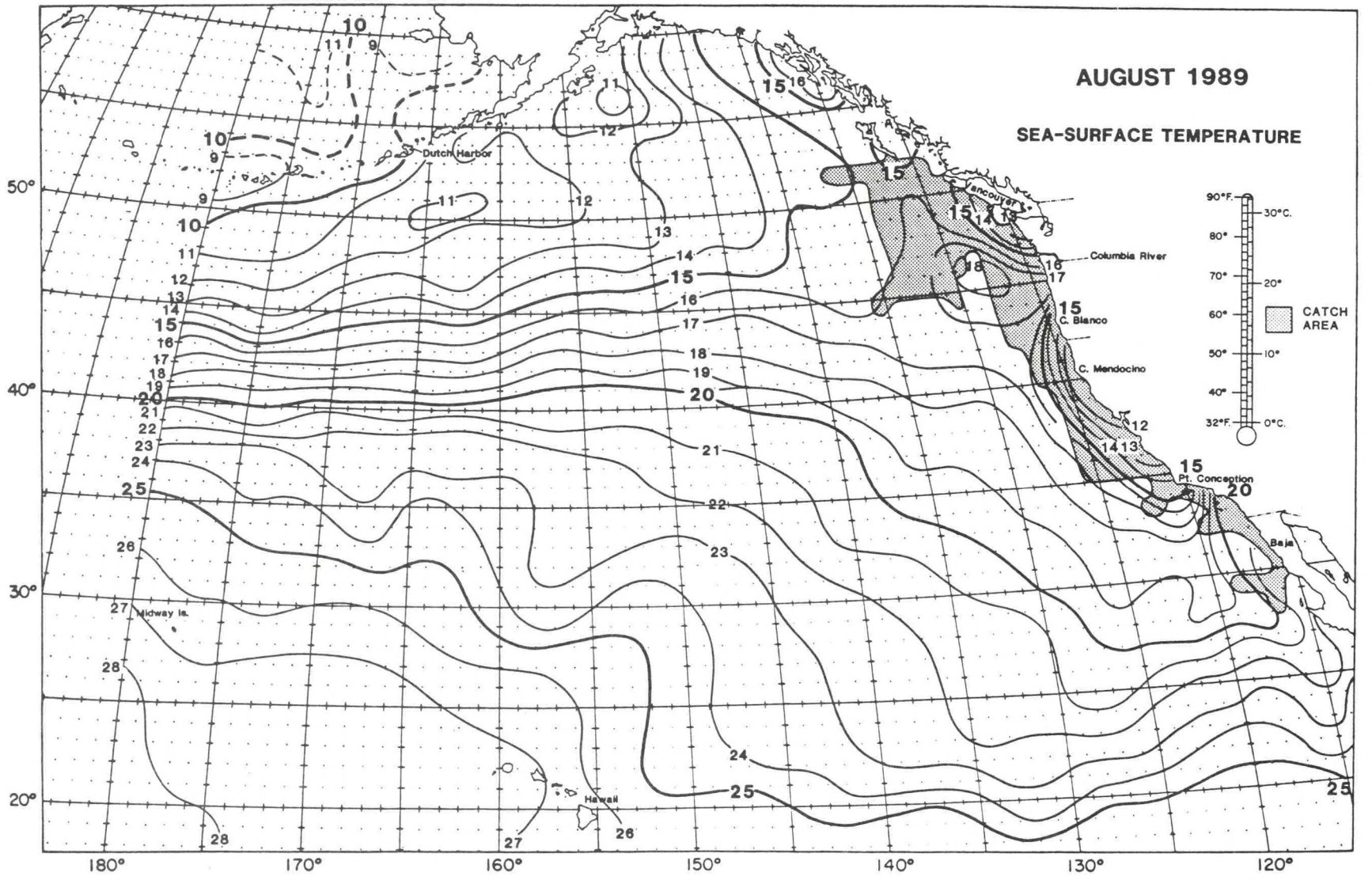

Figure 9c. Average sea-surface temperature (SST) isopleths (^{o}C) and albacore catch area for the north Pacific, August 1989.

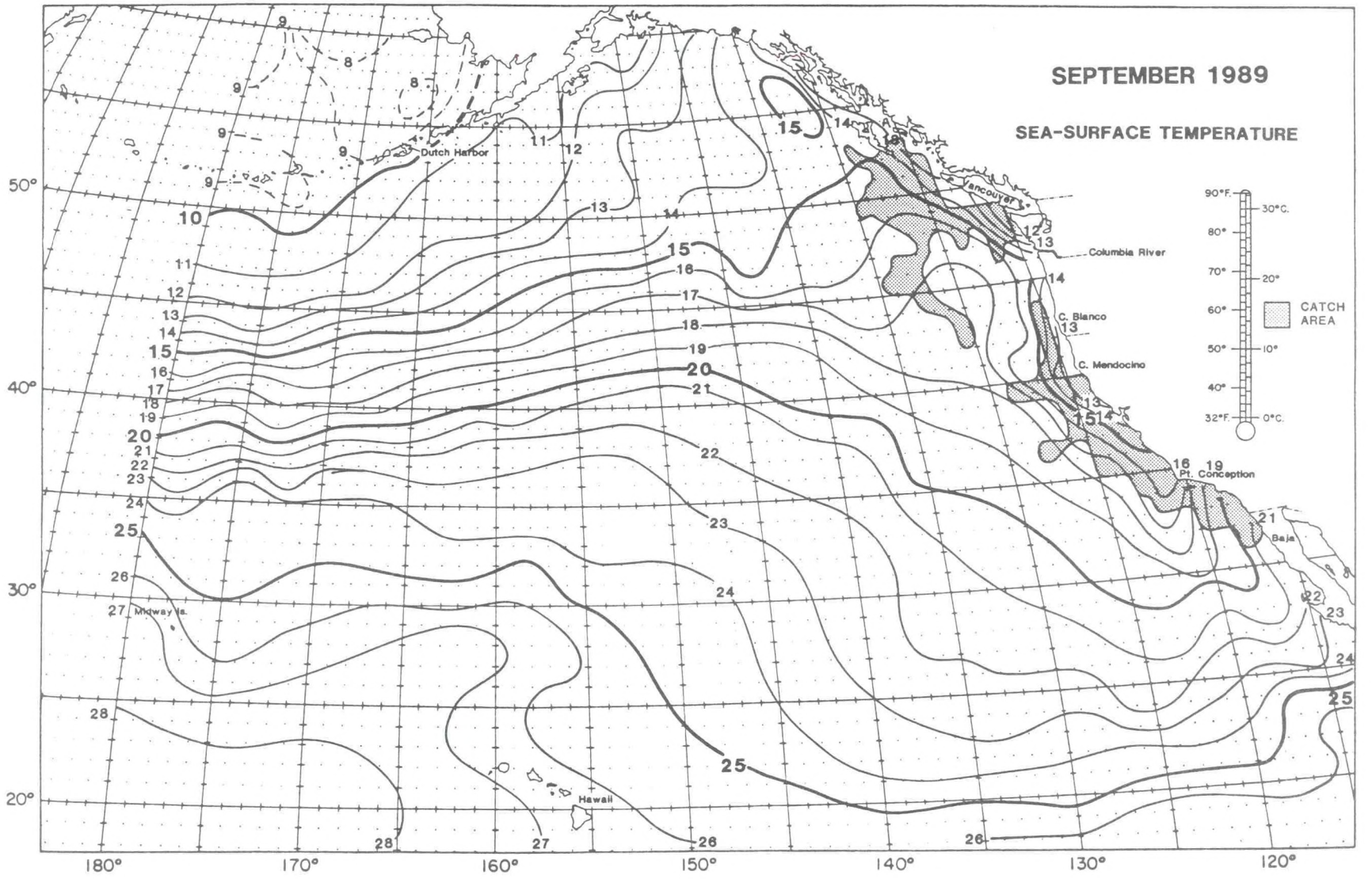

Figure 9d. Average sea-surface temperature (SST) isopleths (°C) and albacore catch area for the north Pacific, September 1989.

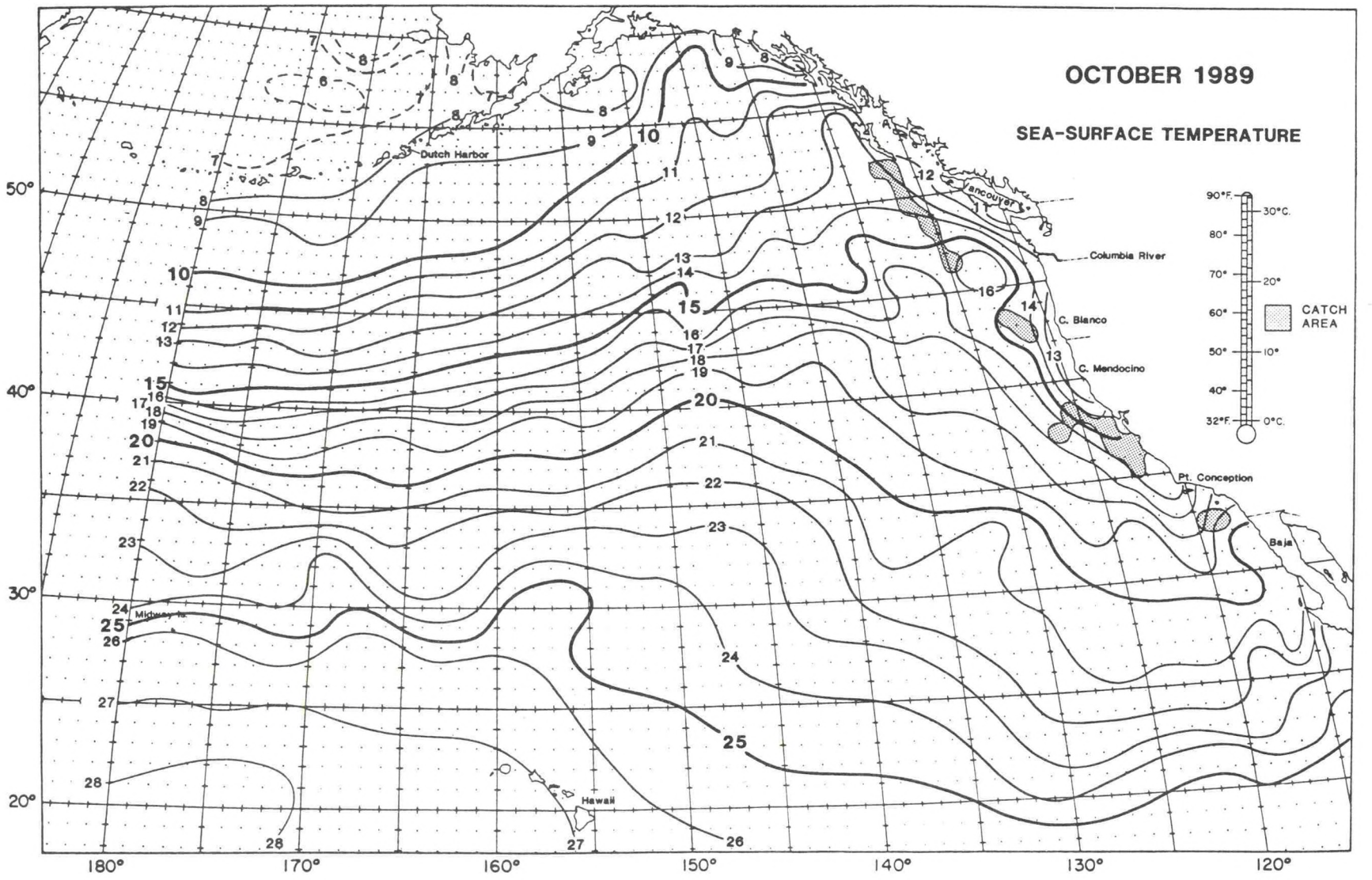

Figure 9e. Average sea-surface temperature (SST) isopleths (^{o}C) and albacore catch area for the north Pacific, October 1989.