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The Resources Agency
DEPARTMENT OF FISH AND GAME

ON BOARD SAMPLING OF THE ROCKFISH AND LINGCOD COMMERCIAL PASSENGER FISHING VESSEL INDUSTRY IN NORTHERN AND CENTRAL CALIFORNIA, MAY 1987 TO DECEMBER 1991

by

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Marine Resources Division

Administrative Report No. 93-4

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ABSTRACT

From May 1987 to June 1990 and from August to December 1991 Fishery Technicians sampled catches on board 690 Commercial Passenger Fishing Vessel (CPFV) trips targeting rockfish and lingcod from the general port areas of Fort Bragg, Bodega Bay, San Francisco, Monterey, and Morro Bay. Data are presented for species composition by port area, year, and month, for catch-per-unit-effort, mean length, and length frequency of lingcod and the 18 most frequently observed rockfish species, and for trends in fishing effort related to fishing time, depth, and distance from port. Total catch estimates are presented based on unadjusted logbook records, logbook records adjusted by sampling data and compliance rates, and effort data from a marine recreational fishing statistics survey.

Average catch of kept fish per angler day was 11.8 and average catch of kept fish per angler hour was 3.7. A trend of an increasing frequency of trips to deep (> 40 fm) locations was observed in the Bodega Bay, San Francisco, and Monterey areas from 1988 to 1990-91. No trend was evident relative to trip frequency and distance from port.

A total of 74 species was observed caught during the study. Rockfishes comprised 88.5% to 97.9% by number of the observed catch by port area. The five most frequently observed species were chilipepper, blue, yellowtail, and widow rockfishes, and bocaccio, with lingcod ranking seventh.

In general, mean length and catch-per-angler-hour of sport fishes caught by CPFV anglers varied considerably and did not show steady declines during the study period. However, port-specific areas of major concern were identified for chilipepper, lingcod, and black rockfish, and to a lesser extent brown, canary, vermilion, yelloweye, olive, and widow rockfish. These areas of concern included steadily declining catch rate, steadily declining mean length, and a high percentage of sexually immature fish in the sampled catch.

Recent sampling of the commercial hook-and-line fishery in northern and central California indicated that most species of rockfishes taken by CPFV anglers are also harvested commercially.

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D. VenTresca established and maintained the location numbering system and verified new locations.

R. McAllister contributed to the sampling and database design.

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INTRODUCTION

The Central California Marine Sport Fish Project has been collecting angler catch data from the Commercial Passenger Fishing Vessel (CPFV) industry for several decades in order to assess the status of this valuable recreational fishery. The project has focused on rockfish and lingcod angling and has not sampled salmon trips. Until recently, catch information was obtained on a general port basis from dockside sampling of CPFVs, also called party boats. This did not allow documentation of specific areas of importance to recreational anglers and was not sufficient to assess the status of rockfish populations at specific locations.

Sport anglers and the CPFV industry have expressed serious concern about the decline in the quality of fishing for rockfish and lingcod in central and northern California. Specifically, they believe the sizes of fish have decreased, catch rates have decreased, and that they must travel farther from port to achieve bag limits of quality (i.e. large) fish. Declines have been attributed in part to commercial fishing activities at or near locations fished by sport anglers.

CPFV operators are required by law to record total catch and location for all fishing trips in Department-provided logbooks. However, the required information is too general for use in assessing the status of the multi-species rockfish complex on a reef-by-reef basis. Many rockfishes tend to be residential, underscoring the need for site-specific data. Rockfish catch data are not reported by species and

information on location is only requested by block number (a block is an area of 100 square miles). Thus, there is a strong need to collect catch information on board CPFVs at sea.

In May 1987 the Central California Marine Sport Fish Project began on board sampling of the CPFV fleet. Data collection continued until June 1990, when state budgetary constraints precluded further sampling, resumed in August 1991 and continues at present. The program depends on the voluntary cooperation of CPFV owners and operators.

This report presents information on catch composition, angler effort, catch per unit effort, mean length, and length frequencies of nearshore sport fishes by port and year for the 1987-1991 sampling period. Location of specific fishing sites will not be identified due to their confidentiality. Total catch and effort estimates are made based on adjustments of logbook data by sampling information, and trends in catch composition and length frequency for selected species are discussed.

METHODS

Study Area

Angler catches on board central and northern California CPFVs were sampled from 12 ports, ranging from Fort Bragg in the north to Port San Luis (Avila Beach) in the south (Figure 1). In 1987 the program began in the Santa Cruz-Monterey area and was subsequently expanded to other ports. Data were

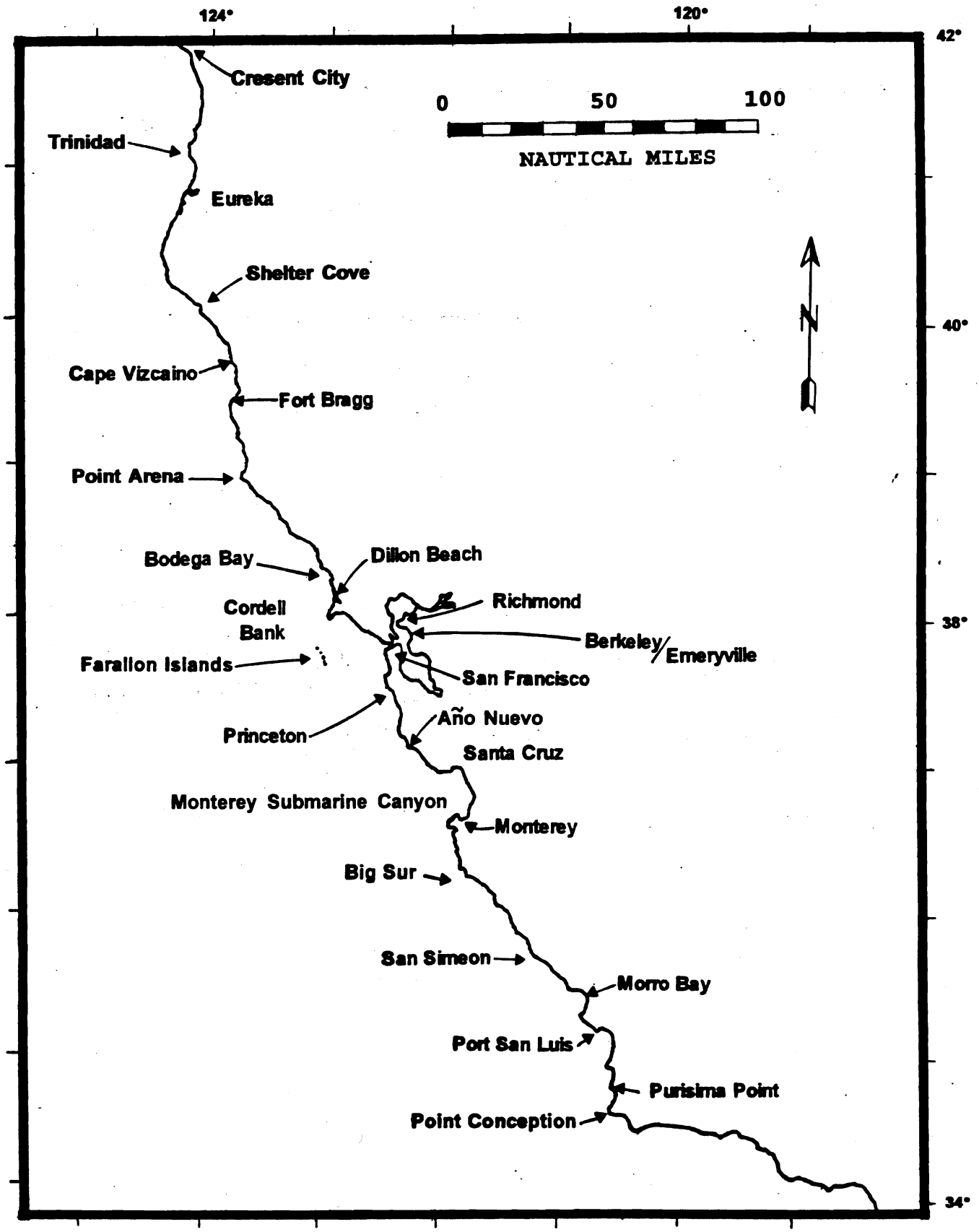

Figure 1. CPFV sampling area in central and northern California.

collected at fishing locations ranging from Cape Vizcaino (ca. lat. 39°45'N) to Purisima Point (ca. lat. 34°45'N), a distance of approximately 300 naut. mi., and out to 150 fm. Fishery Technicians, hired under contract with the Pacific States Marine Fisheries Commission (PSMFC), conducted all on board sampling of catches. They were assigned to the following port groups: 1) Fort Bragg (FB); 2) Bodega Bay and Dillon Beach (BB); 3) Princeton (Half Moon Bay), Berkeley, Emeryville, and Richmond (SF); 4) Santa Cruz and Monterey (MT); 5) San Simeon, Morro Bay, and Port San Luis (MB).

Description of CPFV Fleet

CPFVs targeting on rockfish and lingcod ranged in length from 26 to 102 ft and passenger capacity ranged from 6 to 120 persons (average capacity 44 persons). The number of CPFVs per port ranged from 1 to 12. Approximately 55 CPFVs regularly fished for rockfish and lingcod in central and northern California during the sampling period, although many of these conducted trips infrequently. Trips were usually one half or one full day, the latter typically departing at 0700 and returning by 1600. One vessel out of Morro Bay occasionally operated a 2- or 3-day trip on weekends.

Trip Selection

Trips were selected by Technicians on a random basis from a complete list of rockfish/lingcod CPFVs for each port group. Party boat operators were telephoned and asked if a trip was

available. If the boat was either unavailable or full to capacity, or if the Technician was refused passage, successive boats on the list were contacted until a trip was secured. Targeted sample size for each Technician was one trip for each successive 3-day block in a month, or approximately 10 trips per month. Primarily due to weather constraints and unavailability of trips, this sample size was seldom achieved. Our overall goal was to sample 5-10% of all trips. However, there were additional constraints on weekend and charter trips (often full and unavailable for on board sampling).

Sampling Procedures

Technicians were initially trained in marine fish species identification. Each Technician was equipped with foul weather gear, gloves, clipboard, waterproof data sheets, fish length measuring board, lead pencils, and field guides to California marine fishes. Three basic forms were used for data collection: trip form (Appendix A); species count form (Appendix B); length form (Appendix C). At the start of each trip, the Technician asked the vessel operator for the number of paid and free anglers (the latter was increased if the captain and/or deck hand fished during the trip). Department of Fish and Game vessel number, port code, departure time, type of fishing trip (offshore, nearshore, surface, bottom, mix), and type of fishing tackle used were recorded on the trip form.

When the vessel arrived at a fishing location, the

Technician recorded depth in fathoms, and either latitude and longitude, LORAN coordinates, or land bearings, and the time when fishing lines were lowered. When the last fishing line was raised, time and depth were again recorded and the process was repeated throughout the day. New location coordinates were obtained only when the Technician determined that the vessel had moved to a different location, as defined under 'Shoreside Data Processing'.

At the first fishing location, the Technician chose a reasonable number of anglers to observe throughout the trip and recorded this number (usually less than 20). In most cases, this was less than the total number of anglers. To avoid sample bias, Technicians were careful not to influence the fishing activity of observed anglers by advising them of catch regulations only when asked. Using the species count form, the Technician then identified and counted each fish caught by all observed anglers. If a fish could not be identified to species, it was recorded as "unknown", or to the lowest taxon possible. The ultimate fate of each observed fish was recorded as either kept, released, or used as bait. If the fish was released, the Technician attempted to determine if it survived or died (in the latter case, it was usually consumed by a pelican or gulls). If the fate of a released fish could not be determined, it was recorded as "fate unknown". The combined catch by species for all observed anglers was recorded on one data sheet; individual catches per angler were not recorded.

All observed fish were separated by location on the species count form. If the Technician could not determine whether one location was different from a previous one, it was considered to be different until the locations could be compared using nautical charts.

When fishing had ceased for the day, the Technician then measured total length (TL) in mm of as many observed kept fishes as possible by marking the length of each fish on a plastic measuring board, keeping all species separated. Not all observed kept fishwes were measured due to refusal of an angler to have his catch examined or to early filleting by the deck hand. When time permitted, fishes caught by unobserved anglers also were measured. The total number of kept fishes measured often did not equal the total number of kept fishes observed.

Miscellaneous data were recorded on reproductive condition of fishes, weather and sea conditions, commercial fishing activity in the area, and sightings of marine birds and mammals.

Shoreside Data Processing

All fish measurements on the measuring board were determined to the nearest mm and transferred to the length data form by species.

Confidential codes were assigned to each unique fishing location after plotting the location on a nautical chart. Unique fishing locations were defined as circular areas

separated from other locations by a minimum distance based on depth. For depths less than 20 fm, location centers were no closer than 0.5 naut. mi. to other locations. For depths between 20 and 40 fm, location centers were no closer than 1.0 naut. mi. to each other. For depths greater than 40 fm, location centers were no closer than 2.0 naut. mi. to each other.

Data Entry and Analysis

Data were entered into dBASE databases by Technicians using dBASE or C programs. Technicians then edited their own data and project biologists checked the edits. Data were then transferred to the Monterey office where summaries and graphical displays were produced using dBASE, Lotus 123, and Sigma Plot software programs. Statistical analyses of species composition, catch rates, and length frequency data will be presented in a susbequent administrative report.

Catch Per Angler Day and Catch Per Angler Hour

Catch per angler day (CPAD) is the average catch per angler per day for one or more port areas or years. Catch per angler hour (CPAH), also an average, was calculated by adding the products of the number of observed anglers and the fishing time in hours on each trip and dividing this into the total number of fish caught, for one or more port areas, months, years, or fishing locations. This standardized the catch rate by weighting fishing time and number of anglers in order to

compare angler success.

Mean Length and Catch Per Angler Hour by Location

In order to compare mean length, CPAD, and CPAH of selected sport fishes relative to distance from port and depth, fishing locations were defined as either "near" or "distant", or "shallow", "mixed", or "deep". Near locations were defined as having the location center less than or equal to 10 naut. mi. from any sampled port. Distant locations were defined as having the location center greater than 10 naut. mi. from all sampled ports. This partitioning was based on a tagging study by Miller and Geibel (1973), in which all tagged fish returned by CPFV anglers were caught within 10 naut. mi. of a port area, indicating low or no utilization of more distant fishing areas.

Shallow and deep fishing locations were defined as ones in which all observed depths during sampling trips were less than or greater than 40 fm, respectively. A mixed location was defined as one in which observed depths were greater than and less than, or exactly equal to, 40 fm during the study period. These criteria also were based on work by Miller and Geibel (1973), who reported a change in rockfish species composition north of Point Arguello (lat. 34°35'N) at approximately 240 ft (40 fm).

Mean length and CPAH by port and year for samples of less than 20 fish are presented in tables but will not be discussed.

Length Frequency Histograms

Length frequency histograms are presented for lingcod and the 18 most frequently observed rockfish species, by port area and year, for samples of at least 20 fish. Total length intervals of either 5 or 10 mm are used, based on the maximum total length of the species, with the upper bound of every fifth or tenth interval labeled on the X axis (i.e. 150 = 146-150 mm TL). One exception to this was for lingcod, where the 551- to 560-mm interval was partitioned into a 551- to 558-mm interval (less than minimum legal size) and a 559- to 560-mm interval; the latter was combined with the 561- to 570-mm interval.

Estimated Total Catch and Effort

CPFV log data were obtained from the California Department of Fish and Game's (CDFG) mainframe computer for the years 1987 through 1991 in order to estimate total catch and effort for all marine sport fish except salmon in northern and central California. Interpretation and summarization of logbook data required several intermediate steps for meaningful comparisons with our sampling data. Logs from salmon trips and trips fishing in the San Francisco Bay estuarine complex were eliminated. We restricted analyses to all northern and central California trips targeting only lingcod or rockfish.

Logbook data did not indicate target species; criteria used to eliminate trips targeting other species (e.g.

sturgeon, striped bass, or salmon) were twofold. First, rockfish or lingcod must have been caught on the trip (virtually eliminating striped bass or sturgeon trips.) Second, if salmon were caught, and the catch of all fish was less than four per angler, the trip was eliminated from the data set. The assumption was that this type of trip was likely targeting salmon rather than rockfish. We feel confident that these criteria were successful in establishing a realistic database.

The logbook data contained a number of multi-day trips taken from the Morro Bay area. To standardize these trips relative to total number of angler days, number of anglers was either doubled or tripled on these trips, depending on whether it was considered a 2- or 3-day trip.

Logbook data initially included all northern and central California ocean and bay ports and were combined into port groups. In general, these port groups corresponded to port groups in this study, with the exception of Crescent City, Eureka, Pt. Arena, Shelter Cove, and Trinidad (Figure 1).

Based on these log data, tables are presented for each year from 1987 through 1991 for northern and central California ports, summarizing the total number of kept fish, rockfish, lingcod, and other fish, total number of angler days, total number of hours fished, and average catch per angler day and per angler hour, based solely on log data.

Additional tables are presented with total estimates adjusted by sampling data for each port area. Correction

factors, based on observed number of anglers and kept fish per angler from sampled trips, were applied to log data from the same trips. Additional adjustments were made based on log compliance ratios. Catch and effort data were each divided by the ratio of the number of observed trips for which logs were submitted to the total number of observed trips for each port area and year. No adjustments were made for the northern California port group, the Fort Bragg area, and the Bodega Bay area in 1990 and 1991 due to insufficient trip sample size. In addition, compliance values were combined for each port area in 1990 and 1991 due to only partial sampling in each year, and an average value was used to adjust catch and effort estimates for those years.

Total catch estimates by port and year for lingcod, the 18 most frequently observed rockfishes, and other rockfishes were made based on adjusted catch estimates of total fish and the proportion of each species from sampling data. An average proportion from the combined 1990-91 samples was applied to the total catch estimates for those years.

A third set of tables, from 1987 to 1989 only, was generated using effort data from recreational fishery telephone surveys conducted by the National Marine Fisheries Service, Marine Recreational Fisheries Statistics Survey (MRFSS), and analyzed by CIC Research, Inc., San Diego, California. Differences in total catch and effort estimates using the above three methods will be discussed.

RESULTS AND DISCUSSION

From May 1987 to June 1990 and from August to December 1991 Technicians sampled 690 CPFV trips (Table 1). Since only partial years were sampled in 1987, 1990, and 1991, any analysis of trends must account for seasonal differences in fishing effort. By combining data from 1990 and 1991, all months are represented except July; comparisons between these combined data and data from 1988 and 1989 will then be meaningful and will be made frequently in this report.

Weekend catch and effort data were under-represented in this study. Only 59 of 690 trips sampled (8.6%) occurred on weekends. Operators of 55 vessels cooperated in the study, with a range of 14 to 36 vessels participating in a particular year. Eleven vessels were sampled more than 20 times each and accounted for 59% of the total sampling effort. Ten CPFVs were sampled in all of the 5 years.

Total Observed Fishing Effort

Technicians observed 9158 anglers, or 73.4% of all anglers fishing on sampled trips. Mean number of observed anglers per sampled trip was 13.3 and ranged from 7.4 in the Fort Bragg area to 16.4 in the San Francisco area. Mean number of total anglers per sampled trip was 18.1.

Total observed fishing time was 2165.2 hr, or an average of 3.14 hr per sampled trip. The San Francisco area had the greatest average fishing time per trip, 3.5 hr, while the Fort Bragg area had the lowest, 2.7 hr (Table 2). For all port

TABLE 1. Summary of Commercial Passenger Fishing Vessel Trips Sampled in Northern and Central California, 1987 to 1991.

Port Area	Number trips sampled	Number anglers observed	Number observed fish		Mean number of fish per angler day		Mean number of fish per angler hour	
			All	Kept	All	Kept	All	Kept
1987								
Monterey	90	1179	16,929	16,376	14.4	13.9	4.7	4.5
1988								
Fort Bragg	3	26	334	328	12.9	12.6	5.9	5.8
Bodega Bay	23	285	3403	3113	11.9	10.9	3.9	3.5
San Francisco	46	797	7883	7492	9.9	9.4	2.8	2.6
Monterey	96	1388	22,353	21,436	16.1	15.4	5.1	4.9
Morro Bay	42	635	4773	4615	7.5	7.3	2.2	2.1
Total	210	3131	38,746	36,984	12.4	11.8	3.7	3.6
1989								
Fort Bragg	3	29	369	346	12.7	11.9	4.8	4.5
Bodega Bay	20	206	2707	2564	13.1	12.4	4.0	3.8
San Francisco	54	887	10,189	9848	11.5	11.1	3.2	3.1
Monterey	98	1421	18,226	17,202	12.8	12.1	4.2	4.0
Morro Bay	55	486	4919	4519	10.1	9.3	3.5	3.2
Total	230	3029	36,410	34,478	12.0	11.4	3.8	3.6
1990								
Fort Bragg	1	11	163	154	14.8	14.0	5.5	5.2
Bodega Bay	1	8	94	90	11.7	11.2	3.4	3.2
San Francisco	24	343	4340	4095	12.7	11.9	3.8	3.5
Monterey	24	288	3551	3411	12.3	11.8	4.6	4.4
Morro Bay	24	210	2627	2442	12.5	11.6	3.7	3.4
Total	74	860	10,775	10,192	12.5	11.9	4.0	3.8

TABLE 1. (continued)

Port Area	Number trips sampled	Number anglers observed	Number observed fish All	Number observed fish Kept	Mean number of fish per angler day All	Mean number of fish per angler day Kept	Mean number of fish per angler hour All	Mean number of fish per angler hour Kept
1991								
Fort Bragg	11	68	781	646	11.5	9.5	4.0	3.3
Bodega Bay	7	60	871	843	14.5	14.0	4.7	4.5
San Francisco	14	232	2490	2346	10.7	10.1	2.9	2.8
Monterey	23	263	3076	2971	11.7	11.3	3.6	3.5
Morro Bay	31	336	3807	3626	11.3	10.8	3.6	3.4
Total	86	959	11,025	10,432	11.5	10.9	3.5	3.3
Grand total	690	9158	113,885	108,462	12.4	11.8	3.9	3.7

Table 2. Average Fishing Time per Observed Trip.

	Fishing time in hours					
Port area	1987	1988	1989	1990	1991	All Years
Fort Bragg	-	2.1	2.7	2.7	2.9	2.7
Bodega Bay	-	3.1	3.2	3.5	3.1	3.1
San Francisco	-	3.6	3.4	3.3	3.6	3.5
Monterey	3.0	3.0	3.0	2.7	3.1	3.0
Morro Bay	-	3.4	2.9	3.4	3.2	3.2
All ports	3.0	3.2	3.1	3.1	3.2	3.1

areas combined, average fishing time per trip was very similar from 1988 to 1991, ranging from 3.1 to 3.2 hr. The Fort Bragg area was the only one in which average fishing time per trip increased substantially (38%) from 1988 to 1991, probably because a higher proportion of full day trips were sampled in 1990 and 1991.

Total Observed Catch and Catch Per Angler Day

Technicians counted and identified 113,885 fishes caught by observed anglers (Table 1); of these, 108,462 (95.2%) were kept. For all port areas combined, average catch of all fish, including those released or used for bait, per observed angler per day was 12.4 and ranged from 11.5 in 1991 to 14.4 in 1987, when only the Monterey area was sampled. Average catch of kept fish was 11.8 and ranged from 10.9 in 1991 to 14.4 in 1987. Approximately 30 years earlier, Miller and Gotshall (1965) estimated average CPFV catch of kept fish from the

Crescent City to Port San Luis area as 11.8, ranging from 5.3 in the Crescent City/Fort Bragg area to 14.8 in the Santa Cruz/Monterey area.

No single port area had either the highest or lowest average catch per angler day in all years sampled. Highest average catch per angler day (all fish) was 16.1 in the Monterey area in 1988. Lowest catch per angler day was 7.5 in the Morro Bay area in 1988. For all areas combined, there was a slight but steady decline from 1988 to 1990-91 in the average catch per angler day for all fish (12.4 to 12.0) and for kept fish (11.9 to 11.3).

Catch Per Angler Hour

Catch per angler hour ranged from 2.2 to 5.9 for all fish for a particular port and year (Table 1) and averaged 3.9 overall. For kept fish only, CPAH ranged from 2.1 to 5.8 and averaged 3.7 overall. From 1988 to 1991 the Fort Bragg and Monterey areas consistently had higher catch rates than the San Francisco and Morro Bay areas. The Monterey area experienced a 20% decline in CPAH for all fish from 5.1 in 1988 to 4.1 in 1990-91, while the Morro Bay area showed a 64% increase, from 2.2 to 3.6, during the same period.

The combined mean CPAH for all ports in 1990-91 was 3.7 and 3.5 for all fish and kept fish, respectively. Mean CPAH for all fish in 1988 was identical to the combined mean CPAH for 1990-91 for all ports combined.

Fishing Effort by Depth

Of 690 sampled trips from the five port areas, 34% fished exclusively at shallow locations, 37% fished exclusively at deep locations, and 29% fished at either exclusively mixed locations or a combination of shallow, mixed, and deep locations (Table 3). The Monterey area had the highest percentage of deep-location trips (61%), primarily due to the proximity of Monterey Submarine Canyon, while the Bodega Bay area ranked second with 47% of sampled trips fishing deep locations, primarily Cordell Bank. Conversely, the Fort Bragg

TABLE 3. Summary of Sampled CPFV Trips by Depth of Fishing Locations for Each Port Area, 1987 to 1991.

	Percent of Sampled Trips					
	1987	1988	1989	1990-91	All years	N trips
Fort Bragg Area						
Shallow	-	33	0	83	61	11
Deep	-	33	67	0	17	3
Mixed	-	33	33	17	22	4
Bodega Bay Area						
Shallow	-	35	35	12	31	16
Deep	-	43	45	63	47	24
Mixed	-	22	20	25	22	11
San Francisco Area						
Shallow	-	74	63	53	64	88
Deep	-	4	11	18	11	15
Mixed	-	22	26	29	25	35
Monterey Area						
Shallow	17	22	19	19	19.5	65
Deep	56	56	63	72	61	201
Mixed	27	21	17	9	19.5	65
Morro Bay Area						
Shallow	-	52	20	35	34	52
Deep	-	10	9	11	10	15
Mixed	-	38	71	54	56	85

and San Francisco areas had the highest percentages of shallow-location trips, both exceeding 60%. Fifty-six percent of Morro Bay area sampled trips were to mixed depths, a frequency more than twice as great as any other port area.

In all port areas except Fort Bragg, a higher percentage of sampled trips fished at deep locations in 1990-91 than in 1988. The increase was slight in the Morro Bay area (1%), but ranged from 14 to 19% for the Bodega Bay, San Francisco, and Monterey areas. Only 18 trips were sampled in the Fort Bragg area during the study, and only three of these, all in 1988, and 1989, fished deep locations.

Fishing Effort by Distance from Port

Technicians identified and sampled 194 discrete fishing locations, as defined previously, many of which were sampled on multiple occasions. Of these, 110 were near locations and 84 were distant locations. In general, the Bodega Bay and San Francisco area ports had a relatively high percentage (> 75) of distant locations, while the Fort Bragg and Morro Bay areas had relatively low percentages (< 20) of distant locations.

For all port areas combined, 59% of the 690 sampled trips fished in near locations, 33% fished in distant locations, and 8% fished in mixed locations. From 1988 to the combined years 1990-91, there was virtually no difference in the percentage of distant trips, ranging from 32 to 35%.

More than 20 years ago Miller and Odemar (1968) noted that a trend was occurring in the San Francisco and Montrerey

port areas in which larger CPFVs were traveling to more distant fishing grounds. From 1988 to 1991 this trend had apparently stabilized; virtually all of the study area's coastline is now reachable during a one-day trip.

Catch per Angler Hour by Distance from Port and Depth

Sixty percent of all fish observed during the study period were taken at near locations. However, Bodega Bay and San Francisco area anglers caught 92% and 82%, respectively, of their fish at distant locations. In the Fort Bragg, Monterey, and Morro Bay areas 85%, 75%, and 84%, respectively, of all observed fish were caught at near locations.

Mean CPAH was greater at distant locations in the Fort Bragg, San Francisco, and Morro Bay areas (Table 4). The difference was pronounced in the Fort Bragg area but sample size was small (two trips). In the Morro Bay area 18 distant-location trips produced a mean CPAH 46% greater than that of the near-location trips.

TABLE 4. Mean Catch Per Angler Hour from Near and Distant Fishing Locations by Port Area, All Years Combined.

	NEAR		DISTANT	
Port area	N fish	Mean CPAH	N fish	Mean CPAH
Fort Bragg	1404	4.40	243	6.07
Bodega Bay	598	4.05	6477	3.99
San Francisco	4579	3.86	20323	4.42
Monterey	47788	4.71	16347	4.32
Morro Bay	13467	2.85	2659	4.17

Fifty-five percent of all observed fish were taken at either exclusively shallow or exclusively deep locations. Of these, approximately twice as many were caught at deep locations compared with shallow locations. This was influenced by the greater number of trips sampled in the Monterey area. For the northern port areas of Fort Bragg, Bodega Bay, and San Francisco, CPAH was higher at exclusively shallow locations compared with deep locations, while the opposite was true for the Monterey and Morro Bay areas (Table 5). Mean CPAH for deep locations at the latter two areas was heavily influenced by the relatively high catch rate of chilipepper and yellowtail rockfish, respectively.

TABLE 5. Mean Catch Per Angler Hour from Shallow and Deep Fishing Locations by Port Area, All Years Combined.

	SHALLOW		DEEP	
Port area	N fish	Mean CPAH	N fish	Mean CPAH
Fort Bragg	1108	4.55	90	3.86
Bodega Bay	2752	4.59	2627	4.13
San Francisco	9221	2.83	502	2.65
Monterey	5126	3.76	35492	4.62
Morro Bay	3664	3.03	1933	3.89

Fishing Effort by Single Location Trips

One measure of success in the CPFV industry is the frequency of 1-day trips to a single location, presumably at which sufficient quantities of fish are present for all anglers to catch bag limits (15 rockfishes, 5 lingcod, 20 fish

all species combined). Of the 690 sampled trips, 397 (58%) fished at a single location. Up to seven discrete locations were fished on multiple-location trips. The Fort Bragg area had the highest percentage of single location trips (75), while the Bodega Bay area had the lowest percentage (45). The percentage of single-location trips for all ports combined from 1988 to 1990-91 ranged from 56 to 58 and showed no trend.

The above results do not account for the conscientious efforts of CPFV operators who deliberately fish at multiple locations on a single day to avoid "overfishing" specific locations.

Total Species Composition

A total of 73 species of fish was observed during the study (Appendix D). Twelve of these species individually comprised at least 1.0% of the observed catch in all 5 years sampled. Of these, 10 species were rockfishes. Ten species were each represented by one individual, and 40 others each comprised less than 1.0% of the catch in each of the 5 years sampled.

Overall, the 10 most frequently observed species were, in order of abundance, chilipepper, blue rockfish, yellowtail rockfish, widow rockfish, bocaccio, rosy rockfish, lingcod, canary rockfish, greenspotted rockfish, and Pacific hake. This ranking is influenced by the disproportionate amount of sampling in the Monterey area, and species composition is presented later on a port area basis.

Twenty species accounted for 95% of the observed catch and 37 species comprised 99% of the observed catch. Forty-one species of rockfishes were caught, comprising 91% of the catch. Eighteen of the twenty most frequently observed species were rockfishes. As adults, some species of rockfish primarily occur in schools. Bocaccio, chilipepper, and blue, yellowtail, widow, and olive rockfishes are schooling species. These comprised 65.5% of the total observed catch.

Although fishing effort and sampling effort were not evenly distributed among port areas, some general statements can be made regarding the relative abundance of certain species in the observed CPFV catch. Blue, yellowtail, and rosy rockfishes and lingcod were among the 10 most frequently observed species in all port areas sampled. These four species accounted for 43% of the total observed catch. In addition, bocaccio and widow and canary rockfishes were important components of the catch in most port areas, while chilipepper were locally important in the Monterey and Bodega Bay areas. These eight species comprised 75.8% of the total observed catch.

A recent assessment of rockfishes known to occur off California found that 59 species are harvested by either sport or commercial fisheries (Lea 1992). Forty-one species (69%) are caught in both fisheries (Appendix E); Of these, twenty-one are considered to be relatively important based on historical and current information.

This study found that 15 of the above 21 species occurred

in at least 1.0% of the observed catch during at least one of the 5 years sampled. Cowcod and black-and-yellow, flag, kelp, speckled, and yelloweye rockfishes occurred infrequently. Thus, the rockfish resource is shared extensively by sport and commercial fisheries.

CDFG and National Marine Fisheries Service have routinely sampled offshore commercial trawl and gill net rockfish fisheries. Within the past 5 years, hook-and-line fisheries (longline, vertical set line, troll, and rod and reel) have become important components of the commercial rockfish fishery. During 1991 and 1992, Department biologists began a directed effort towards sampling these fisheries. Preliminary, unpublished data will be referred to here in discussing similarities and differences in species composition with the CPFV fishery.

Species Composition by Port Area

Fort Bragg Area

In the Fort Bragg area 11 species comprised 95% of the observed catch (Table 6). Blue and yellowtail rockfishes accounted for 65% of observed fish. Distinctive features of the catch included an absence of chilipepper, a relatively high percentage of copper, yelloweye, and black rockfishes, and an overall species composition of 98% rockfishes. Several species occurred more frequently in some years, such as black and widow rockfishes in 1991, while others were relatively uncommon, such as blue and canary rockfishes in 1990.

TABLE 6. Summary of Sport Fishes Caught by Observed CPFV Anglers from the Port of Fort Bragg, 1988 to 1991.

Species	1988	1989	1990	1991	Total	Rank
Blue rockfish	190	76	3	300	569	1
Yellowtail rockfish	31	169	122	174	496	2
Canary rockfish	26	46	1	87	160	3
Rosy rockfish	21	27	16	49	113	4
Black rockfish				49	49	5
Olive rockfish	34			11	45	6
Copper rockfish	12	10		18	40	7
Yelloweye rockfish	7	9	6	17	39	8
Lingcod	5	1		18	24	9
Widow rockfish	1			20	21	10
Bank rockfish		13			13	11
Bocaccio	2	7	1	2	12	12
China rockfish				11	11	13
Quillback rockfish	5	1		4	10	14
Greenstriped rockfish		3	5		8	15
Vermilion rockfish				8	8	15
Greenspotted rockfish		1	7		8	15
Gopher rockfish				7	7	18
Kelp greenling				4	4	19
Brown rockfish		3			3	20
Jack mackerel		1			1	21
Silver salmon		1			1	21
King salmon			1		1	21
Rock sole			1		1	21
Starry rockfish				1	1	21
Sanddab sp.				1	1	21
Flatfish sp.		1			1	21
Totals	334	369	163	781	1647	

Samples from the commercial hook-and-line fishery in 1991 and 1992 indicated that chilipepper and yellowtail, yelloweye, vermilion, canary, and greenspotted rockfishes were the predominant species harvested (Pete Kalvass, CDFG, Fort Bragg, pers. comm.). Yellowtail, canary, and yelloweye rockfishes ranked 2, 3, and 8, respectively, in the observed CPFV catch from 1988 to 1991. Vermilion and greenspotted rockfishes were caught less frequently by sport anglers, and chilipepper were not observed in the sport catch. All rockfish species

observed in the CPFV catch were present in commercial hook-and-line samples except olive and bank rockfishes.

Bodega Bay Area

In the Bodega Bay area, 13 species comprised 95% of the observed catch (Table 7). Yellowtail and blue rockfishes and chilipepper accounted for 57% of observed fish. Chilipepper were more frequently observed from 1988 to 1990 than in 1991. Blue rockfish were taken frequently in 1988 and 1989 but were absent or scarce in later years. The species composition observed in 1990 resulted from one sampled trip and is not a good representation of relative abundance in the overall catch. Olive rockfish were noticeably scarce in 1989, similar to the Fort Bragg area. A relatively high percentage of greenspotted, brown, and yelloweye rockfishes characterized the observed catch, and the overall species composition was 96% rockfishes.

Sampling of the commercial hook-and-line rockfish fishery in 1992 revealed the dominant species to be chilipepper, bocaccio, and yellowtail, black, blackgill, greenspotted, brown, starry, yelloweye, and rosy rockfishes (Tom Moore, CDFG, Bodega Bay, pers. comm.). All of these species except black, starry, and blackgill rockfishes ranked among the top 10 species in the observed CPFV catch; black and starry rockfishes ranked 14 and 19, respectively. Blackgill rockfish was not observed; the reported depth range for this species is 720 to 1800 ft (120 to 300 fm; Miller and Lea 1972),

TABLE 7. Summary of Sport Fishes Caught by Observed CPFV Anglers from the Ports of Bodega Bay and Dillon Beach, 1988 to 1991.

Species	1988	1989	1990	1991	Total	Rank
Yellowtail rockfish	414	699	25	399	1537	1
Blue rockfish	748	497		2	1247	2
Chilipepper	768	395	29	34	1226	3
Canary rockfish	211	281	8	36	536	4
Greenspotted rockfish	341	150	8	12	511	5
Brown rockfish	131	172		110	413	6
Bocaccio	142	107	9	146	404	7
Rosy rockfish	119	95	2	20	236	8
Lingcod	125	64	6	11	206	9
Yelloweye rockfish	83	55	2	12	152	10
Greenstriped rockfish	61	29	1	8	99	11
Copper rockfish	52	38		3	93	12
Olive rockfish	44	1		23	68	13
Black rockfish	48	17			65	14
Widow rockfish	2	23		31	56	15
China rockfish	18	17		3	38	16
Flatfish spp.	33	4	2		38	16
Vermilion rockfish	15	11		6	32	18
Gopher rockfish	14	6		1	21	19
Starry rockfish	10	8		5	23	19
Speckled rockfish		7		7	14	21
Squarespot rockfish		11			11	22
Quillback rockfish	5	5			10	23
Kelp greenling	6	2			8	24
Cabezon	3	2			5	25
Jack mackerel	1	4			5	25
King salmon	1	2	1		4	27
Cowcod	1	2		1	4	27
Sanddab spp.	1		2		3	29
Bank rockfish	1	2			3	29
Kelp rockfish	2				2	31
Shortbelly rockfish	1				1	32
Flag rockfish	1				1	32
Shark sp.	1				1	32
Petrale sole				1	1	32
Silver salmon		1			1	32
Totals	3403	2707	94	871	7075	

deeper than most CPFVs fish. Eighteen other species were found in commercial samples; of these, only aurora rockfish was not observed in the CPFV catch. Only squarespot, kelp,

and shortbelly rockfishes were sampled from the CPFV catch but not observed in commercial hook-and-line samples; all three species were minor components of the observed CPFV catch.

San Francisco Area

The San Francisco area had the highest species diversity, with 19 species accounting for 95% of the catch (Table 8). Yellowtail and blue rockfishes comprised 37% of observed fish. Lingcod were relatively more abundant in the catch, ranking 4. However, a steady decline in the percentage of lingcod in the total catch was found, ranging from 9.8% in 1988 to 4.5% in 1991. Black and brown rockfishes were relatively more abundant compared with more southern areas, and Pacific sanddab was a significant component of the catch. Chilipepper was scarce compared with adjacent port areas. The overall species composition was 88% rockfishes, the lowest among the five areas.

A group of species, consisting of gopher, kelp, grass, and black-and-yellow rockfishes and kelp greenling, is indicative of shallow depth fishing, in this case generally less than 120 ft (20 fm). Although numbers are small, the relative abundance of these species decreased by 58% from 1988-89 to 1990-91 (2.4% to 1.0% of the catch). This is most likely a result of a shift towards fishing in greater depths, as previously mentioned.

Several significant changes have occurred in the relative abundance of species taken by CPFV anglers in the San

TABLE 8. Summary of Sport Fishes Caught by Observed CPFV Anglers from the Ports of Princeton, Berkeley, Emeryville, and Richmond, 1988 to 1991.

Species	1988	1989	1990	1991	Total	Rank
Yellowtail rockfish	905	2563	806	735	5009	1
Blue rockfish	1833	1321	658	398	4210	2
Rosy rockfish	771	1211	773	268	3023	3
Lingcod	775	655	212	112	1754	4
Black rockfish	618	661	194	99	1572	5
Widow rockfish	301	761	221	38	1321	6
Canary rockfish	311	454	250	93	1108	7
Brown rockfish	401	207	160	43	811	8
Copper rockfish	199	273	165	84	721	9
Greenspotted rockfish	201	242	61	113	617	10
China rockfish	252	190	101	19	562	11
Starry rockfish	191	130	110	115	546	12
Olive rockfish	10	310	153	24	497	13
Bocaccio	105	204	61	78	448	14
Pacific sanddab	104	171	41	81	397	15
Yelloweye rockfish	143	104	63	48	358	16
Gopher rockfish	119	151	33	9	312	17
Vermilion rockfish	98	106	75	24	303	18
Cabezon	114	67	13	2	196	19
Quillback rockfish	76	75	36	2	189	20
Greenstriped rockfish	80	51	14	9	154	21
Kelp greenling	45	66	17	5	133	22
Pacific hake	72	13	12		97	23
Pacific mackerel	56	11	11		78	24
Petrale sole	23	26	10		59	25
Rosethorn rockfish				55	55	26
Chilipepper	3	12	30	1	46	27
Flag rockfish	5	24	9	8	46	27
Speckled rockfish	1	25	9	10	45	29
King salmon	4	17	12	6	39	30
Rock sole	6	16	15		37	31
Black-and-yellow rockfish	21	8		1	30	32
Squarespot rockfish		21	7		28	33
Jack mackerel	3	18	3		24	34
White croaker	14	4		3	21	35
Swordspine rockfish	5	3		3	11	36
Grass rockfish	6	3			9	37
Kelp rockfish	1	5			6	38
Wolf eel	2	1	1		4	39
Sablefish	1	3			4	39
Rockfish spp.	4				4	39
Yellowfin croaker		3			3	42
California halibut			2	1	3	42
Spiny dogfish	1		1		2	44
Tiger rockfish				2	2	44

TABLE 8. (continued)

Species	1988	1989	1990	1991	Total	Rank
Cowcod	1				1	46
Shortbelly rockfish	1				1	46
Calico rockfish	1				1	46
Irish lord sp.		1			1	46
Halibut sp.		1			1	46
Soupfin shark		1			1	46
Starry skate			1		1	46
Redstripe rockfish				1	1	46
Totals	7883	10,189	4340	2490	24,902	

Francisco area during the past 25 years. In 1966 Miller and Odemar (1968) observed black rockfish to be the most frequently observed species in the party boat catch, while rosy and widow rockfishes ranked 10 and 20, respectively. Black rockfish ranked 5 in the present study from 1988 to 1991, all years combined, and ranked 7 the latter 2 years. The increased relative abundance of rosy and widow rockfishes in catches (ranked 3 and 6, respectively, in the present study) no doubt reflects the greater fishing effort in deeper water.

The most frequently occurring rockfish species in commercial hook-and-line samples from 1992 were yellowtail, brown, rosy, canary, and greenspotted (Becky Ota, CDFG, Menlo Park, pers. comm.). These were all among the top 10 species in the observed CPFV catch. Twenty-one other rockfishes were sampled from the commercial catch; of these, only greenblotched, blackgill, bank, redbanded, and sharpchin rockfishes and Pacific ocean perch were not observed in the CPFV catch. Sport-caught rockfishes not found in commercial

hook-and-line samples included olive, rosethorn, black-and-yellow, squarespot, swordspine, kelp, calico, shortbelly, and cowcod. Of these, only olive rockfish comprised more than 1.0% of the observed CPFV catch.

Monterey Area

The Monterey area accounted for 56.2% of all observed fish, largely due to sampling effort, and was the only port sampled in all 5 years. Chilipepper and yellowtail and blue rockfishes comprised 60% of the observed catch. Seventeen species comprised 95% of the catch (Table 9), and species composition was 91% rockfishes. Unique to this area was the dominance of chilipepper in the catch, primarily due to the proximity of Monterey Canyon on the fishing grounds. Chilipepper often were targeted and comprised 30.3% of the observed catch. Until the 1980s, chilipepper was only a minor component of the CPFV catch (Oda 1992). A 1966 survey of the CPFV catch ranked chilipepper 13 in abundance among observed fishes in the Monterey area (Miller and Odemar 1968).

Pacific hake, sablefish, and Pacific mackerel occurred in catches more frequently than in other areas, although a trend of decreasing catch frequency was observed from 1987 (6.3% of catch) to 1991 (1.0% of catch). This port area was the only one in which canary rockfish was not among the 10 most frequently observed species. Brown and China rockfishes were also relatively scarce compared with areas to the north and

TABLE 9. Summary of Sport Fishes Caught by Observed CPFV Anglers from the Ports of Santa Cruz and Monterey, 1987 to 1991.

Species	1987	1988	1989	1990	1991	Total	Rank
Chilipepper	6196	6521	5550	941	193	19,401	1
Blue rockfish	2838	4872	2627	113	511	10,961	2
Yellowtail rockfish	1848	2619	2477	431	703	8078	3
Widow rockfish	884	2441	733	601	57	4716	4
Bocaccio	1361	1100	1035	585	305	4386	5
Pacific hake	626	1003	545	126	2	2302	6
Rosy rockfish	432	410	663	110	175	1790	7
Lingcod	566	470	542	24	96	1698	8
Greenspotted rockfish	185	195	804	125	183	1492	9
Greenstriped rockfish	171	357	566	101	157	1352	10
Olive rockfish	130	516	492	13	107	1258	11
Starry rockfish	266	206	449	36	162	1119	12
Canary rockfish	157	221	278	142	85	883	13
Pacific mackerel	202	267	30	1	7	507	14
Vermilion rockfish	98	117	174	57	53	499	15
Sablefish	238	96	68	21	23	446	16
Squarespot rockfish	98	186	88	10	1	383	17
Copper rockfish	39	36	214	10	34	333	18
Pacific sanddab	26	75	130	6	28	265	19
Speckled rockfish	60	38	98	11	54	261	20
Jack mackerel	69	100	45	5		219	21
Gopher rockfish	86	55	43	11	23	218	22
Bank rockfish	74	87	2			163	23
Yelloweye rockfish	31	21	52	7	28	139	24
Black rockfish	55	60	19			134	25
Sanddab spp.	2	1	121			124	26
China rockfish	34	23	40	2	22	121	27
Brown rockfish	9	20	68	1	21	119	28
Flag rockfish	10	11	63	10	22	116	29
Rosethorn rockfish	9	28	48	20		105	30
Stripetail rockfish	7	52	28	7		94	31
Shortbelly rockfish	2	49	31	3	5	90	32
Petrale sole	4	29	25	3	9	70	33
Cabezon	36	7	3			46	34
Rock sole	12	4	15	1		32	35
Spiny dogfish	4	13	3	4		24	36
King salmon	7	4	10	2		23	37
Rockfish spp.	4	4	10	5		23	37
Cowcod	5	1	6	4	5	21	39
Kelp greenling	5	1	10		1	17	40
Quillback rockfish	7	4	5			16	41
Splitnose rockfish	2	7	4	1		14	42
Swordspine rockfish	6	4	1			11	43
Black-and-yellow rockfish	4	5				9	44
Speckled sanddab	6			1		7	45

TABLE 9. (continued)

Species	1987	1988	1989	1990	1991	Total	Rank
Pacific sardine	1	4				5	46
Aurora rockfish		5				5	46
Grass rockfish	4					4	48
Greenblotched rockfish	3	1				4	48
Halfbanded rockfished	1	3				4	48
Blue shark	1		1		2	4	48
White croaker	2	1				3	52
Kelp rockfish			3			3	52
California lizardfish			3			3	52
Jacksmelt	2					2	55
Starry skate	1					1	56
Fantail sole	1					1	56
Redstripe rockfish	1					1	56
Pacific bonito	1					1	56
Sharpchin rockfish		1				1	56
Ratfish		1				1	56
English sole		1				1	56
Butter sole			1			1	56
Wolf eel			1			1	56
Chameleon rockfish			1			1	56
Flatfish sp.			1			1	56
Tiger rockfish					1	1	56
Ocean whitefish					1	1	56
Totals	16,929	22,353	18,226	3551	3076	64,135	

south. The shallow water species complex referred to in the San Francisco area discussion was poorly represented at 0.4% of the observed catch.

Commercial hook-and-line samples in the Monterey area fall into three general categories. An offshore longline fishery catches primarily chilipepper, bocaccio, and yellowtail, blackgill, bank, widow, and speckled rockfishes (Bob Leos, CDFG, Monterey, pers. comm.). A hook-and-line fishery in the Monterey Bay area harvests mainly bocaccio and greenspotted, yellowtail, starry, yelloweye, speckled, and copper rockfishes. A nearshore hook and line fishery exists

south of Big Sur, including Big Creek Reserve. Under agreement with the reserve manager, fishermen have been recording catch composition landed at the reserve. Dominant species were black, blue, olive, kelp, grass, gopher, black-and-yellow, vermilion, and brown rockfishes.

All rockfish species identified in commercial samples were present in the observed CPFV catch except blackgill and redbanded. For the 29 species of CPFV-caught rockfishes for which n > 10, only squarespot, rosethorn, swordspine, quillback, and cowcod were not sampled in the commercial hook-and-line fishery in 1992.

Morro Bay Area

In the Morro Bay area, 16 species comprised 95% of the observed catch (Table 10), and species composition was 93% rockfishes. Yellowtail and blue rockfishes comprised 40% of observed fish. Distinctive features of the catch included a relatively high frequency of vermilion and gopher rockfishes and a relative scarcity of chilipepper. The shallow water species complex comprised 6.4% of the observed catch, the highest of the five areas. Of significance was a steady decline in the relative abundance of canary rockfish, from 6.5% in 1988 to 2.3% in 1991, and the relatively high frequency of olive and black rockfish in 1991.

Morro Bay commercial hook-and-line samples in 1992 consisted primarily of chilipepper, bocaccio, and yellowtail, vermilion, gopher, and blue rockfishes (Sandra Owen, CDFG,

TABLE 10. Summary of Sport Fishes Caught by Observed Anglers from the Ports of San Simeon, Morro Bay, and Port San Luis, 1988 to 1991.

Species	1988	1989	1990	1991	Total	Rank
Yellowtail rockfish	1064	1225	831	543	3663	1
Blue rockfish	856	754	209	937	2756	2
Vermilion rockfish	399	578	328	176	1481	3
Gopher rockfish	322	309	37	309	977	4
Bocaccio	210	219	324	141	894	5
Lingcod	262	310	111	184	867	6
Rosy rockfish	310	284	129	128	851	7
Widow rockfish	318	88	169	152	727	8
Canary rockfish	308	224	101	87	720	9
Copper rockfish	199	163	125	70	557	10
Brown rockfish	31	188	49	191	459	11
Starry rockfish	218	94	53	91	456	12
Olive rockfish	20	15	8	351	394	13
Black rockfish		8	26	178	212	14
China rockfish	82	41	12	56	191	15
Greenspotted rockfish	54	58	41	28	181	16
Chilipepper		141	3	30	174	17
Greenstriped rockfish	22	33	22	13	90	18
Pacific sanddab	6	33	14	20	73	19
Pacific mackerel		19		46	65	20
Yelloweye rockfish	19	30	9	2	60	21
Flag rockfish	19	17	10	8	54	22
Kelp greenling	13	9	2	8	32	23
Jack mackerel	7	23			30	24
Spiny dogfish	6	14	3	2	25	25
Cabezon	5	1	3	10	19	26
Rock sole	3	6	6	3	18	27
Speckled sanddab		11			11	28
Black-and-yellow rockfish		2		8	10	29
Petrale sole	7	2		1	10	29
California halibut	1			8	9	31
Speckled rockfish		4		4	8	32
Grass rockfish	1			6	7	33
Kelp rockfish				5	5	34
Sablefish				5	5	34
Squarespot rockfish	4	1			5	34
Calico rockfish	1	2			3	37
King salmon		3			3	37
Treefish				3	3	37
California lizardfish	2				2	40
Greenblotched rockfish	2				2	40
Ocean whitefish	1			1	2	40
Sanddab spp.	1	1			2	40
Pacific tomcod	1	1			2	40
Pacific hake		2			2	40

TABLE 10. (continued)

Species	1988	1989	1990	1991	Total	Rank
White croaker		2			2	40
Blue shark		2			2	40
Wolf eel		1	1		2	40
Quillback rockfish		1			1	49
Cowcod			1		1	49
Rockfish sp.				1	1	49
Striped surfperch				1	1	49
Totals	4773	4919	2627	3807	16,126	

Morro Bay, pers. comm.). All except chilipepper comprise the top five species in the observed CPFV catch; chilipepper ranked 17. Nineteen other species were identified in commercial hook-and-line samples, and all of them were observed in the CPFV catch. Only four rockfish species caught incidentally by CPFV anglers (squarespot, calico, greenblotched, and quillback) were not observed in commercial samples.

Species Composition by Month

Fort Bragg Area

Few trips were sampled in winter or spring and only in September were more than three trips sampled. Catch per angler hour (CPAH) for all fish ranged from 2.5 in October to 6.2 in December (Table 11). Only three species, blue, yellowtail, and rosy rockfish, were observed in all months sampled. Blue rockfish had higher catch rates in July, August, November, and December, while yellowtail rockfish were caught more frequently in February and June. Shallow-water

TABLE 11. Catch Per Angler Hour by Month, All Years Combined, for the 20 Most Frequently Caught Species from the Fort Bragg Area.

	Catch per angler hour											
Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Blue rockfish	-	0.10	-	-	-	0.23	2.09	2.53	1.81	0.37	2.58	2.26
Yellowtail rockfish	-	4.11	-	-	-	2.44	0.78	0.17	1.62	0.67	0.41	0.22
Canary rockfish	-	0.03	-	-	-	1.34	-	0.22	0.48	0.30	0.61	1.83
Rosy rockfish	-	0.54	-	-	-	0.06	0.52	0.19	0.31	0.17	0.29	0.75
Black rockfish	-	-	-	-	-	-	-	0.03	0.09	0.15	0.75	-
Olive rockfish	-	-	-	-	-	-	-	0.67	0.01	0.02	0.52	-
Copper rockfish	-	-	-	-	-	0.35	0.11	0.22	0.12	0.06	-	0.11
Yelloweye rockfish	-	0.20	-	-	-	0.23	0.04	0.17	0.07	0.06	0.03	0.75
Lingcod	-	-	-	-	-	0.06	-	0.03	0.06	0.24	0.03	-
Widow rockfish	-	-	-	-	-	-	-	-	0.05	0.15	0.12	0.22
Bank rockfish	-	-	-	-	-	-	-	-	0.08	-	-	-
Bocaccio	-	0.03	-	-	-	0.12	-	0.03	0.04	0.04	-	-
China rockfish	-	-	-	-	-	-	-	-	0.03	0.13	0.03	-
Quillback rockfish	-	-	-	-	-	0.06	-	0.11	0.02	0.02	0.03	-
Greenstriped rockfish	-	0.17	-	-	-	-	-	-	0.02	-	-	-
Vermilion rockfish	-	-	-	-	-	-	-	-	0.03	0.02	0.09	-
Greenspotted rockfish	-	0.24	-	-	-	-	-	-	<0.01	-	-	-
Gopher rockfish	-	-	-	-	-	-	-	-	0.02	0.09	-	-
Kelp greenling	-	-	-	-	-	-	-	0.03	0.01	0.02	-	-
Brown rockfish	-	-	-	-	-	-	0.11	-	-	-	-	-
All fish	-	5.49	-	-	-	4.88	3.69	4.43	4.88	2.52	5.48	6.25
Number of trips	0	1	0	0	0	1	1	2	7	3	2	1

species such as blue rockfish are generally caught more frequently in the summer and fall in California when weather and sea conditions are better and boats can safely operate inshore. The lowest CPAH for all fish in October coincided with the highest CPAH for lingcod. This is the traditional start of the lingcod season and CPFVs targeting this species spent less time fishing for the more abundant schooling rockfishes.

Bodega Bay Area

Seasonal variations in CPAH were evident for some of the more common rockfishes. Blue rockfish were scarce or absent in the observed catch from December to March (Table 12). Chilipepper were caught more frequently in August and from December to March and were not observed from May to July. Lingcod and bocaccio CPAH was highest from September to February, and September had the second lowest overall CPAH (2.9). The lowest average catch rate was observed in July. CPAH for all fish exceeded 5.0 in February, May, and June. Only three species, yellowtail, canary, and rosy rockfishes, were observed in all months sampled.

San Francisco Area

A group of species consisting of blue, black, brown, and gopher rockfishes and cabezon had a higher CPAH from March or April to July or August than during the fall and winter (Table 13). These species are caught more frequently in

TABLE 12. Catch Per Angler Hour by Month, All Years Combined, for the 20 Most Frequently Caught Species from the Bodega Bay Area.

	Catch per angler hour											
Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Yellowtail rockfish	0.36	0.61	0.07	-	0.57	0.20	1.17	0.56	1.09	1.35	1.39	0.53
Blue rockfish	-	-	-	-	1.91	3.83	0.12	0.30	0.13	0.27	0.23	0.01
Chilipepper	1.67	3.37	3.10	-	-	-	-	1.37	0.22	0.80	0.05	1.37
Canary rockfish	0.13	0.80	0.07	-	0.27	0.18	0.41	0.38	0.26	0.42	0.19	0.02
Greenspotted rockfish	0.77	0.33	0.03	-	0.85	-	0.17	0.38	0.23	0.34	0.19	0.10
Brown rockfish	-	-	-	-	0.95	0.32	0.23	0.50	0.04	0.15	0.07	-
Bocaccio	0.16	0.67	0.14	-	0.06	-	0.08	0.10	0.42	0.19	0.59	0.29
Rosy rockfish	0.26	0.07	0.21	-	0.02	0.01	0.30	0.10	0.05	0.15	0.26	0.26
Lingcod	0.11	0.20	-	-	0.11	0.09	0.04	0.07	0.14	0.14	0.12	0.28
Yelloweye rockfish	0.11	0.09	-	-	0.03	0.04	0.14	0.14	0.06	0.07	0.14	0.06
Greenstriped rockfish	0.10	0.02	-	-	0.19	-	0.06	0.07	0.05	0.05	0.05	0.03
Copper rockfish	-	-	-	-	0.01	0.09	0.02	0.19	0.03	0.02	-	-
Olive rockfish	-	-	-	-	-	0.01	-	0.02	<0.01	0.05	-	0.46
Black rockfish	-	-	-	-	0.12	0.20	-	<0.01	-	0.03	0.01	-
Widow rockfish	-	-	-	-	-	-	-	0.03	0.04	0.08	0.01	0.01
China rockfish	-	-	-	-	0.02	0.09	-	0.03	<0.01	0.02	-	-
Vermilion rockfish	-	0.07	-	-	-	0.02	0.03	0.03	-	0.02	0.01	0.02
Gopher rockfish	-	-	-	-	-	0.02	-	0.02	<0.01	0.03	-	-
Starry rockfish	0.04	-	0.03	-	-	-	0.01	0.01	<0.01	0.01	0.04	0.03
Squarespot rockfish	-	-	-	-	-	0.03	0.01	-	0.01	0.01	0.01	-
All fish	3.78	6.35	3.76	-	5.16	5.15	2.81	4.37	2.86	4.28	3.42	3.50
Number of trips	2	2	1	0	3	6	4	9	7	10	5	2

TABLE 13. Catch Per Angler Hour by Month, All Years Combined, for the 25 Most Frequently Caught Species from the San Francisco Area.

Species	Catch per angler hour											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Yellowtail rockfish	0.82	0.80	0.84	0.49	0.13	0.31	0.15	0.52	0.93	0.68	1.47	0.74
Blue rockfish	0.24	0.94	0.76	0.52	0.45	0.80	1.05	0.37	0.36	0.39	0.41	0.29
Rosy rockfish	0.47	0.70	0.42	0.24	0.20	0.38	0.08	0.37	0.44	0.44	0.48	0.55
Lingcod	0.22	0.31	0.18	0.20	0.40	0.08	0.12	0.22	0.22	0.23	0.18	0.35
Black rockfish	-	-	0.02	0.49	0.59	0.25	0.41	0.17	0.02	0.02	0.09	-
Widow rockfish	0.29	0.58	0.35	0.05	0.12	0.13	-	0.03	0.11	0.23	0.30	0.43
Canary rockfish	0.15	0.16	0.26	0.14	0.11	0.09	0.06	0.14	0.12	0.11	0.27	0.12
Brown rockfish	-	-	0.08	0.22	0.17	0.18	0.21	0.08	0.04	0.03	0.03	<0.01
Copper rockfish	0.11	0.18	0.18	0.09	0.06	0.04	0.04	0.09	0.06	0.09	0.17	0.12
Greenspotted rockfish	0.13	0.07	0.09	0.10	0.04	0.04	-	0.14	0.04	0.07	0.17	0.01
China rockfish	0.04	0.12	0.04	0.06	0.06	0.07	<0.01	0.08	0.06	0.03	0.02	0.10
Starry rockfish	0.04	0.13	0.05	0.09	0.10	0.09	0.12	0.09	0.05	0.11	0.07	0.04
Olive rockfish	0.07	0.08	0.02	0.06	0.02	0.09	0.04	0.02	0.05	0.02	0.24	0.13
Bocaccio	0.07	0.09	0.07	0.03	0.01	0.04	<0.01	0.05	0.07	0.07	0.13	0.10
Pacific sanddab	0.11	0.03	0.05	0.04	0.02	0.03	0.02	0.04	0.06	0.07	0.09	0.07
Yelloweye rockfish	0.06	0.13	0.02	0.03	0.02	0.04	0.01	0.09	0.04	0.05	0.03	0.03
Gopher rockfish	-	<0.01	<0.01	0.04	0.07	0.05	0.15	0.07	0.02	<0.01	0.01	<0.01
Vermilion rockfish	0.06	0.01	0.04	0.05	0.05	0.04	0.06	0.04	0.03	0.02	0.03	0.05
Cabezon	<0.01	<0.01	0.01	0.04	0.04	0.02	0.05	0.03	0.03	0.01	-	<0.01
Quillback rockfish	0.04	0.04	0.01	0.03	0.01	0.02	0.02	0.01	0.04	0.02	0.02	0.08
Greenstriped rockfish	0.01	0.04	0.03	0.01	0.01	0.02	-	0.04	0.01	0.04	0.01	-
Kelp greenling	-	0.03	0.01	0.05	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Pacific hake	<0.01	-	-	0.04	<0.01	0.07	-	-	-	-	-	-
Pacific mackerel	-	-	0.01	-	-	0.01	-	-	0.04	0.02	-	-
Petrale sole	0.02	0.02	-	<0.01	0.01	<0.01	<0.01	0.01	0.01	0.01	0.02	0.01
All fish	2.99	4.54	3.56	3.18	2.75	2.94	2.66	2.78	2.92	2.80	4.31	3.29
Number of trips	5	6	13	14	11	17	8	16	18	13	12	5

shallower water (less than 40 fathoms) and indicate a trend towards deeper fishing in fall and winter. Blue rockfish, also more abundant in shallow water, had higher catch rates from February to July. Conversely, widow, yellowtail, and rosy rockfishes and bocaccio (deeper-water species) had higher catch rates during fall and winter.

Three peaks of lingcod CPAH occurred in December, February, and May. None of these months coincided with the traditional start of lingcod season in other areas. In addition, the May peak is atypical for this species which is generally known for its inshore distribution in fall and winter.

Pacific hake were only caught in January and from April to June, while Pacific mackerel had highest CPAH in September and October.

CPAH for all species generally was lower from May to October and compared with other areas had a relatively narrow range of values for all months.

Monterey Area

The Monterey area showed seasonal variablity for several common species. Chilipepper CPAH increased steadily from February to June, peaking at 2.9 (Table 14). Except for April, a similar trend occurred for blue rockfish from January to June. These two species were largely responsible for the highest overall CPAH of 6.7 and 6.8 in May and June, respectively. These were the highest monthly CPAH values

TABLE 14. Catch Per Angler Hour by Month, All Years Combined, for the 25 Most Frequently Caught Species from the Monterey Area.

	Catch per angler hour											
Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chilipepper	1.57	0.83	1.27	2.06	2.62	2.92	1.40	2.13	0.99	0.02	0.39	1.68
Blue rockfish	0.12	0.36	0.57	0.28	1.61	1.81	1.34	0.60	1.00	0.33	0.50	1.02
Yellowtail rockfish	0.51	0.93	0.57	0.67	0.58	0.53	0.47	0.49	0.78	0.58	0.41	0.66
Widow rockfish	1.21	0.76	0.57	0.46	0.19	0.10	0.08	0.12	0.51	0.31	0.26	0.09
Bocaccio	0.36	0.46	0.37	0.28	0.43	0.12	0.10	0.39	0.26	0.30	0.55	0.14
Pacific hake	-	-	0.11	0.29	0.71	0.77	0.27	0.01	-	-	-	-
Rosy rockfish	0.09	0.20	0.13	0.12	0.06	0.06	0.09	0.14	0.25	0.10	0.14	0.14
Lingcod	0.16	0.05	0.05	0.05	0.04	0.03	0.12	0.03	0.09	0.34	0.21	0.23
Greenspotted rockfish	0.26	0.15	0.15	0.07	0.05	0.10	0.06	0.18	0.07	0.06	0.13	0.01
Greenstriped rockfish	0.16	0.15	0.20	0.10	0.02	0.09	0.07	0.17	0.06	0.02	0.13	0.13
Olive rockfish	0.03	0.07	0.04	0.06	0.05	0.06	0.03	0.10	0.24	0.11	0.11	0.07
Starry rockfish	0.05	0.07	0.07	0.12	0.04	0.02	0.06	0.07	0.13	0.09	0.13	0.05
Canary rockfish	0.10	0.15	0.09	0.09	0.02	0.02	0.03	0.04	0.06	0.08	0.08	0.05
Pacific mackerel	0.04	-	-	0.07	0.04	0.01	0.08	0.06	0.02	0.02	0.04	0.02
Vermilion rockfish	0.01	0.11	0.03	0.03	0.01	0.04	0.02	0.03	0.04	0.05	0.03	0.01
Sablefish	0.03	0.01	<0.01	0.05	0.03	0.07	0.03	0.08	0.02	-	0.01	0.02
Squarespot rockfish	0.05	0.03	0.04	0.02	0.05	0.03	0.01	0.01	0.07	0.02	<0.01	0.01
Copper rockfish	0.02	0.03	0.01	0.01	0.02	<0.01	0.04	0.02	0.02	0.04	0.04	<0.01
Pacific sanddab	<0.01	0.01	0.04	0.03	0.01	0.01	0.01	0.02	0.04	<0.01	0.03	-
Jack mackerel	-	0.01	<0.01	<0.01	0.01	0.01	0.02	0.01	0.03	0.01	0.03	0.03
Gopher rockfish	<0.01	0.01	<0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.04	0.01	-
Bank rockfish	-	-	-	<0.01	<0.01	-	0.04	0.02	0.03	-	-	-
Yelloweye rockfish	0.01	0.02	0.02	<0.01	<0.01	<0.01	<0.01	0.01	0.01	0.01	0.02	0.01
Black rockfish	-	<0.01	-	-	-	-	0.05	-	<0.01	0.03	-	-
China rockfish	<0.01	<0.01	-	<0.01	<0.01	<0.01	0.01	<0.01	0.01	0.03	0.01	-
All fish	5.08	4.52	4.39	4.97	6.65	6.85	4.51	4.85	4.85	2.69	3.36	4.43
Number of trips	14	20	19	28	29	29	29	44	38	39	32	10

among all areas sampled.

Chilipepper CPAH plummeted to 0.02 in October and CPAH for nine of the ten most frequently observed rockfish species declined from September to October. Similar to the Fort Bragg area, this coincided with the beginning of lingcod season. CPAH for lingcod increased almost fourfold to the highest value of the year (0.34) while overall CPAH was the lowest of all months (2.7).

In May and June a decline in CPAH occurred for widow, rosy, greenstriped, starry, and canary rockfishes coinciding with an increase in CPAH for chilipepper and blue rockfish. Compared with other rockfish, yellowtail rockfish showed a relatively narrow range of CPAH (0.41 to 0.93), less than a threefold difference among all months.

Pacific hake showed a pronounced seasonal variablity with highest catch rates in the spring (primarily May and June), similar to the San Francisco area and similar to chilipepper in the Monterey area. Sablefish and Pacific mackerel catch rates generally were higher from April to August.

Morro Bay Area

There were few seasonal trends in CPAH for most rockfish species in the Morro Bay area, and this area had the most narrow range of monthly CPAH for all fish among all areas (Table 15). Blue rockfish were caught more frequently from August to November, while vermilion rockfish had a higher CPAH from January to June. Several rockfishes showed a narrow

TABLE 15. Catch Per Angler Hour by Month, All Years Combined, for the 25 Most Frequently Caught Species from the Morro Bay Area.

Species	Catch per angler hour											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Yellowtail rockfish	1.17	0.57	1.35	0.92	0.58	0.46	0.38	0.57	0.70	0.63	0.63	0.81
Blue rockfish	0.25	0.16	0.42	0.24	0.48	0.31	0.38	0.53	0.78	0.61	0.79	0.40
Vermilion rockfish	0.54	0.19	0.36	0.47	0.57	0.37	0.17	0.24	0.20	0.22	0.19	0.21
Gopher rockfish	0.13	0.32	0.05	0.03	0.16	0.30	0.21	0.10	0.23	0.29	0.25	0.17
Bocaccio	0.47	0.47	0.31	0.18	0.16	0.09	0.15	0.14	0.16	0.09	0.05	0.25
Lingcod	0.22	0.32	0.19	0.17	0.10	0.10	0.10	0.13	0.15	0.25	0.20	0.15
Rosy rockfish	0.28	0.15	0.24	0.11	0.15	0.14	0.15	0.18	0.13	0.10	0.17	0.20
Widow rockfish	0.14	0.58	0.20	0.03	0.10	-	0.02	0.11	0.14	0.23	0.14	0.23
Canary rockfish	0.16	0.04	0.14	0.20	0.24	0.19	0.15	0.13	0.06	0.10	0.13	0.19
Copper rockfish	0.21	0.03	0.22	0.15	0.16	0.12	0.06	0.09	0.09	0.09	0.07	0.07
Brown rockfish	0.02	0.37	<0.01	0.03	0.05	0.02	0.22	<0.01	0.23	0.06	0.17	0.02
Starry rockfish	0.02	0.08	0.09	0.06	0.10	0.10	0.08	0.12	0.06	0.07	0.11	0.07
Olive rockfish	-	0.06	-	<0.01	0.02	0.01	0.02	0.05	0.10	0.25	0.12	0.02
Black rockfish	-	0.21	-	-	-	-	0.01	0.03	0.13	0.06	0.02	-
China rockfish	0.02	0.08	0.02	0.02	0.04	0.04	0.06	0.03	0.03	0.06	0.06	0.01
Greenspotted rockfish	0.06	0.09	0.03	0.04	0.05	0.04	0.04	0.02	0.02	0.02	0.02	0.09
Chilipepper	0.02	-	-	0.41	-	0.01	<0.01	-	0.01	-	-	0.06
Greenstriped rockfish	0.10	-	0.01	0.01	0.01	0.02	0.05	0.01	<0.01	0.01	-	0.05
Pacific sanddab	0.04	0.02	0.02	0.04	0.01	0.02	-	0.01	-	0.01	0.02	0.02
Pacific mackerel	-	-	-	-	-	-	-	0.02	0.02	<0.01	0.06	-
Yelloweye rockfish	0.02	0.01	<0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Flag rockfish	0.01	-	0.01	0.02	0.02	0.03	<0.01	0.01	<0.01	0.01	0.01	0.01
Kelp greenling	-	0.02	-	<0.01	<0.01	0.01	<0.01	0.01	0.01	0.01	-	<0.01
Jack mackerel	-	-	-	-	-	-	0.06	<0.01	-	-	-	-
Spiny dogfish	0.02	-	<0.01	-	0.01	0.01	<0.01	<0.01	0.01	-	-	-
All fish	3.93	3.79	3.69	3.19	3.05	2.39	2.35	2.57	3.33	3.23	3.23	3.07
Number of trips	9	6	10	10	12	8	10	22	18	21	14	12

range in monthly CPAH. Rosy rockfish CPAH ranged only from 0.10 to 0.28 fish, a factor of 2.8. CPAH of yellowtail and vermilion rockfishes varied only by a factor of 3.6 and 3.4, respectively. These low variabilities are indicative of species that are widespread, abundant, and are either sought after (yellowtail and vermilion) or caught incidentally (rosy) year-round.

Lingcod showed a peak CPAH in October, similar to the Fort Bragg and Monterey areas, but also had a peak in February. Overall catch rates were not lowest during these 2 months, indicating that there was less targeting of lingcod.

Seasonal trends were evident for several other non-rockfishes. Pacific mackerel and jack mackerel were both caught only in the June to November period.

Percentage of Fish Retained by Port and Year

Approximately 95% of all observed fish were kept by CPFV anglers (Table 16). There was no trend in percentage of fish retained from 1988 to 1991, with all years averaging 95%. The Fort Bragg area had the lowest percentage of kept fish, but this was influenced by one shallow-water trip in 1991 in which 50% of the fish caught (mostly blue rockfish) were released. Excluding this trip, 94.6% of observed fish were kept in 1991 and 95.2% of observed fish were kept for all years combined. The Bodega Bay area showed a consistent increase in the percentage of kept fish from 1988 to 1991. No port area showed a consistent decline during this period.

Table 16. Percentage of Observed Fish Retained by Port and Year.

Port area	1987	1988	1989	1990	1991	All years
Fort Bragg	-	98.2	93.8	94.5	84.7	89.5
Bodega Bay	-	91.5	94.7	95.7	96.8	93.4
San Francisco	-	95.0	96.7	94.4	94.2	95.5
Monterey	96.7	95.9	94.4	96.1	96.6	95.4
Morro Bay	-	96.7	91.9	93.0	95.2	94.3
All ports	96.7	95.4	94.7	94.6	94.6	95.2

Percentage of Fish Retained by Port and Species

Fourteen of the twenty most frequently observed species (all areas combined), all rockfishes, had retention rates exceeding 90% for all areas (Table 17). Species are presented in order of decreasing abundance in the total observed catch. Blue and rosy rockfish were the only species observed ($n \geq 10$) in the Fort Bragg area with retention rates less than this. In the Bodega Bay area, blue, rosy, greenstriped, gopher, and squarespot rockfish had relatively low retention rates. All rockfish species in the San Francisco area except rosy and rosethorn had retention rates greater than 95%. In the Monterey area, rosy, squarespot, and stripetail rockfishes had relatively low retention rates among the rockfishes. In the Morro Bay area, rosy and greenstriped were the only rockfishes with retention rates less than 90%.

Except for blue rockfish, all of the above species have maximum total lengths no less than 16 in. (406 mm) (Miller and

TABLE 17. Percentage of Observed Fish Retained by Port and Species.

	Percentage retained (for n ≥ 10 at each port) Port area				
Species	FB	BB	SF	MT	MB
Chilipepper	-	99.6	100.0	99.4	98.3
Blue rockfish	80.5	87.7	95.7	95.0	98.8
Yellowtail rockfish	97.2	97.2	98.0	97.9	97.6
Widow rockfish	95.2	95.9	95.1	98.7	98.3
Bocaccio	91.7	100.0	98.4	99.0	99.7
Rosy rockfish	74.3	60.2	88.6	89.0	83.9
Lingcod	100.0	71.0	87.1	77.2	49.2
Canary rockfish	95.6	97.8	98.3	99.9	99.2
Greenspotted rockfish	-	96.7	98.4	98.9	96.1
Vermilion rockfish	-	100.0	99.3	99.8	99.9
Olive rockfish	97.8	98.5	99.6	98.6	99.0
Starry rockfish	-	95.2	98.5	98.4	98.5
Black rockfish	98.0	97.0	99.2	97.0	100.0
Brown rockfish	-	90.6	99.5	97.5	98.9
Copper rockfish	100.0	100.0	99.4	99.7	98.9
Greenstriped rockfish	-	80.8	98.7	96.0	84.4
Gopher rockfish	-	81.0	98.4	97.2	97.5
China rockfish	100.0	97.4	99.6	99.2	100.0
Yelloweye rockfish	97.4	99.3	99.2	100.0	100.0
Pacific sanddab	-	-	94.2	90.6	87.7
Pacific mackerel	-	-	89.9	86.6	18.5
Sablefish	-	-	-	96.6	-
Squarespot rockfish	-	80.0	96.4	75.8	-
Speckled rockfish	-	100.0	100.0	99.6	-
Jack mackerel	-	100.0	95.7	98.6	70.0
Cabezon	-	-	98.5	100.0	68.4
Quillback rockfish	100.0	-	100.0	100.0	-
Flag rockfish	-	-	97.8	99.1	92.6
Kelp greenling	-	-	94.7	76.5	59.4
Bank rockfish	100.0	-	-	99.4	-
Rosethorn rockfish	-	-	81.8	93.3	-
Petrale sole	-	-	93.2	98.6	100.0
Stripetail rockfish	-	-	-	86.2	-
Shortbelly rockfish	-	-	-	93.3	-
Rock sole	-	-	100.0	100.0	94.4
King salmon	-	-	74.4	82.6	-
Spiny dogfish	-	-	-	8.3	16.0
Black and yellow rockfish	-	-	100.0	-	100.0
Cowcod	-	-	-	100.0	-
White croaker	-	-	57.1	-	-
Swordspine rockfish	-	-	100.0	90.9	-
Speckled sanddab	-	-	-	-	54.5
Splitnose rockfish	-	-	-	100.0	-

Lea 1972), and observed fish which were discarded were often less than 12 in. (305 mm). There is no minimum size limit for rockfishes caught in California waters. Although many small fishes are kept by CPFV anglers, length is the most important factor affecting retention rates for sport fish in general.

Rosy rockfish accounted for 15% of the 5424 observed fish returned (all species); this species had an overall retention rate of 86.7% for all areas combined.

Miller and Gotshall (1965) estimated retention rates on board CPFVs in 1960 from the Bodega Bay area to Port San Luis. Retention rate of all rockfish species was 94.1%, comparable to the average rate observed for all fish in this study. Rockfishes with relatively low (<80%) retention rates in their study included rosy, greenstriped, squarespot, and stripetail, indicating that little change in angler preference among large and small rockfishes has occurred in the past 30 years.

Lingcod have had a minimum legal size of 22 in. (559 mm) since 1981. The Morro Bay area had a much lower retention rate for lingcod than other areas. Conversely, no lingcod were observed returned in the Fort Bragg area. This will be discussed later relative to length frequency.

For observed species ($n \geq 10$) other than rockfishes and lingcod, only sablefish, petrale sole, and rock sole consistently had retention rates greater than 90%. Several other species demonstrated significant regional differences. Greater than 85% of observed Pacific mackerel were retained in

the Monterey and San Francisco areas while only 18.5% were kept in the Morro Bay area. Morro Bay anglers showed a reduced preference for jack mackerel, kelp greenling, and cabezon, although length of the latter two species may have been an important factor affecting retention rate. Spiny dogfish and white croaker had low retention rates in all port areas in which they were observed. A considerable decrease in retention rate for white croaker has occurred since Miller and Gotshall's (1965) study, from 94.9% in 1960 to 57.1% in this study.

Number of Fish Measured and Maximum Lengths

Fishery Technicians measured 97,571 fishes during this study. Maximum total lengths by port for those species with at least 20 fish measured are presented in Appendix F. New maximum total lengths were recorded for copper, gopher, greenstriped, shortbelly, and squarespot rockfishes compared with those reported in Miller and Lea (1972).

Catch and Length Data for Nineteen Species

Chilipepper

Chilipepper are targeted by CPFVs in the Bodega Bay and Monterey areas and accordingly catch rates were much higher than in other areas (Table 18). A trend of decreasing CPAH was evident in the Bodega Bay area from 1988 to 1990-91 and in the Monterey area from 1987 to 1990-91, with decreases of 67% and 59%, respectively.

TABLE 18. Catch Per Angler Day and Catch Per Angler Hour for Chilipepper by Port and Year.

	Catch per angler day						Catch per angler hour					
Port area	1987	1988	1989	1990-91	1990	1991	1987	1988	1989	1990-91	1990	1991
Fort Bragg	-	-	-	-	-	-	-	-	-	-	-	-
Bodega Bay	-	2.69	1.92	0.93	3.62	0.57	-	0.87	0.59	0.29	1.04	0.18
San Francisco	-	<0.01	0.01	0.05	0.09	<0.01	-	<0.01	<0.01	0.02	0.03	<0.01
Monterey	5.26	4.70	3.91	2.06	3.27	0.73	1.71	1.50	1.29	0.70	1.22	0.23
Morro Bay	-	-	0.29	0.06	0.01	0.09	-	-	0.10	0.02	<0.01	0.03

TABLE 19. Catch Per Angler Hour and Mean Length of Chilipepper for Near and Distant Locations and Shallow and Deep Locations by Port, All Years Combined.

	Catch per angler hour				Number of fish measured				Mean total length (mm)			
Port area	Near	Distant	Shallow	Deep	Near	Dist	Shal	Deep	Near	Dist	Shal	Deep
Fort Bragg	-	-	-	-	-	-	-	-	-	-	-	-
Bodega Bay	-	.75	-	1.45	-	1001	-	440	-	393	-	392
San Francisco	-	.01	<.01	.01	-	55	1	1	-	427	300	348
Monterey	1.31	1.62	-	2.20	7815	3332	-	10112	344	334	-	342
Morro Bay	.03	.05	-	.34	151	74	-	217	329	354	-	337

TABLE 20. Mean Length of Chilipepper Caught by CPFV Anglers by Port and Year.

	Number of fish measured					Mean total length (mm)				
Port area	1987	1988	1989	1990	1991	1987	1988	1989	1990	1991
Fort Bragg	-	-	-	-	-	-	-	-	-	-
Bodega Bay	-	523	359	31	89	-	387	390	393	440
San Francisco	-	1	13	40	1	-	300	451	424	348
Monterey	3557	3485	3415	534	263	324	342	357	345	350
Morro Bay	-	-	155	-	67	-	-	329	-	354

Only in the Monterey and Morro Bay areas were chilipepper caught at both near and distant locations; in both areas CPAH was higher at distant locations (Table 19). All chilipepper in the Bodega Bay area were observed at distant locations, primarily Cordell Bank.

Of 18,547 chilipepper caught at either shallow or deep locations, all but three (in the San Francisco area) (99.98%) were taken at deep locations (Table 19).

Chilipepper were consistently larger in the Bodega Bay area compared with the Monterey and Morro Bay areas (Table 20). Those sampled in the Bodega Bay area had mean lengths at or near 390 mm (15.4 in.) from 1988 to 1990. In 1991 mean length increased almost 50 mm (2.0 in.) from the previous year.

When considering chilipepper sampled from near and distant locations, the Monterey area showed a relatively small difference of 10 mm (0.4 in.) in mean length (Table 19). However, chilipepper sampled from near locations in the Morro Bay area averaged 25 mm (1.0 in.) less than those from distant locations, indicating relatively heavy fishing pressure on stocks near port.

In a qualitative stock assessment of chilipepper, Rogers and Bence (1992) reported that a strong 1984 year class entered the California recreational fishery in 1986 and would likely influence the fishery through 1992-93.

A strong mode at 361-400 mm (14.2-15.7 in.) characterized the 1988 Bodega Bay samples (Figure 2); the following year, a

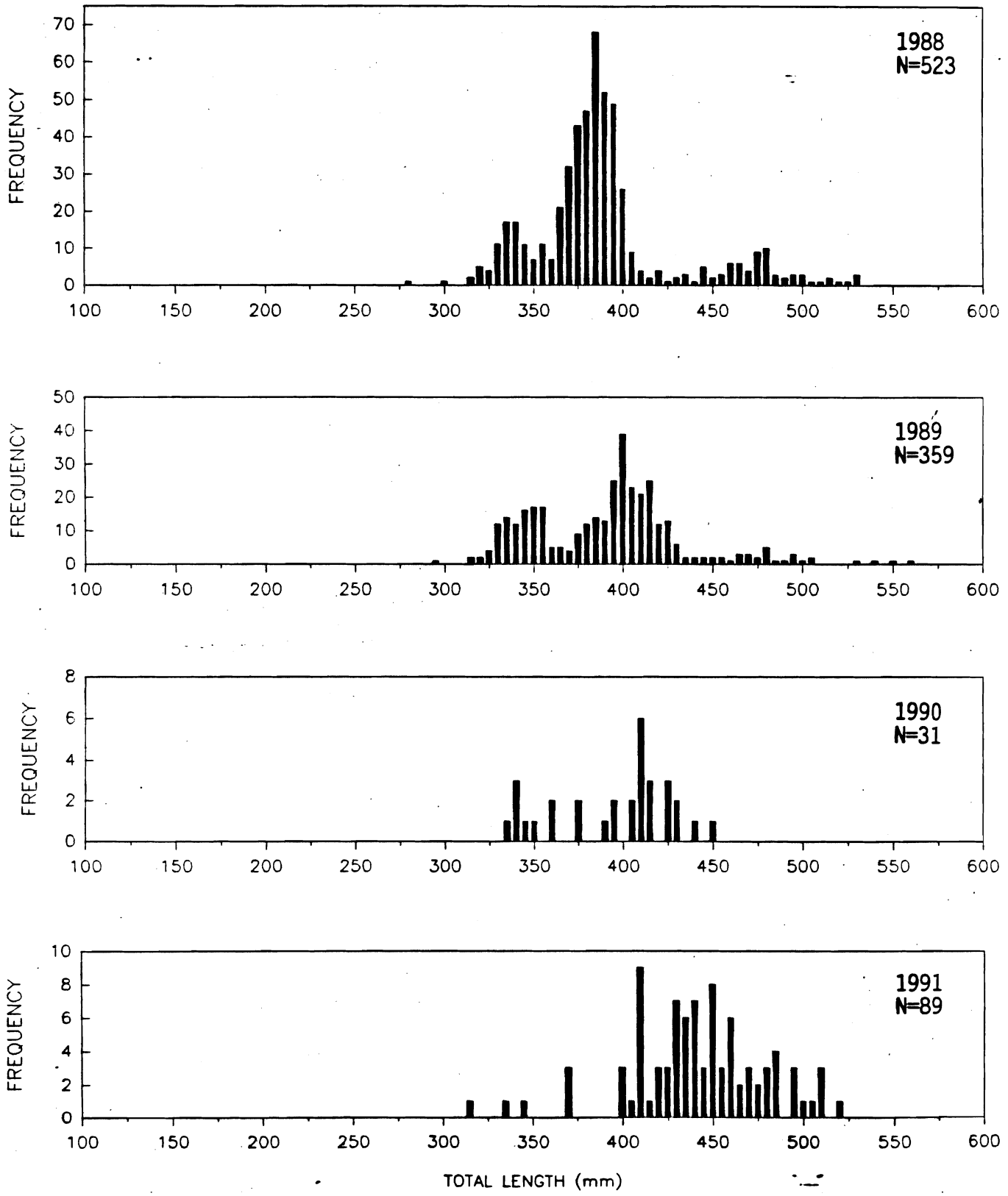

FIGURE 2. Length frequency of chilipepper from the Bodega Bay area, 1988 to 1991.

shift in the mode to 391-415 mm (15.4-16.3 in.) was likely the result of growth of one or two strong year classes and probably includes the 1984 year class. Fifty percent of male and female chilipepper are sexually mature at 310 mm (12.2 in.) and 340 mm (13.4 in.), respectively. thus, the majority of fish sampled from the Bodega Bay catch were most likely sexually mature.

The relatively few chilipepper measured in the San Francisco area in 1990 had a strong mode at 416-435 mm (16.4-17.1 in.) (Figure 3) and most likely were females from one or two strong year classes, including the 1984 year class.

A different length distribution was evident for chilipepper sampled from the Monterey area (Figure 4). In 1987 the majority of fish were in the 296- to 350-mm (11.7- to 13.8-in.) length range. Thus, a significant proportion of the catch was comprised of sexually immature fish. A shift in the mode to 341-365 mm (13.4-14.4 in.), and then to 371-395 mm (14.6-15.6 in.) occurred during the next 2 years; it is likely that the 1984 year class was well represented here. In 1989, a second mode was evident at 326-355 mm (12.8-14.0 in.). These fish first appeared in 1988 as a smaller mode at 266-300 mm (10.5-11.8 in.). In this length range, annual growth of 50-60 mm (2.0-2.4 in.) is typical for both sexes (Wilkins 1980). Another pulse of recruitment was evident in 1990 in the 221- to 265-mm (8.7- to 10.4-in.) length range (Figure 4). By 1990 the distribution of length frequencies was much more widespread than in 1987, indicating a mixture of year classes.

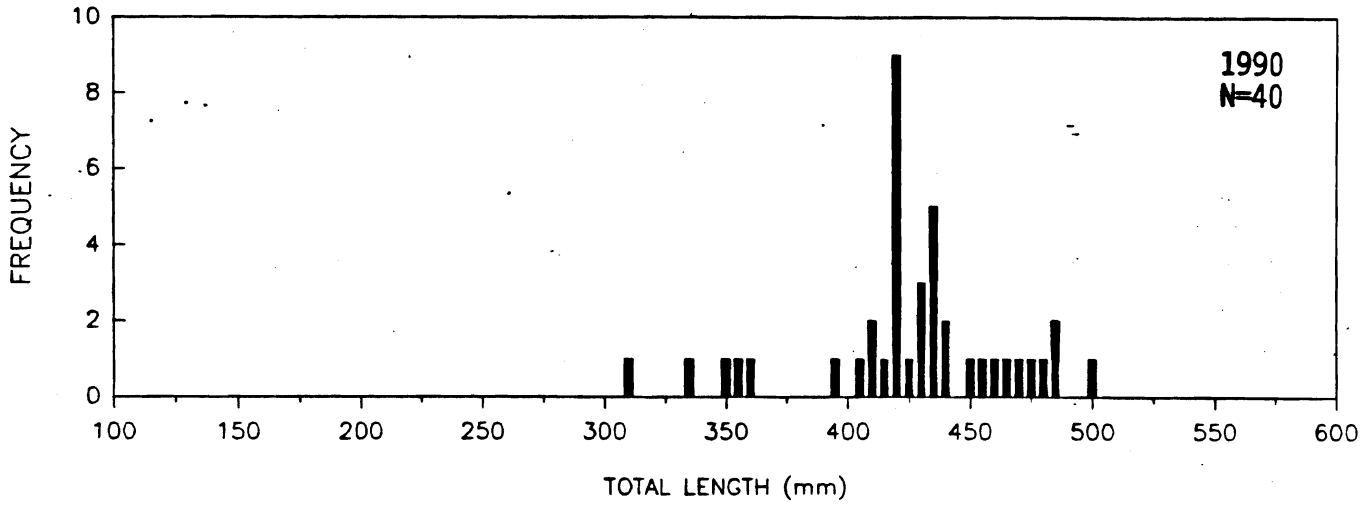

FIGURE 3. Length frequency of chilipepper from the San Francisco area in 1990.

Mean length varied by only 15 mm (0.6 in.) from 1988 to 1991, another indication of several well-represented year classes.

The 1988 Morro Bay sample showed a relatively high percentage of sexually immature fish less than 301 mm (11.9 in.) (Figure 5) compared with other port areas. In 1991, similar to the Bodega Bay and Monterey areas, a strong showing of larger fish, most of these probably females, occurred in the 396- to 455-mm (15.6- to 17.9-in.) length range.

Total length at 100% sexual maturity was reported to be 380 mm (15.0 in.) for males and 390 mm (15.4 in.) for females (Wyllie-Echeverria 1987). Length frequency data from the Monterey and Morro Bay areas in this study indicated that the majority of chilipepper were less than these lengths. A biological assessment of Pacific Coast chilipepper stocks was completed in 1986 and the resource was reported in good condition

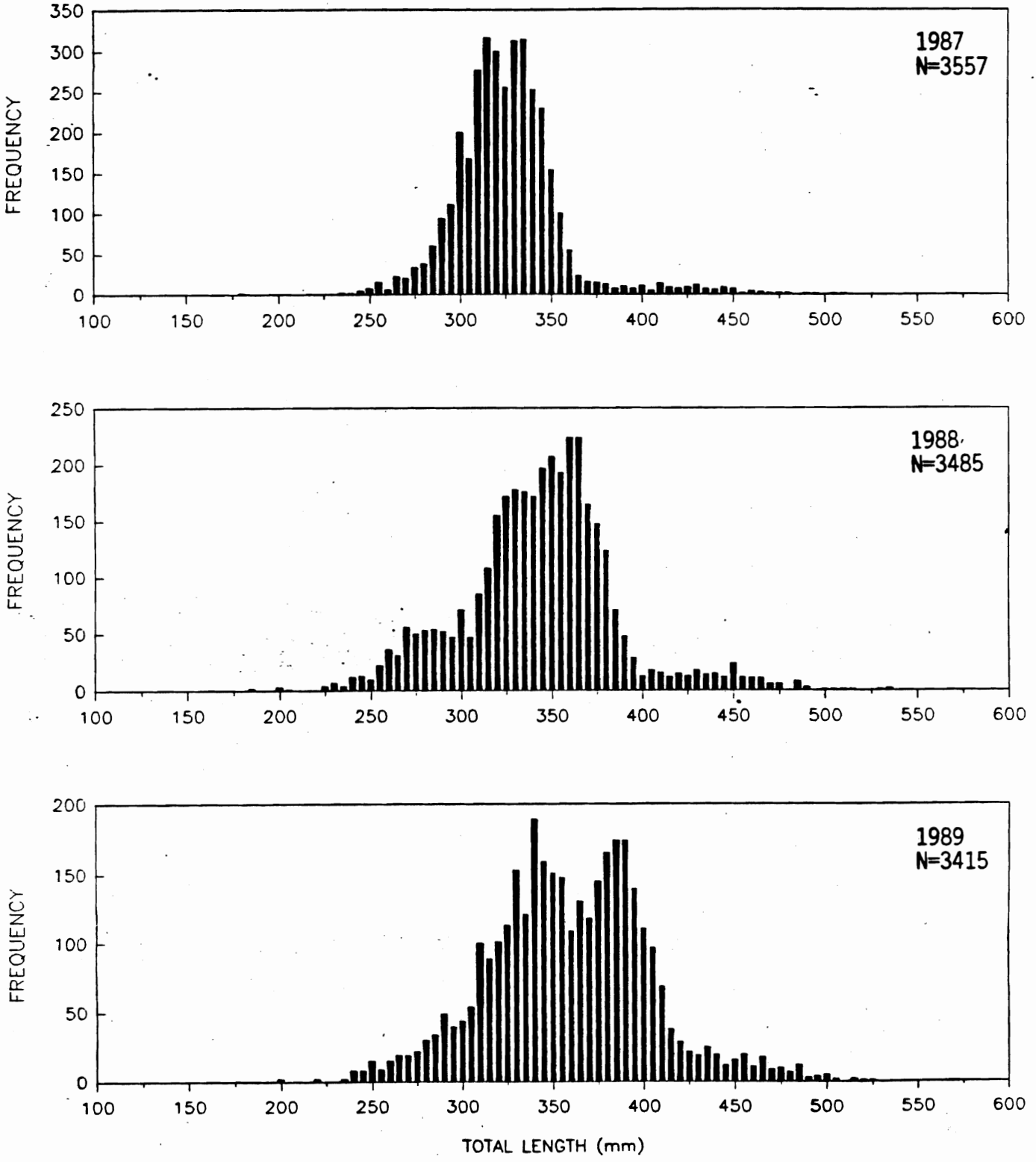

FIGURE 4. Length frequency of chilipepper from the Monterey area, 1987 to 1991.

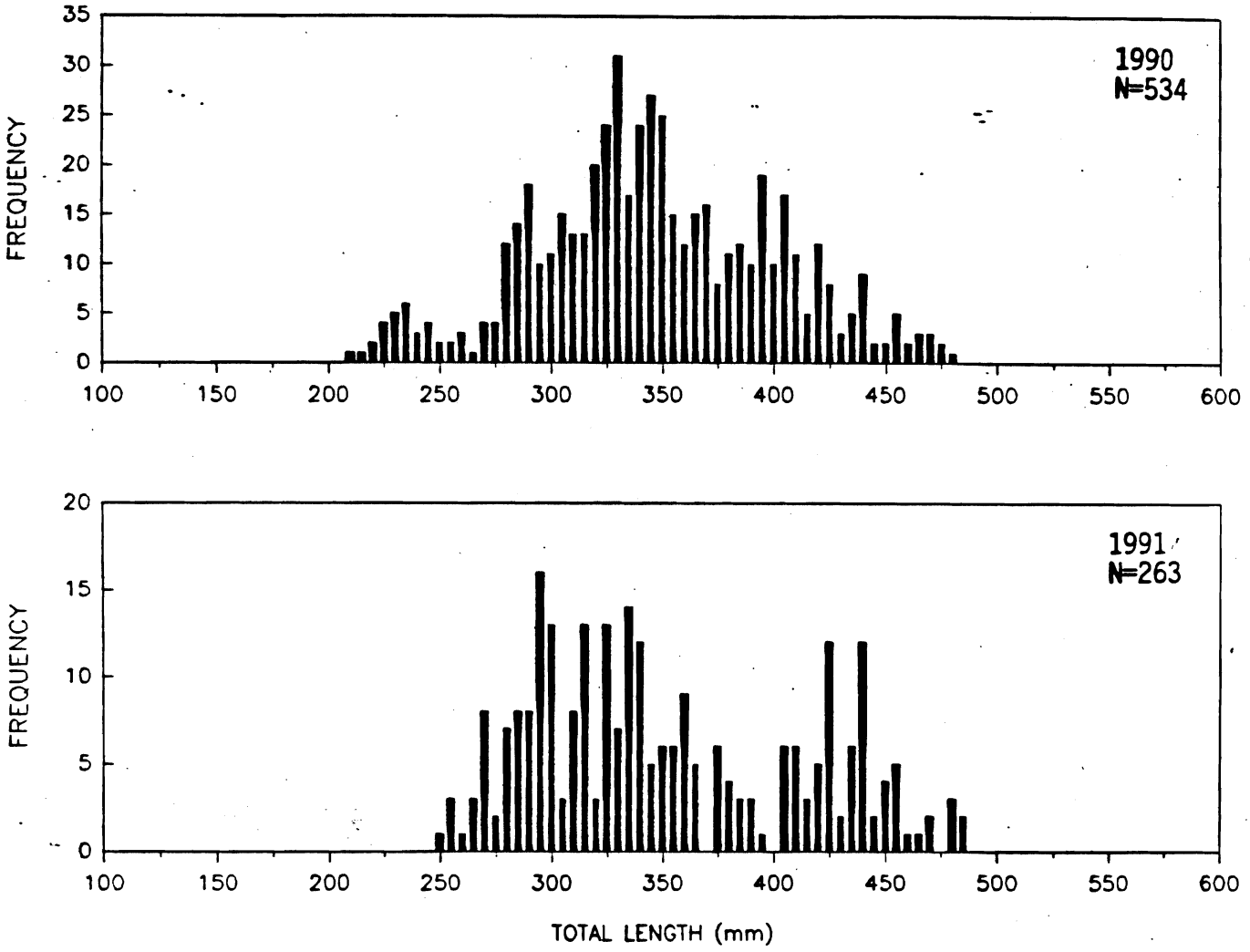

FIGURE 4. (continued).

up to that time (Pacific Fisheries Management Council 1990). Rogers and Bence (1992) reported that, due to the strong 1984 year class, the stock of chilipepper in California waters was stable or increasing until 1989. However, a high proportion of sexually immature fish occurred in the CPFV catch from two port areas from 1987 to 1991.

In addition, reported annual California commercial landings

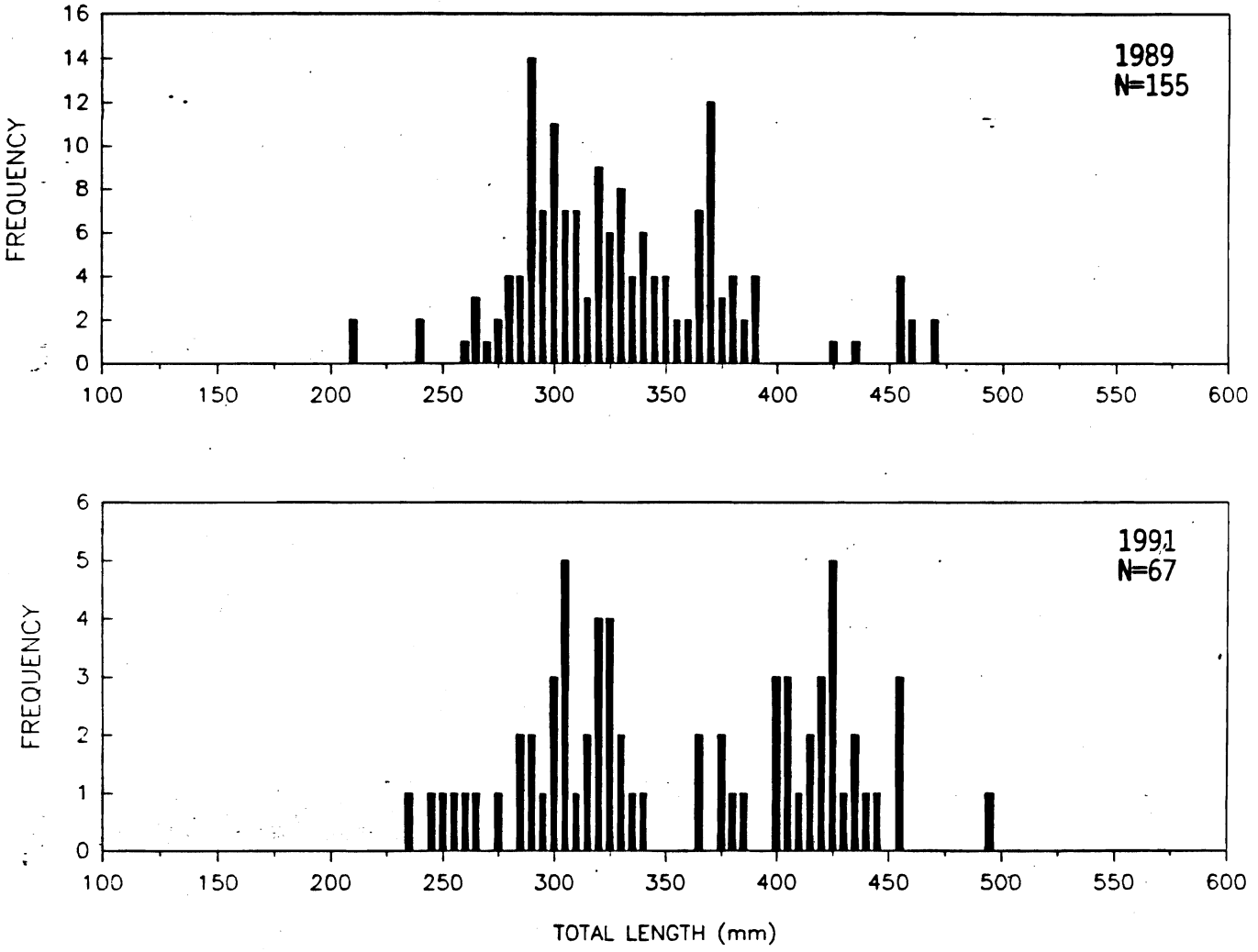

FIGURE 5. Length frequency of chilipepper from the Morro Bay area in 1989 and 1991.

have increased since 1986 (Oda 1992). Chilipepper were not separated from the bocaccio/chilipepper group for reporting purposes until 1991. That year, landings were approximately 1.9 million lb and in 1992 were approximately 3.3 million lb (Dept. Fish and Game, Marine Fisheries Statistics Unit, Long Beach, unpubl. data). Due to the migratory nature of this species and its vulnerability to midwater trawling and, as of 1992, troll

longlining (J. Mello, Dept. Fish and Game, Bodega Bay, pers. comm.), stocks fished seasonally by CPFVs may also sustain heavy commercial fishing pressure in the same or other areas. Thus, the observed declines in CPAH and the high proportion of immature fish caught in the Monterey and Morro Bay areas during this study may be related to increased commercial fishing pressure and are a cause for concern.

Blue Rockfish

Blue rockfish catch rates were highly variable among port areas for a given year and among years (Table 21). Highest mean CPAH was observed in the Fort Bragg area in 1988, but only three trips were sampled. CPAH declined in all areas sampled except Morro Bay from 1988 to 1990-91. The drastic decline in the Bodega Bay area was in part due to a shift in effort from shallow to deep locations (Table 3). The Morro Bay area showed a 64% increase in CPAH for blue rockfish from 1988 to 1990-91.

Catch rates were higher at distant locations compared with near locations for the Fort Bragg, Bodega Bay, and Morro Bay areas (Table 22). For the latter two areas, CPAH was approximately twice as high at distant locations. Catch rates were higher at near locations in the San Francisco and Monterey areas. This is directly related to a relatively high proportion of near locations also being shallow locations, where blue rockfish are relatively more abundant, in these areas. In all port areas, blue rockfish CPAH was much higher

TABLE 21. Catch Per Angler Day and Catch Per Angler Hour for Blue Rockfish by Port and Year.

Port area	Catch per angler day						Catch per angler hour					
	1987	1988	1989	1990-91	1990	1991	1987	1988	1989	1990-91	1990	1991
Fort Bragg	-	7.31	2.62	3.84	0.27	4.41	-	3.38	0.99	1.34	0.10	1.53
Bodega Bay	-	2.62	2.41	0.03	-	0.03	-	0.85	0.74	0.01	-	0.01
San Francisco	-	2.30	1.49	1.84	1.92	1.72	-	0.64	0.42	0.53	0.57	0.47
Monterey	2.41	3.51	1.85	1.13	0.39	1.94	0.78	1.12	0.61	0.39	0.15	0.61
Morro Bay	-	1.35	1.55	2.10	1.00	2.79	-	0.39	0.54	0.64	0.30	0.87

TABLE 22. Catch Per Angler Hour and Mean Length of Blue Rockfish for Near and Distant Locations and Shallow and Deep Locations by Port, All Years Combined.

Port area	Catch per angler hour				Number of fish measured				Mean total length (mm)			
	Near	Distant	Shallow	Deep	Near	Dist	Shal	Deep	Near	Dist	Shal	Deep
Fort Bragg	1.56	1.80	1.99	.26	351	64	220	3	324	354	317	372
Bodega Bay	.35	.74	2.07	.01	42	790	935	7	305	321	322	344
San Francisco	.89	.46	.89	-	960	2897	2615	-	313	296	282	-
Monterey	.89	.51	2.03	.01	4578	990	1211	12	291	296	289	305
Morro Bay	.46	.92	.69	.19	3650	869	1239	80	287	287	290	309

TABLE 23. Mean Length of Blue Rockfish Caught by CPFV Anglers by Port and Year.

Port area	Number of fish measured					Mean total length (mm)				
	1987	1988	1989	1990	1991	1987	1988	1989	1990	1991
Fort Bragg	-	127	35	5	248	-	358	364	273	310
Bodega Bay	-	377	648	-	17	-	293	342	-	323
San Francisco	-	1803	1543	591	316	-	297	298	303	295
Monterey	1538	2450	1285	103	428	283	296	296	286	291
Morro Bay	-	1031	1455	302	1909	-	282	291	299	287

at shallow compared with deep locations (Table 22). For example, in the San Francisco area, no blue rockfish were taken at deep locations, and in the Bodega Bay and Monterey areas, CPAH was approximately 200 times higher at shallow locations.

No port area showed a consistent decrease or increase in mean length during the sampling period (Table 23). Mean length varied by less than 20 mm (0.8 in.) among all years sampled for the San Francisco, Monterey, and Morro Bay areas.

For the more southern port areas of San Francisco to Morro Bay, mean length of blue rockfish from distant locations showed no consistent trend (Table 22) compared with near locations. However, in the Fort Bragg and Bodega Bay areas, fish from distant locations averaged 30 mm (1.2 in.) and 16 mm (0.6 in.), respectively, greater than those from near locations, indicating less fishing pressure in the former locations.

Mean length of blue rockfish from deep locations in the Morro Bay area was greater than that from shallow locations (Table 22).

In 1988, mean length from the Fort Bragg area was 358 mm (14.1 in.), more than 60 mm (2.4 in.) greater than any other port area that year. The length frequency distribution showed few fish less than 300 mm (11.8 in.) (Figure 6). By 1991, a major shift towards smaller, immature fish had occurred and mean length decreased by 48 mm (1.9 in.). Wyllie-Echeverria (1987) reported the length at 50% sexual maturity to be 280 mm

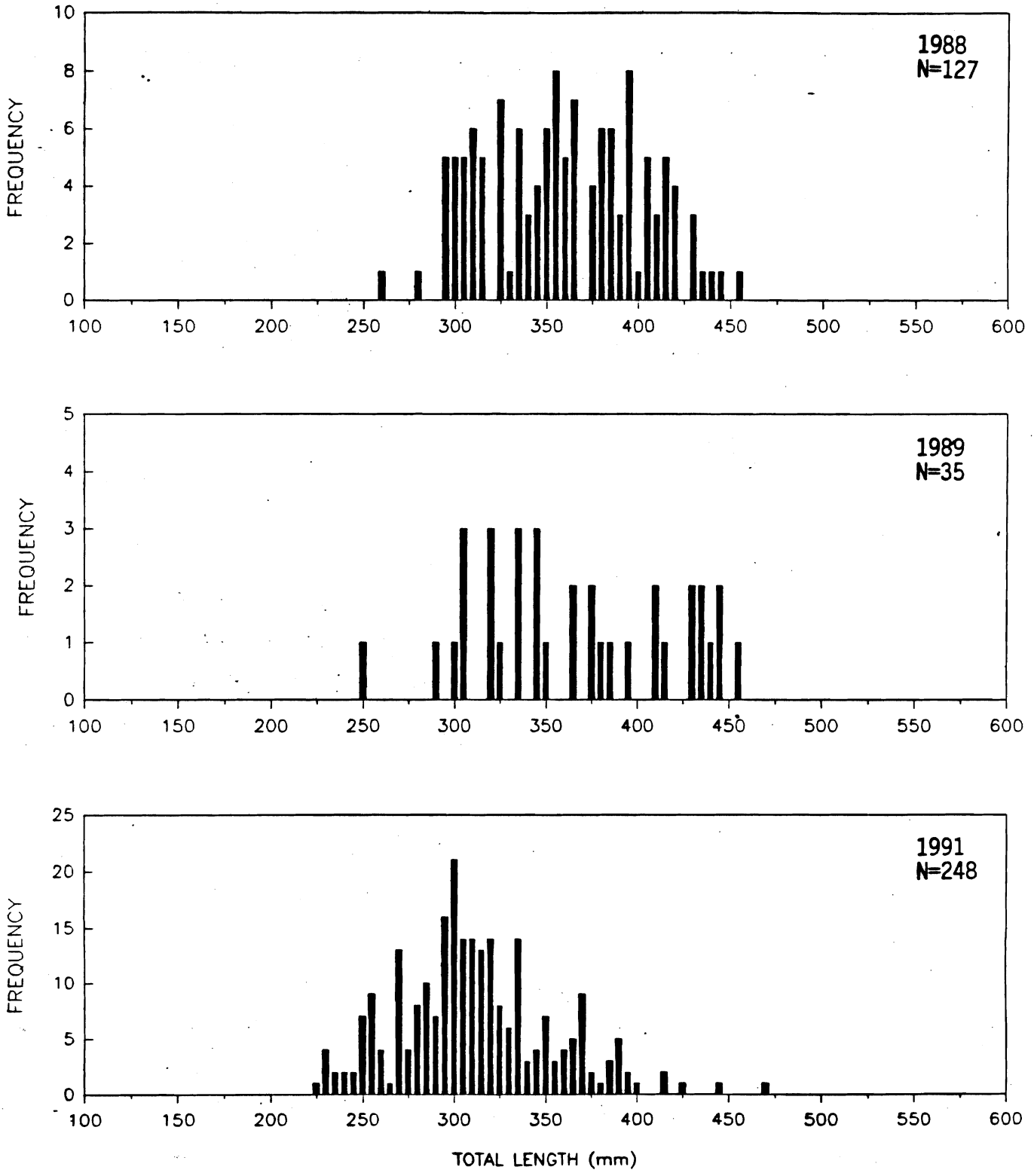

FIGURE 6. Length frequency of blue rockfish from the Fort Bragg area in 1988, 1989, and 1991.

(11.0 in.) for males and 290 mm (11.4 in.) for females.

Bodega Bay area blue rockfish samples in 1988 showed a radically different distribution of sampled lengths compared with Fort Bragg, characterized by a bimodality with many fish less than 275 mm (10.8 in.) (Figure 7). In 1989, these smaller fish were scarce, the sampled population had a single mode, and mean length had increased 51 mm (2.0 in.) from the previous year. The mode at 326-345 mm (12.8-13.6 in.) was likely a result of growth of one or more strong year classes, which ranged from 296 to 315 mm (11.7 to 12.4 in.) in 1988.

Although mean length varied little in the San Francisco area during the sampling period, length frequency distribution indicated a pulse of recruitment entering the fishery in 1989 (Figure 8) with lengths ranging from 231 to 265 mm (9.1 to 10.4 in.). By 1991, a unimodal distribution was apparent with few fish larger than 370 mm (14.6 in.; Figure 8).

Blue rockfish sampled from the Monterey area showed remarkably similar mean lengths and length frequency distributions from 1987 to 1991. Mean length varied only 13 mm (0.5 in.) during the 5 years (Table 22). The majority of fish were in the 250- to 350-mm (9.8- to 13.8-in.) length range and exhibited a single mode (Figure 9). Based on length-age data from Miller and Geibel (1973), this length range corresponds to a relatively wide age range of 5 to 12 years and thus indicates a good mix of year classes with relatively constant recruitment.

Blue rockfish sampled from the Morro Bay area exhibited a

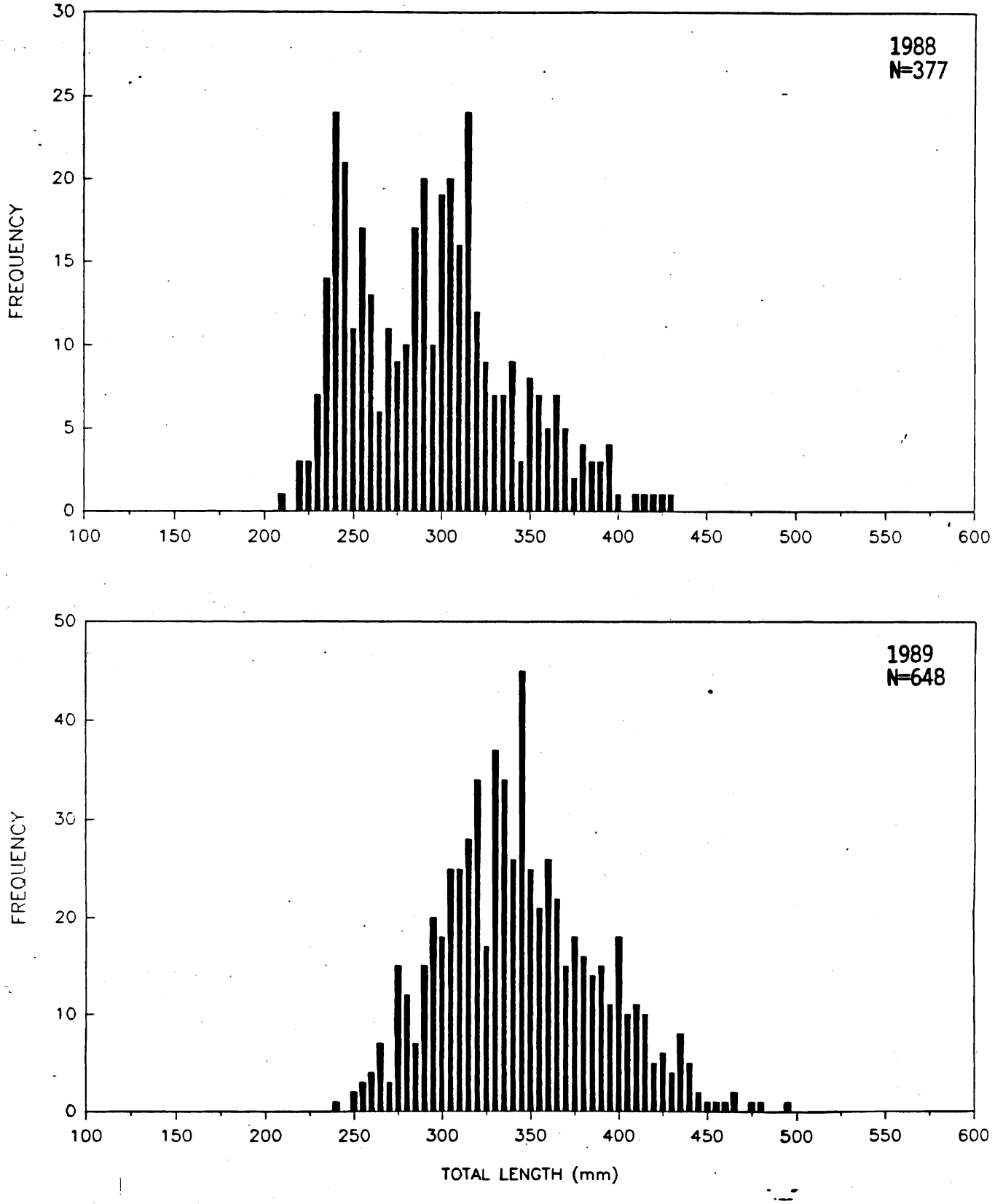

FIGURE 7. Length frequency of blue rockfish from the Bodega Bay area in 1988 and 1989.

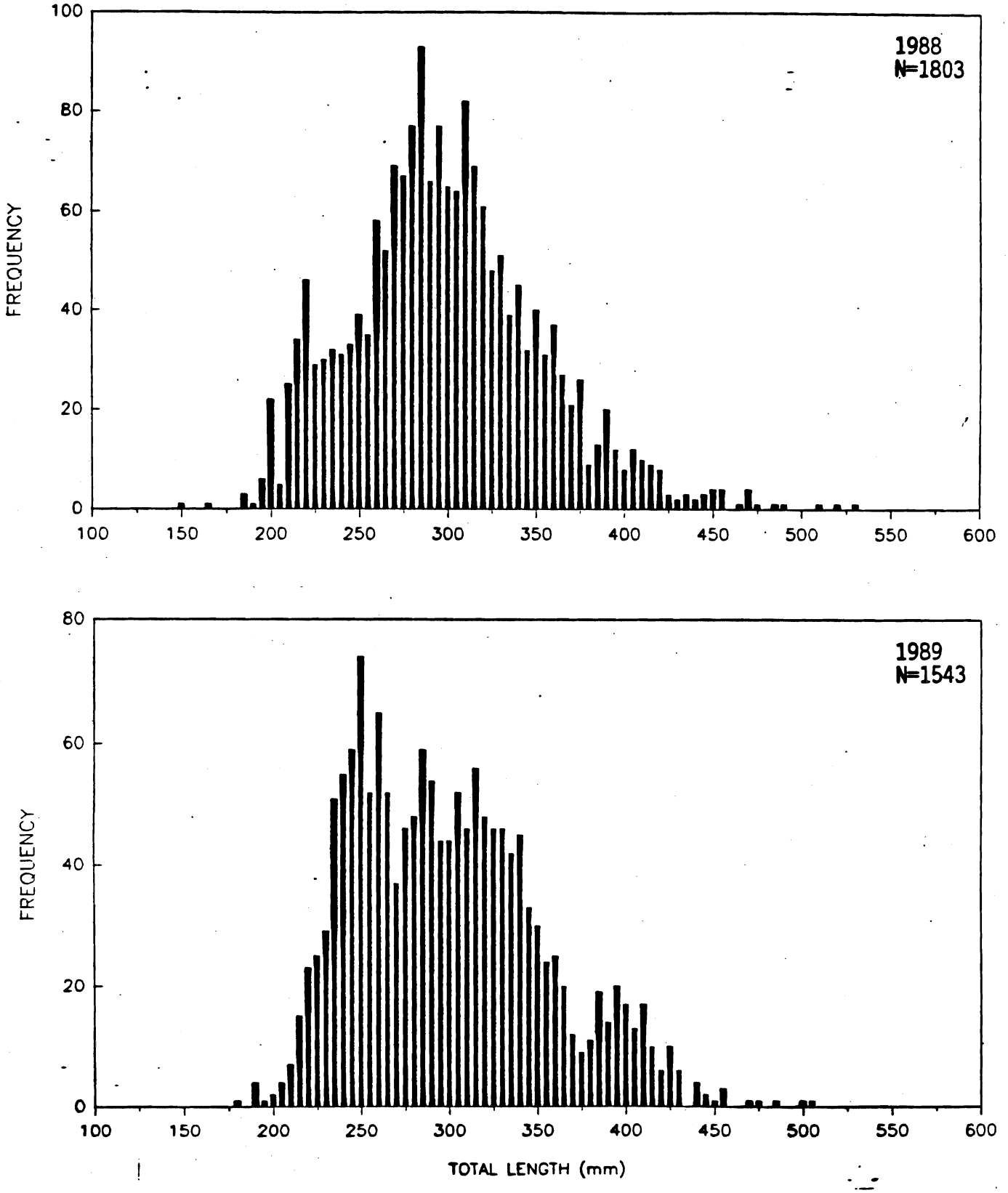

FIGURE 8. Length frequency of blue rockfish from the San Francisco area, 1988 to 1991.

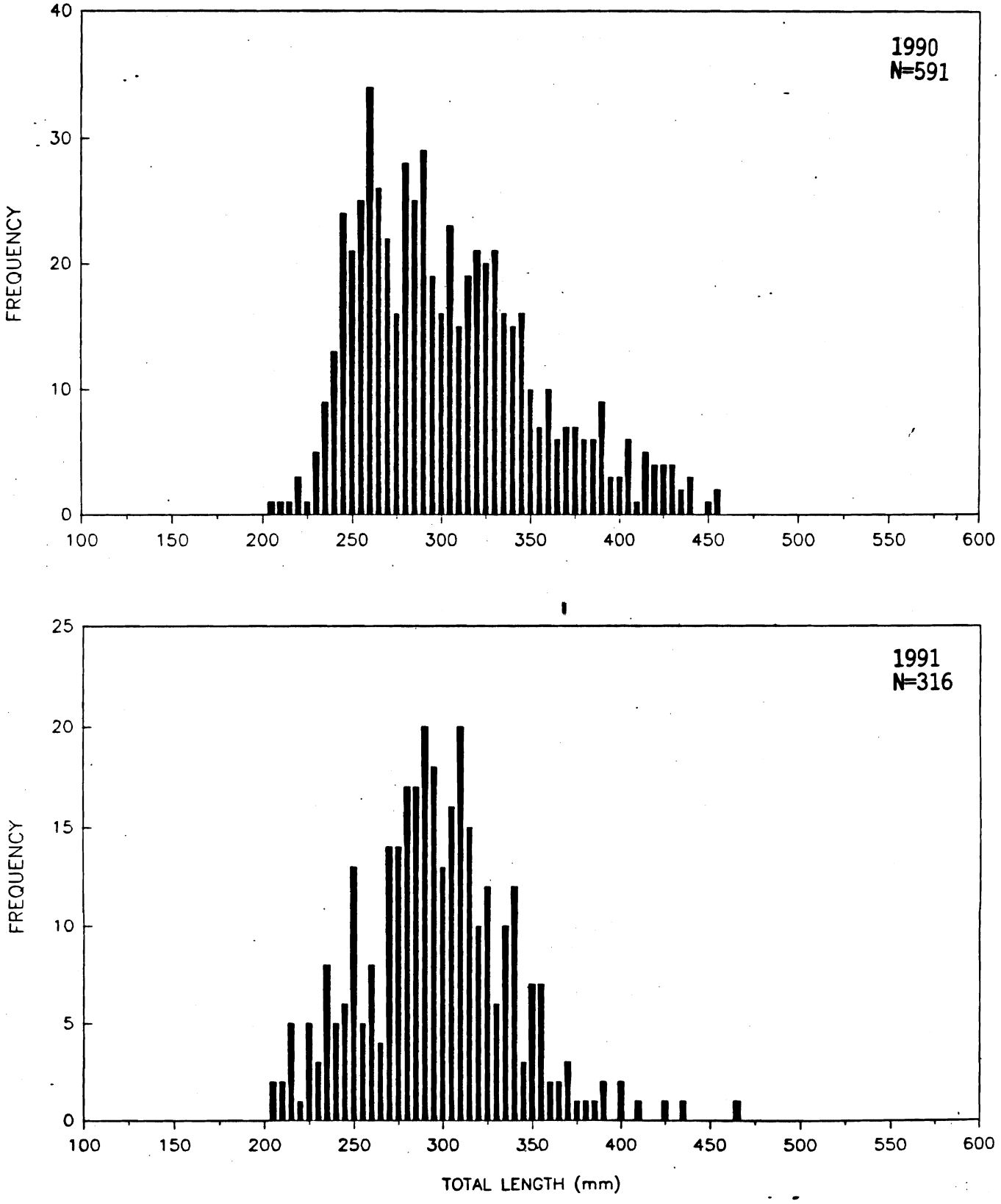

FIGURE 8. (continued).

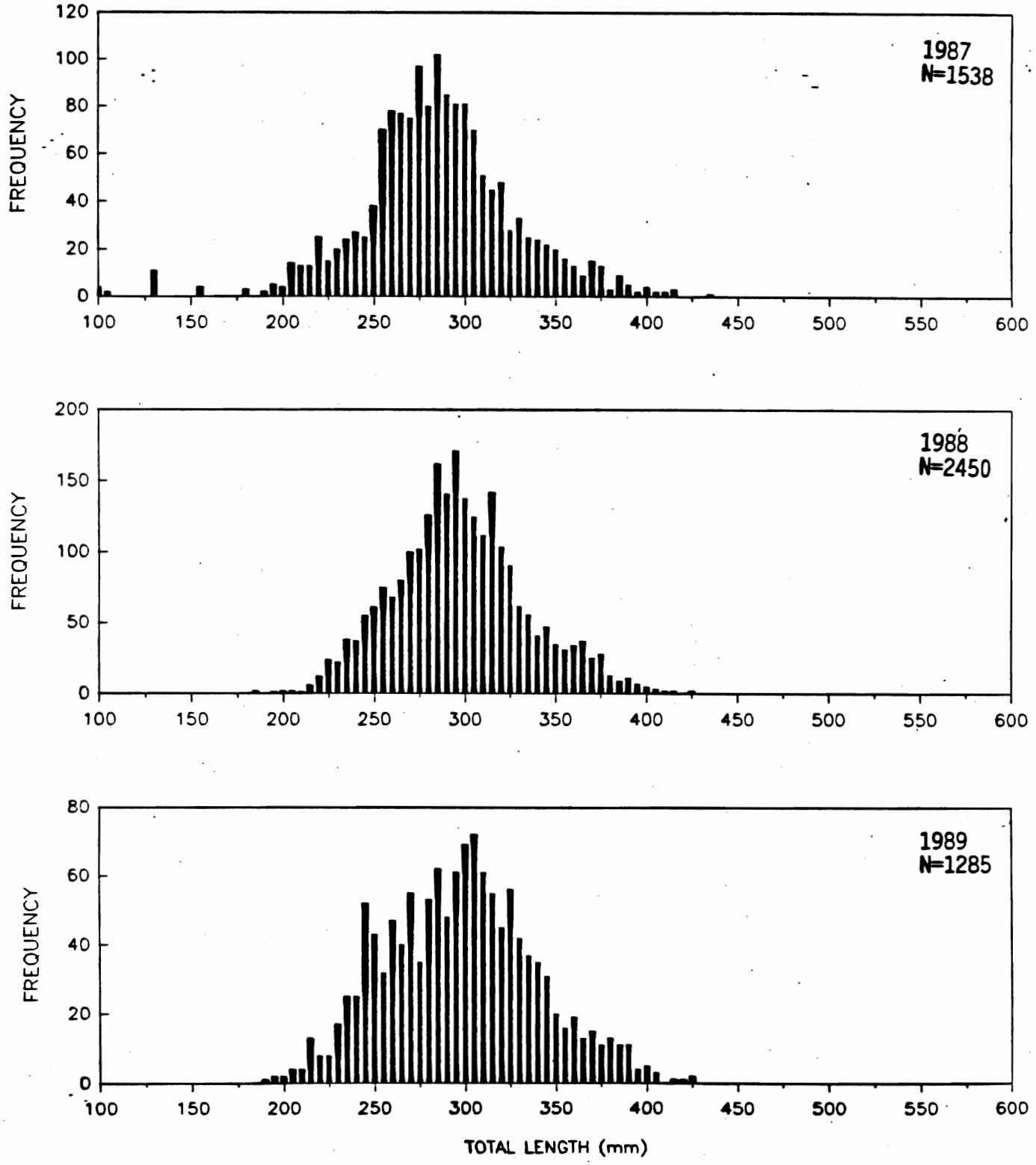

FIGURE 9. Length frequency of blue rockfish from the Monterey area, 1987 to 1991.

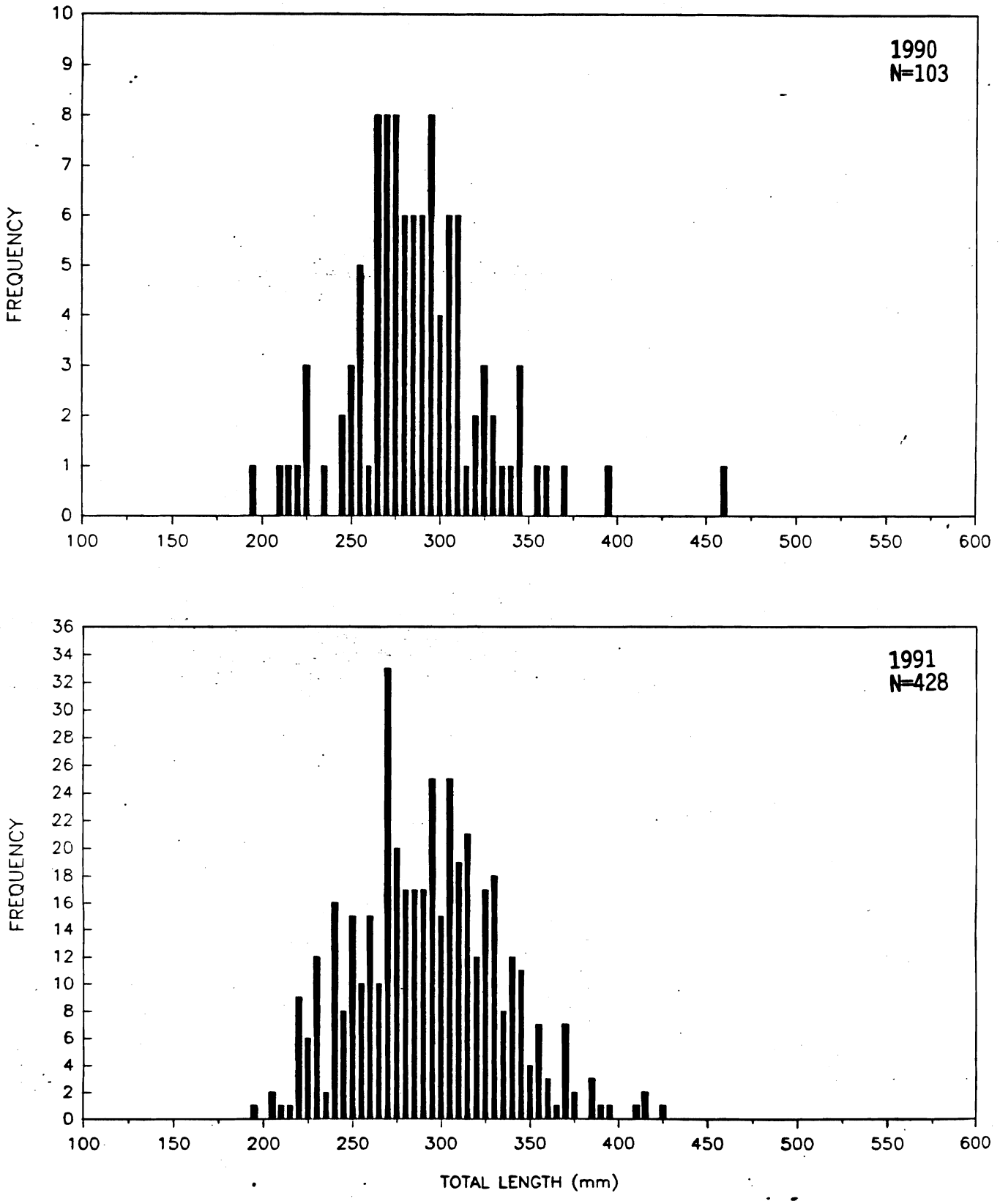

FIGURE 9. (continued).

length frequency distribution (Figure 10) similar to that of the Monterey area, although in 1988 comparatively fewer fish were caught greater than 340 mm (13.4 in.). This resulted in the smallest mean length of any port and year sampled during the study (Table 22).

Miller and Geibel (1973) sampled the CPFV blue rockfish fishery extensively from 1960 to 1970 in the Año Nuevo, Monterey, and Morro Bay areas (Figure 1). Mean length of 37,437 blue rockfish from the Año Nuevo and Monterey areas averaged 289 mm (11.4 in.), compared with a mean length of 292 mm (11.5 in.) for 5804 fish sampled from the Monterey area in this study. Annual mean length of fish from Miller and Geibel's study varied from 255 to 311 mm (10.0 to 12.2 in.) in the Año Nuevo area and from 267 to 314 mm (10.5 to 12.4 in.) in the Monterey area and was heavily influenced by periodic influxes of smaller fish. They reported a slight decline in mean length for CPFV-caught fish during their 10-year study and noted that the fishery was becoming more dependent on incoming small fish as CPFV operators continued to locate semi-isolated stocks of older and larger blue rockfish.

Miller and Geibel measured 11,159 blue rockfish from the Morro Bay CPFV fishery and found a mean length of 304 mm (12.0 in.). This is 16 mm (0.6 in.) greater than the 288-mm (11.3-in.) mean length observed in this study. They reported a general decline in mean length from 1960 to 1970 but observed larger than average fish compared with most other ports. For example, fish sampled from 1960 to 1962 averaged 316 mm (12.4

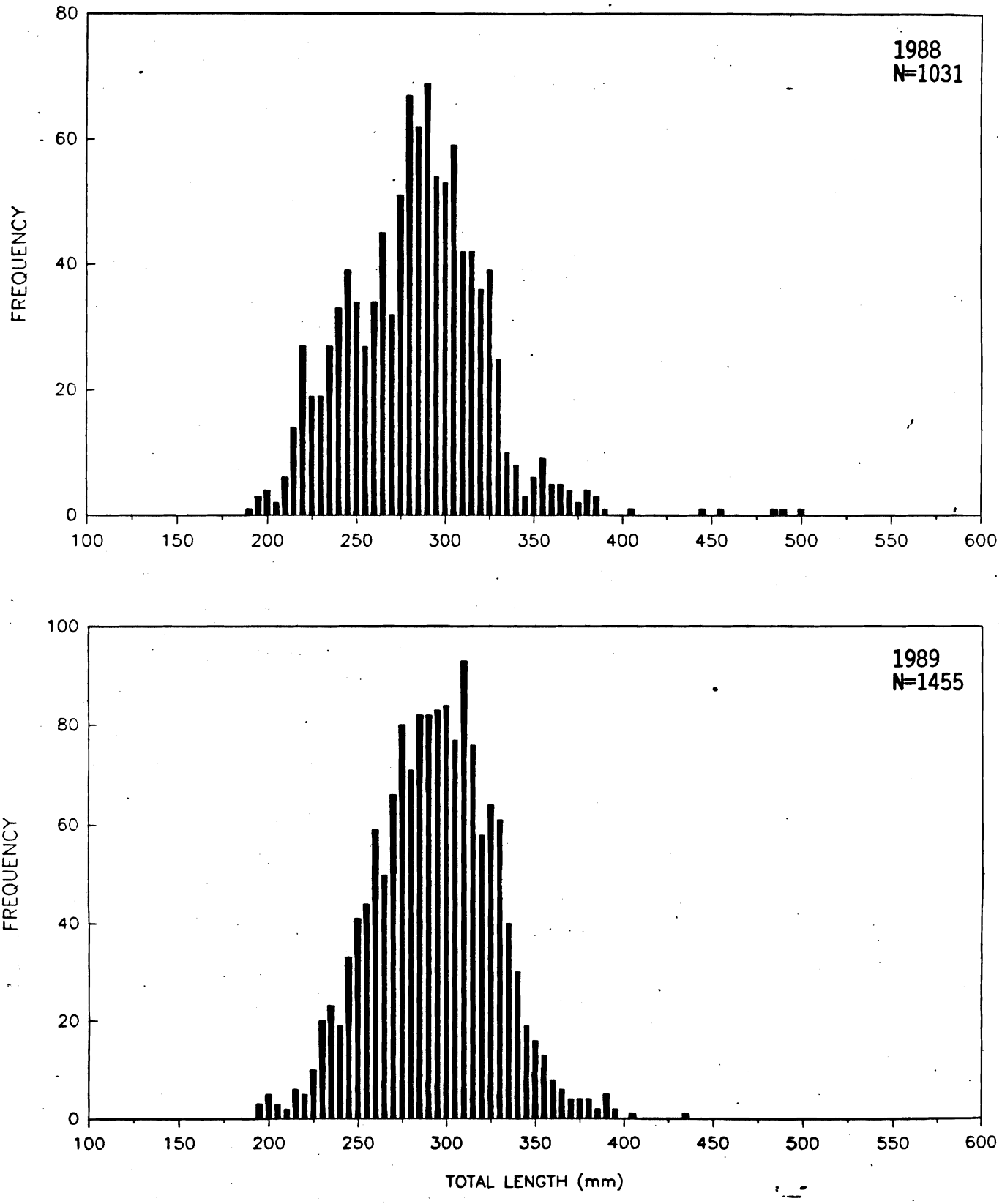

FIGURE 10. Length frequency of blue rockfish from the Morro Bay area, 1988 to 1991.

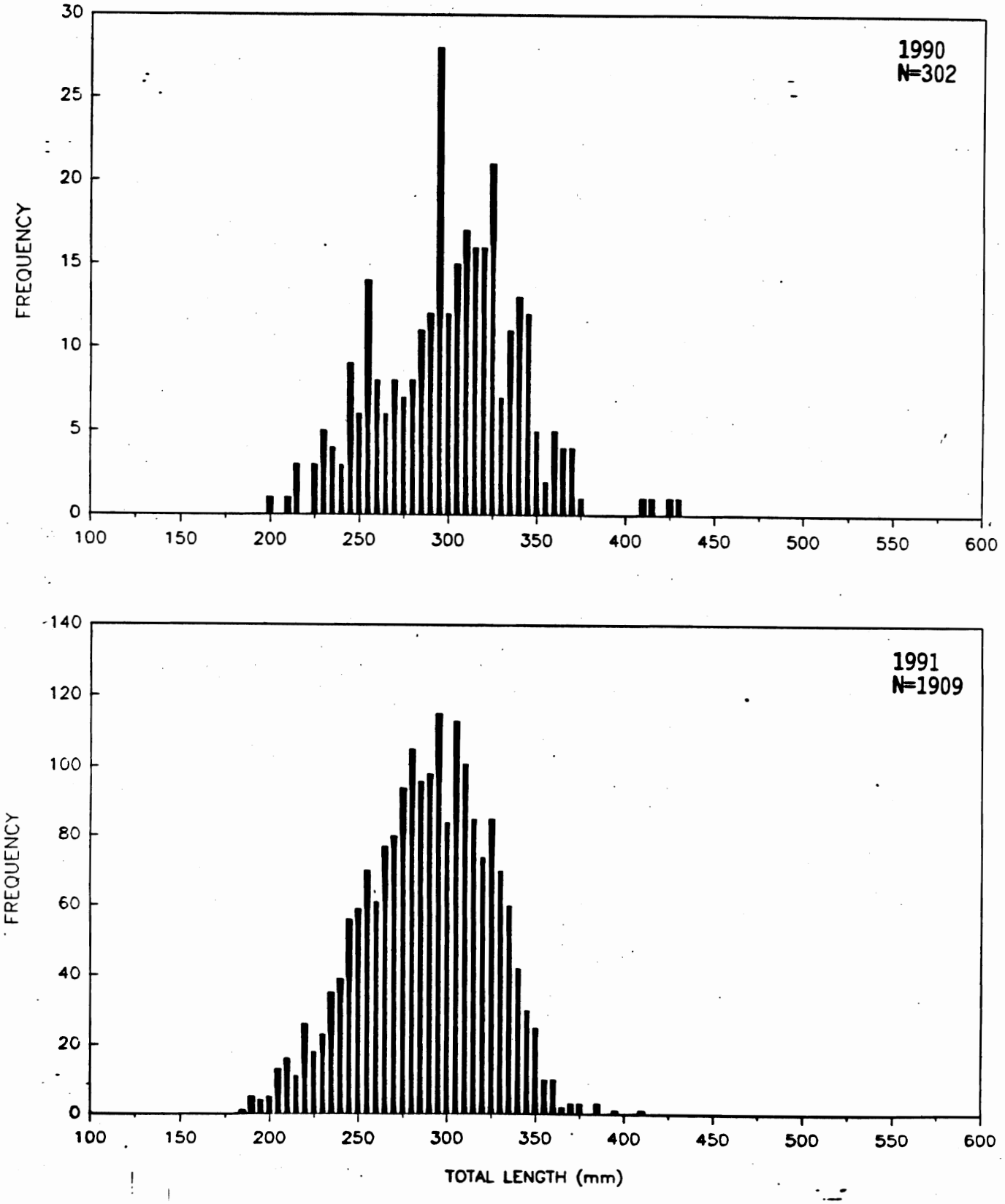

FIGURE 10. (continued).

in.) but from 1967 to 1970 mean length was only 294 mm (11.6 in.).

Thus, 20 years later it appears that the CPFV blue rockfish fishery in the Monterey and Morro Bay areas has stabilized, under heavy fishing pressure, with an average length fish of 290 to 300 mm (11.4 to 11.8 in.), a high proportion of sexually immature fish, and relatively few older and larger (> 350 mm (13.8 in.) fish available.

Local areas in central California, particularly the nearshore area of southern Monterey Bay, continue to show the effects of extreme fishing pressure largely due to the private skiff and diver modes. Mean length of blue rockfish caught by hook-and-line sport anglers in this area south to Yankee Point (approximately 10 naut. mi. from the port of Monterey) declined from 319 mm (12.6 in.) in the 1978-1983 period to 239 mm (9.4 in.) in 1986-1987 (R. Lea, Dept. Fish and Game, Monterey, unpubl. data). The latter length is well below that reported for 50% sexual maturity. This area is the primary destination of private skiffs fishing from Monterey and is occasionally fished by CPFVs.

Yellowtail Rockfish

Yellowtail rockfish had relatively high catch rates in all port areas in all years sampled (Table 24) and is considered a staple of the CPFV industry. The Fort Bragg and Bodega Bay areas generally had higher CPAH rates. All port areas showed increases in CPAH ranging from 17% to 321% from

TABLE 24. Catch Per Angler Day and Catch Per Angler Hour for Yellowtail Rockfish by Port and Year

	Catch per angler day						Catch per angler hour					
Port area	1987	1988	1989	1990-91	1990	1991	1987	1988	1989	1990-91	1990	1991
Fort Bragg	-	1.19	5.83	3.75	11.09	2.56	-	0.55	2.19	1.31	4.11	0.89
Bodega Bay	-	1.45	3.39	6.24	3.12	6.65	-	0.47	1.04	1.98	0.89	2.14
San Francisco	-	1.14	2.89	2.68	2.35	3.17	-	0.32	0.81	0.77	0.70	0.86
Monterey	1.57	1.89	1.74	2.06	1.50	2.67	0.51	0.60	0.57	0.70	0.56	0.83
Morro Bay	-	1.68	2.52	2.52	3.96	1.62	-	0.49	0.88	0.77	1.17	0.51

TABLE 25. Catch Per Angler Hour and Mean Length of Yellowtail Rockfish for Near and Distant Locations and Shallow and Deep Locations by Port, All Years Combined.

	Catch per angler hour				Number of fish measured				Mean total length (mm)			
Port area	Near	Distant	Shallow	Deep	Near	Dist	Shal	Deep	Near	Dist	Shal	Deep
Fort Bragg	1.34	1.67	.90	1.89	387	84	168	34	371	307	350	450
Bodega Bay	1.38	.82	.83	.83	217	1552	503	605	328	406	324	423
San Francisco	.96	.56	.18	.77	1234	4207	531	212	315	352	290	368
Monterey	.62	.46	.44	.32	3737	1119	241	1883	329	358	298	361
Morro Bay	.70	.54	.32	1.20	5064	420	292	426	285	330	308	323

TABLE 26. Mean Length of Yellowtail Rockfish Caught by CPFV Anglers by Port and Year.

	Number of fish measured					Mean total length (mm)				
Port area	1987	1988	1989	1990	1991	1987	1988	1989	1990	1991
Fort Bragg	-	28	108	114	221	-	415	420	391	308
Bodega Bay	-	340	818	32	625	-	380	377	434	413
San Francisco	-	1164	2772	755	814	-	341	343	340	348
Monterey	1230	1369	1809	358	737	332	315	337	351	373
Morro Bay	-	1228	2282	1192	1109	-	281	287	293	299

1988 to 1990-91.

Comparison of near and distant location catch rates indicated that CPFV operators did not have to travel far in order to locate schools of yellowtail rockfish (Table 25); only in the Fort Bragg area did CPAH for distant locations exceed that of near locations.

Except for the Monterey area, CPAH at deep locations was equal to or greater than that of shallow locations (Table 25). Monterey area CPFVs target on chilipepper at deep locations and catch rate for yellowtail rockfish may not indicate true abundance relative to depth.

Mean length of yellowtail rockfish varied by 112 mm (4.4 in.) and 57 mm (2.2 in.), respectively, in the Fort Bragg and Bodega Bay areas from 1988 to 1991 (Table 26). In contrast, mean length varied by only 8 mm (0.3 in.) for San Francisco area samples from 1988 to 1991. Monterey area yellowtail rockfish samples demonstrated a steady increase in mean length from 315 mm (12.4 in.) in 1988 to 373 mm (14.7 in.) in 1991. Those sampled from the Morro Bay area showed a consistently smaller mean length compared with other port areas, although a small but steady increase occurred in mean length during the study period.

Although yellowtail rockfish are widely distributed in the northeast Pacific Ocean, their center of abundance is in waters from northern California to British Columbia (Alverson et al. 1964; Westrheim 1970). They are uncommon in the CPFV catch south of Santa Barbara County (30 to 85 miles south of

Morro Bay; Ally et al. 1991). Fraidenburg (1980) observed a north to south latitudinal cline of decreasing size and age for yellowtail rockfish from Oregon and California. Only in 1988 and 1989 was a consistent trend observed of decreasing mean length with decreasing latitude for all port areas (Table 26).

In contrast to angler CPAH data, mean length of yellowtail rockfish from distant locations was greater than that from near locations for all port areas except Fort Bragg (Table 25), indicating reduced fishing pressure in distant locations. Differences ranged from 29 to 78 mm (1.1 to 3.1 in.).

A dramatic difference in mean length between deep and shallow locations was evident for all port areas (Table 25), with mean length at deep locations as much as 100 mm (3.9 in.) greater than those at shallow locations. This may be a form of isothermic submergence, described by Briggs (1974), in which larger individuals of certain species occurred at greater depths (and colder temperatures) in areas of warmer water, such as the Southern California Bight. In this area, Love et al. (1990) found juvenile yellowtail rockfish at 30 to 129 m (99 to 426 ft) depth, while adults first appeared at 120 m (396 ft). Many other rockfish species exhibited similar behavior. Love et al. considered this to be characteristic of northern species seeking colder water in the southern part of their range. Lea et al. (1993) described ontogenetic movement of young-of-the-year yellowtail rockfish from shallow to deep

water in central California.

Length frequency distributions for the Fort Bragg area indicated a wide length range of fish were available to CPFV anglers from 1988 to 1990 (Figure 11). In 1991, when a high percentage of sampled trips went to shallow locations, yellowtail rockfish greater than 400 mm (15.7 in.) were almost nonexistent, mean length decreased 83 mm (3.3 in.) from that of 1990, and most fish were sexually immature. Wyllie-Echeverria (1987) reported length at 50% sexual maturity to be 340 mm (13.4 in.) for males and 370 mm (14.6 in.) for females. However, only one trip was sampled in 1990.

Yellowtail rockfish from the Bodega Bay area showed a strong bimodal, and possibly trimodal, length frequency distribution in 1988 (Figure 12); the mode of smaller fish ranged from 250 to 300 mm (9.8 to 11.8 in.). In 1989, this mode shifted approximately 50 mm (2.0 in.) and was again apparent in 1991 at 386 to 420 mm (15.2 to 16.5 in.). This roughly corresponded to calculated growth of yellowtail rockfish from age 4 to age 8 (Lea et al. 1993), and thus would represent a strong 1984 year class.

Yellowtail rockfish from the San Francisco area also showed a multimodal length frequency distribution in 1988 (Figure 13), with two smaller modes at approximately 261 to 310 mm (10.3 to 12.2 in.). In 1989, length frequency distribution was fairly similar to that of the Bodega Bay area with the exception of relatively few fish greater than 500 mm (19.7 in.) and relatively more fish less than 281 mm (11.1

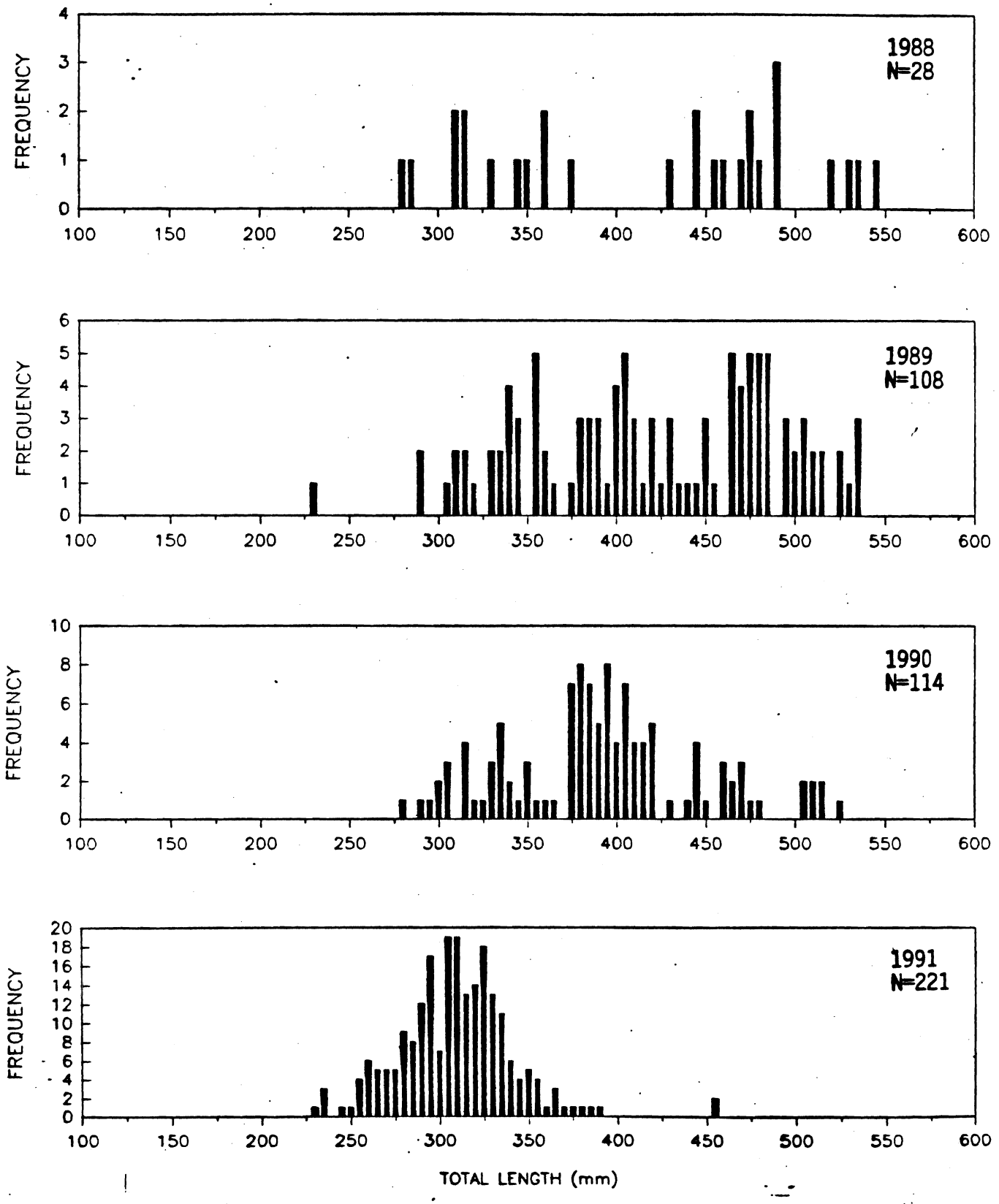

FIGURE 11. Length frequency of yellowtail rockfish from the Fort Bragg area, 1988 to 1991.

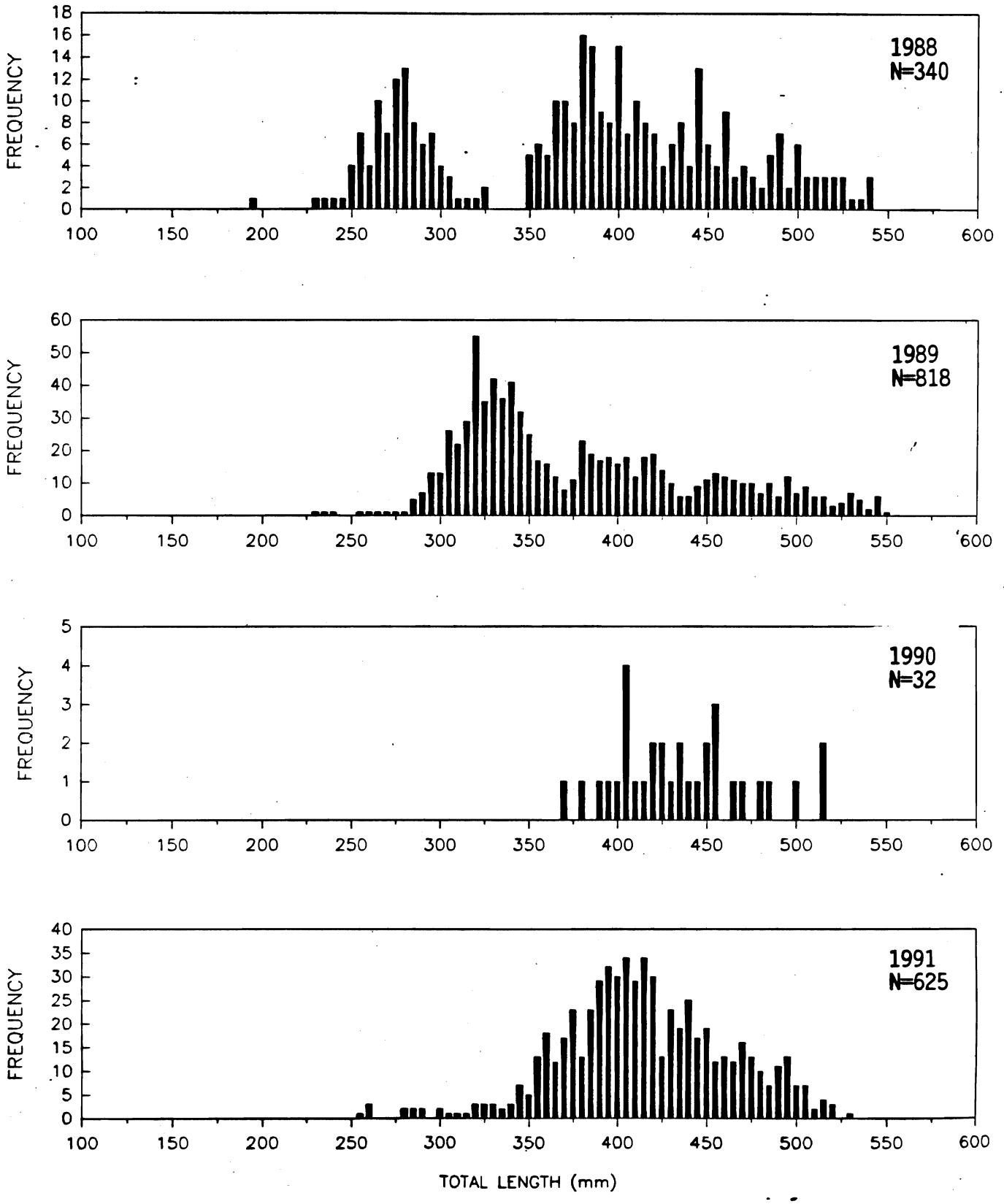

FIGURE 12. Length frequency of yellowtail rockfish from the Bodega Bay area, 1988 to 1991.

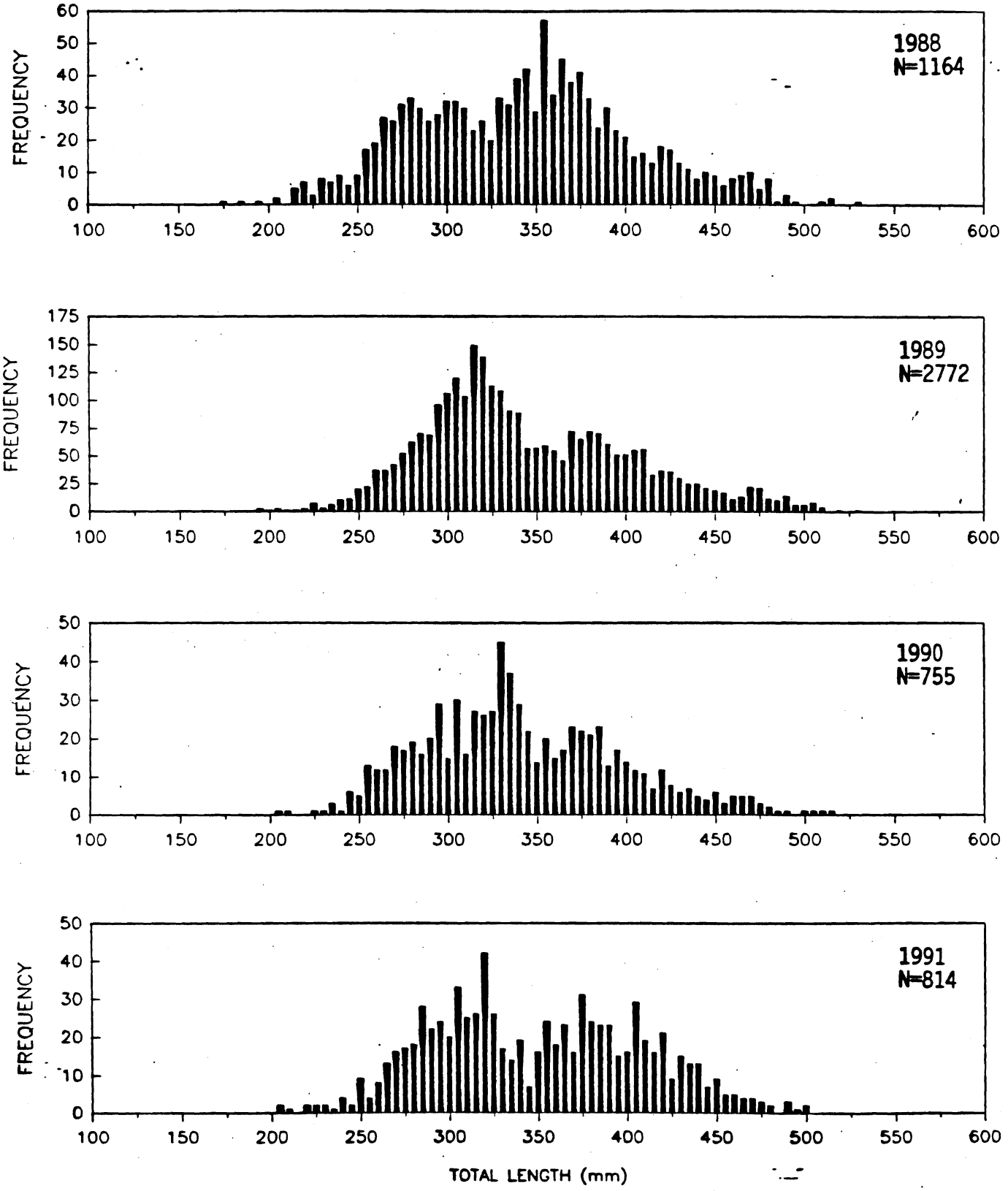

FIGURE 13. Length frequency of yellowtail rockfish from the San Francisco area, 1988 to 1991.

in.). Little change was evident in 1990 and 1991. Based on length-age data from Lea et al. (1993), the majority of fish in the CPFV catch from the San Francisco area were between 4 and 12 years old; a significant proportion of yellowtail rockfish were below the reported lengths at 50% sexual maturity.

In the Monterey area, a pulse of recruitment entered the fishery in 1987 at 231 to 270 mm (9.1 to 10.6 in.) but was overshadowed by large numbers of fish in the 326- to 375-mm (12.8- to 14.8-in.) range (Figure 14). By 1988 these larger fish had become relatively scarce and the smaller mode from 1987 began to dominate the catch. By 1991 a good mix of year classes was evident (Figure 14).

The Morro Bay area length frequency distribution varied little among years and contained few fish greater than 350 mm (13.8 in.) in all years sampled (Figure 15). Most fish were below the lengths at 50% sexual maturity and indicated a cause for concern. However, this area is near the southern end of this species' range and may not be dependent on local adult populations for successful recruitment.

Widow Rockfish

Widow rockfish CPAH was highest in the Monterey area in 1988 and 1990-91 and in the San Francisco area in 1989 (Table 27), showing the importance of this species to anglers in these areas. Only the Monterey area showed a decrease (27%) in CPAH from 1988 to 1990-91.

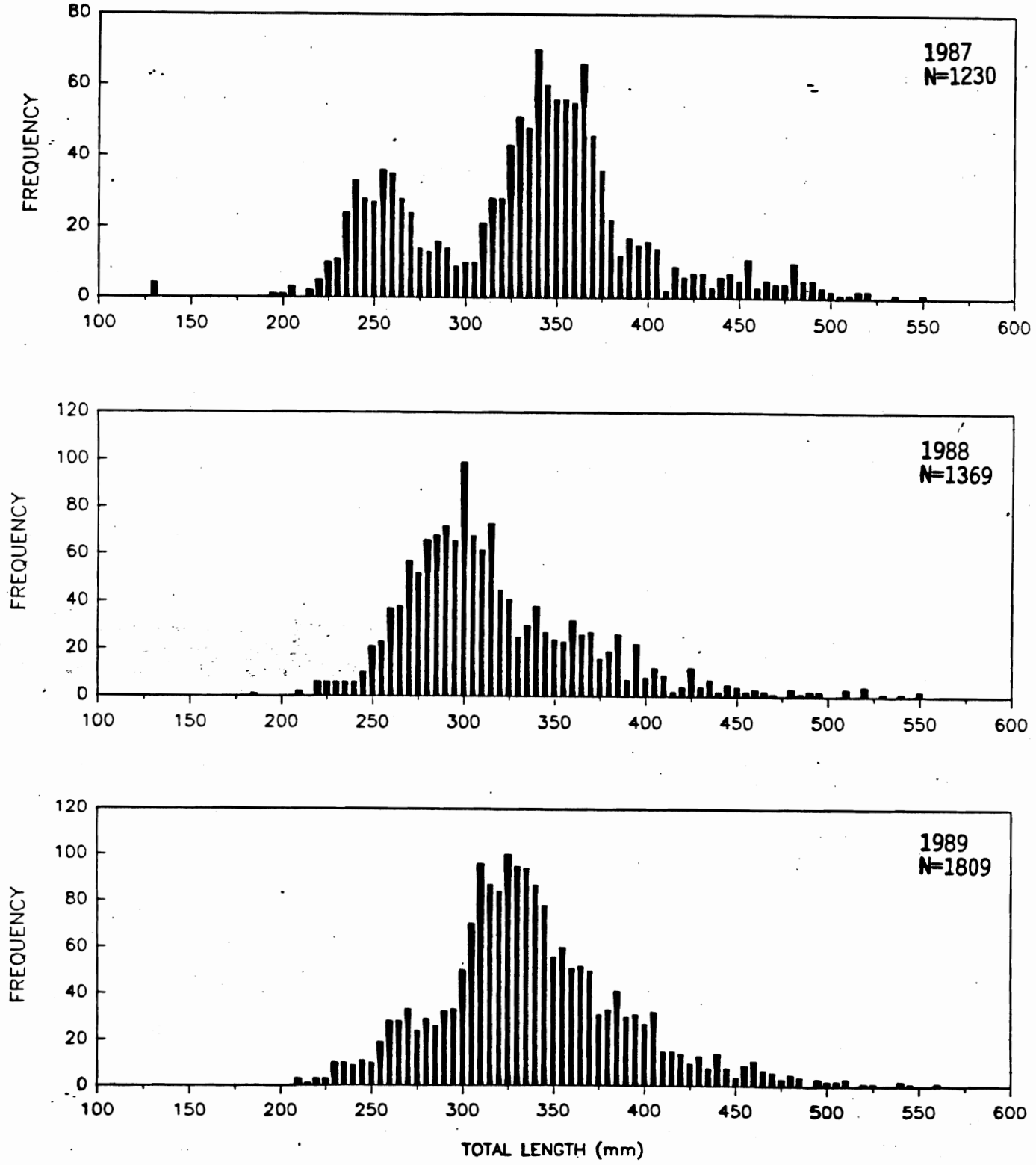

FIGURE 14. Length frequency of yellowtail rockfish from the Monterey area, 1987 to 1991.

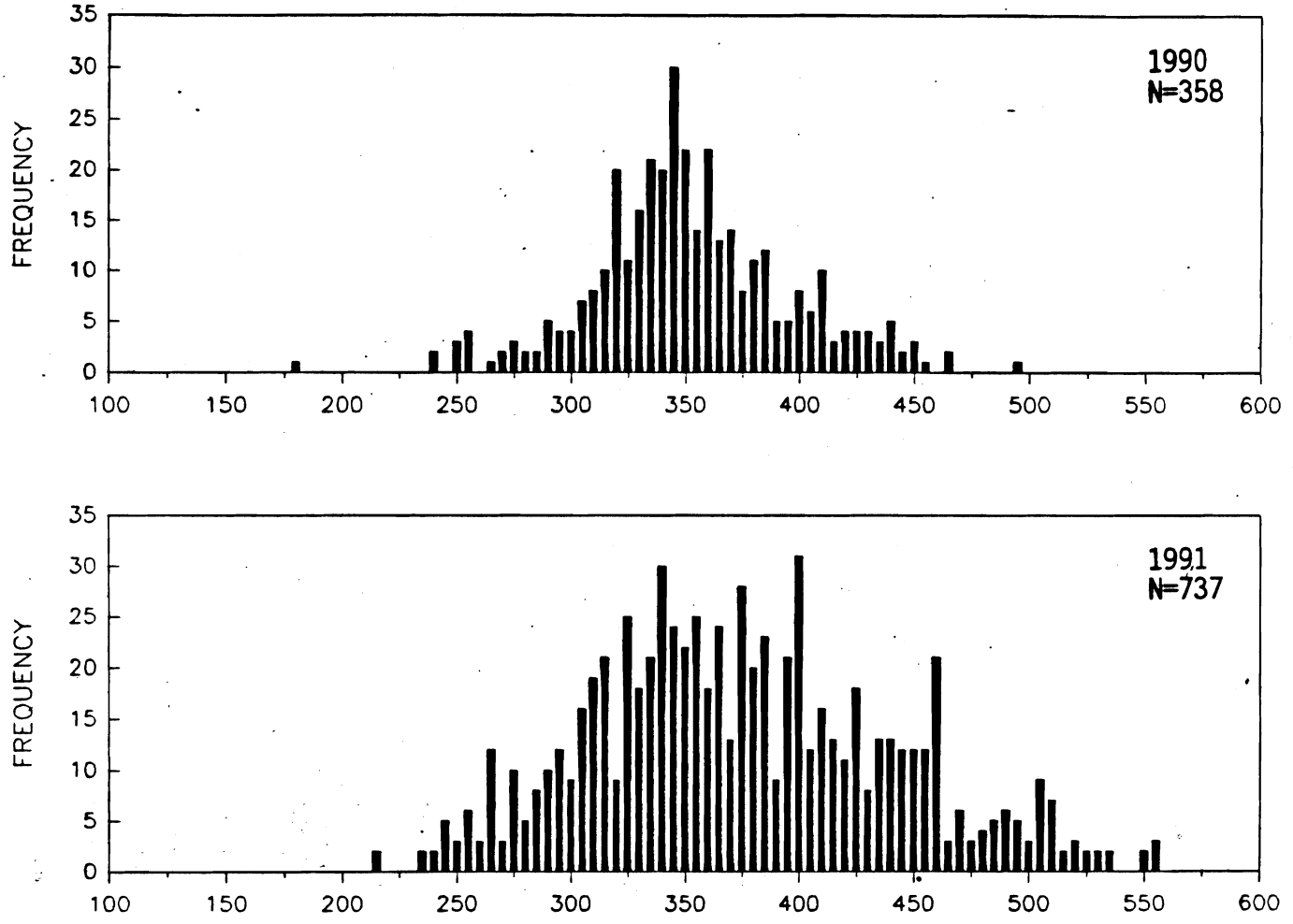

FIGURE 14. (continued).

From the San Francisco to the Morro Bay area, catch rates were higher at near locations compared with distant locations (Table 28). No consistent trend among port areas was evident relative to CPAH and depth (Table 28); CPAH was six times higher at deep locations compared with shallow locations in the Monterey area, and more than five times higher at shallow locations in the San Francisco area.

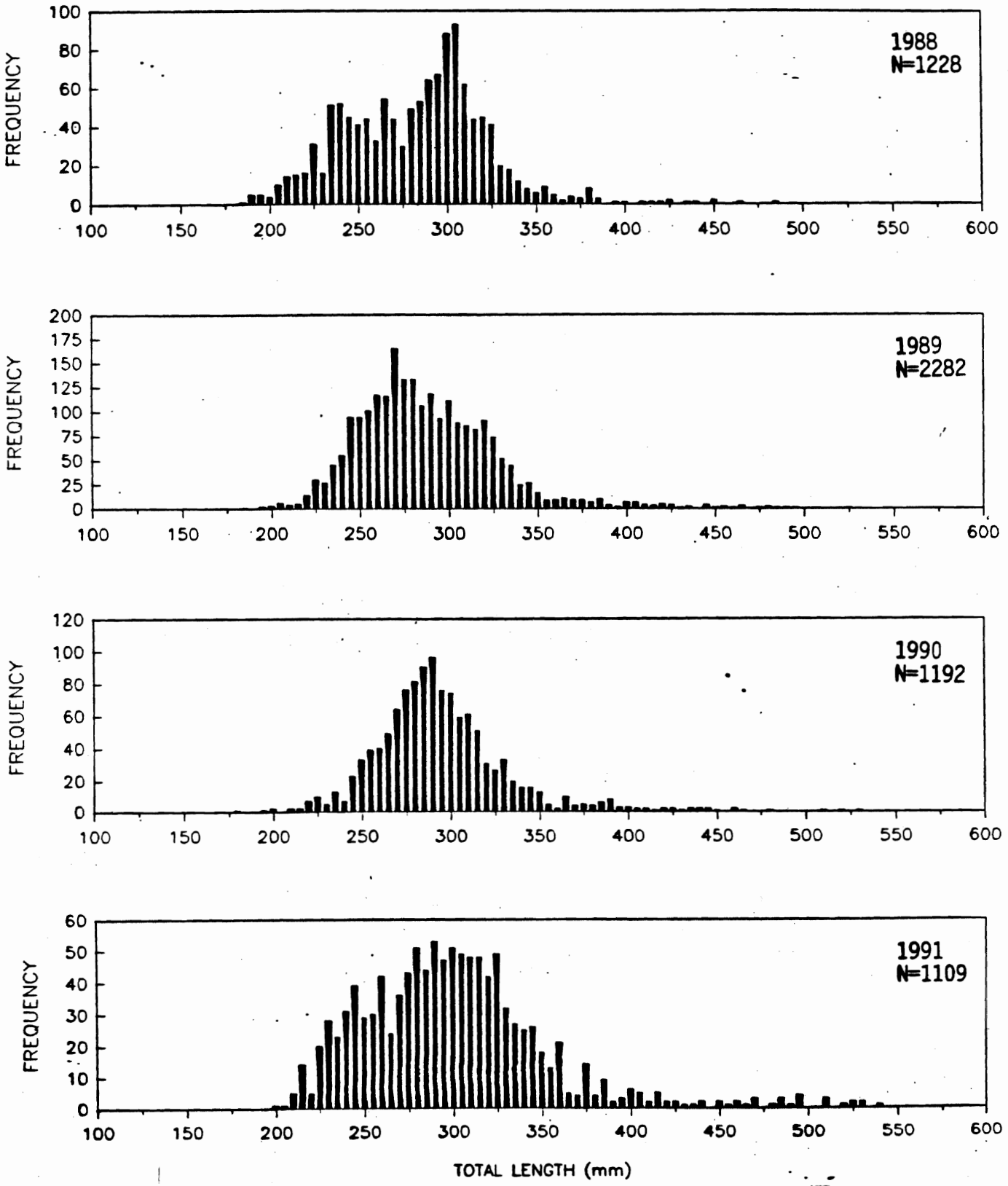

FIGURE 15. Length frequency of yellowtail rockfish from the Morro Bay area, 1988 to 1991.

TABLE 27. Catch Per Angler Day and Catch Per Angler Hour for Widow Rockfish by Port and Year.

	Catch per angler day						Catch per angler hour					
Port area	1987	1988	1989	1990-91	1990	1991	1987	1988	1989	1990-91	1990	1991
Fort Bragg	-	0.04	-	0.25	-	0.29	-	0.02	-	0.09	-	0.10
Bodega Bay	-	0.01	0.08	0.46	-	0.52	-	<0.01	0.02	0.13	-	0.17
San Francisco	-	0.38	0.86	0.45	0.64	0.16	-	0.11	0.24	0.13	0.19	0.04
Monterey	0.75	1.76	0.52	1.19	2.09	0.22	0.24	0.56	0.17	0.41	0.78	0.07
Morro Bay	-	0.50	0.18	0.59	0.80	0.45	-	0.15	0.06	0.18	0.24	0.14

TABLE 28. Catch Per Angler Hour and Mean Length of Widow Rockfish for Near and Distant Locations and Shallow and Deep Locations by Port, All Years Combined.

	Catch per angler hour				Number of fish measured				Mean total length (mm)			
Port area	Near	Distant	Shallow	Deep	Near	Dist	Shal	Deep	Near	Dist	Shal	Deep
Fort Bragg	.05	.12	.05	-	16	2	14	-	270	285	269	-
Bodega Bay	-	.03	-	.03	-	61	3	27	-	442	335	453
San Francisco	.37	.13	.11	.02	447	745	244	5	311	311	261	404
Monterey	.42	.11	.07	.43	2627	281	56	1961	323	309	308	331
Morro Bay	.14	.07	.05	.09	919	48	58	33	290	318	265	346

TABLE 29. Mean Length of Widow Rockfish Caught by CPFV Anglers by Port and Year.

	Number of fish measured					Mean total length (mm)				
Port area	1987	1988	1989	1990	1991	1987	1988	1989	1990	1991
Fort Bragg	-	-	-	-	18	-	-	-	-	272
Bodega Bay	-	-	24	1	46	-	-	385	501	440
San Francisco	-	339	684	187	29	-	302	306	329	337
Monterey	552	1450	462	405	51	314	315	322	347	364
Morro Bay	-	386	145	209	263	-	273	299	296	308

From the San Francisco to the Morro Bay area, widow rockfish showed a consistent trend of increasing mean length with each year sampled (Table 29). Among these areas, mean lengths were highest in the Monterey area and lowest in the Morro Bay area. The few fish sampled in the Bodega Bay area in 1989 and 1991 had mean lengths more than 60 mm (2.4 in.) greater than those from the Monterey area. A clinal trend of mean length decreasing with decreasing latitude was evident. Lenarz (1987) noted that younger widow rockfish (less than 7 years old) may grow faster in Oregon compared with California. Cooperrider (1987) found that a significant portion of the California recreational catch of widow rockfish was less than 7 years old. Although it is difficult to separate the effects of fishing pressure from environmental factors in relation to mean length of fishes, it appears that this clinal trend was common among the most frequently observed rockfishes in this study.

Boehlert and Kappenman (1980) found a trend of increasing growth rate with increasing latitude for the splitnose rockfish, Sebastes diploproa, from southern California to northern Washington and also observed mean sizes increasing to the north. They attributed the latter to an increased number of juveniles and fewer larger specimens in the southern area. They discussed variation of growth with latitude for rockfishes and hypothesized three mechanisms to explain this: i) latitudinal variation in environmental factors; ii) short

term density-dependent response to fishing pressure and available prey; and iii) density-independent, evolutionary responses at the population level. Relating to the first hypothesis, they cited Beverton and Holt (1959) in stating that relatively higher temperatures (in southern waters) usually result in an increase in growth rate but a decrease in maximum predicted size. Mean size and maximum size of splitnose rockfish increased with depth and latitude, from southern California to Washington, as temperature decreased (Boehlert 1980). Boehlert and Kappenman (1980) concluded that the latter two hypotheses could only be tested with the cessation of fishing.

For some species in the Monterey area, including widow rockfish, a departure occurred from the clinal trend; sampled fish from the Monterey area, although farther south than the San Francisco area, had a greater mean length. Fishing depth was probably the cause. Sixty-seven percent of all widow rockfish measured in the Monterey area were from deep locations, whereas less than one percent of all fish measured in the San Francisco area were from deep locations. Deeper locations have experienced less fishing pressure and may also show the effects of isothermic submergence. Both factors would result in larger fish available to anglers.

The difference in mean length of widow rockfish from the San Francisco area from deep and shallow locations was remarkable. Although only five fish were measured from deep locations, these averaged 143 mm (6.6 in.) longer than 244

fish measured from shallow locations.

There was no trend evident in mean length relative to near and distant locations in the three most southern port areas (Table 28).

The length frequency distribution from the Bodega Bay area in 1989 exhibited a surprisingly wide length range for such a small sample (Figure 16). In sharp contrast to more southerly port areas, the 1991 sample consisted primarily of large fish ranging from 346 to 510 mm (13.6 to 20.1 in.). The majority of these fish were taken at distant, deep locations and were probably from a stock that has not experienced heavy fishing pressure. Based on data from Lenarz (1987), those fish exceeding 450 mm (17.7 in.) were at least 12 years old.

Length frequency distributions from the San Francisco area exhibited bimodality in 1988, 1989, and 1990 (Figure 17), indicating at least several strong year classes. In 1988, those fish centered at 246 to 260 mm (9.7 to 10.2 in.) were most likely 3-year olds, while the larger mode at 311 to 330 mm (12.2 to 13.0 in.) were most likely 4- and 5-year olds (Lenarz 1987, 1992).

The Monterey area samples showed a more unimodal distribution in 1987 and 1988 (Figure 18) with a relative scarcity of lengths corresponding to 3-year olds. However, by 1989 some recruitment was evident with a strong showing of fish from 256 to 310 mm (9.7 to 11.8 in.) (probably 3- and 4-yr olds), similar to the San Francisco area). A shift in length frequency distribution to the right in 1990 is most

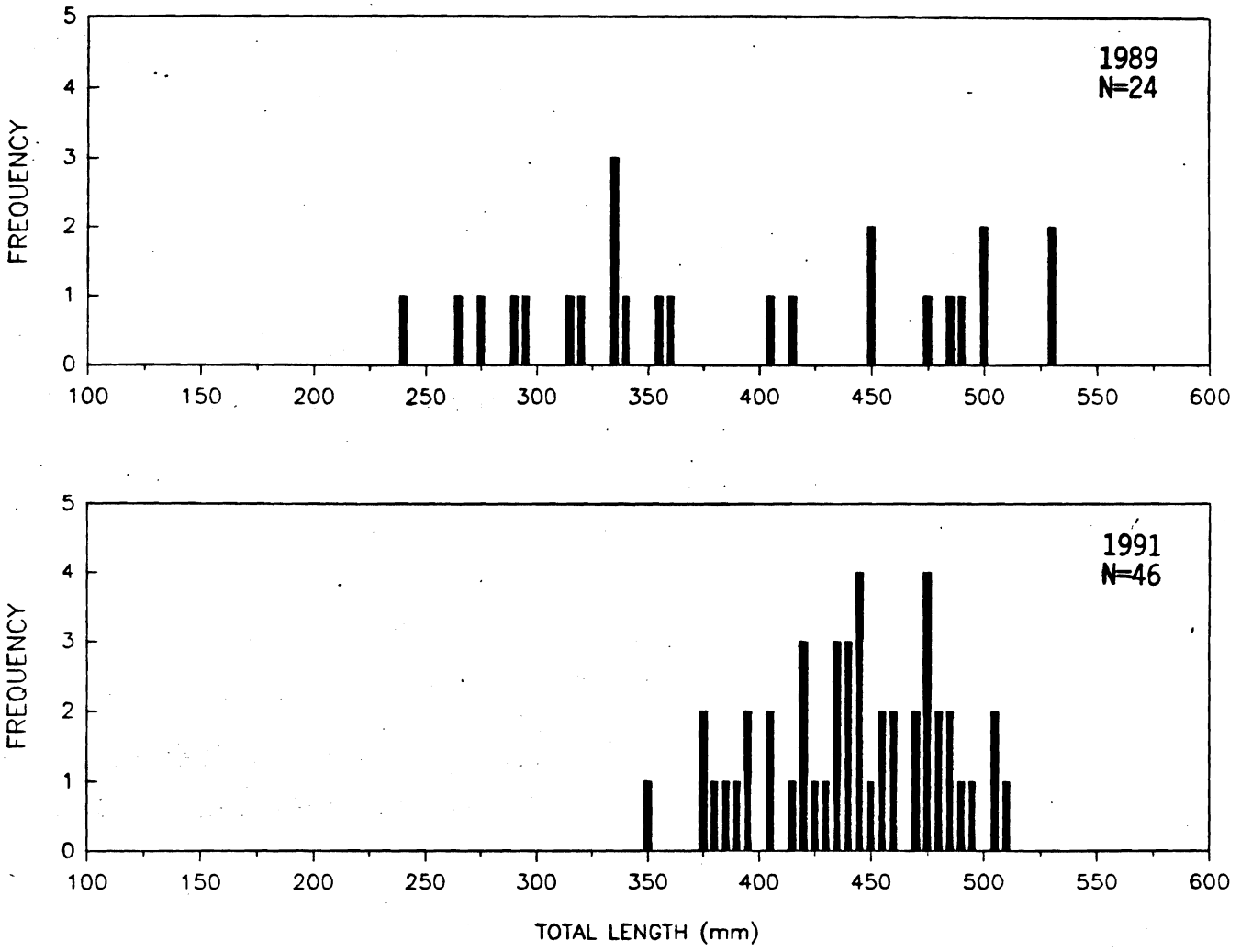

FIGURE 16. Length frequency of widow rockfish from the Bodega Bay area in 1989 and 1991.

likely the result of these strong year classes (Figure 18).

In the Morro Bay area, a moderate pulse of recruitment of fish less than 221 mm (8.7 in.) was evident in 1988 (Figure 19) and resulted in the lowest mean length of any port area and year (273 mm or 10.7 in.). By 1991, few fish were caught less than 246 mm (9.7 in.), a minor mode of larger fish occurred at 356 to 385 mm (14.0 to 15.2 in.), and mean length was the largest

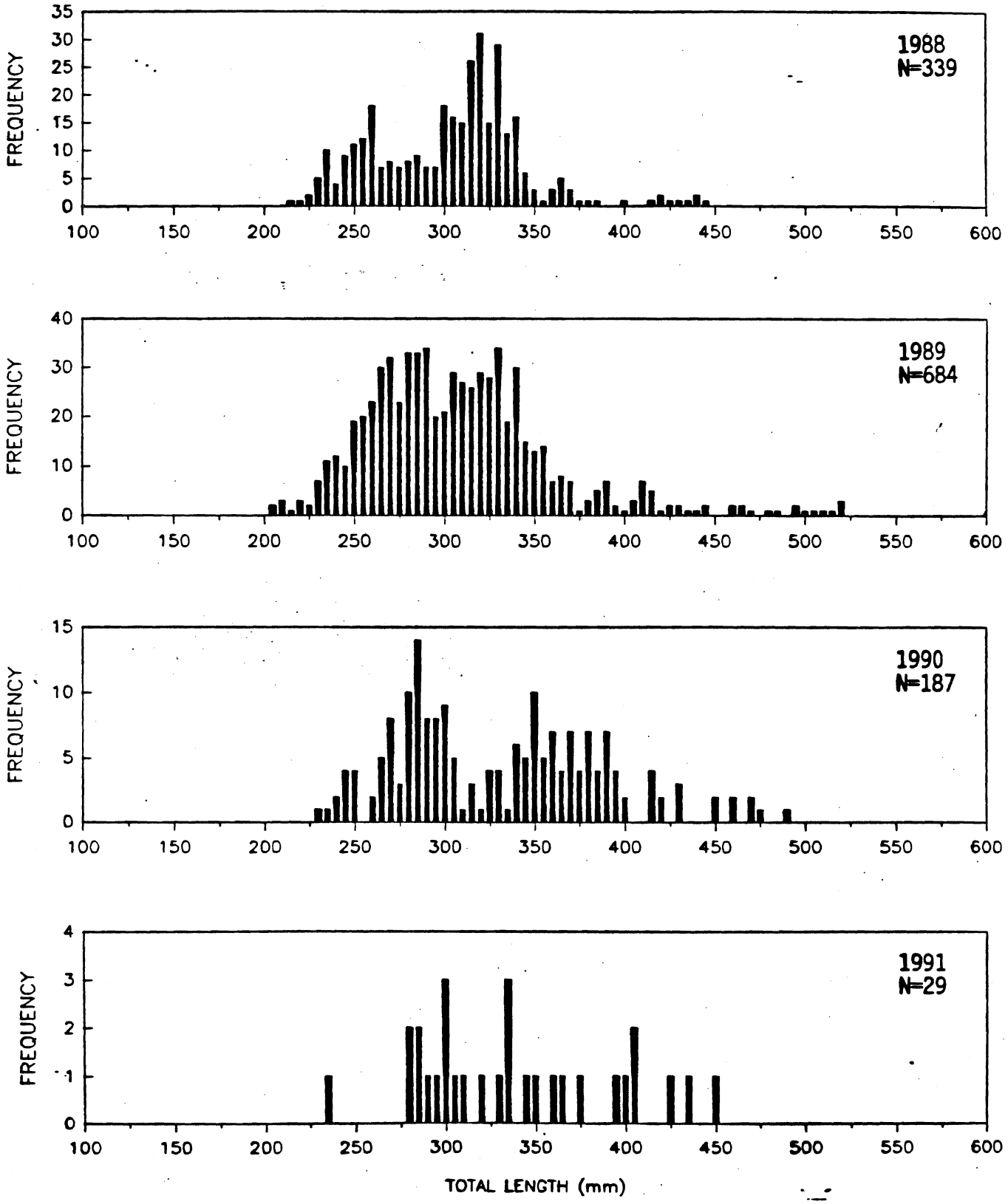

FIGURE 17. Length frequency of widow rockfish from the San Francisco area, 1988 to 1991.

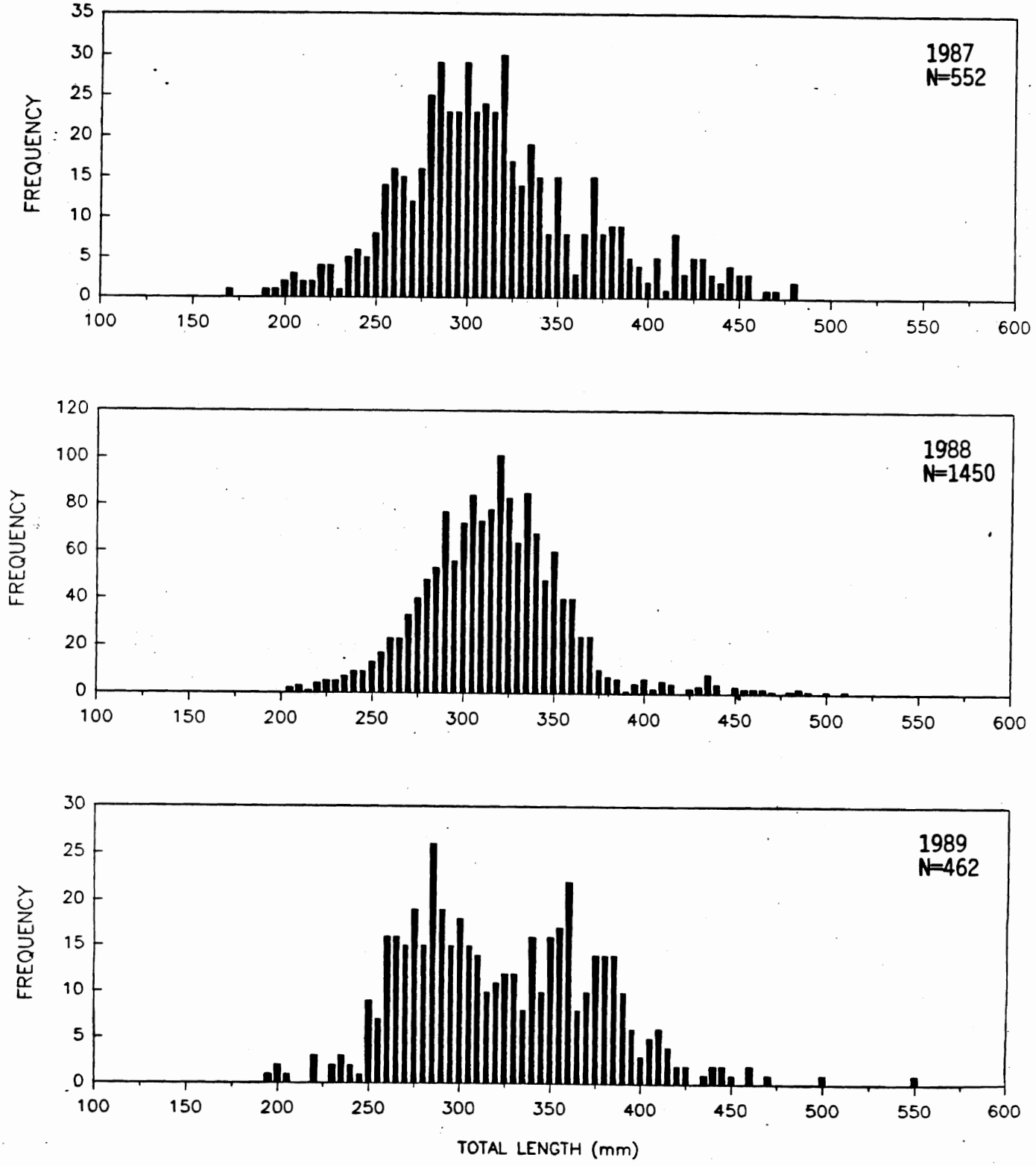

FIGURE 18. Length frequency of widow rockfish from the Monterey area, 1987 to 1991.

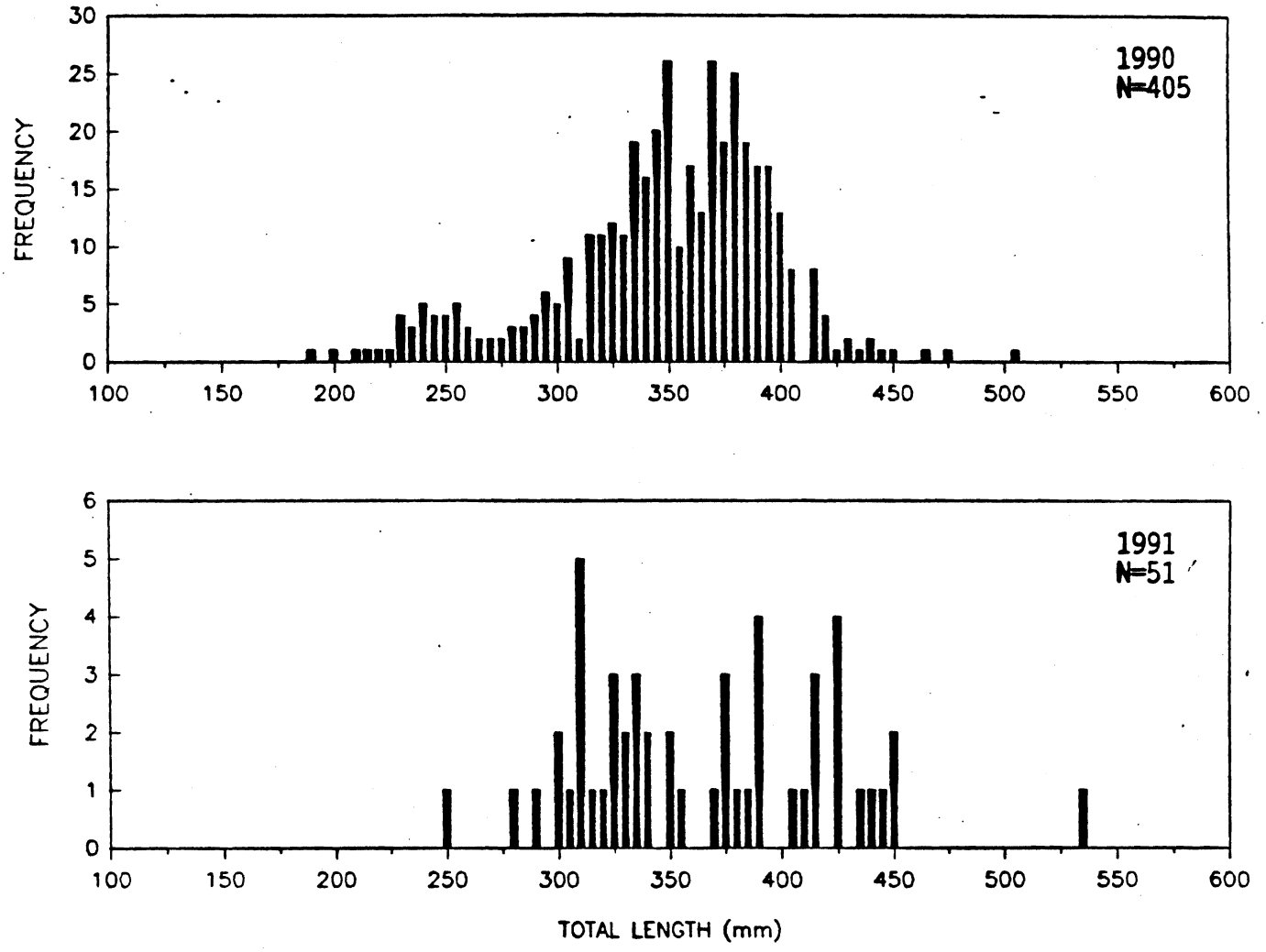

FIGURE 18. (continued).

observed during the study period in this area.

Of concern in the widow rockfish CPFV fishery is the length at which 50% of all fish are sexually mature. Wyllie-Echeverria (1987) reported this to be 360 mm (14.2 in.) and 370 mm (14.6 in.) for males and females, respectively. For all years sampled in the Morro Bay area, annual mean length was less than these values, indicating the catch of a significant number of sexually

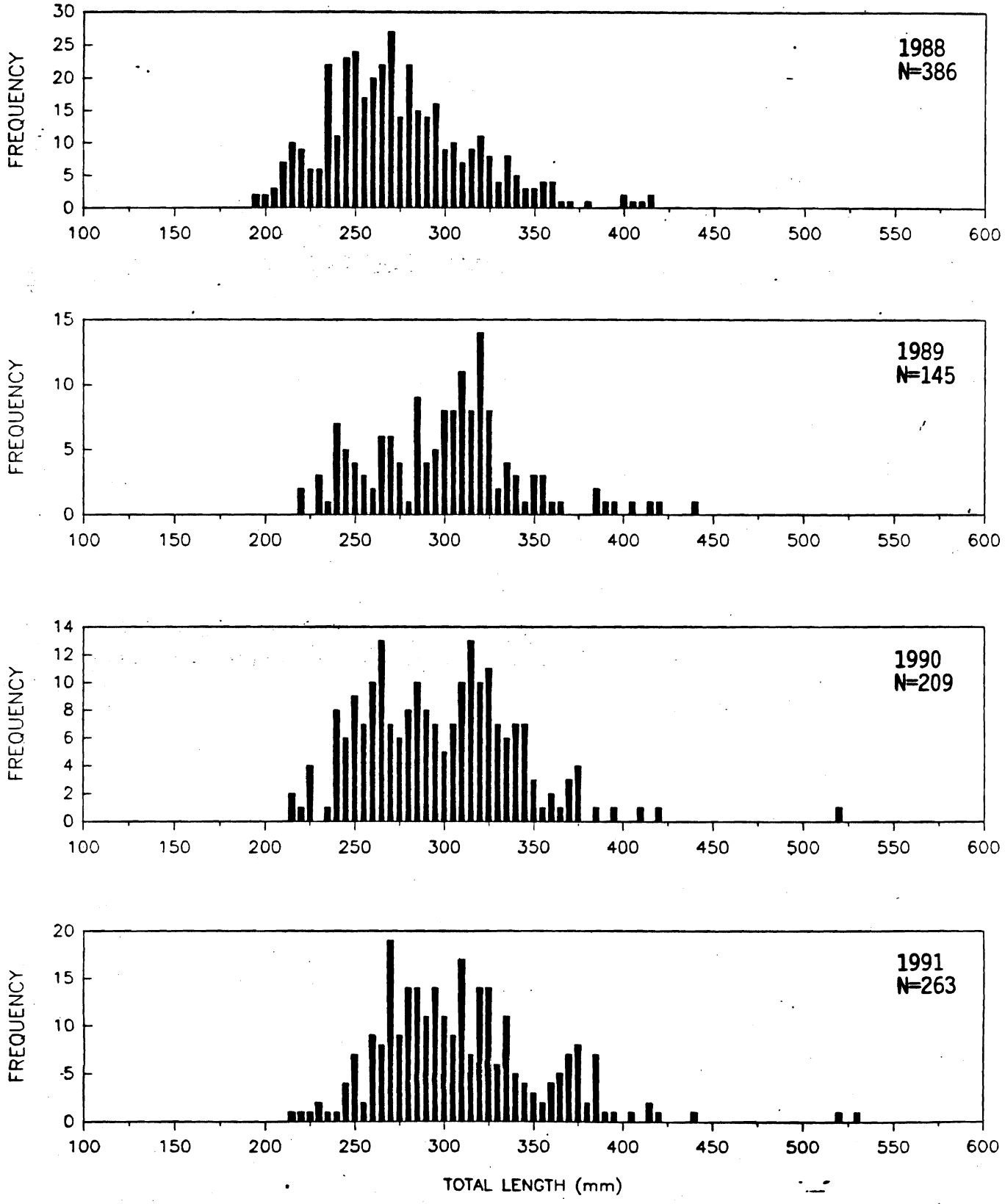

FIGURE 19. Length frequency of widow rockfish from the Morro Bay area, 1988 to 1991.

immature fish. Length frequency histograms also indicate a high proportion of sexually immature fish in the San Francisco and Monterey area catches.

Bocaccio

Catch rates for bocaccio increased from 1988 to 1990-91 in all port areas with sufficient sample size (Table 30). Similar to chilipepper, highest CPAH occurred in the Bodega Bay and Monterey areas, where Cordell Bank and Monterey Submarine Canyon, respectively, provided the majority of the catch. The increased CPAH in 1990-91 for the Bodega Bay area was possibly due to an increase in effort at deeper locations.

Catch rates were much higher at distant than at near locations for the Bodega Bay and Monterey areas (Table 31), while other port areas showed no differences or the opposite trend. In all areas, bocaccio CPAH ranged from 3 to 26 times higher at deep locations compared with shallow locations (Table 31).

Mean length of bocaccio showed a strong clinal trend, decreasing with decreasing latitude from the Bodega Bay area to the Morro Bay area, with differences as great as 174 mm (6.9 in.) for a given year (Table 32). No port area showed a consistent trend of increasing or decreasing mean length during the study period.

In the San Francisco and Morro Bay areas considerable differences in mean length were observed for bocaccio from near and distant locations (Table 31). Mean lengths from

TABLE 30. Catch Per Angler Day and Catch Per Angler Hour for Bocaccio by Port and Year.

Port area	Catch per angler day						Catch per angler hour					
	1987	1988	1989	1990-91	1990	1991	1987	1988	1989	1990-91	1990	1991
Fort Bragg	-	0.08	0.24	0.04	0.09	0.03	-	0.04	0.09	0.01	0.03	0.01
Bodega Bay	-	0.50	0.52	2.28	1.12	2.43	-	0.16	0.16	0.72	0.32	0.78
San Francisco	-	0.13	0.23	0.24	0.18	0.34	-	0.04	0.06	0.07	0.05	0.09
Monterey	1.15	0.79	0.73	1.61	2.03	1.16	0.38	0.25	0.24	0.55	0.76	0.36
Morro Bay	-	0.33	0.45	0.85	1.54	0.42	-	0.10	0.16	0.26	0.46	0.13

TABLE 31. Catch Per Angler Hour and Mean Length of Bocaccio for Near and Distant Locations and Shallow and Deep Locations by Port, All Years Combined.

Port area	Catch per angler hour				Number of fish measured				Mean total length (mm)			
	Near	Distant	Shallow	Deep	Near	Dist	Shal	Deep	Near	Dist	Shal	Deep
Fort Bragg	.03	.02	.03	.09	11	4	10	-	606	603	596	-
Bodega Bay	-	.25	.01	.26	1	495	7	129	259	592	545	602
San Francisco	.08	.05	.01	.07	77	358	15	17	448	500	499	476
Monterey	.31	.31	.01	.43	2145	785	31	2194	471	471	477	468
Morro Bay	.15	.31	.08	.46	1012	225	123	268	429	493	453	475

TABLE 32. Mean Length of Bocaccio Caught by CPFV Anglers by Port and Year.

Port area	Number of fish measured					Mean total length (mm)				
	1987	1988	1989	1990	1991	1987	1988	1989	1990	1991
Fort Bragg	-	3	6	-	6	-	690	569	-	600
Bodega Bay	-	151	111	10	211	-	594	600	648	582
San Francisco	-	96	218	55	69	-	511	476	487	507
Monterey	917	728	686	434	304	476	464	484	430	500
Morro Bay	-	249	398	477	281	-	459	426	404	492

distant locations were 52 and 64 mm (2.0 and 2.5 in.) greater, respectively, than from near locations, indicating heavier fishing pressure in the latter area. No difference in mean length was observed in the 2930 bocaccio measured from near and distant locations in the Monterey area.

No consistent pattern was evident in mean length from shallow and deep locations among the four more southern port areas (Table 31). In the Monterey area, where more than 2000 fish were measured from deep locations, mean length was less than that for shallow locations. In trawl surveys off California and Oregon, Wilkins (1980) found that bocaccio less than 425 mm TL (16.7 in.)(he used fork length) were more abundant in shallow water. However, shallow water was defined as less than 100 fm. Since the overwhelming majority of CPFV effort occurred in less than 100 fm, the tendency of larger fish occurring in deeper water was not apparent here.

The length frequency distribution in the Bodega Bay area showed a strong bimodal distribution in 1988 with a significant proportion of fish in the 661- to 750-mm (26.0- to 29.5-in.) range (Figure 20). Based on length-age data from Thomas and Bence (1992), these fish most likely were more than 14 years old. Most fish were above the lengths at 50% sexual maturity of 430 mm (16.9 in.) for males and 440 mm (17.3 in.) for females (Wyllie-Echeverria 1987). Bocaccio are relatively fast growing and age at the primary mode of 511 to 530 mm (20.1 to 20.9 in.) was approximately 7 years (D. Thomas, CDFG, Menlo Park, pers. comm.). In 1989 a shift in the primary mode

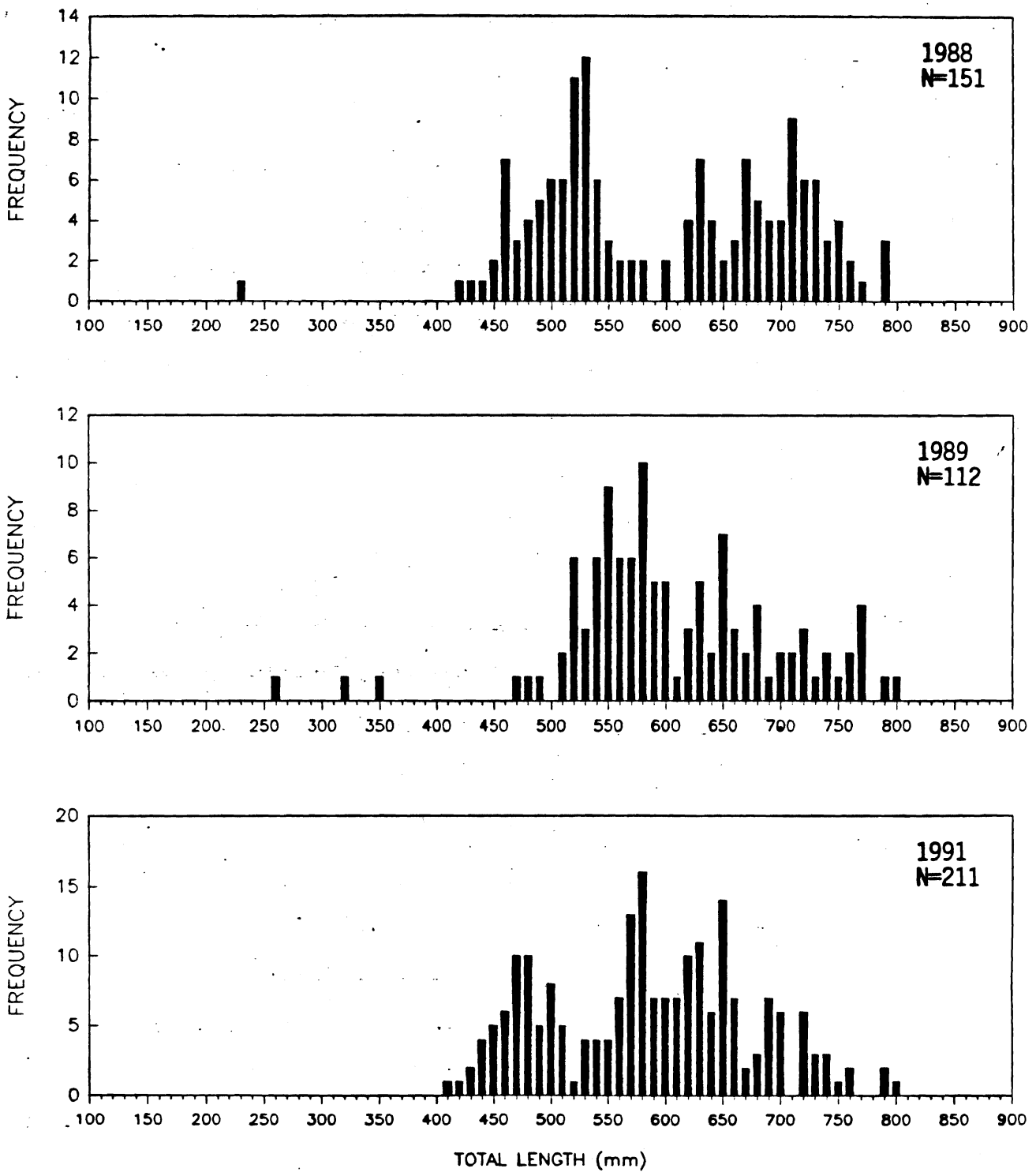

FIGURE 20. Length frequency of bocaccio from the Bodega Bay area in 1988, 1989, and 1991.

to 541 to 580 mm (21.3 to 22.8 in.) was evident. By 1991 a pulse of recruitment of smaller fish less than 511 mm (20.1 in.) was apparent.

Bocaccio sampled from the San Francisco area in 1988 exhibited a strong mode in the length frequency distribution (Figure 21) which progressed during the next 2 years from approximately 450 to 550 mm (17.7 to 21.7 in.). This is most likely the strong 1984 year class (D. Thomas, Dept. Fish and Game, Menlo Park, pers. comm.). A higher proportion of fish less than 421 mm (16.6 in.), compared with the Bodega Bay area, appeared in 1989 samples.

Monterey area bocaccio samples were dominated by a single mode from 1987 to 1989 (Figure 22). This mode was similar to that from the San Francisco area during the latter 2 years. A relatively strong showing of fish less than 421 mm (16.6 in.) appeared in 1989. By 1991, these smaller fish, most likely 5-year olds (D. Thomas, Dept. Fish and Game, Menlo Park, pers. comm.), were strongly represented in the 441- to 480-mm (17.4- to 18.9-in.) length range (Figure 22).

Consistent with more northern areas, Morro Bay area bocaccio showed a strong mode centered at 461 to 470 mm (18.1 to 18.5in.) in 1988 and a strong pulse of recruitment in 1989 centered at 331 to 340 mm (13.0 to 13.4 in.) (Figure 23). The latter most likely consisted of 3-year olds (Thomas and Bence 1992). By 1991, similar to the Monterey area, a mode at 441 to 480 mm (17.4 to 18.9 in.) predominated.

In summary, the CPFV fishery for bocaccio appears to be

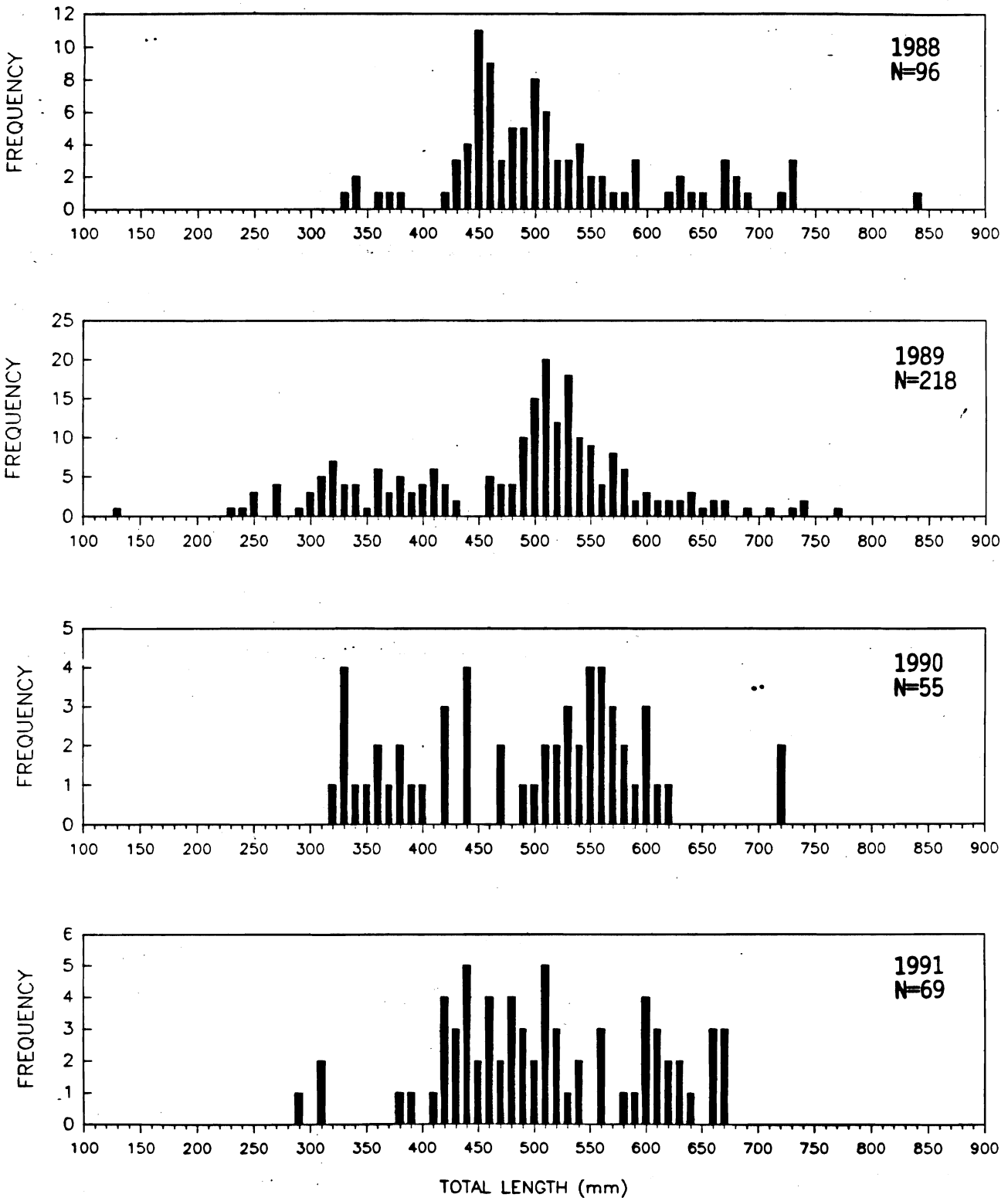

FIGURE 21. Length frequency of bocaccio from the San Francisco area, 1988 to 1991.

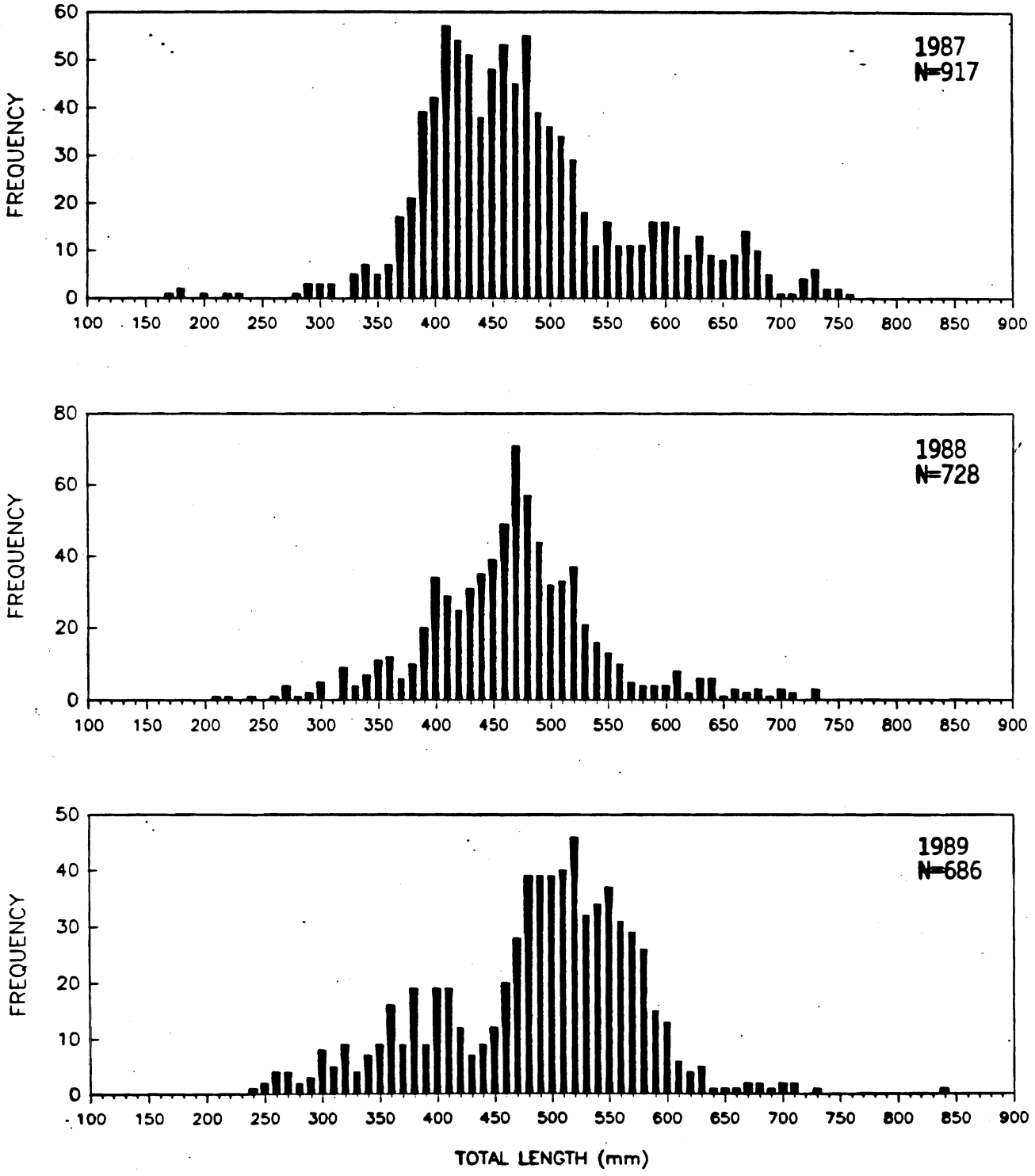

FIGURE 22. Length frequency of bocaccio from the Monterey area, 1987 to 1991.

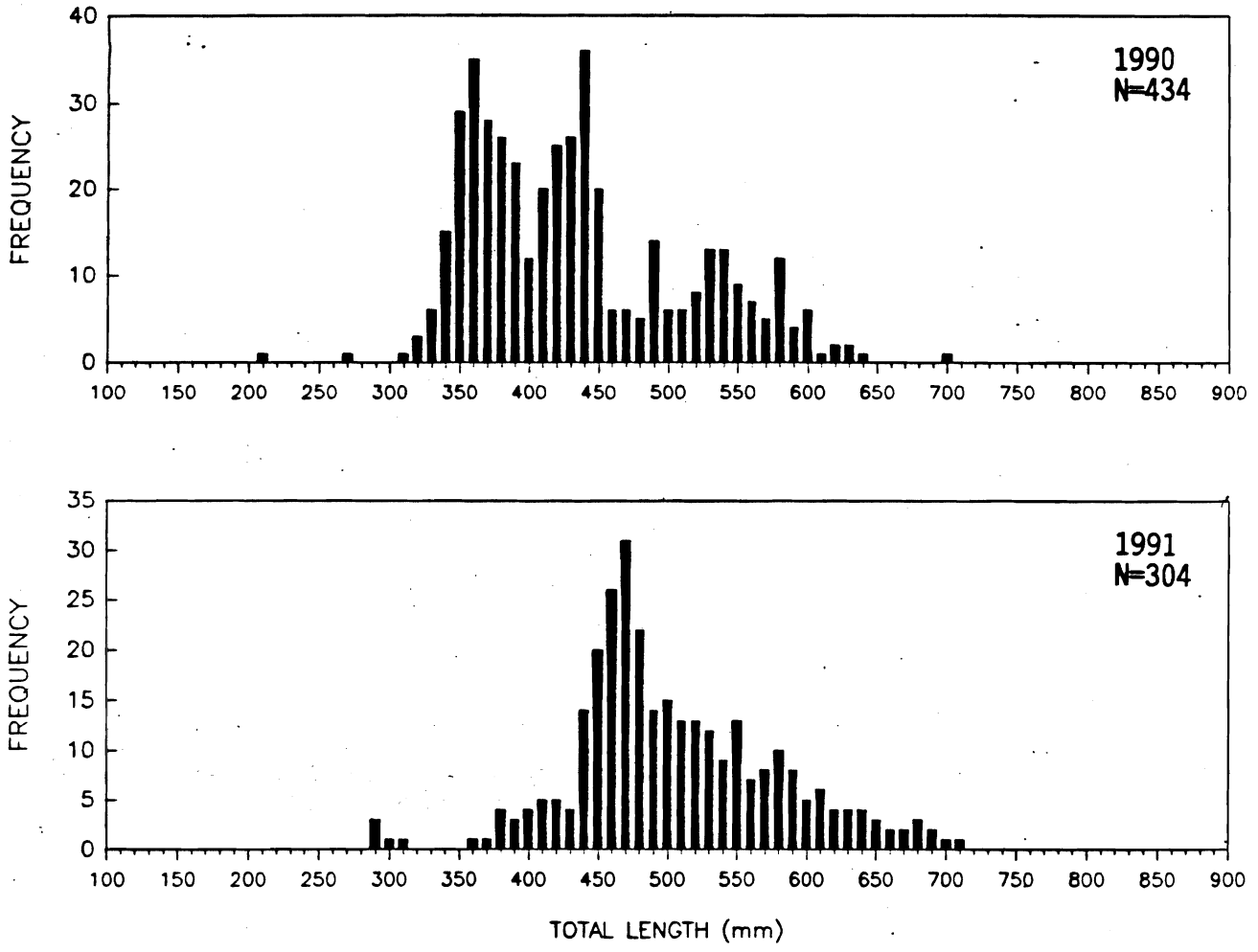

FIGURE 22. (continued).

dependent on periodic recruitment of strong year classes, as noted by Thomas and Bence (1992). Commercial stocks of bocaccio are now considered to be at relatively low levels compared with the 1960s and 1970s (Thomas and Bence 1992). However, the importance of this species to sport anglers has changed little since 1960. Bocaccio ranked 4 in the CPFV catch from northern and central California in that year (Miller and Gotshall 1965)

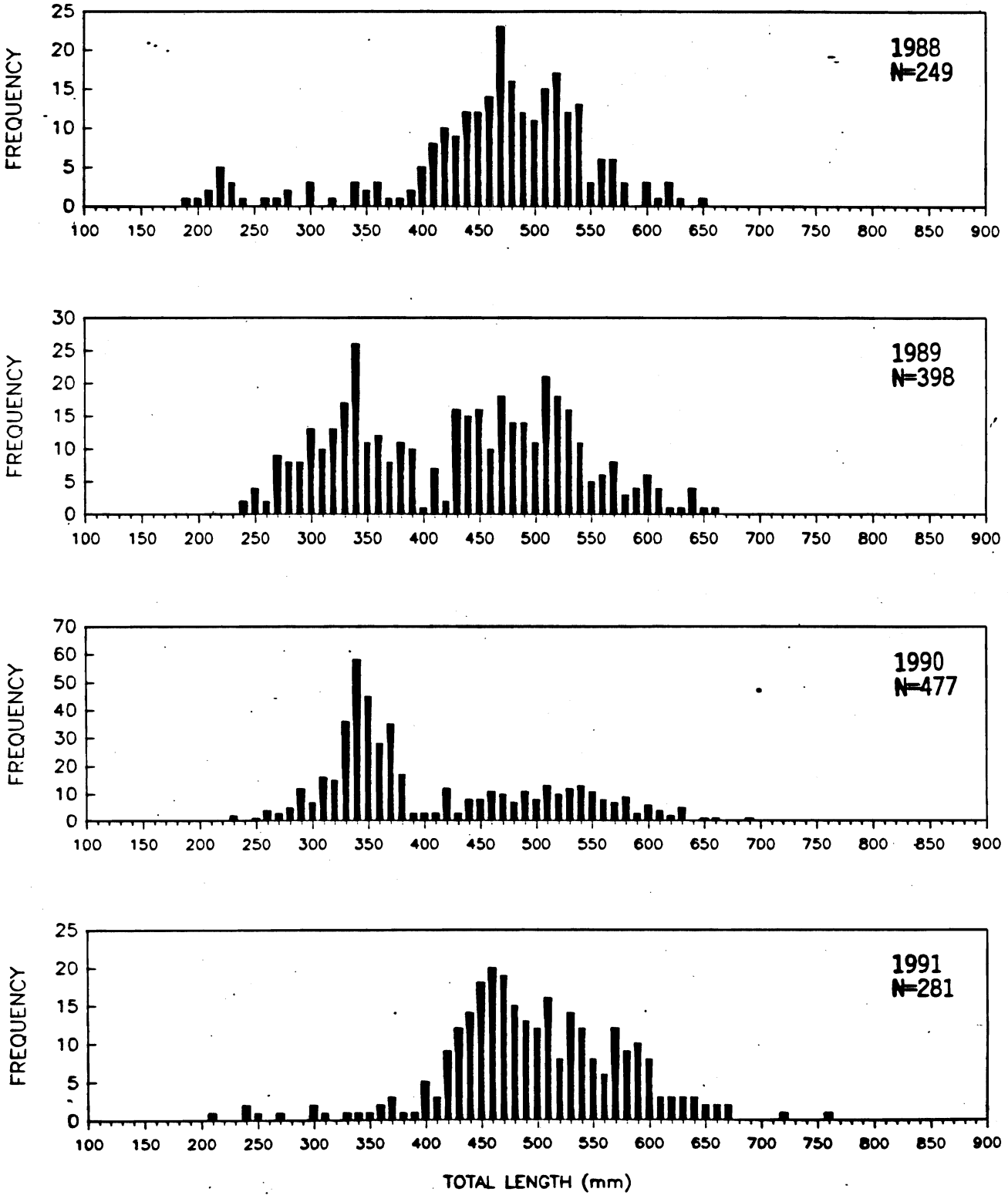

FIGURE 23. Length frequency of bocaccio from the Morro Bay area, 1988 to 1991.

and ranked 5 overall in this study. Mean length is largely dependent on growth of strong year classes, and 5 years of on board sampling is insufficient to determine trends in the health of the bocaccio CPFV fishery.

Rosy Rockfish

No consistent trend was observed among all port areas for rosy rockfish CPAH from 1988 to 1990-91 (Table 33). No large declines were observed, and the San Francisco area experienced an almost twofold increase in catch rate. Catch rates were generally highest in the Fort Bragg and San Francisco areas.

Rosy rockfish are one of only two of the most frequently observed species not considered desirable by many CPFV anglers due to their small size. Thus, in port areas such as Fort Bragg, Bodega Bay, and San Francisco, where CPAH was higher at distant locations (Table 34), other reasons than targeted overfishing must be considered to explain the lower CPAH at near locations. Only two distant-location trips were sampled in the Fort Bragg area, and only four near-location trips were sampled in the Bodega Bay area; numbers of observed rosy rockfish were low and the large reported differences in CPAH may not be real. In the San Francisco area, a relatively high proportion of distant locations were also deep locations. Rosy rockfish apparently were caught with greater frequency at deep locations compared with shallow locations in this area; this would explain the higher CPAH at distant locations.

However, rosethorn and rosy rockfishes are species

TABLE 33. Catch Per Angler Day and Catch Per Angler Hour for Rosy Rockfish by Port and Year.

	Catch per angler day						Catch per angler hour					
Port area	1987	1988	1989	1990-91	1990	1991	1987	1988	1989	1990-91	1990	1991
Fort Bragg	-	0.81	0.93	0.82	1.45	0.72	-	0.37	0.35	0.29	0.54	0.25
Bodega Bay	-	0.42	0.46	0.32	0.25	0.33	-	0.13	0.14	0.10	0.07	0.11
San Francisco	-	0.97	1.37	1.81	2.25	1.16	-	0.27	0.38	0.52	0.67	0.31
Monterey	0.37	0.30	0.47	0.52	0.38	0.67	0.12	0.09	0.15	0.18	0.14	0.21
Morro Bay	-	0.49	0.58	0.47	0.61	0.38	-	0.14	0.20	0.14	0.18	0.12

TABLE 34. Catch Per Angler Hour and Mean Length of Rosy Rockfish for Near and Distant Locations and Shallow and Deep Locations by Port, All Years Combined.

	Catch per angler hour				Number of fish measured				Mean total length (mm)			
Port area	Near	Distant	Shallow	Deep	Near	Dist	Shal	Deep	Near	Dist	Shal	Deep
Fort Bragg	.28	.62	.27	.13	50	25	38	1	266	263	265	297
Bodega Bay	.03	.14	.04	.10	4	132	13	6	259	258	284	269
San Francisco	.33	.38	.08	.31	252	2968	225	89	223	246	232	233
Monterey	.13	.13	.10	.06	586	281	37	333	226	234	229	235
Morro Bay	.17	.11	.14	.15	987	70	90	53	226	231	226	243

TABLE 35. Mean Length of Rosy Rockfish Caught by CPFV Anglers by Port and Year.

	Number of fish measured					Mean total length (mm)				
Port area	1987	1988	1989	1990	1991	1987	1988	1989	1990	1991
Fort Bragg	-	7	4	4	60	-	287	283	258	262
Bodega Bay	-	82	48	-	2	-	252	269	-	267
San Francisco	-	994	1315	683	243	-	247	245	246	224
Monterey	255	142	396	76	133	226	228	232	230	226
Morro Bay	-	356	443	120	172	-	223	229	229	228

similar in color pattern and relative size and are difficult to distinguish. It is possible that some rosethorn rockfish were misidentified as rosy rockfish in the more northern port areas on trips to deep locations. Rosethorn rockfish usually occur below 70 fm (Miller and Lea 1972), a depth occasionally fished by San Francisco area CPFVs and often fished by Bodega Bay area CPFVs. Thus CPAH for rosy rockfish at deep and distant locations may be lower than reported here.

There were no consistent trends in mean length among any of the port areas for rosy rockfish (Table 35). Mean length varied little in the Monterey and Morro Bay areas and in the San Francisco area was nearly identical from 1988 to 1990. This would be expected for a species with a relatively small maximum length of 324 mm (12.75 in.; Miller and Lea 1972).

Mean length of rosy rockfish from distant locations was greater than that from near locations for the three most southern port areas (Table 34). In these same areas, mean length was slightly to moderately larger at deep locations compared with shallow locations.

Length frequency distribution in the Fort Bragg area in 1991 showed the majority of fish to be in the 226- to 285-mm (8.9- to 11.2-in.) range (Figure 24). Due to a relatively slow growth rate and small maximum length, this represents an age range of approximately 9 to 15 years, based on data from Lea et al. (1993). Fish younger than 7 years, equivalent to approximately 200 mm (7.9 in.), did not enter the fishery. This is the length at 50% sexual maturity reported by Wyllie-

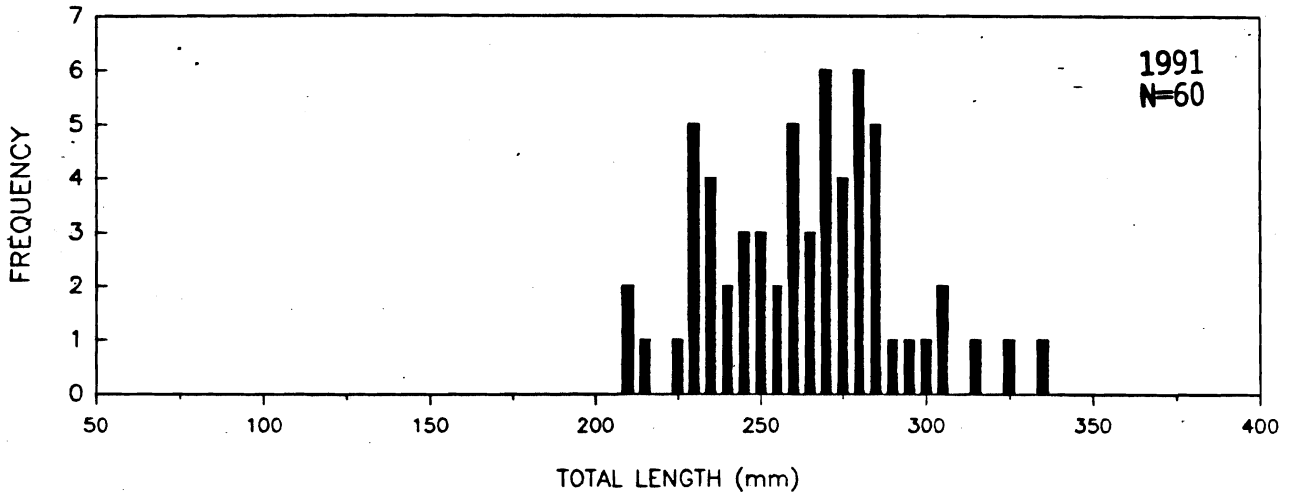

FIGURE 24. Length frequency of rosy rockfish from the Fort Bragg area in 1991.

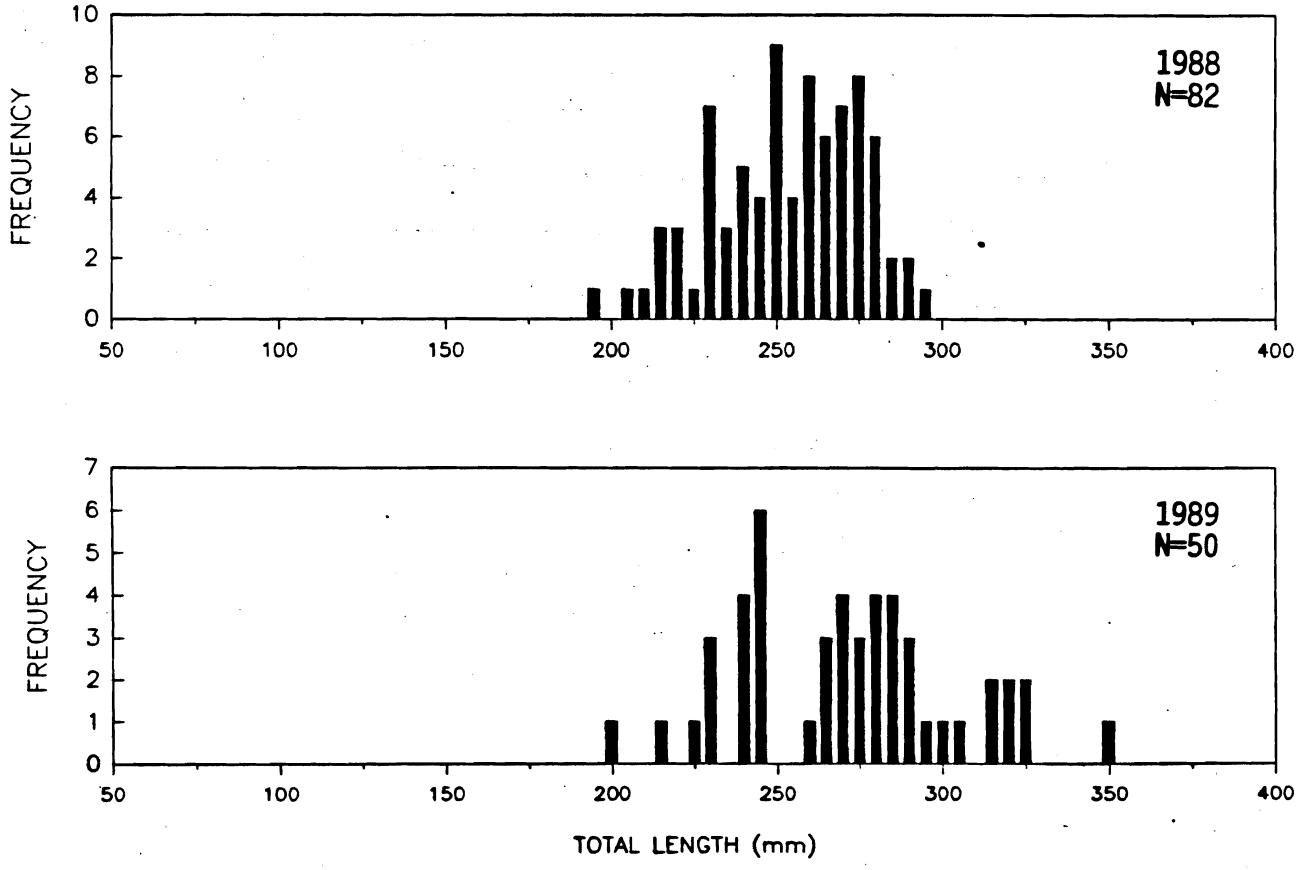

FIGURE 25. Length frequency of rosy rockfish from the Bodega Bay area in 1988 and 1989.

Echeverria (1987) and indicates that few juveniles are caught by CPFV anglers.

The Bodega Bay area length frequency distribution in 1988 was similar to that of the Fort Bragg area in 1991 (Figure 25). In 1989 several fish greater than 300 mm (11.8 in.) caused the mean of this small sample to increase by 17 mm (0.7 in.) from the previous year.

Length frequency distribution in the San Francisco area was remarkably similar from 1988 to 1990 (Figure 26), indicating relatively constant recruitment coupled with a wide range of ages (based on length range). In 1991, a shift towards smaller fish occurred. Because this species is not targeted, this shift is most likely due to recruitment rather than increased fishing pressure on larger fish.

The observed catch in the Monterey and Morro Bay areas exhibited a relatively static, consistent, and unimodal length frequency distribution (Figures 27 and 28) during most years sampled. The one exception occurred in 1991 in the Monterey area where relatively more smaller fish were measured. The few rosy rockfish less than 151 mm (5.9 in.) in the Monterey area in 1987 were most likely a result of higher retention rates for this species in this area.

Lingcod

Lingcod are one of the most desirable sport fishes, but due to their non-schooling, territorial behavior, lingcod catch rates are typically low. Lingcod CPAH declined from

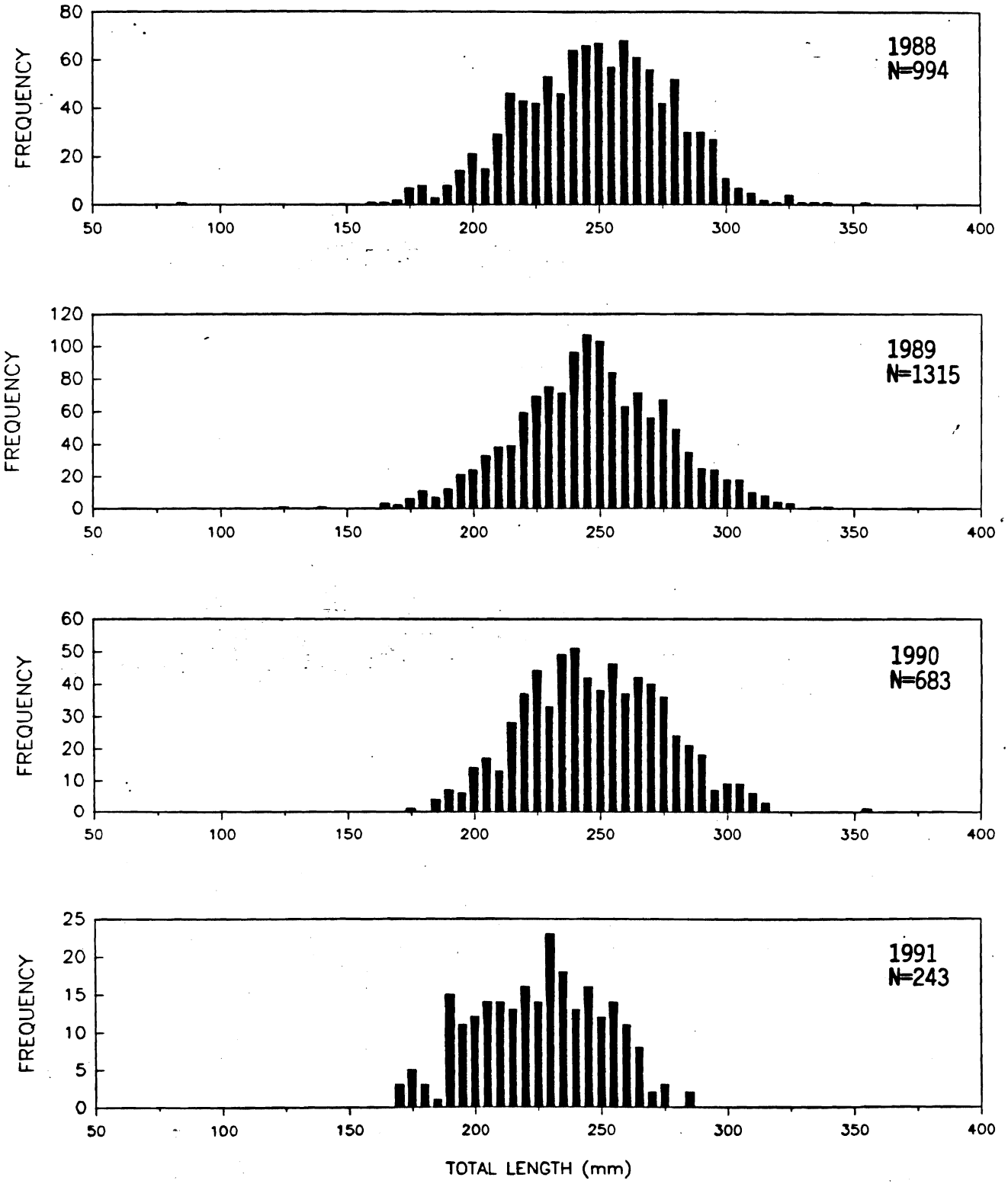

FIGURE 26. Length frequency of rosy rockfish from the San Francisco area, 1988 to 1991.

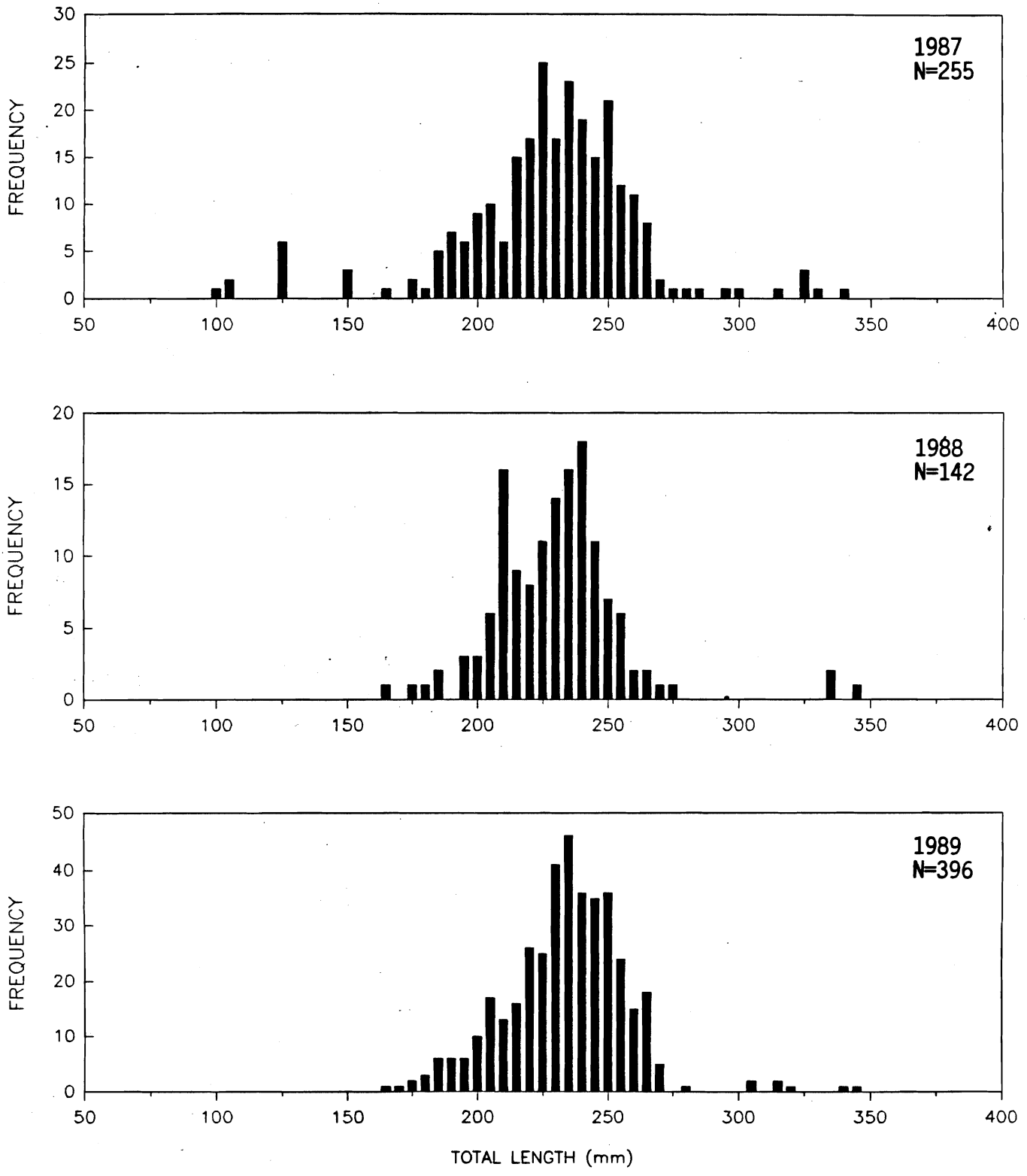

FIGURE 27. Length frequency of rosy rockfish from the Monterey area, 1987 to 1991.

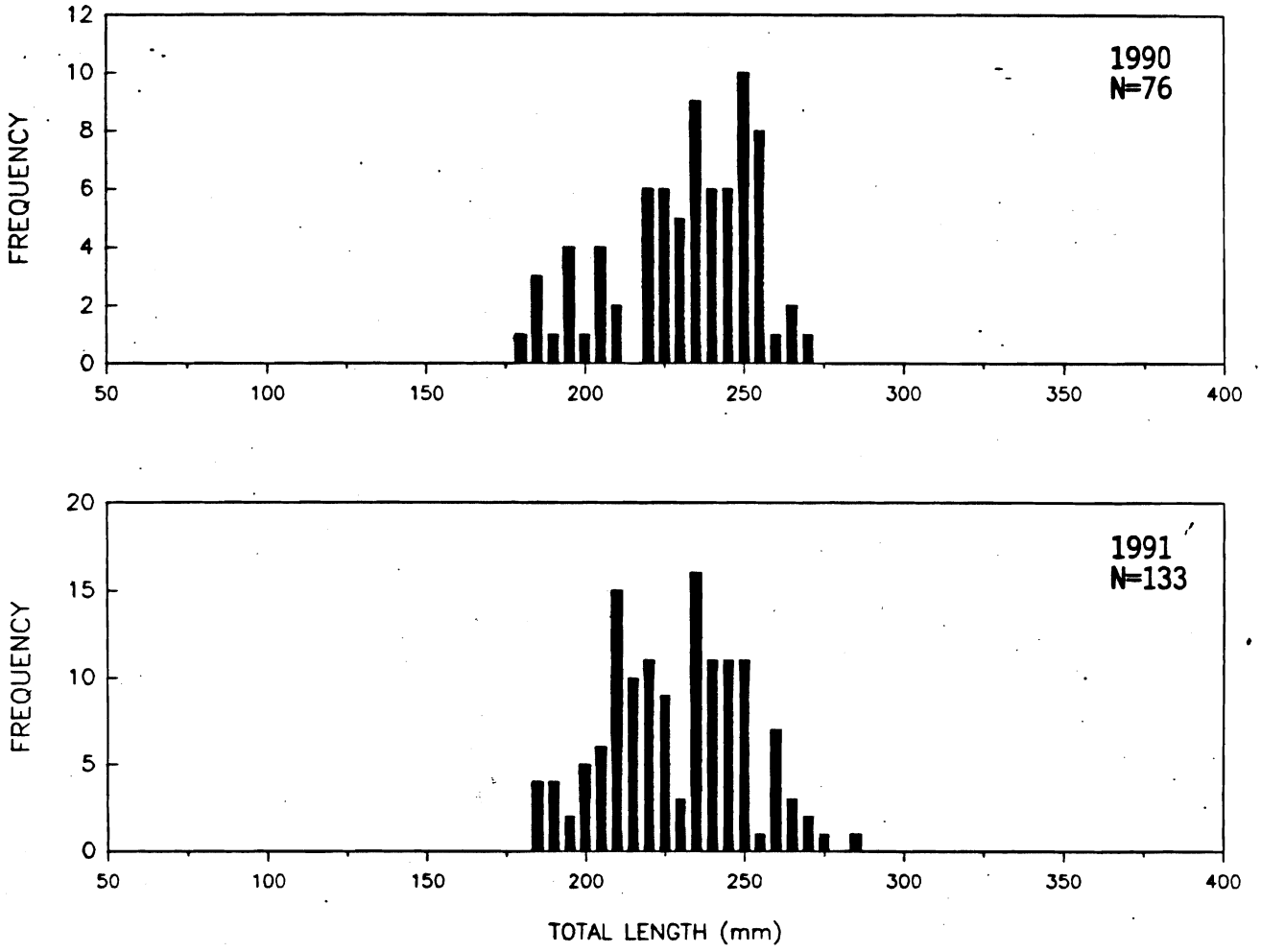

FIGURE 27. (continued).

1988 to 1990-91 in all port areas except Morro Bay (Table 36). Catch rates were somewhat higher in the San Francisco and Morro Bay areas.

Mean CPAH at near locations was lower than at distant locations for the San Francisco, Monterey, and Morro Bay areas (Table 37). Since lingcod can occur in relatively shallow water close to all port areas, as well as at deep and distant

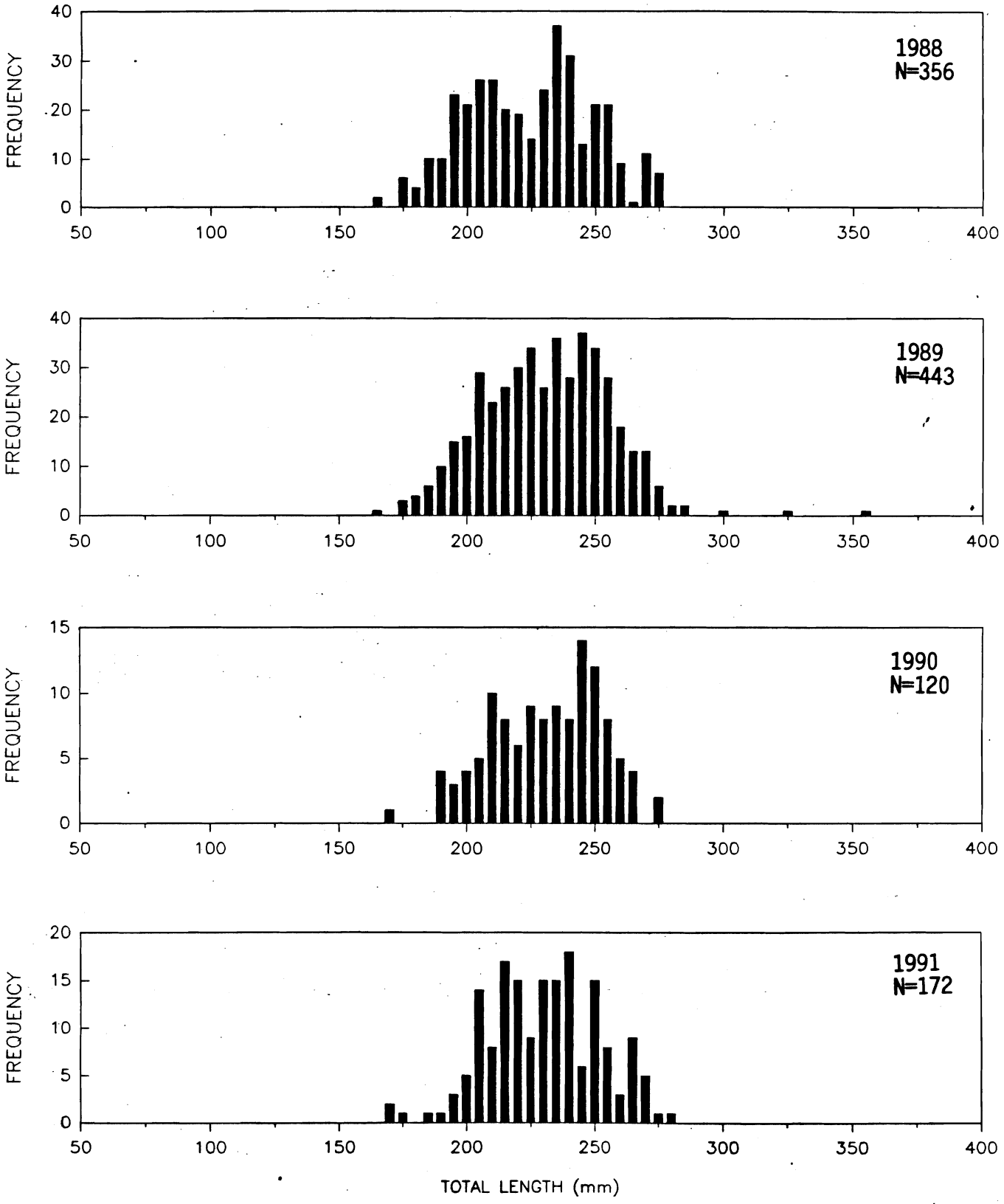

FIGURE 28. Length frequency of rosy rockfish from the Morro Bay area, 1988 to 1991.

TABLE 36. Catch Per Angler Day and Catch Per Angler Hour for Lingcod by Port and Year.

Port area	Catch per angler day						Catch per angler hour					
	1987	1988	1989	1990-91	1990	1991	1987	1988	1989	1990-91	1990	1991
Fort Bragg	-	0.19	0.03	0.23	-	0.26	-	0.09	0.01	0.08	-	0.09
Bodega Bay	-	0.44	0.33	0.25	0.75	0.18	-	0.14	0.10	0.08	0.21	0.06
San Francisco	-	0.97	0.74	0.56	0.62	0.48	-	0.27	0.21	0.16	0.18	0.13
Monterey	0.48	0.34	0.38	0.22	0.08	0.37	0.16	0.11	0.13	0.07	0.03	0.11
Morro Bay	-	0.41	0.64	0.54	0.53	0.55	-	0.12	0.22	0.17	0.16	0.17

TABLE 37. Catch Per Angler Hour and Mean Length of Lingcod for Near and Distant Locations and Shallow and Deep Locations by Port, All Years Combined.

Port area	Catch per angler hour				Number of fish measured				Mean total length (mm)			
	Near	Distant	Shallow	Deep	Near	Dist	Shal	Deep	Near	Dist	Shal	Deep
Fort Bragg	.07	.07	.07	.04	26	2	22	-	677	693	686	-
Bodega Bay	.22	.11	.14	.07	8	122	44	20	639	731	658	724
San Francisco	.12	.23	.22	.33	64	1233	376	76	647	642	646	687
Monterey	.11	.15	.29	.08	656	330	213	382	664	644	639	689
Morro Bay	.15	.27	.17	.27	417	113	146	66	608	628	624	651

TABLE 38. Mean Length of Lingcod Caught by CPFV Anglers by Port and Year.

Port area	Number of fish measured					Mean total length (mm)[1]				
	1987	1988	1989	1990	1991	1987	1988	1989	1990	1991
Fort Bragg	-	5	-	-	23	-	665	-	-	681
Bodega Bay	-	64	51	4	13	-	744	669	721	769
San Francisco	-	560	518	147	107	-	643	633	645	672
Monterey	306	313	320	13	63	644	662	659	609	687
Morro Bay	-	178	183	61	154	-	603	622	617	630

[1] minimum legal size is 559 mm.

locations, these results indicate that this species experienced heavy fishing pressure at near locations in these areas.

In the San Francisco and Morro Bay areas, CPAH was higher at deep locations (Table 37), while in the Monterey area the lower CPAH at deep locations may have been influenced by relatively high targeted effort on chilipepper, which, unlike lingcod, are not caught on the bottom.

Mean length of lingcod decreased with decreasing latitude in all areas except Monterey (Table 38). The Monterey area had a relatively high proportion of lingcod taken from deep locations (Table 37).

No port area showed a consistent trend of increasing or decreasing mean length during the study period.

For port areas with at least 20-fish samples, only the Morro Bay area showed a greater mean at distant locations compared with shallow locations (Table 37). Deep location mean lengths exceeded those from shallow locations for all port areas except Fort Bragg (no fish observed from deep locations) by as much as 66 mm (2.6 in.).

The small sample from the Fort Bragg area in 1991 was characterized primarily by fish from near, shallow locations, and few fish greater than 800 mm (31.5 in.) were observed (Figure 29). The break along the length axis separates legal-sized (≥ 559 mm or 22.0 in.) from sublegal-sized fish. In contrast, the Bodega Bay area sample in 1988 contained fish as large as 1081 to 1090 mm (42.6 to 42.9 in.) (Figure 30), taken

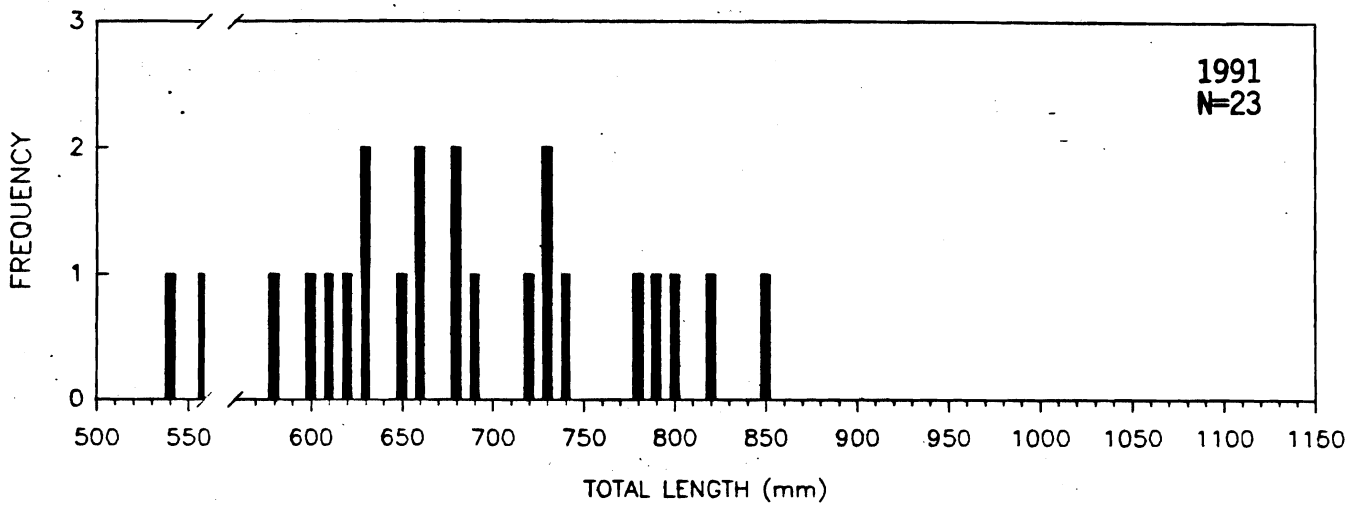

FIGURE 29. Length frequency of lingcod from the Fort Bragg area in 1991.

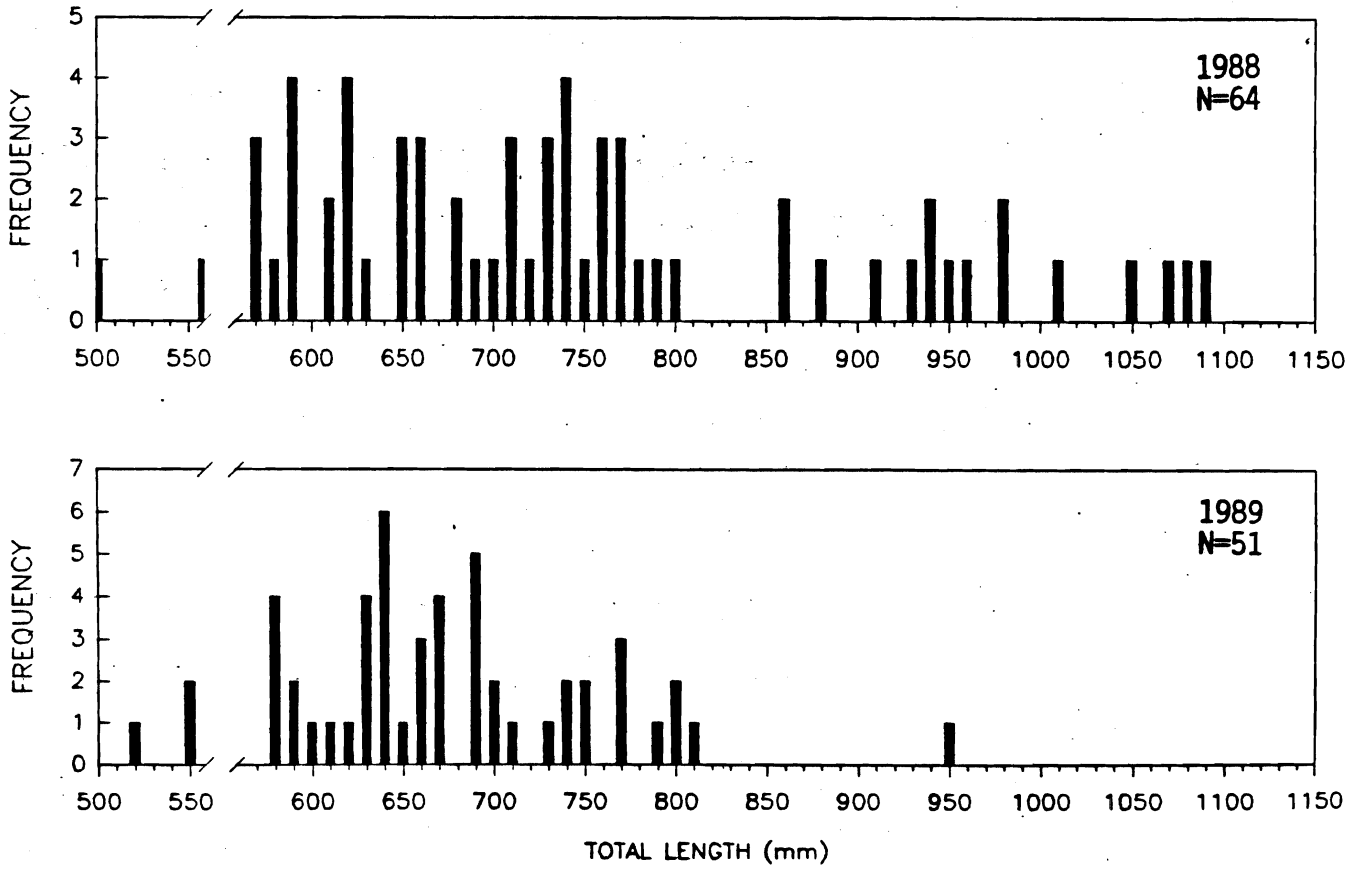

FIGURE 30. Length frequency of lingcod from the Bodega Bay area in 1988 and 1989.

primarily at distant locations.

Lingcod caught in the San Francisco area exhibited a consistent length frequency distribution from 1988 to 1991 with the mode near minimum legal size and few fish greater than 850 mm (33.5 in.) (Figure 31). This type of distribution is indicative of relatively heavy fishing pressure in which a significant proportion of the catch is near minimum legal size several years in succession.

In spite of a five-fish bag limit and minimum legal size which have been in effect since 1981, sublegal-sized lingcod were often retained, particularly in the San Francisco, Monterey, and Morro Bay areas. In the San Francisco area, twenty percent of all lingcod measured from 1988 to 1990 were less than minimum legal size, and forty-five percent of all fish sampled were no greater than 50 mm (2.0 in.) above minimum legal size. In 1991, 15% of fish sampled were less than minimum legal size, 37% of all fish sampled were no greater than 50 mm (2.0 in.) above minimum legal size, and mean length increased 27 mm (1.1 in.) from the previous year (Table 37).

From 1987 to 1989 and in 1991, samples from the Monterey area exhibited a more uniform length frequency distribution than the San Francisco area in the range from 559 mm (22.0 in.) to 750 mm (29.5 in.) (Figure 32). Fewer sublegal-sized fish (12% of the total) were observed than in the San Francisco area. Similar to the San Francisco area, mean length increased in 1991 from previous years, and relatively

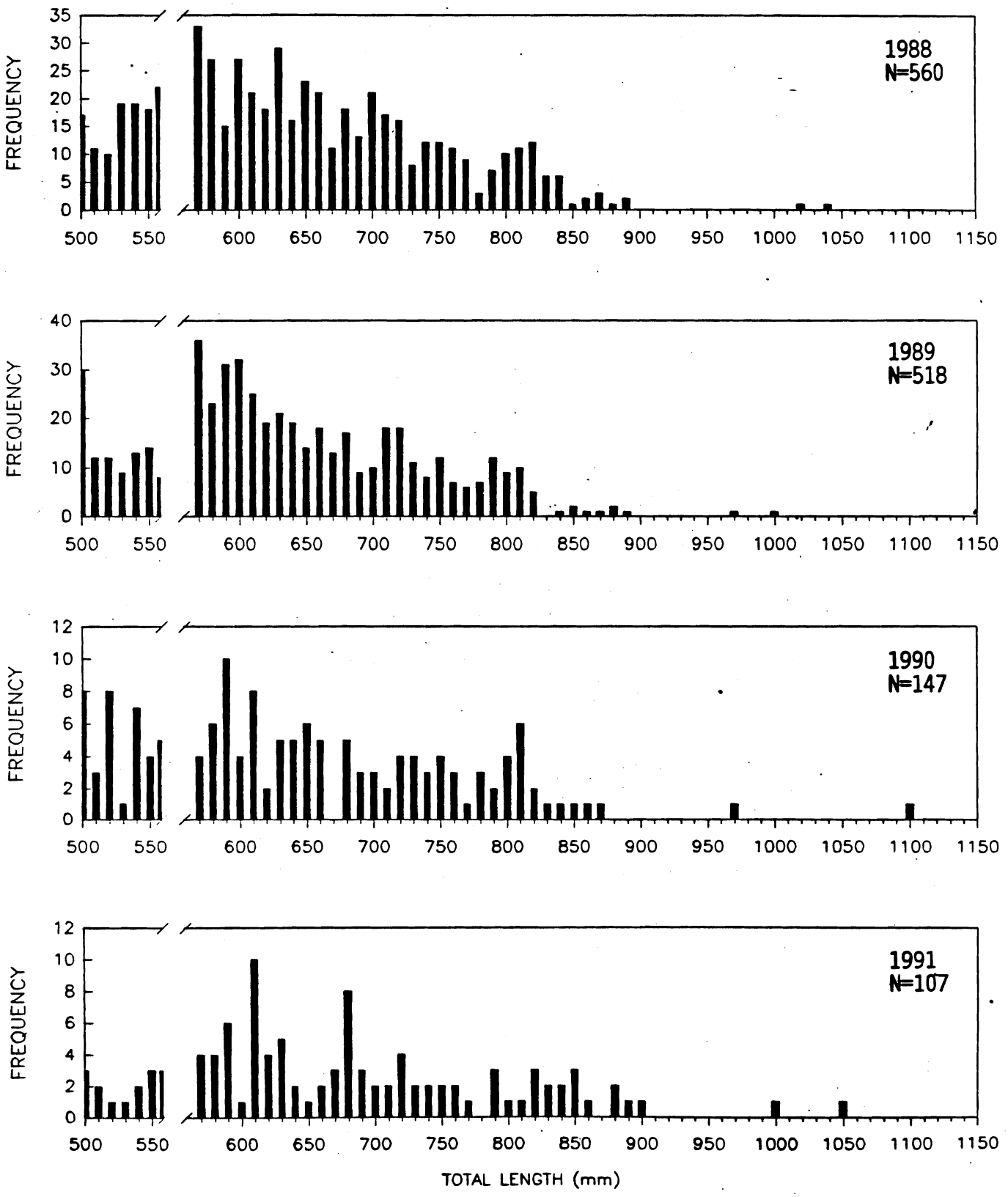

FIGURE 31. Length frequency of lingcod from the San Francisco area, 1988 to 1991.

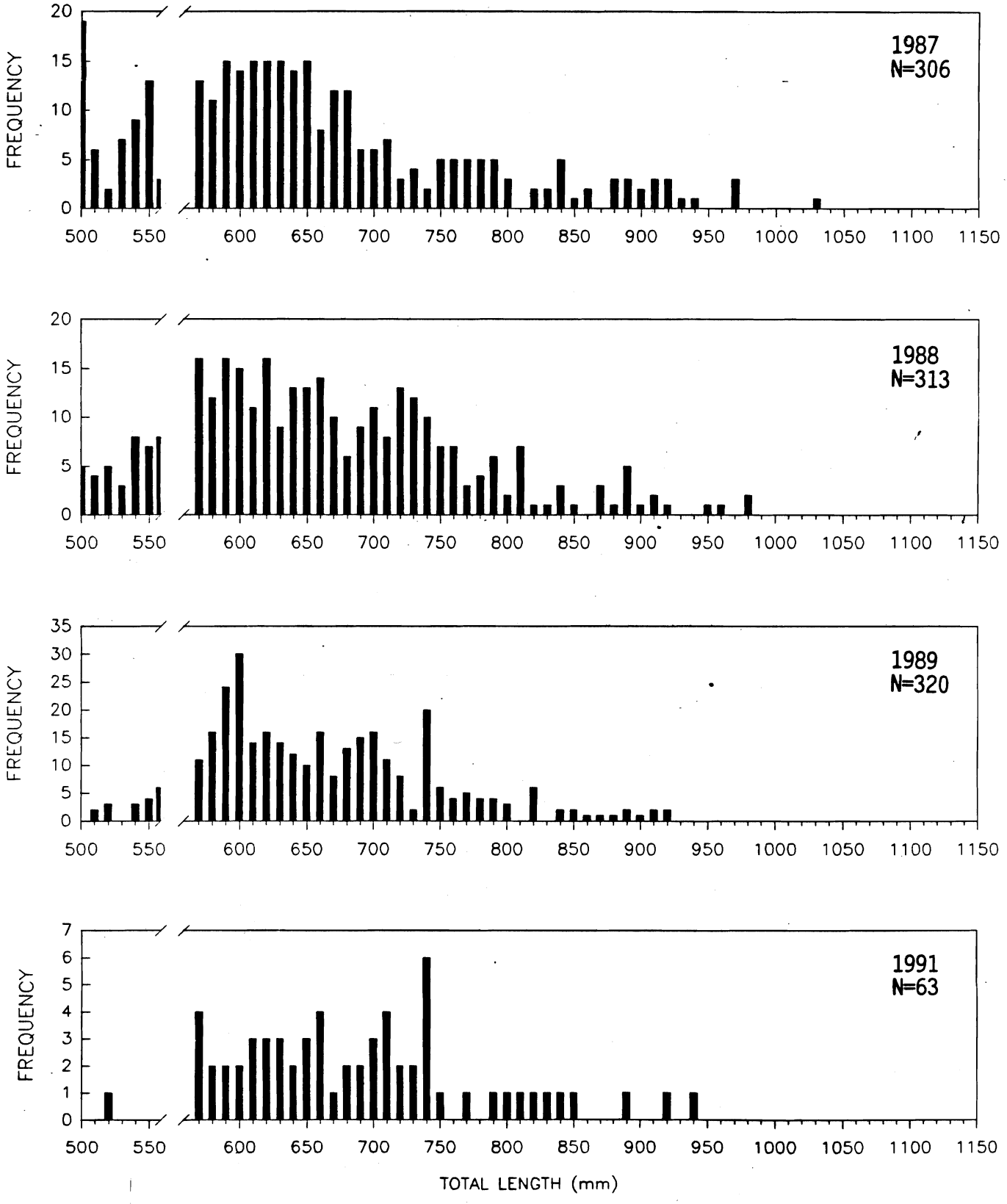

FIGURE 32. Length frequency of lingcod from the Monterey area, 1987 to 1989 and 1991.

few (2%) sublegal-sized fish were observed.

Samples from the Morro Bay area either demonstrated a relatively high proportion of fish within a narrow length range (1988) or a mode just above minimum legal size (1989 to 1991) (Figure 33). Similar to the San Francisco area, this is indicative of relatively heavy fishing pressure. Retention of sublegal-sized fish averaged 17% from 1988 to 1990 and was 8% in 1991.

At minimum legal size, male and female lingcod are between 3 and 4 years old (Miller and Geibel 1973). Age at 50% sexual maturity for males is less than 2 years and for females is between 4 and 5 years (Miller and Geibel 1973). Thus, present minimum legal size allows most males and some females to spawn at least once before becoming vulnerable to legal sport take. Miller and Geibel stated that oceanographic conditions are largely responsible for good recruitment and the effects would be noticed throughout California.

Canary Rockfish

Mean CPAH for canary rockfish was higher in the northern port areas (Table 39). Either increases or small declines in CPAH were observed from 1988 to 1990-91. These data alone do not indicate cause for concern relative to potential overfishing.

In all port areas except Fort Bragg, CPAH at near locations was equal to or greater than that at distant locations (Table 40). No trend among port areas was evident

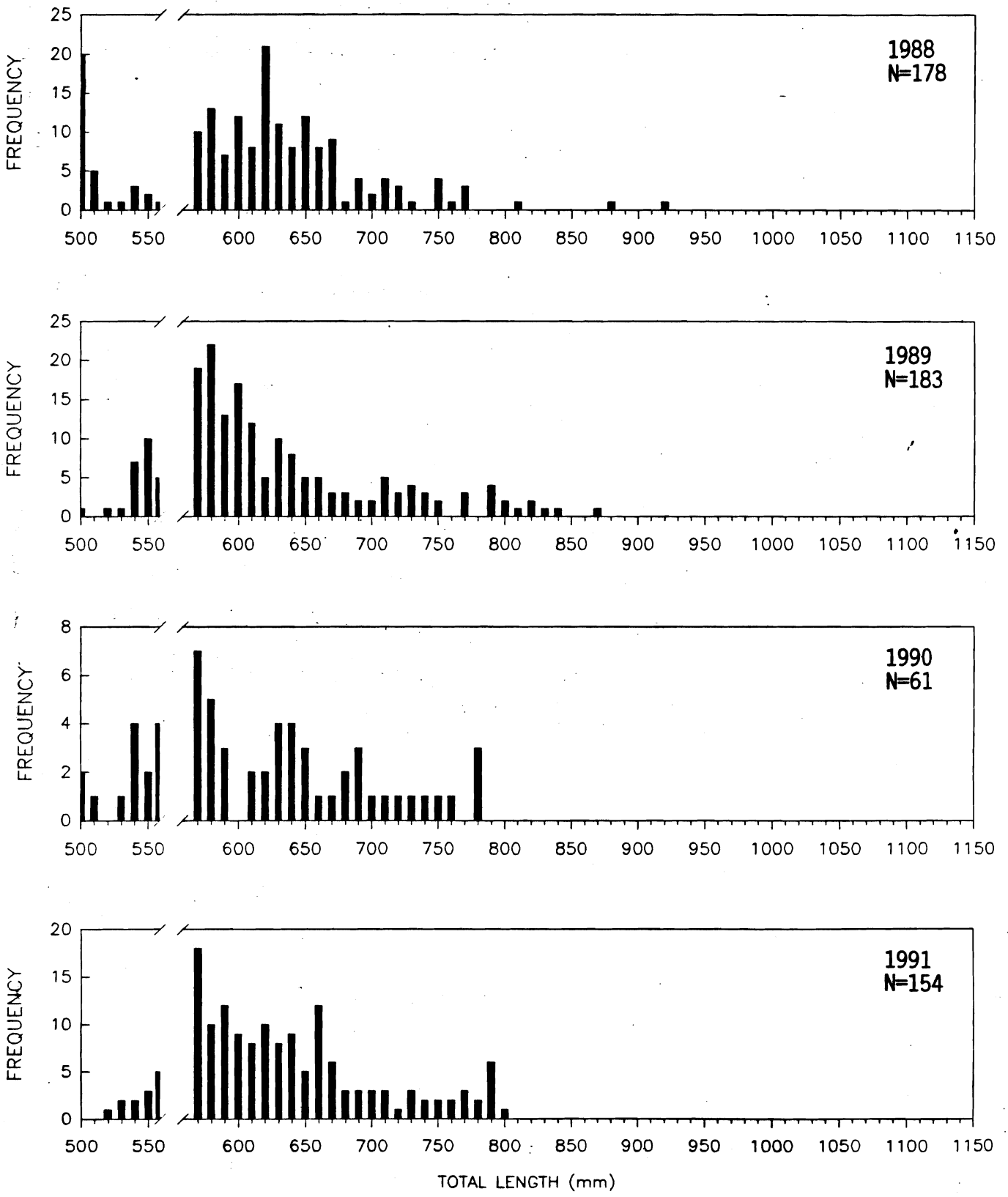

FIGURE 33. Length frequency of lingcod from the Morro Bay area, 1988 to 1991.

TABLE 39. Catch Per Angler Day and Catch Per Angler Hour for Canary Rockfish by Port and Year.

	Catch per angler day						Catch per angler hour					
Port area	1987	1988	1989	1990-91	1990	1991	1987	1988	1989	1990-91	1990	1991
Fort Bragg	-	1.00	1.59	1.11	0.09	1.28	-	0.46	0.60	0.39	0.03	0.44
Bodega Bay	-	0.74	1.36	0.65	1.00	0.60	-	0.24	0.42	0.21	0.29	0.19
San Francisco	-	0.39	0.51	0.60	0.73	0.40	-	0.11	0.14	0.17	0.22	0.11
Monterey	0.13	0.16	0.20	0.41	0.49	0.32	0.04	0.05	0.06	0.14	0.18	0.10
Morro Bay	-	0.49	0.46	0.34	0.48	0.26	-	0.14	0.16	0.11	0.14	0.08

TABLE 40. Catch Per Angler Hour and Mean Length of Canary Rockfish for Near and Distant Locations and Shallow and Deep Locations by Port, All Years Combined.

	Catch per angler hour				Number of fish measured				Mean total length (mm)			
Port area	Near	Distant	Shallow	Deep	Near	Dist	Shal	Deep	Near	Dist	Shal	Deep
Fort Bragg	.43	.57	.42	.99	148	39	119	15	337	327	330	375
Bodega Bay	.62	.27	.43	.31	98	463	299	192	315	421	333	449
San Francisco	.21	.13	.10	.06	244	946	346	17	327	338	297	344
Monterey	.06	.06	.05	.06	496	144	44	427	380	380	325	392
Morro Bay	.14	.06	.07	.22	965	61	94	114	338	332	314	368

TABLE 41. Mean Length of Canary Rockfish Caught by CPFV Anglers by Port and Year.

	Number of fish measured					Mean total length (mm)				
Port area	1987	1988	1989	1990	1991	1987	1988	1989	1990	1991
Fort Bragg	-	14	32	1	140	-	364	367	332	325
Bodega Bay	-	170	393	6	58	-	389	404	488	370
San Francisco	-	361	544	247	116	-	329	338	331	330
Monterey	103	157	217	158	96	393	377	372	389	369
Morro Bay	-	387	371	159	155	-	336	324	345	354

for catch rate relative to depth (Table 40).

Mean length of canary rockfish in all years sampled showed a clinal trend from the Bodega Bay area to the Morro Bay area, with the exception of the Monterey area (Table 41). Boehlert and Kappeman (1980) concluded that there was a lack of latitudinal difference in growth for canary rockfish from California and Washington, but their maximum lengths of fish sampled for age were larger for both sexes in Washington. Similar to widow rockfish and lingcod, mean length in the Monterey area was always greater than that of the San Francisco area to the north for any given year. This may be due to isothermic submergence. The majority of fish (58%) measured from the Monterey area were caught at deep locations, as compared to only 1% from the San Francisco area.

No port area showed a consistent trend of increasing or decreasing mean length during the study period.

The difference in mean length of canary rockfish between near and distant locations was pronounced only in the Bodega Bay area, where fish from distant locations averaged 106 mm (4.2 in.) greater than those from near locations (Table 40). Fish sampled from deep locations consistently had greater mean lengths than those from shallow locations in all port areas; the difference was as much as 116 mm (4.6 in.) in the Bodega Bay area.

Relatively small fish were observed in the Fort Bragg area sample in 1991 (Figure 34), where the majority of sampled trips went to near, shallow locations. Based on length-age

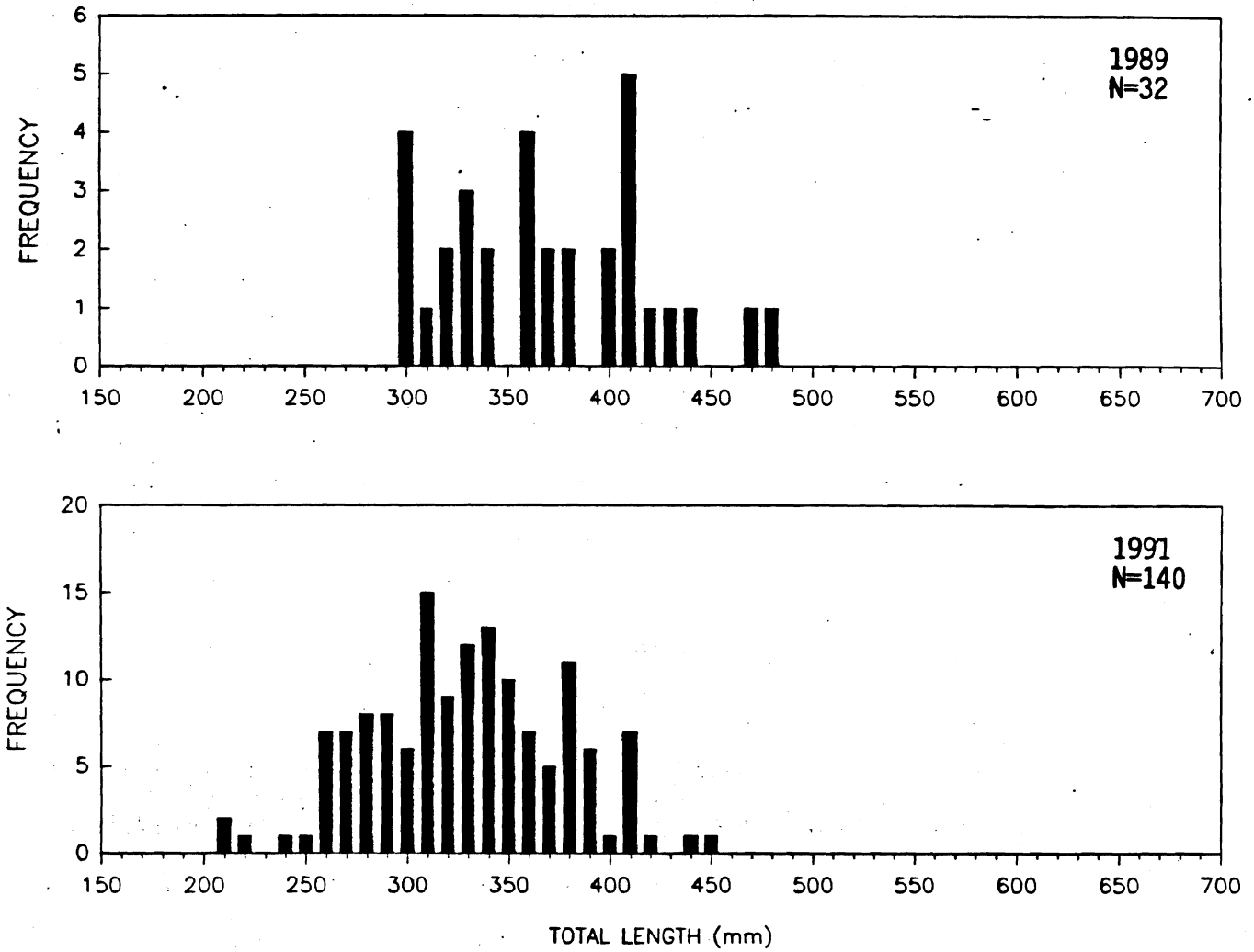

FIGURE 34. Length frequency of canary rockfish from the Fort Bragg area in 1989 and 1991.

data from Lea et al. (1993), those fish in the 251- to 300-mm (9.9- to 11.8-in.) length range were most likely 3 to 5 years old. Canary rockfish are targeted by commercial and sport skiff fisheries in northern California, particularly in the Eureka area. Adams (1992b) reported a 10% decline in mean length in the Fort Bragg area during the 1980s.

In sharp contrast to other port areas, Bodega Bay area

samples showed a wide range of length frequencies with most fish between 250 and 550 mm (9.8 to 21.7 in.) and some exceeding 600 mm (23.6 in.; Figure 35). This encompasses an extremely wide age range. Adams (1992b) reported a maximum age of 60 years for canary rockfish, and at age 50 males and females averaged 538 and 569 mm (21.2 and 22.4 in.), respectively. A strong mode appeared in the 1989 sample at 321 to 350 mm (12.6 to 13.8 in.) (Figure 35). Based on length-age data from Lea et al. (1993), this mode consisted of a high proportion of 5-and 6-year olds (1984 and 1983 year classes).

Length frequency distributions for canary rockfish from the San Francisco area were fairly uniform during the sampling period with the majority of fish in the length range corresponding to 3-to 5-years old (Lea et al. 1993) and few fish greater than 440 mm (17.7 in.; Figure 36). This equals the length reported by Wyllie-Echeverria (1987) and Adams (1992b) for 50% sexual maturity for females. Length for 50% male sexual maturity was reported as 400 mm (15.7 in.) by Wyllie-Echeverria (1987) and Adams (1992b). Phillips (1964) estimated size at 50% sexual maturity for females and males at 356 mm (14.0 in.).

Canary rockfish sampled from the Monterey area exhibited a unimodal distribution each year with the mode ranging from 351-360 mm (13.8-14.2 in.) to 381-390 mm (15.0-15.4 in.; Figure 37). Relatively fewer smaller fish in the 1987 and 1990 samples resulted in a greater mean length. A slightly

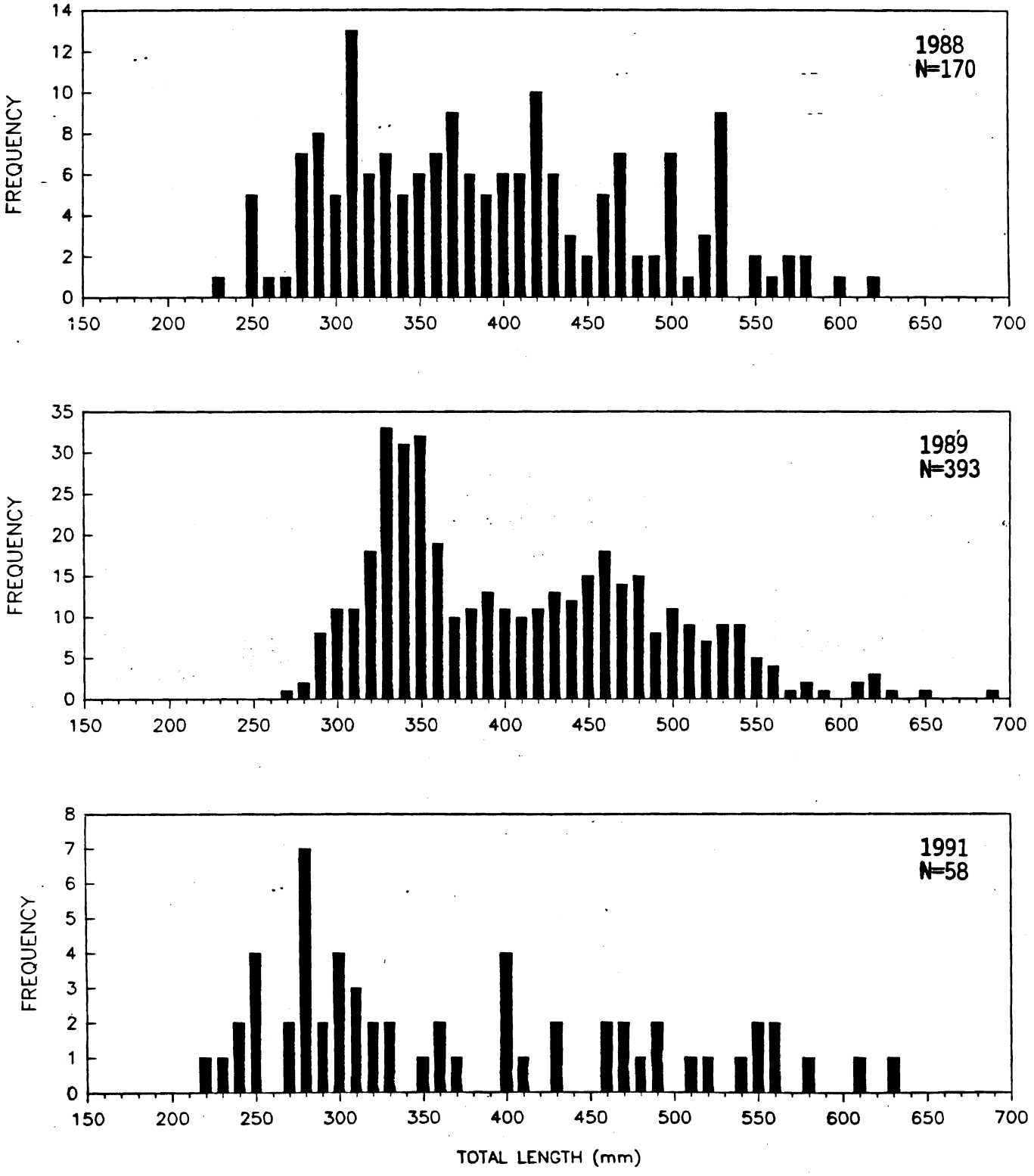

FIGURE 35. Length frequency of canary rockfish from the Bodega Bay area in 1988, 1989, and 1991.

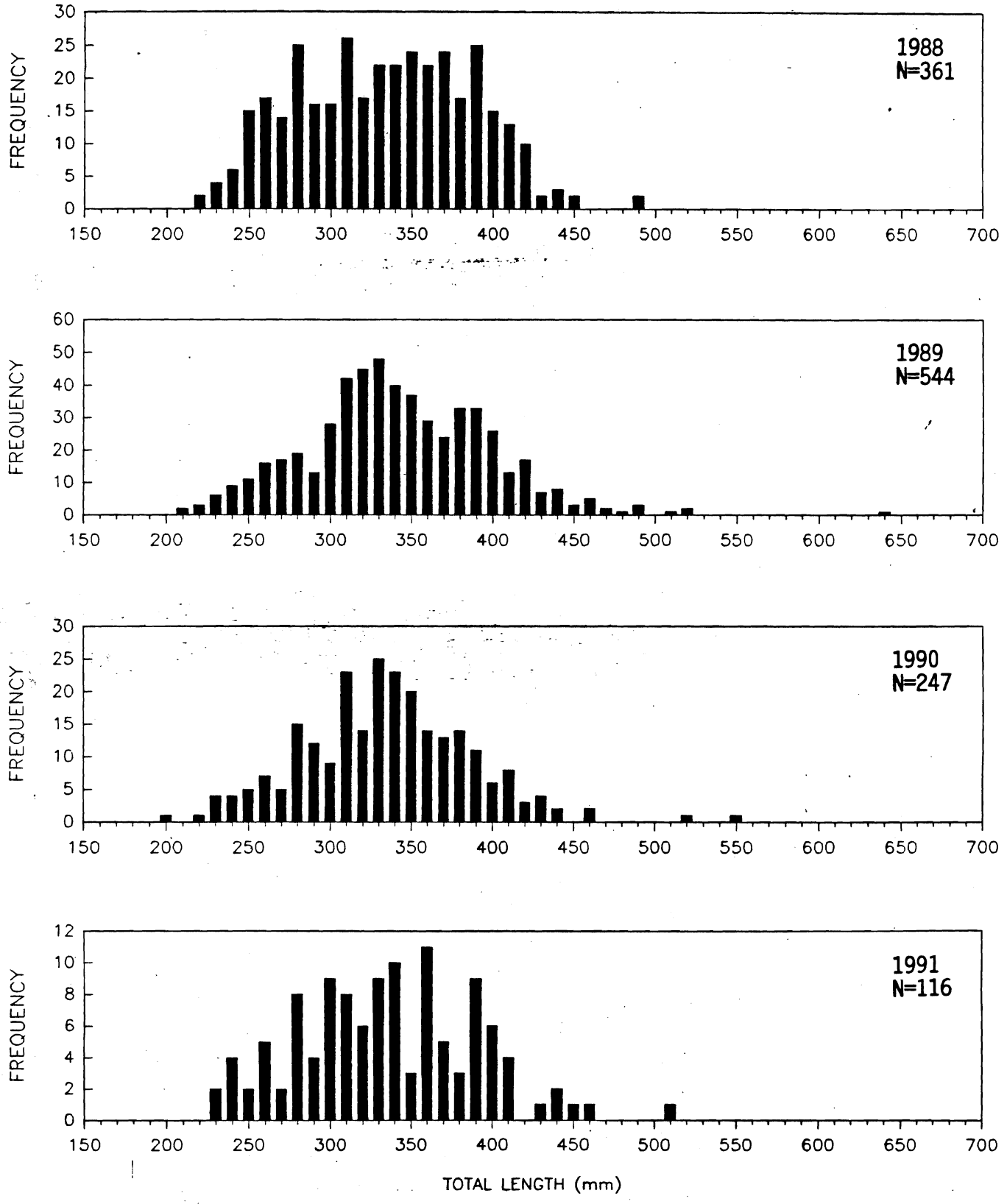

FIGURE 36. Length frequency of canary rockfish from the San Francisco area, 1988 to 1991.

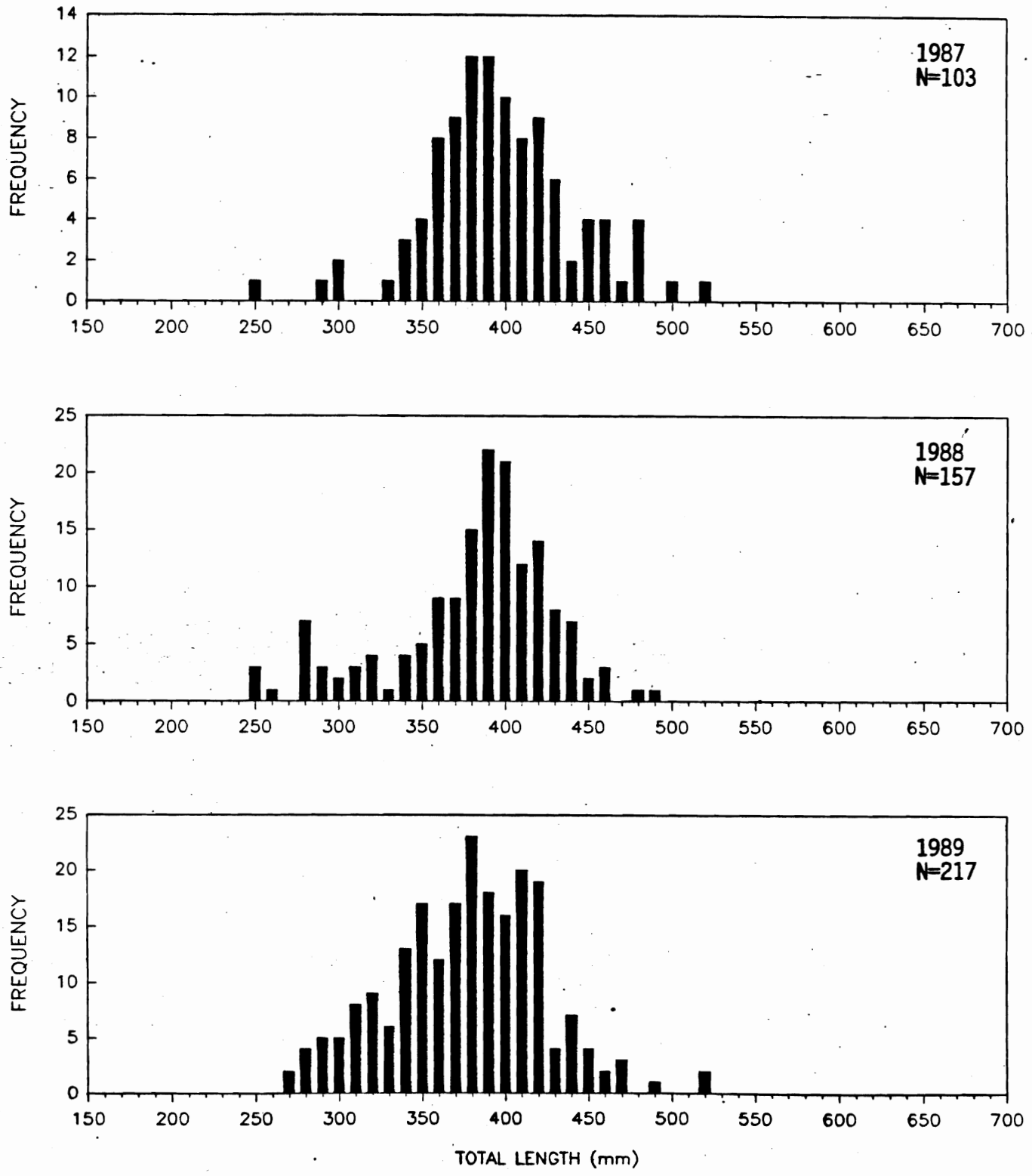

FIGURE 37. Length frequency of canary rockfish from the Monterey area, 1987 to 1991.

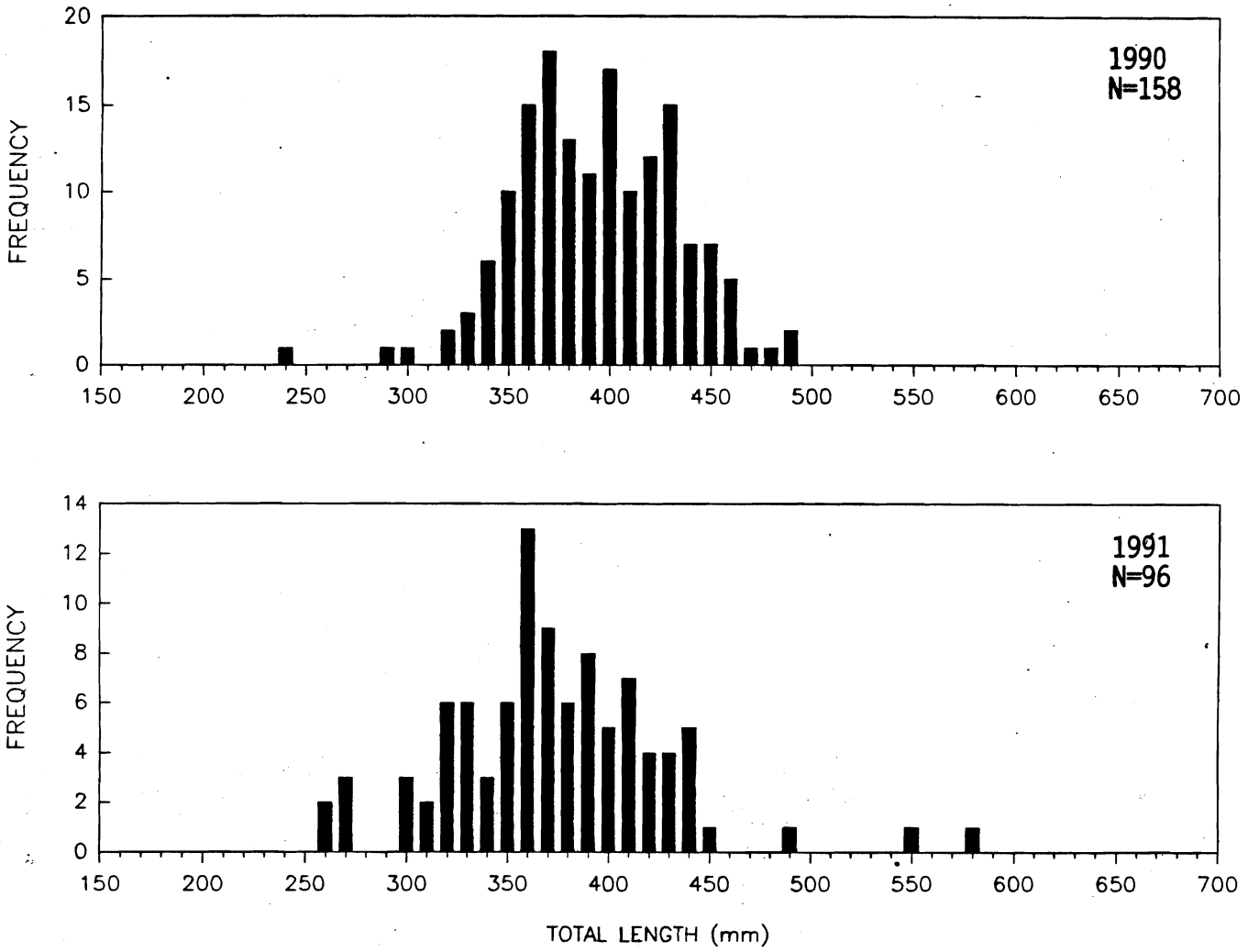

FIGURE 37. (continued).

higher proportion of larger fish above the length range of 50% sexual maturity was observed compared with the San Francisco area.

Morro Bay area samples of canary rockfish exhibited a strong bimodal distribution in 1988, with modes at 271 to 290 mm (10.7 to 11.4 in.) and 381 to 390 mm (15.0 to 15.4 in.; Figure 38). The mode of smaller fish appeared to progress each year, reaching

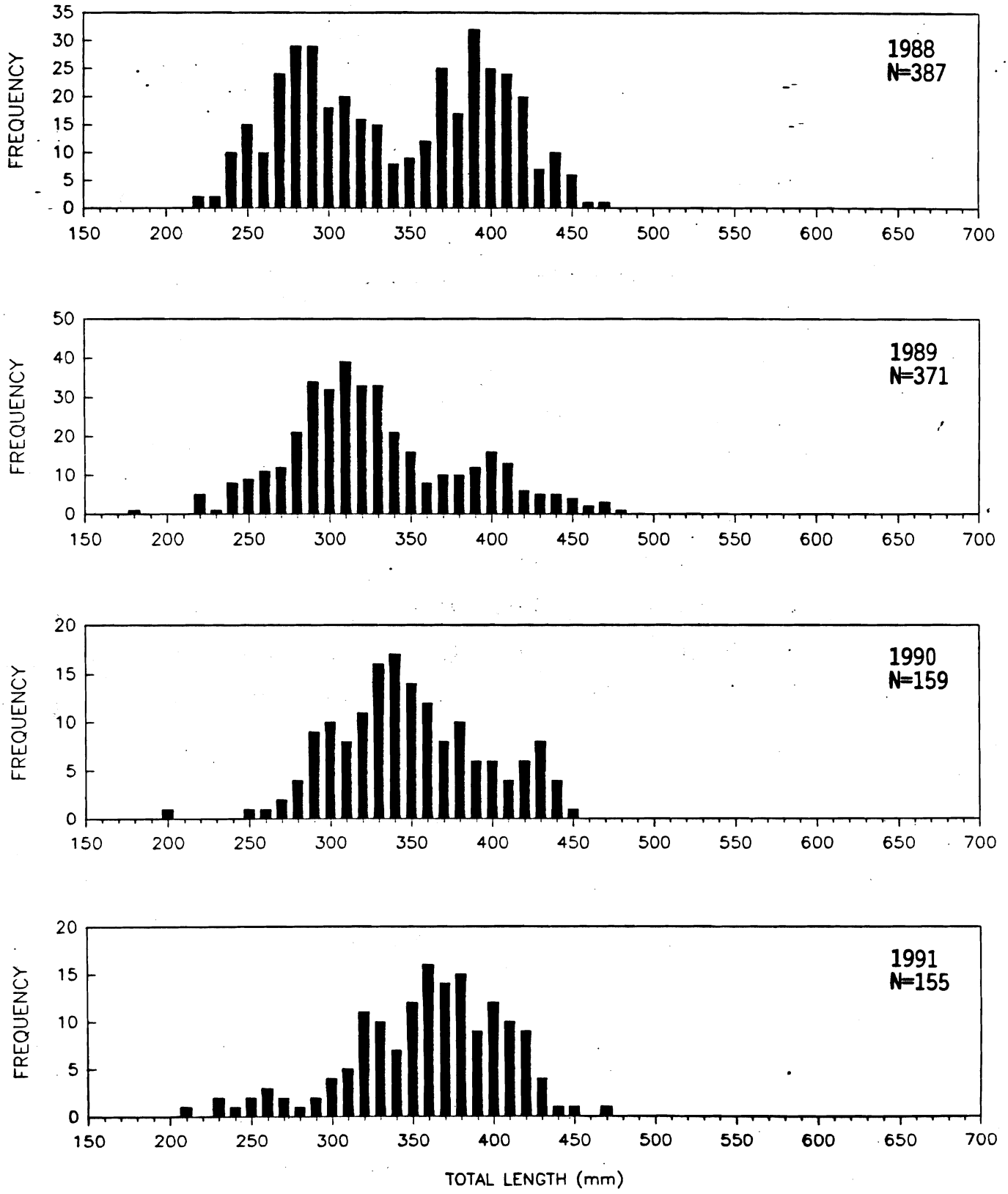

FIGURE 38. Length frequency of canary rockfish from the Morro Bay area, 1988 to 1991.

351 to 380 mm (13.8 to 15.0 in.) by 1991. This increase is greater than that calculated by Lea et al. (1993) for 4 years of growth in this length range and thus may indicate more than one year class comprising the mode. However, the 1984 year class, which at 5 years of age would have a mean length of 335 mm (13.2 in.; Lea et al. 1993) is probably well represented in the 1989 sample, similar to the Bodega Bay and San Francisco areas.

Even if the lower value for 50% sexual maturity reported by Phillips (1964) is considered, a significant portion of the canary rockfish CPFV catch from all port areas may not have reached sexual maturity, and this is a cause for concern. Recruitment may be dependent on relatively unfished stocks in deeper water or more remote areas. As long as these stocks do not receive heavy fishing pressure, the smaller fish caught in shallower water should be a sustainable, albeit low-quality, resource in central California.

Greenspotted Rockfish

A substantial decline in CPAH occurred for greenspotted rockfish in the Bodega Bay area from 1988 to 1990-91 (Table 42); all other port areas showed increases in catch rate. Only eight trips were sampled in 1990-91 in the Bodega Bay area, and this anomaly may be due to insufficient sample size.

Catch rates for greenspotted rockfish were much higher at deep locations than at shallow locations for all port areas except Fort Bragg where few fish were observed caught (Table

TABLE 42. Catch Per Angler Day and Catch Per Angler Hour for Greenspotted Rockfish by Port and Year.

	Catch per angler day						Catch per angler hour					
Port area	1987	1988	1989	1990-91	1990	1991	1987	1988	1989	1990-91	1990	1991
Fort Bragg	-	-	0.03	0.09	0.64	-	-	-	0.01	0.03	0.24	-
Bodega Bay	-	1.20	0.73	0.29	1.00	0.20	-	0.39	0.22	0.09	0.29	0.06
San Francisco	-	0.25	0.27	0.30	0.18	0.49	-	0.07	0.08	0.09	0.05	0.13
Monterey	0.15	0.14	0.57	0.56	0.43	0.70	0.05	0.04	0.19	0.19	0.16	0.22
Morro Bay	-	0.09	0.12	0.13	0.20	0.08	-	0.02	0.04	0.04	0.06	0.03

TABLE 43. Catch Per Angler Hour and Mean Length of Greenspotted Rockfish for Near and Distant Locations and Shallow and Deep Locations by Port, All Years Combined.

	Catch per angler hour				Number of fish measured				Mean total length (mm)			
Port area	Near	Distant	Shallow	Deep	Near	Dist	Shal	Deep	Near	Dist	Shal	Deep
Fort Bragg	.03	-	<.01	-	6	-	1	-	303	-	379	-
Bodega Bay	.03	.31	.01	.64	5	568	6	246	351	359	267	355
San Francisco	.06	.08	<.01	.40	60	645	2	109	319	335	336	333
Monterey	.06	.23	<.01	.18	457	635	-	1175	328	325	-	325
Morro Bay	.03	.05	.01	.08	209	53	5	77	307	316	326	310

TABLE 44. Mean Length of Greenspotted Rockfish Caught by CPFV Anglers by Port and Year.

	Number of fish measured					Mean total length (mm)				
Port area	1987	1988	1989	1990	1991	1987	1988	1989	1990	1991
Fort Bragg	-	-	1	5	-	-	-	379	288	-
Bodega Bay	-	334	195	10	27	-	361	358	344	353
San Francisco	-	204	279	58	164	-	326	342	332	330
Monterey	115	138	719	109	221	339	315	325	332	321
Morro Bay	-	60	98	67	56	-	289	306	316	323

43). This in part explains the higher mean CPAH for Bodega Bay and Monterey areas at distant locations (Table 43), since these areas had the highest proportion of distant locations which were also deep locations.

Greenspotted rockfish demonstrated the clinal trend of decreasing mean length with decreasing latitude from the Bodega Bay area to the Morro Bay area (Table 44). Fish from the Bodega Bay area averaged from 28 to 72 mm (1.1 to 2.8 in.) greater in mean length than those from the Morro Bay area. The only consistent trend of increasing or decreasing mean length for a port area during the study period occurred in the Morro Bay area, where mean length gradually increased from 289 mm (11.4 in.) to 323 mm (12.7 in.). Within all port areas with adequate sample size, mean length varied relatively little among years.

Differences in mean length between near and distant locations were small to moderate in all port areas and were not consistent among ports (Table 43). The greatest difference occurred in the San Francisco area, where fish from distant locations averaged 16 mm (0.6 in.) greater than those from near locations.

Length frequency distributions from the Bodega Bay area showed a decrease in the relative proportion of large fish from 1988 to 1989 (Figure 39). Those fish ranging from 366 to 440 mm (14.4 to 17.3 in.) were approximately 13 to 20 years old, based on length-age data from Lea et al. (1993). The overall length range of the 1988 and 1989 distributions

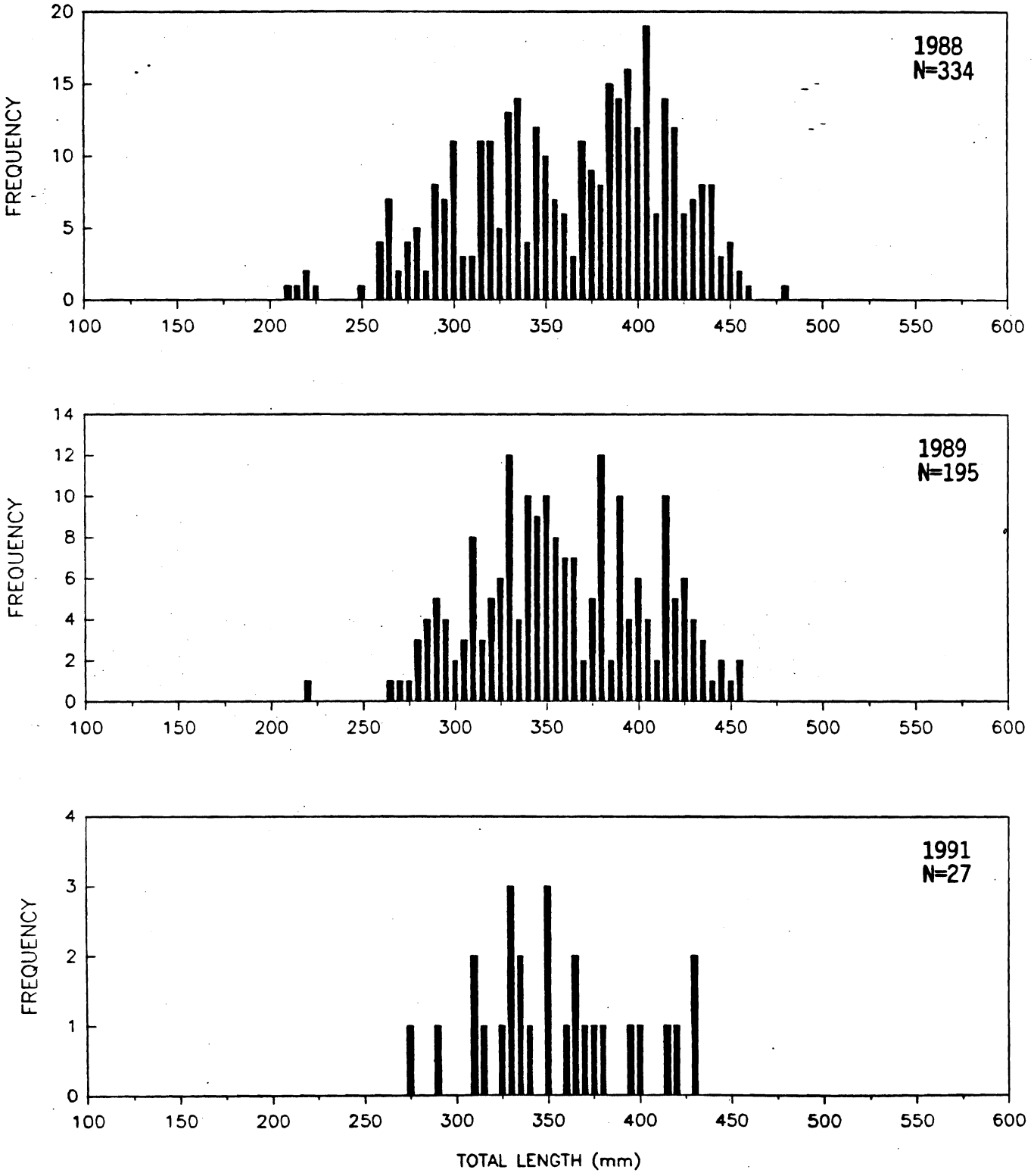

FIGURE 39. Length frequency of greenspotted rockfish from the Bodega Bay area in 1988, 1989, and 1991.

corresponds to an age range of approximately 6 to more than 20 years (Lea et al. 1993). This wide age range would tend to produce a more stable length frequency structure less influenced by periodic recruitment. Length at 50% sexual maturity is 270 mm (10.6 in.) for males and 280 mm (11.0 in.) for females (Wyllie-Echeverria 1987). Thus the sport take of juveniles is relatively minor.

The length frequency distribution for the San Francisco area showed a strong mode in 1989 at 336 to 355 mm (13.2 to 14.0 in.) (Figure 40), but it was difficult to detect modes in other years at smaller or larger lengths. A relatively wide length (and thus age) range characterized the samples.

Monterey area length frequency distributions generally showed a peak of abundance between 300 and 356 mm (11.8 and 14.0 in.) in all 5 years (Figure 41). This length interval corresponds to an age range of approximately 9 to 13 years (Lea et al. 1993), and the population appeared relatively stable during the sampling period.

Morro Bay area samples contained a higher proportion of greenspotted rockfish less than 296 mm (11.7 in.) compared with other areas (Figure 42). Thus, a significant portion (approximately 20%) of the catch most likely consisted of juveniles. The length frequency distributions were fairly consistent among years, similar to other areas.

Vermilion Rockfish

Vermilion rockfish CPAH was moderately high in the Morro

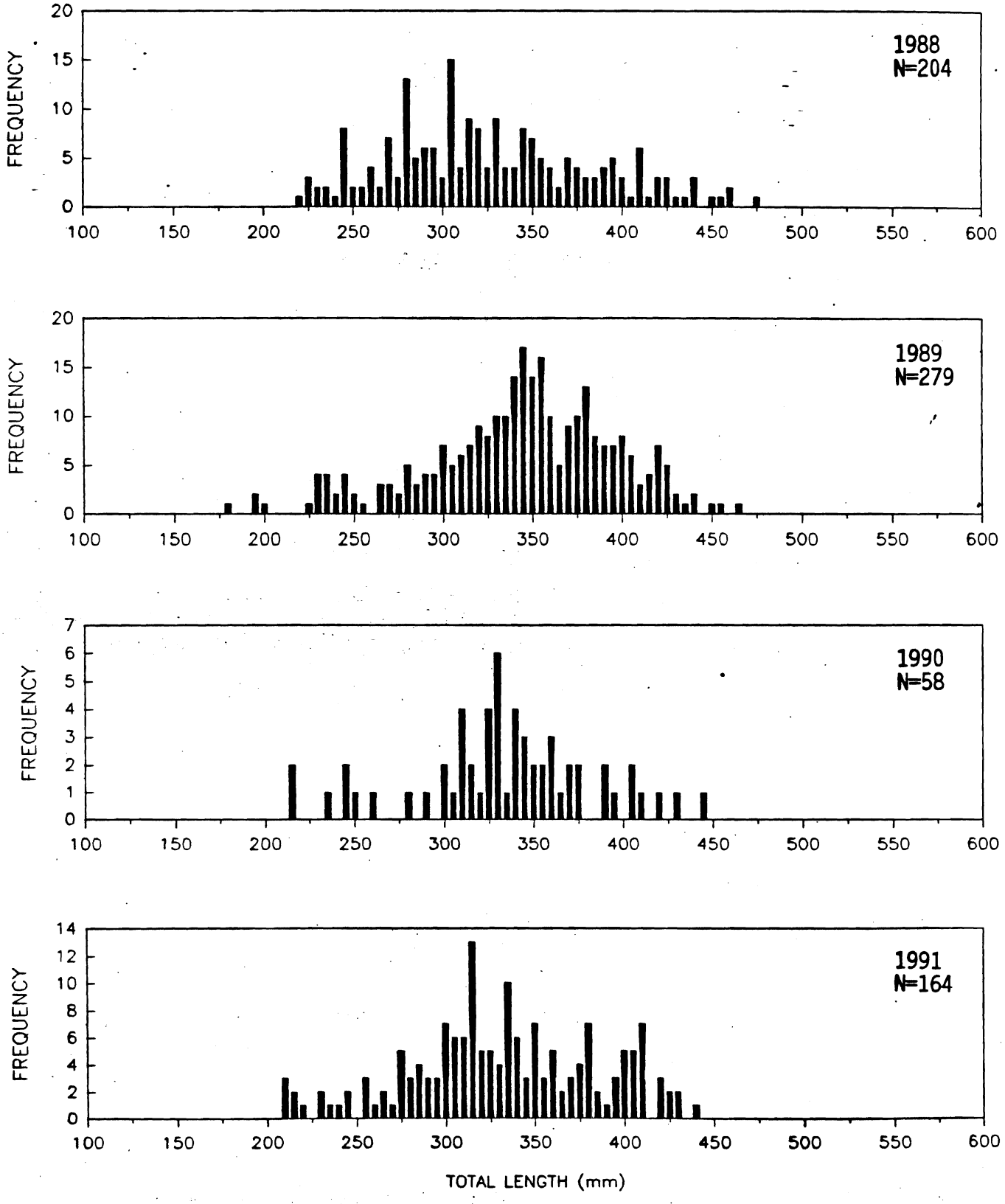

FIGURE 40. Length frequency of greenspotted rockfish from the San Francisco area, 1988 to 1991.

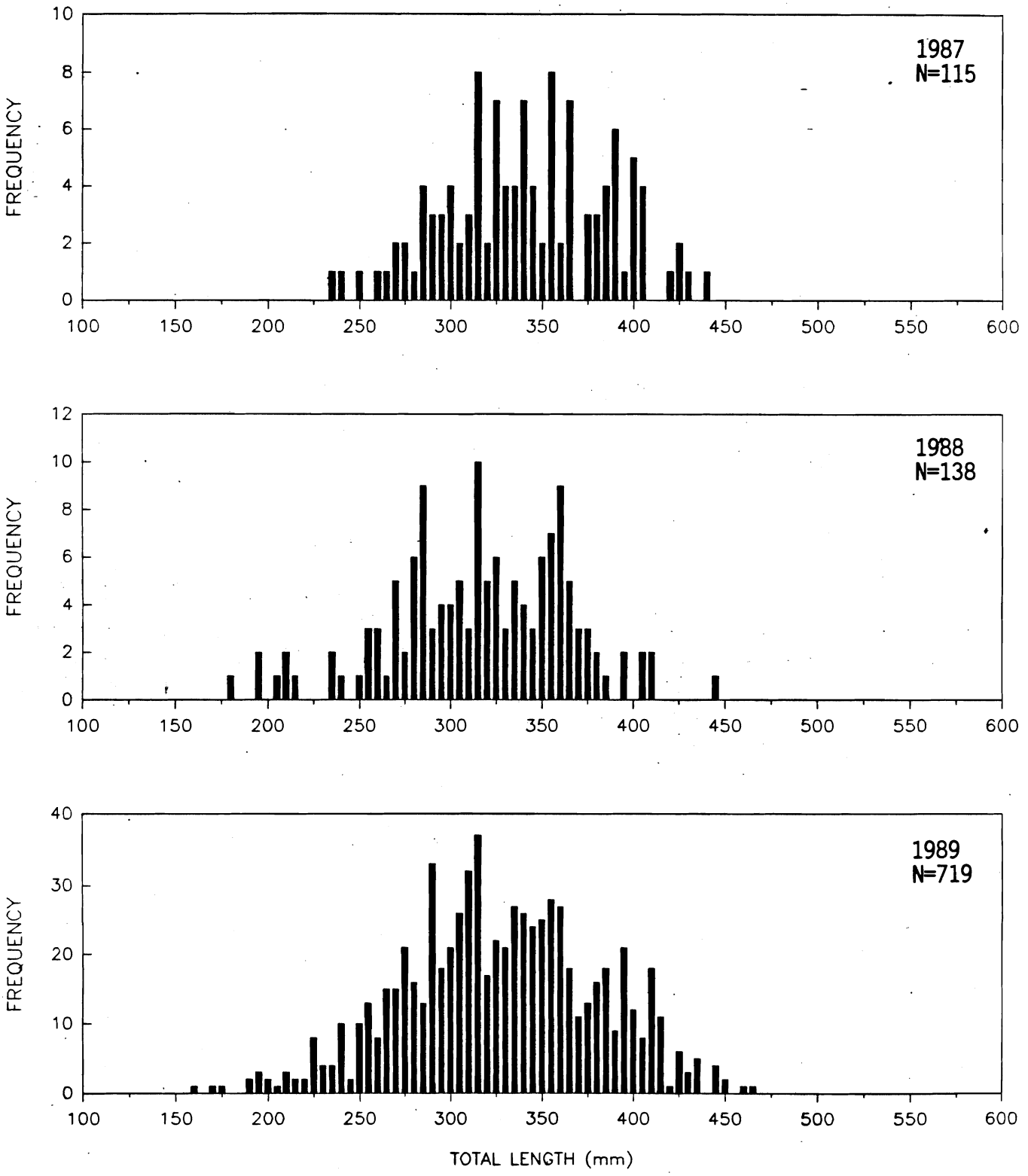

FIGURE 41. Length frequency of greenspotted rockfish from the Monterey area, 1987 to 1991.

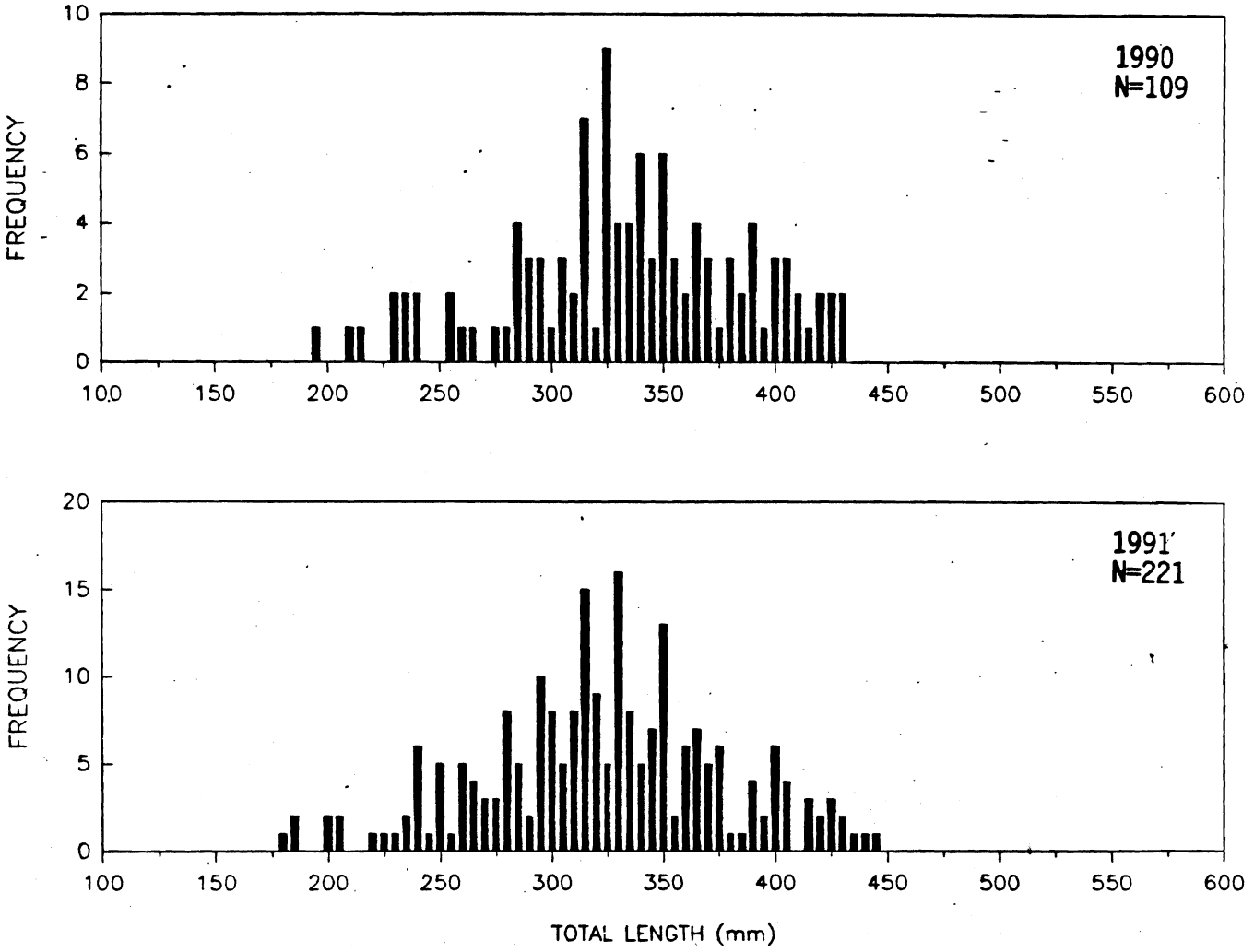

FIGURE 41. (continued).

Bay area and relatively low elsewhere (Table 45). This species is highly desirable, sought by all rockfish anglers, and appears to have been relatively stable in abundance from 1988 to 1990-91. Mean CPAH was higher in all port areas in 1990-91 compared with 1988.

Only in the Monterey area were catch rates lower at near locations compared with distant locations (Table 46). This

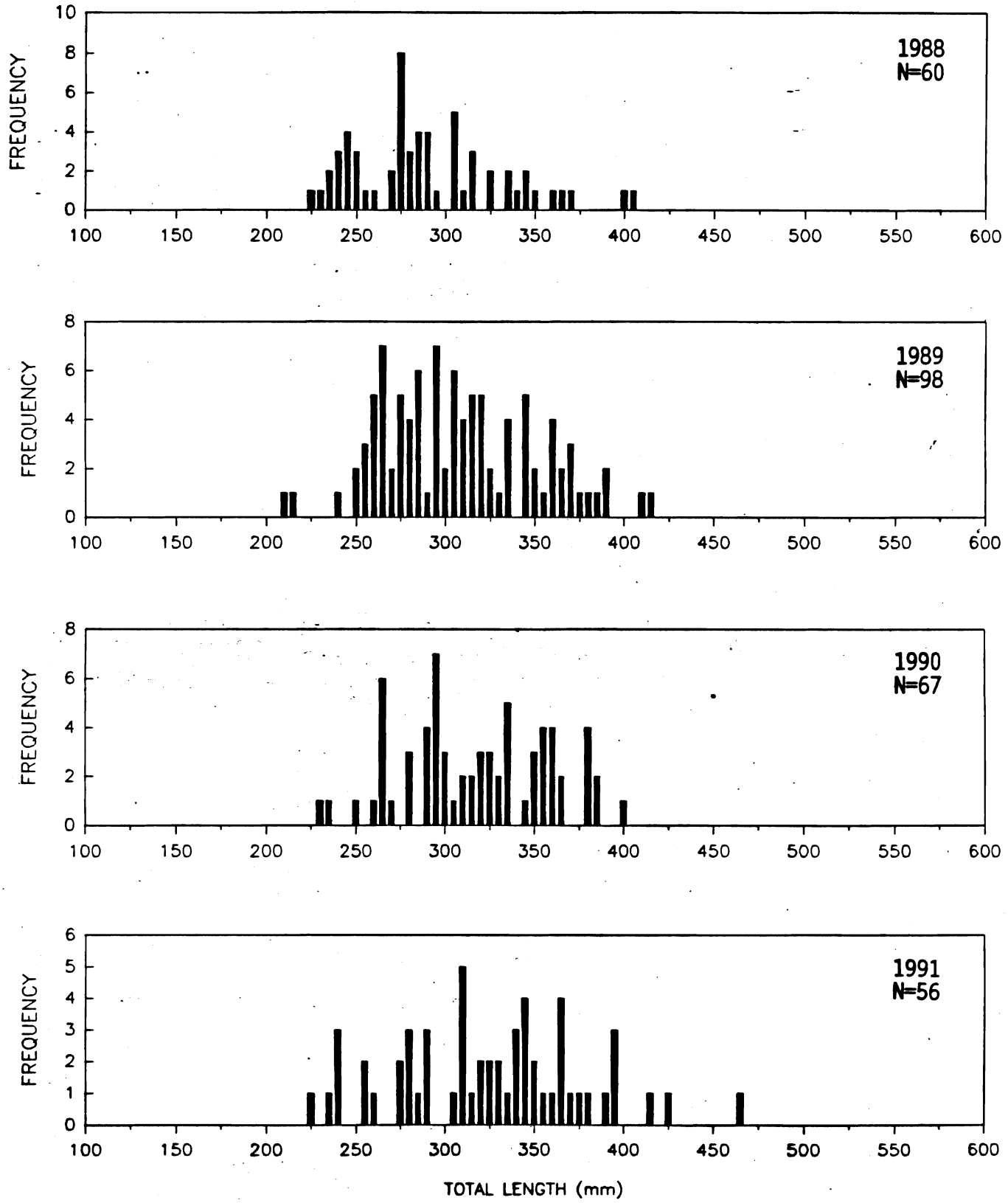

FIGURE 42. Length frequency of greenspotted rockfish from the Morro Bay area, 1988 to 1991.

TABLE 45. Catch Per Angler Day and Catch Per Angler Hour for Vermilion Rockfish by Port and Year.

Port area	Catch per angler day						Catch per angler hour					
	1987	1988	1989	1990-91	1990	1991	1987	1988	1989	1990-91	1990	1991
Fort Bragg	-	-	-	0.10	-	0.12	-	-	-	0.04	-	0.04
Bodega Bay	-	0.05	0.05	0.09	-	0.10	-	0.02	0.02	0.03	-	0.03
San Francisco	-	0.12	0.12	0.17	0.22	0.10	-	0.03	0.03	0.05	0.06	0.03
Monterey	0.08	0.08	0.12	0.20	0.20	0.20	0.03	0.03	0.04	0.07	0.07	0.06
Morro Bay	-	0.63	1.19	0.92	1.56	0.52	-	0.18	0.42	0.28	0.46	0.16

TABLE 46. Catch Per Angler Hour and Mean Length of Vermilion Rockfish for Near and Distant Locations and Shallow and Deep Locations by Port, All Years Combined.

Port area	Catch per angler hour				Number of fish measured				Mean total length (mm)			
	Near	Distant	Shallow	Deep	Near	Dist	Shal	Deep	Near	Dist	Shal	Deep
Fort Bragg	.03	-	.03	-	11	5	11	-	471	455	471	-
Bodega Bay	.02	.02	.03	.01	3	45	29	7	431	515	474	617
San Francisco	.05	.04	.04	.01	53	212	108	1	356	418	393	569
Monterey	.03	.05	.06	.03	219	151	52	142	371	417	371	391
Morro Bay	.29	.18	.17	.54	1982	124	180	149	337	422	379	398

TABLE 47. Mean Length of Vermilion Rockfish Caught by CPFV Anglers by Port and Year.

Port area	Number of fish measured					Mean total length (mm)				
	1987	1988	1989	1990	1991	1987	1988	1989	1990	1991
Fort Bragg	-	-	-	-	16	-	-	-	-	466
Bodega Bay	-	22	18	-	10	-	518	531	-	447
San Francisco	-	87	99	68	22	-	402	404	401	437
Monterey	65	76	132	58	54	439	337	381	394	424
Morro Bay	-	489	1021	457	286	-	318	335	350	397

species was caught with greater success in shallow rather than deep locations in all port areas except Morro Bay (Table 46); in this area CPAH was more than two times higher at deep locations.

As with many other rockfishes in this study, vermilion rockfish exhibited the clinal trend of decreasing mean length with decreasing latitude from the Bodega Bay area to the Monterey area (Table 47).

The only consistent trend of mean length during the study period occurred in the Morro Bay area, where mean length increased substantially from 318 mm (12.5 in.) in 1988 to 397 mm (15.6 in.) in 1991. The Monterey area experienced a wide fluctuation in mean length of 102 mm (4.0 in.) during 5 years of sampling (Table 47).

For the three most southern port areas, mean length of vermilion rockfish from distant locations was substantially greater than that from near locations, with differences as great as 85 mm (3.3 in.) in the Morro Bay area (Table 46). This is a strong indication of heavier fishing pressure in areas close to port.

In the Monterey and Morro Bay areas mean length from deep locations was approximately 20 mm (0.8 in.) greater than that from shallow locations (Table 46), an indication of isothermic submergence or difference in fishing pressure over time. In Southern California Bight trawl surveys, Love et al. (1990) observed young-of-the-year vermilion rockfish in waters 5 to 30 m (16 to 99 ft) deep, juveniles and small adults at 90 to

149 m (297 to 492 ft), and large adults from 210 m (693 ft) to their maximum sampling depth.

In contrast to vermilion rockfish samples from all other port areas, the small number measured from the Bodega Bay area in 1988 were relatively large (Figure 43). This species is long-lived, and the mode at 541 to 570 mm (21.3 to 22.4 in.) corresponds to an age range of 14 to 18 years, based on length-age data from Lea et al. (1993).

Vermilion rockfish from the San Francisco area exhibited a wide range of lengths from approximately 200 to 670 mm (7.9 to 26.4 in.) (Figure 44). The relatively strong mode in 1989 at 321 to 370 mm (12.6 to 14.6 in.) corresponds to a 4- to 5-year age range (Lea et al. 1993). Length at 50% sexual maturity is reported to be 380 mm (15.0 in.) for males and 370 mm (14.6 in.) for females (Wyllie-Echeverria 1987). Thus, a significant proportion of the sport catch consisted of juveniles in this year and in 1988 and 1990.

The Monterey area length frequency distribution in 1988 indicated significant recruitment of juveniles to the fishery (Figure 45). The mode at 291 to 300 mm (11.5 to 11.8 in.) corresponds to an age of 3+ years according to Lea et al. (1993). Thus, there appears to be a strong 1985 year class of vermilion rockfish. Similar to the San Francisco area, in 1989 a strong mode was evident centered at 331 to 340 mm (13.0 to 13.4 in.). This shift in length frequency distribution is consistent with annual growth determined by Lea et al. (1993) for 3+ year-old fish. By 1991 this year class still was

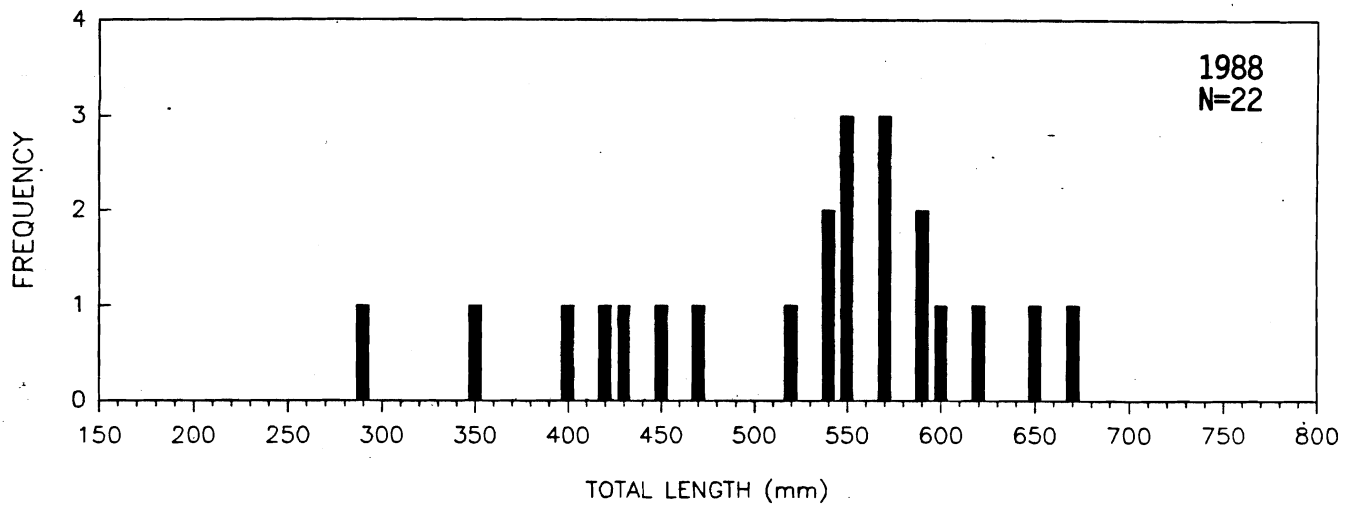

FIGURE 43. Length frequency of vermilion rockfish from the Bodega Bay area in 1988.

prominent at 411 to 430 mm (16.2 to 16.9 in.) (Figure 56), again consistent with calculated growth rate.

Length frequency distribution from the Morro Bay area exhibited a unimodal progression from 1988 to 1991 (Figure 46), similar to the Monterey area. The increase in the modal length from 291-300 mm (11.4-11.8 in.) in 1988 to 401-410 mm (15.8-16.1 in.) in 1991 agrees well with growth data from Lea et al. (1993) for an age range of 3+ to 6+ years.

In the Monterey and Morro Bay areas, the combination of a single strong year class supporting the fishery and the take of a significant number of juveniles in 1988 and 1989 (and 1990 in the Morro Bay area) indicates cause for concern.

Intense fishing pressure can dramatically alter the size and population structure of vermilion rockfishs. VenTresca (1992), using unpublished data (J. Hardwick, CDFG, Vallejo), reported a steady decline in the average size of vermilion rockfish taken by

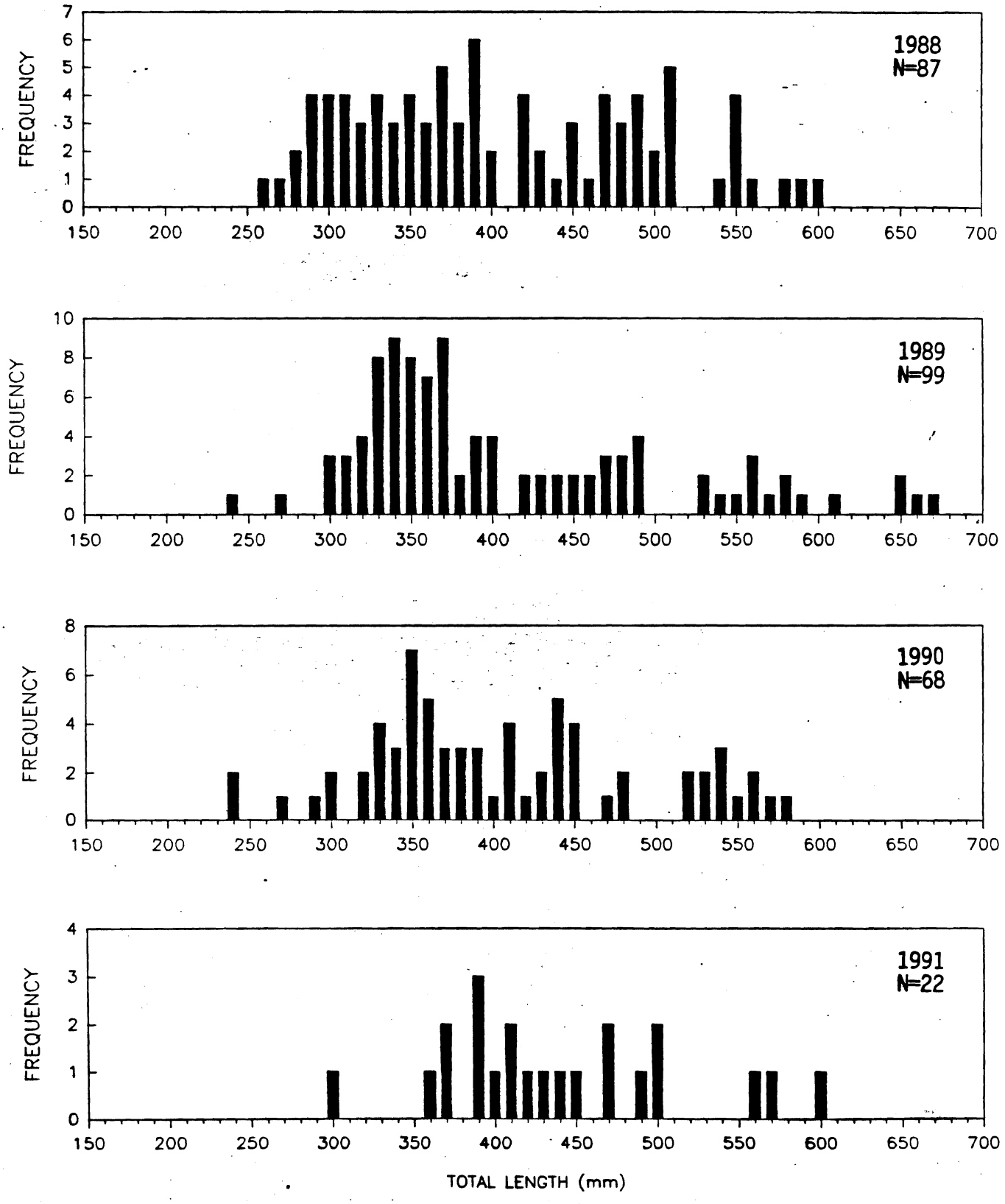

FIGURE 44. Length frequency of vermilion rockfish from the San Francisco area, 1988 to 1991.

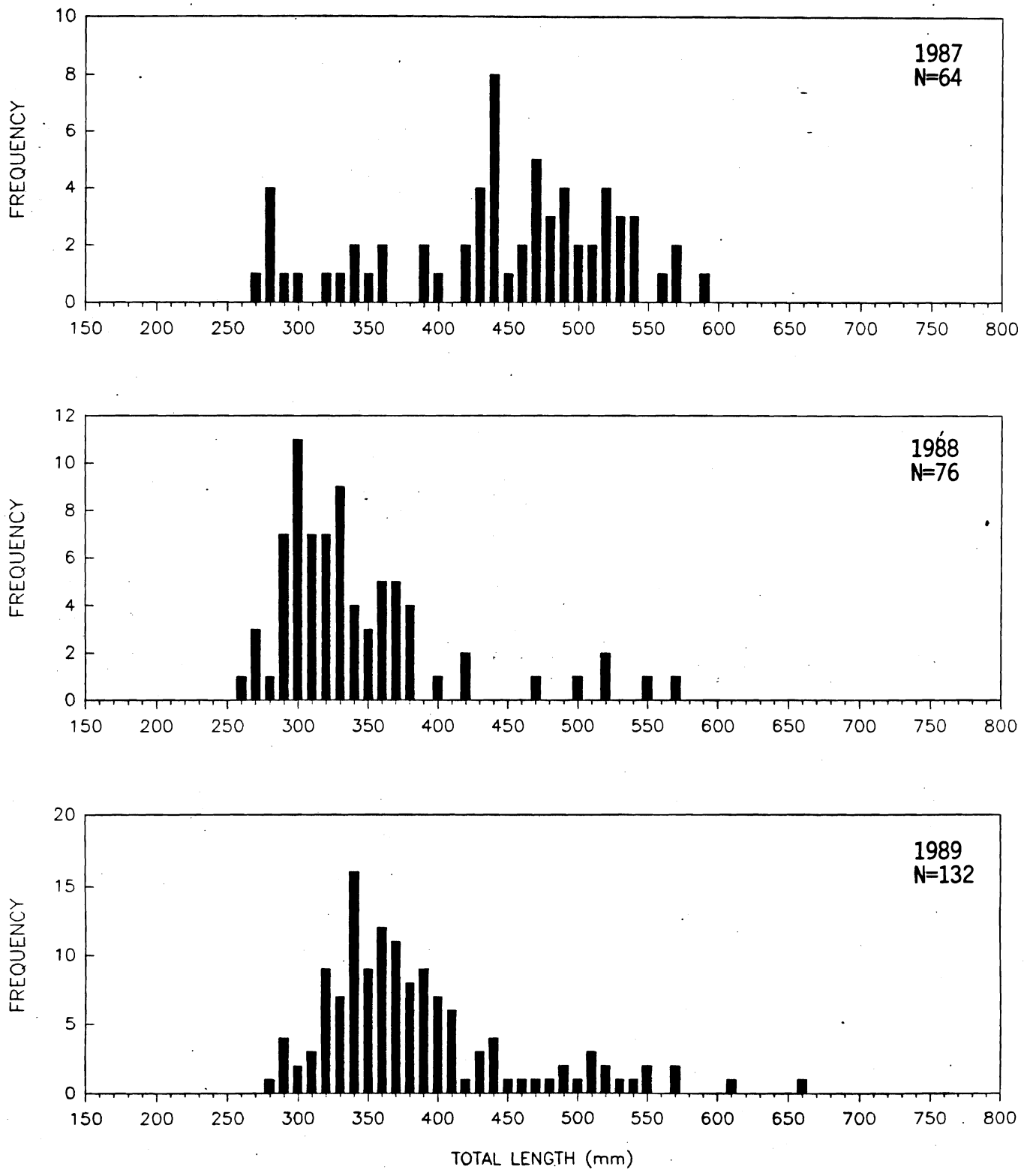

FIGURE 45. Length frequency of vermilion rockfish from the Monterey area, 1987 to 1991.

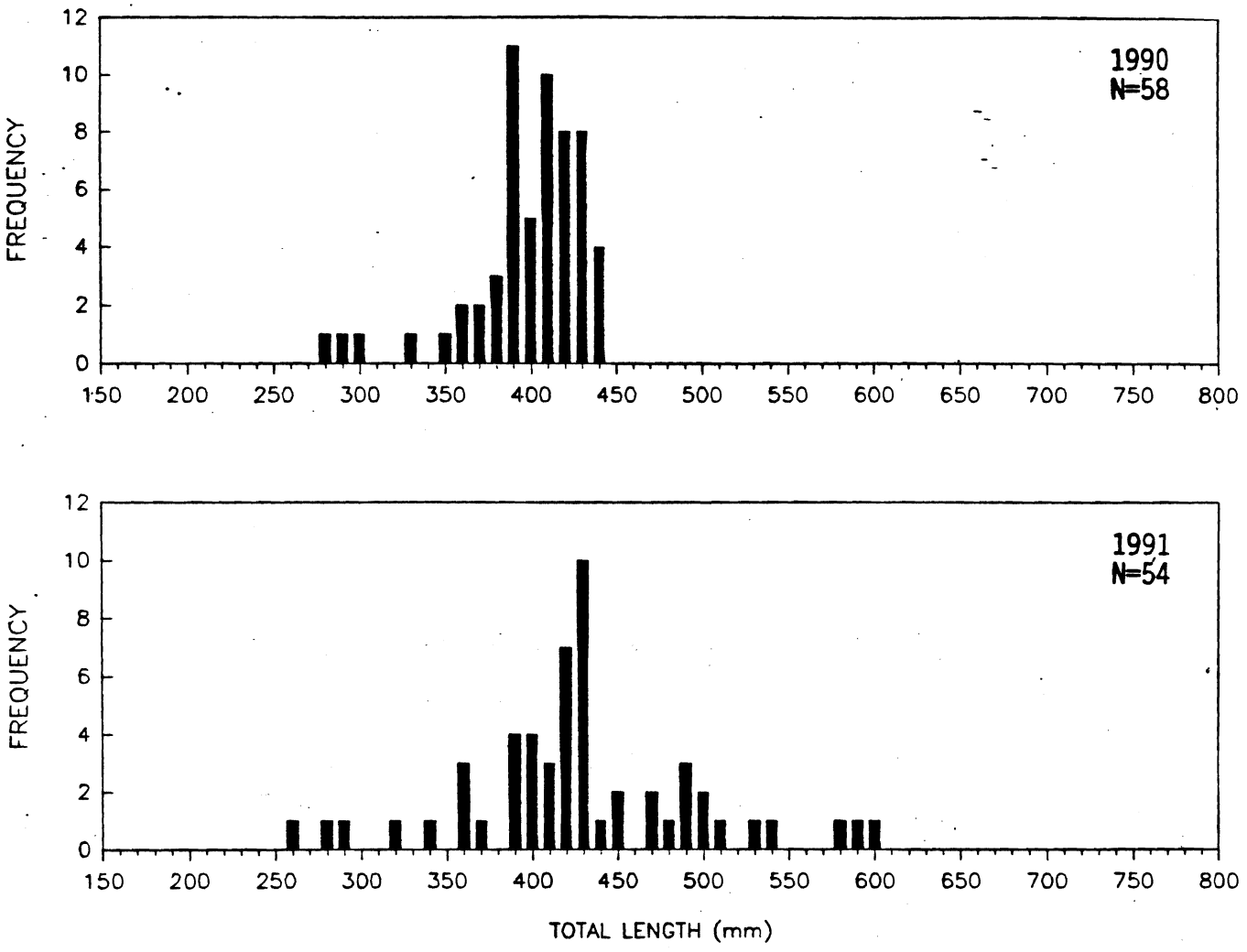

FIGURE 45. (continued).

sport hook-and-line anglers (skiff) in the nearshore area within 10 naut. mi. of the port of Monterey. Mean length decreased from 477 mm (18.8 in.) in 1981 to 363 mm (14.3 in.) in 1987. The latter length is close to the mean length from near and shallow locations of 371 mm (14.6 in.) in the Monterey area from 1987 to 1991 in this study.

On the positive side, CPAH of vermilion rockfish did not

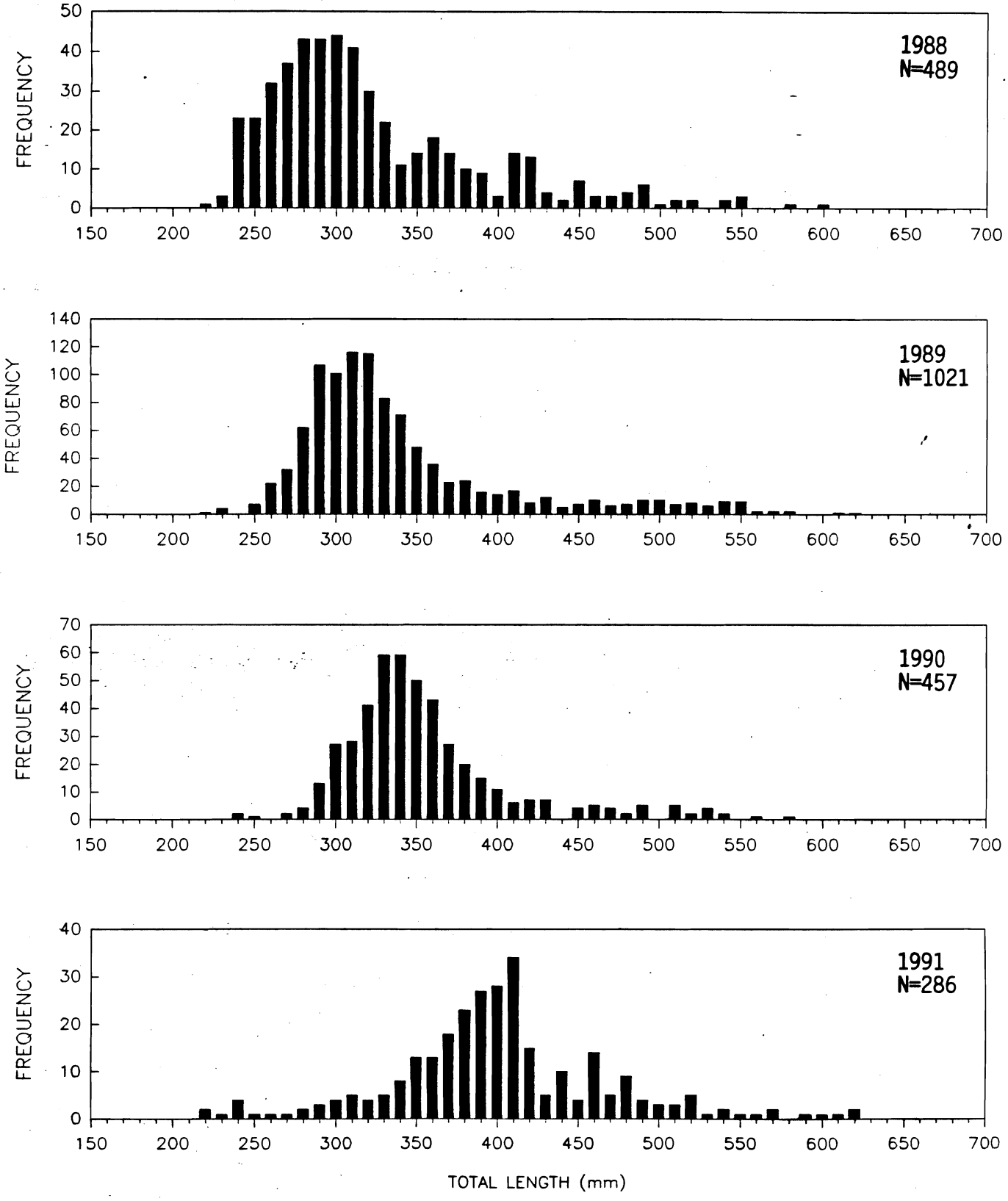

FIGURE 46. Length frequency of vermilion rockfish from the Morro Bay area, 1988 to 1991.

decline during this study period and by 1991 a significant proportion of the catch was comprised of fish in the length range of sexually mature adults. An encouraging sign in the fishery in the near future would be another strong pulse of recruitment.

Olive Rockfish

The San Francisco and Morro Bay areas showed increases in CPAH for olive rockfish of 10- to 20-fold from 1988 to 1990-91 (Table 48), while catch rate declined in the Monterey areas during the same period. In 1991 in the Morro Bay area, many CPFVs began to fish midwater over shallow bottom with live bait, resulting in the catch of relatively more olive and black rockfish (I. Hennig, PSMFC, Morro Bay, pers. comm.). In all port areas, CPFV operators realized higher catch rates at distant locations (Table 49). Except for the Bodega Bay area, olive rockfish CPAH was higher at shallow locations (Table 49).

In general, olive rockfish mean length was highest in the Bodega Bay area and lowest in the Morro Bay area (Table 50). However, the clinal trend of decreasing length with decreasing latitude was not consistent within the Monterey to San Francisco area. In 1991, olive rockfish from the Bodega Bay area averaged 78 mm (3.1 in.) longer than those from the Morro Bay area. Within a port area for sample size of at least 20 fish, mean length varied by less than 30 mm (1.2 in). No consistent trend of mean length was observed for any port

TABLE 48. Catch Per Angler Day and Catch Per Angler Hour for Olive Rockfish by Port and Year.

Port area	Catch per angler day						Catch per angler hour					
	1987	1988	1989	1990-91	1990	1991	1987	1988	1989	1990-91	1990	1991
Fort Bragg	-	1.15	-	0.14	-	0.16	-	0.60	-	0.05	-	0.06
Bodega Bay	-	0.15	<0.01	0.34	-	0.38	-	0.05	<0.01	0.11	-	0.12
San Francisco	-	0.01	0.35	0.31	0.45	0.10	-	<0.01	0.10	0.09	0.13	0.03
Monterey	0.11	0.37	0.35	0.22	0.05	0.41	0.04	0.12	0.11	0.07	0.02	0.13
Morro Bay	-	0.03	0.03	0.66	0.04	1.04	-	0.01	0.01	0.20	0.01	0.33

TABLE 49. Catch Per Angler Hour and Mean Length of Olive Rockfish for Near and Distant Locations and Shallow and Deep Locations by Port, All Years Combined.

Port area	Catch per angler hour				Number of fish measured				Mean total length (mm)			
	Near	Distant	Shallow	Deep	Near	Dist	Shal	Deep	Near	Dist	Shal	Deep
Fort Bragg	.09	.40	.18	-	24	11	14	-	355	281	335	-
Bodega Bay	-	.04	<.01	.02	-	75	1	30	-	411	307	427
San Francisco	.02	.07	.03	.02	18	541	102	2	338	376	371	322
Monterey	.08	.10	.18	<.01	568	268	125	9	379	370	362	367
Morro Bay	.06	.18	.17	<.01	434	174	255	8	331	346	335	358

TABLE 50. Mean Length of Olive Rockfish Caught by CPFV Anglers by Port and Year.

Port area	Number of fish measured					Mean total length (mm)				
	1987	1988	1989	1990	1991	1987	1988	1989	1990	1991
Fort Bragg	-	19	-	-	16	-	285	-	-	386
Bodega Bay	-	21	-	-	54	-	408	-	-	412
San Francisco	-	26	346	163	24	-	366	376	374	369
Monterey	89	364	328	10	88	380	366	383	359	394
Morro Bay	-	32	44	13	531	-	346	343	322	334

area.

Mean length of olive rockfish from the Morro Bay area was 15 mm (0.6 in.) greater at distant locations compared with near locations, but this trend was not apparent in the Monterey area (Table 49).

As with many species sampled in this study, olive rockfish from the Bodega Bay area were relatively large, with the majority exceeding 380 mm (15.0 in.) (Figure 47). At this length olive rockfish are approximately 6 years old (Lea et al. 1993), and all males and most females are sexually mature (Wyllie-Echeverria 1987).

Length frequency distributions from the San Francisco area were relatively stable from 1988 to 1991 (Figure 48). The mode at approximately 341-350 mm (13.4-13.8 in.) corresponds to a 4+ year-old fish (Lea et al. 1993, Love and Westphal 1981) and was at or above the lengths for 50% sexual maturity reported by Wyllie-Echeverria (1987) for males (330 mm (13.0 in.)) and females (350 mm (13.8 in.)). The length range of the majority of fish, from 261 to 500 mm (10.3 to 19.7 in.) corresponds to a wide age range of 2+ to more than 14 years (Lea et al. 1993). Based on these samples, the San Francisco area olive rockfish resource appears in good condition.

The length frequency distribution from the Monterey area in 1989 (Figure 49) was similar to the San Francisco area, and indicated a moderate shift to the right from the previous year with proportionally fewer fish less than 321 mm (12.6 in.).

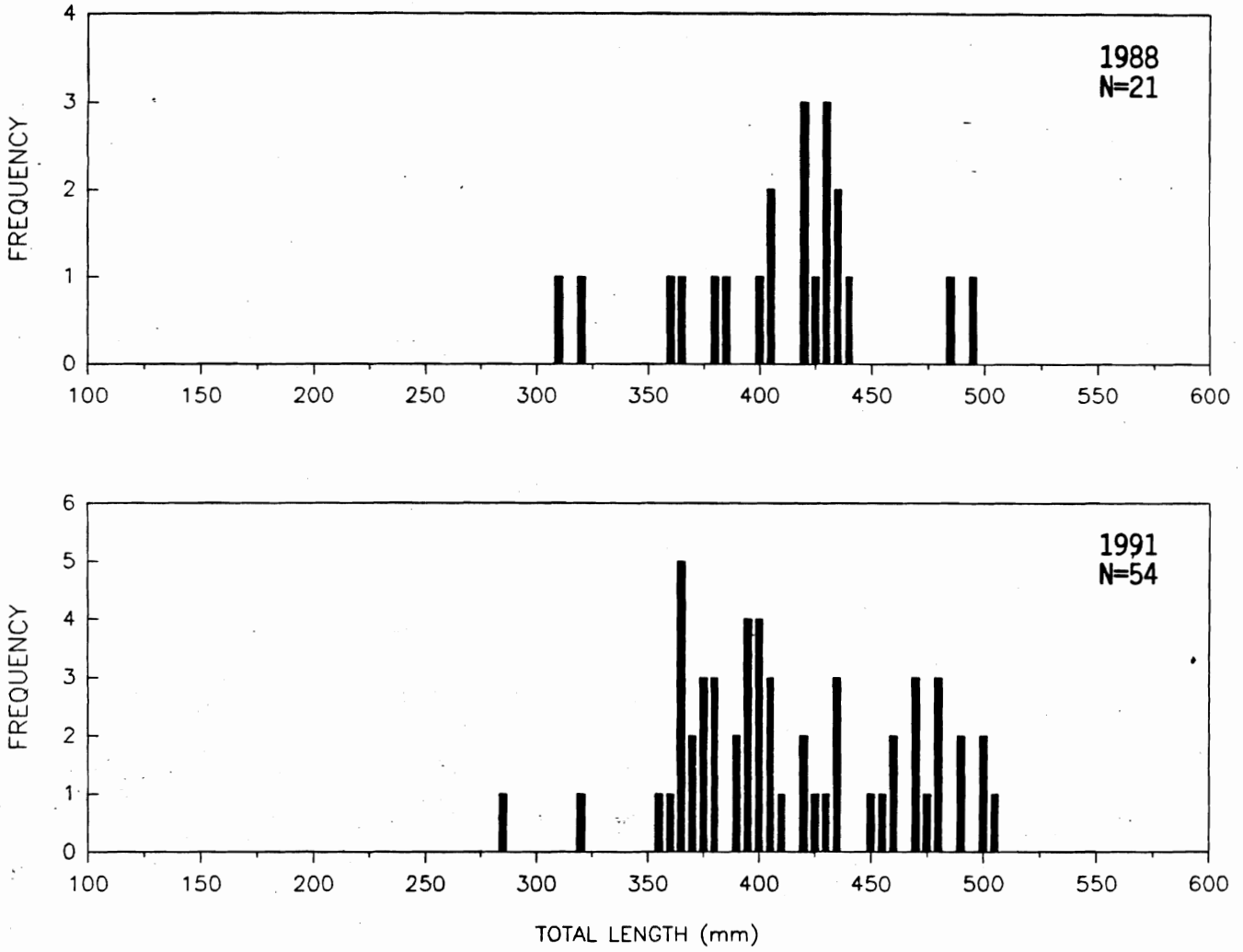

FIGURE 47. Length frequency of olive rockfish from the Bodega Bay area in 1988 and 1991.

By 1991, a further shift toward larger fish indicated a relatively strong year class may have comprised part of the catch.

Similar to blue rockfish, olive rockfish demonstrated the effect of locally heavy fishing pressure on populations in the nearshore waters of southern Monterey Bay (unpublished data, R. Lea, CDFG, Monterey). Mean length of fish caught by hook-and-

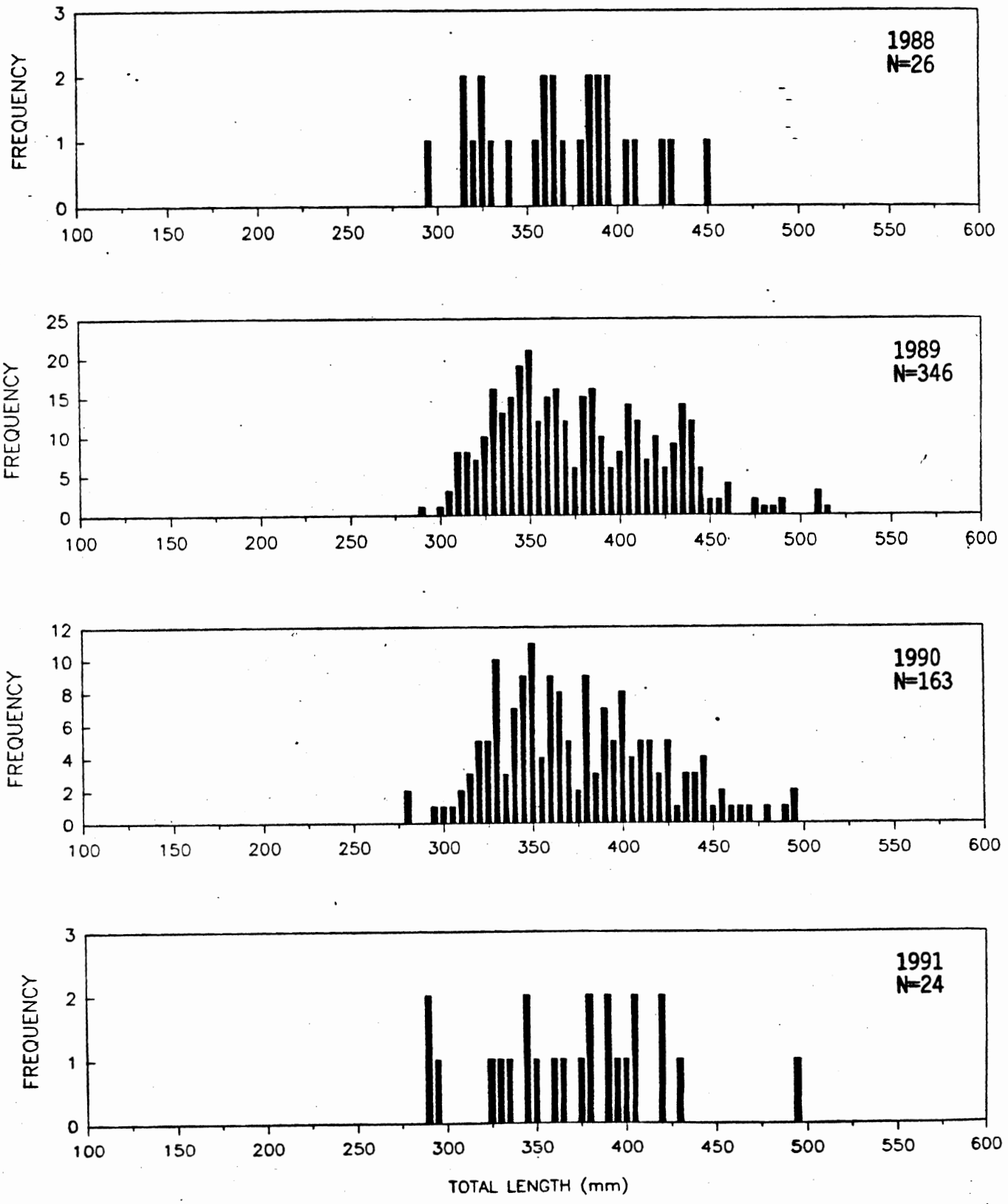

FIGURE 48. Length frequency of olive rockfish from the San Francisco area, 1988 to 1991.

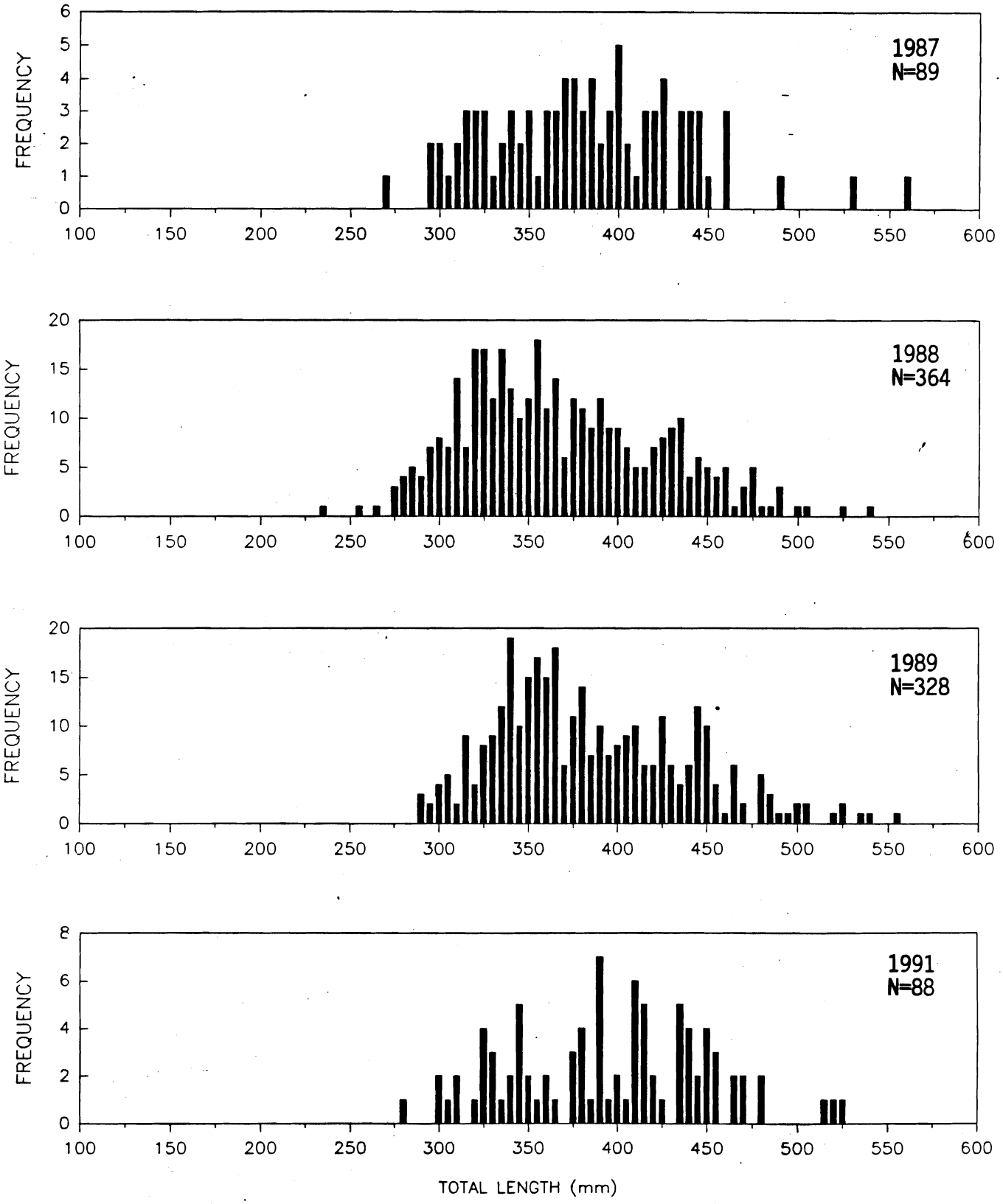

FIGURE 49. Length frequency of olive rockfish from the Monterey area, 1987 to 1989 and 1991.

line anglers, primarily in skiffs, decreased from 374 mm (14.7 in.) in 1978-83 to 295 mm (11.6 in.) in 1986-87. Due to the expanding range of the CPFV fleet, fishing effort can be distributed more evenly and effects of local fishing pressure can be minimized.

Morro Bay area length frequency distributions were dissimilar to other port areas (Figure 50). A relatively high proportion of fish below 330 to 350 mm (12.9 to 13.8 in.), the lengths at 50% sexual maturity for males and females, respectively, (Wyllie-Echeverria 1987) characterized all samples, indicating some cause for concern. However, the high proportion of fish less than 276 mm (10.9 in.) in 1991 most likely indicated a strong pulse of recruitment. Data from Lea et al. (1993) indicated that fish in this length range were less than 3 years old. Unless fishing pressure increases significantly in shallow areas, it is likely that this recruitment will provide good fishing opportunities for several years in the Morro Bay area.

Starry Rockfish

Starry rockfish CPAH increased from 1988 to 1990-91 in all port areas except Morro Bay (Table 51). No trend was evident in catch rate for near and distant locations (Table 52), with little difference in CPAH for all port areas except Morro Bay. In general, CPAH for starry rockfish was similar at deep and shallow locations except for the San Francisco area, where catch rate was more than 16 times higher at deep

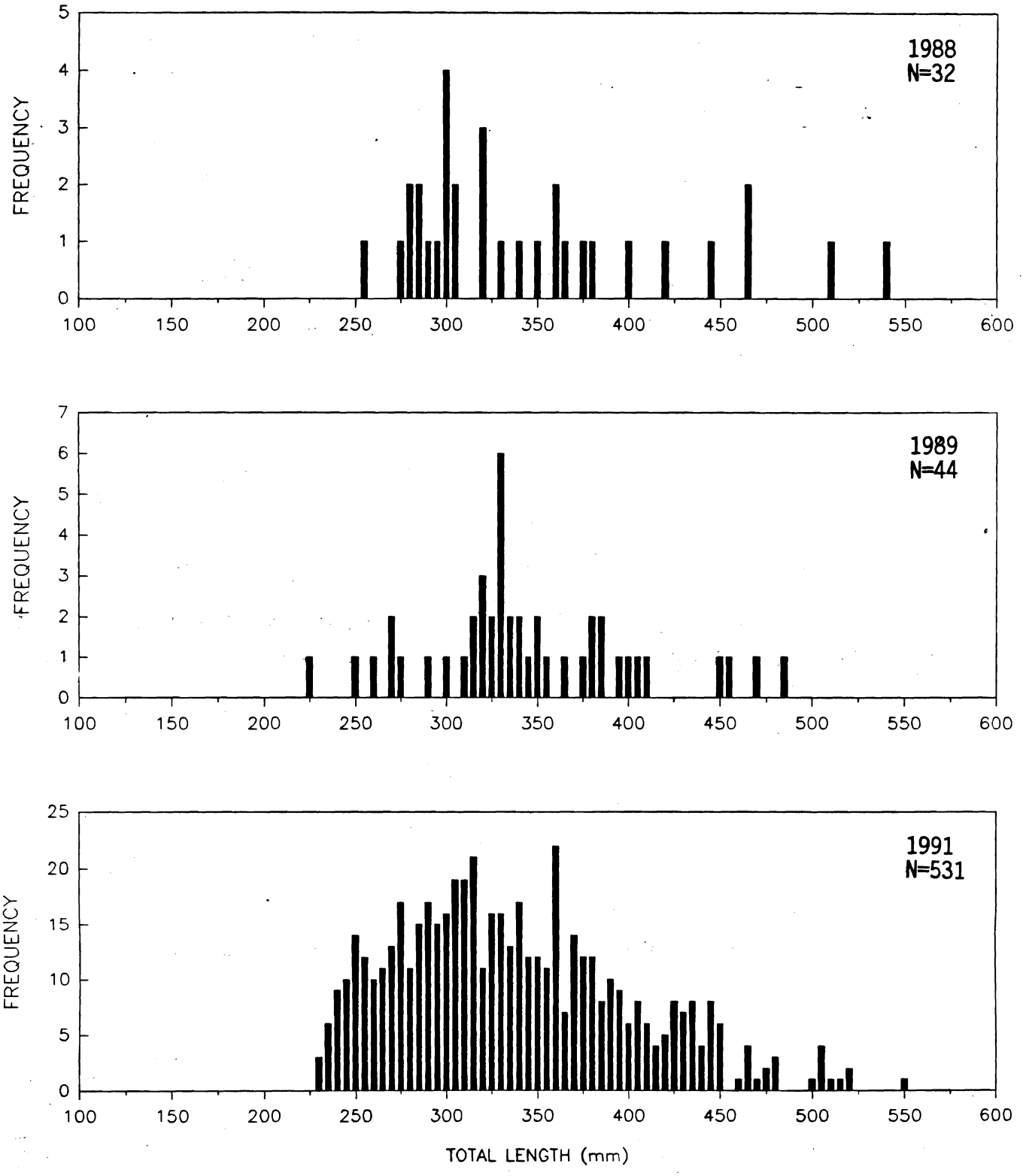

FIGURE 50. Length frequency of olive rockfish from the Morro Bay area in 1988, 1989, and 1991.

TABLE 51. Catch Per Angler Day and Catch Per Angler Hour for Starry Rockfish by Port and Year.

Port area	Catch per angler day						Catch per angler hour					
	1987	1988	1989	1990-91	1990	1991	1987	1988	1989	1990-91	1990	1991
Fort Bragg	-	-	-	0.01	-	0.01	-	-	-	<0.01	-	0.01
Bodega Bay	-	0.04	0.03	0.07	-	0.08	-	0.01	0.01	0.02	-	0.03
San Francisco	-	0.24	0.15	0.39	0.32	0.50	-	0.07	0.04	0.11	0.10	0.14
Monterey	0.23	0.15	0.32	0.36	0.12	0.62	0.07	0.05	0.10	0.12	0.05	0.19
Morro Bay	-	0.34	0.19	0.26	0.25	0.27	-	0.10	0.07	0.08	0.07	0.08

TABLE 52. Catch Per Angler Hour and Mean Length of Starry Rockfish for Near and Distant Locations and Shallow and Deep Locations by Port, All Years Combined.

Port area	Catch per angler hour				Number of fish measured				Mean total length (mm)			
	Near	Distant	Shallow	Deep	Near	Dist	Shal	Deep	Near	Dist	Shal	Deep
Fort Bragg	<.01	-	<.01	-	3	-	2	-	291	-	285	-
Bodega Bay	-	.01	-	<.01	-	35	-	-	-	374	-	-
San Francisco	.05	.07	<.01	.16	67	609	13	66	306	341	297	343
Monterey	.08	.08	.03	.04	538	210	14	234	297	313	308	307
Morro Bay	.09	.04	.07	.06	573	45	50	43	308	297	314	308

TABLE 53. Mean Length of Starry Rockfish Caught by CPFV Anglers by Port and Year.

Port area	Number of fish measured					Mean total length (mm)				
	1987	1988	1989	1990	1991	1987	1988	1989	1990	1991
Fort Bragg	-	-	2	-	1	-	-	291	-	291
Bodega Bay	-	16	4	-	9	-	377	379	-	365
San Francisco	-	229	172	106	169	-	339	338	331	340
Monterey	192	131	316	33	158	314	301	299	291	297
Morro Bay	-	206	168	88	158	-	310	309	304	303

locations (Table 52).

Among the three most southern port areas, the Monterey area had the smallest mean length from 1988 to 1991 (Table 53), unlike most other frequently observed species. Within each of the above port areas, mean length of starry rockfish had a relatively narrow range of 7 to 23 mm (0.3 to 0.9 in.). Samples from the Morro Bay area exhibited a slight but consistent decline in mean length from 1988 to 1991 (Table 53).

Mean length of starry rockfish from distant locations in the San Francisco and Monterey area was 35 mm (1.4 in.) and 16 mm (0.6 in.), respectively, greater than that from near locations (Table 53). When considering only distant locations, a clinal trend was evident of decreasing mean length with decreasing latitude from the Bodega Bay area to the Morro Bay area.

Starry rockfish may live to at least 19 years (Lea et al. 1993) and grows relatively slowly, adding only about 10 mm (0.4 in.) per year after age 10 (approximately 320 mm or 12.6 in.). Length at 50% sexual maturity was reported to be 300 mm (11.8 in.) for males and 270 mm (10.6 in.) for females (Wyllie-Echeverria 1987). Length frequency distributions of starry rockfish from the San Francisco area were fairly consistent from 1988 to 1991 and were skewed to the right (Figure 51). The sampled length range corresponds to a wide age range and a relatively high proportion of sexually mature adults.

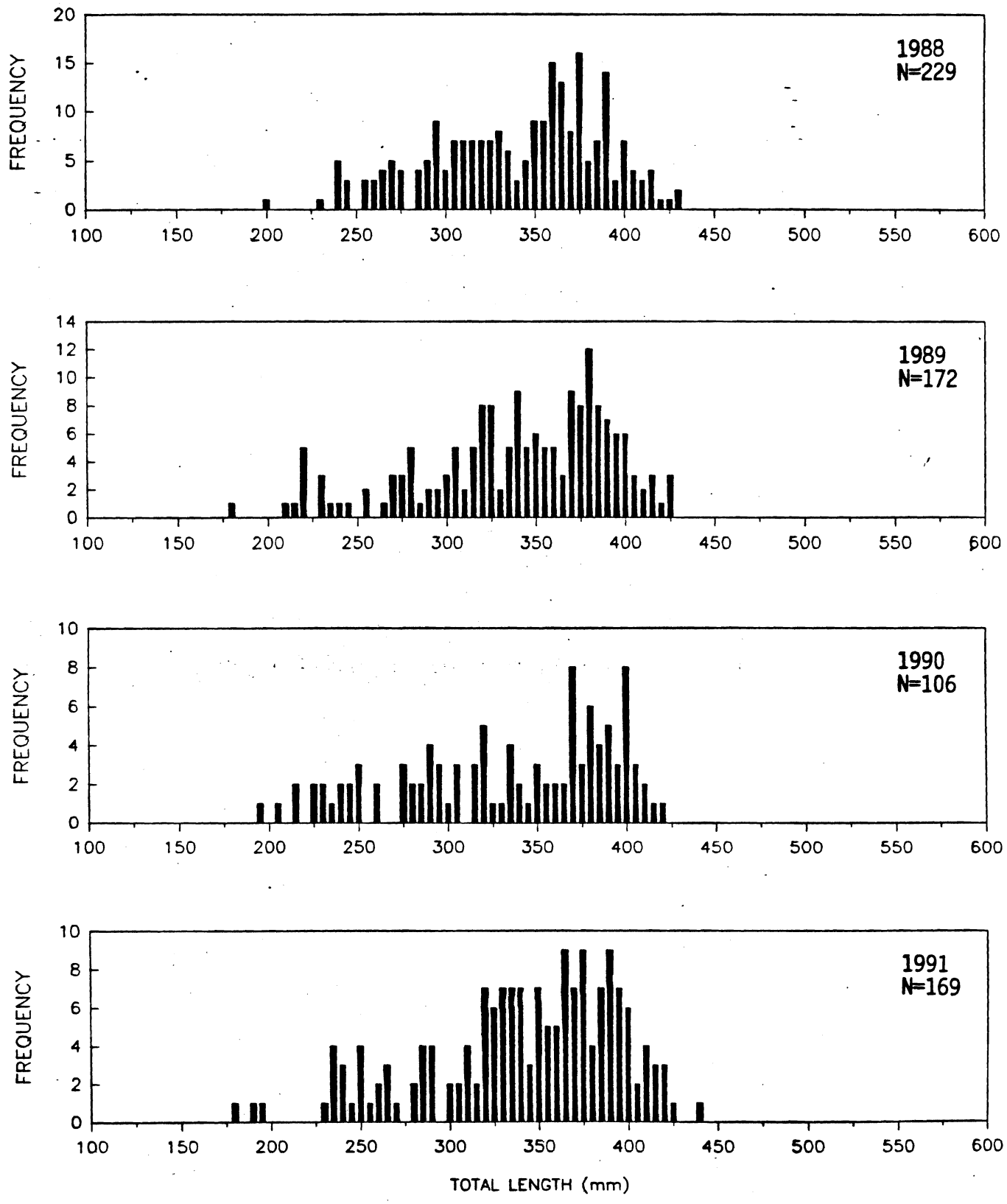

FIGURE 51. Length frequency of starry rockfish from the San Francisco area. 1988 to 1991.

The Monterey area length frequency distributions showed a shift toward smaller fish from 1987 to 1988 and then a fairly stable pattern through 1991 (Figure 52). There were no indications of strong pulses of recruitment during the study period. Starry rockfish do not reach 250 mm (9.8 in.) until 6 years of age (Lea et al. 1993). However, the majority of fish exceeded the length at 50% sexual maturity for females, and CPAH showed no declining trend, both indicators of a healthy fishery.

The Morro Bay area exhibited relatively stable length frequency distributions from 1988 to 1991, with only a slight shift to the left in 1991 (Figure 53).

Black Rockfish

Catch rates for black rockfish were highly variable in most port areas during the study period (Table 54). This species clearly was of most importance in the San Francisco area, where 77% of all observed black rockfish were taken. A gradual decline in CPAH in this area occurred from 1988 to 1990-91.

Mean catch rate at distant locations in the San Francisco area was more than four times greater than at near locations and in the Morro Bay area was 10 times greater at distant locations (Table 55). No black rockfish were observed at deep locations (Table 55), indicating a primary distribution shallower than 40 fm.

Although sample size was small for many port areas and

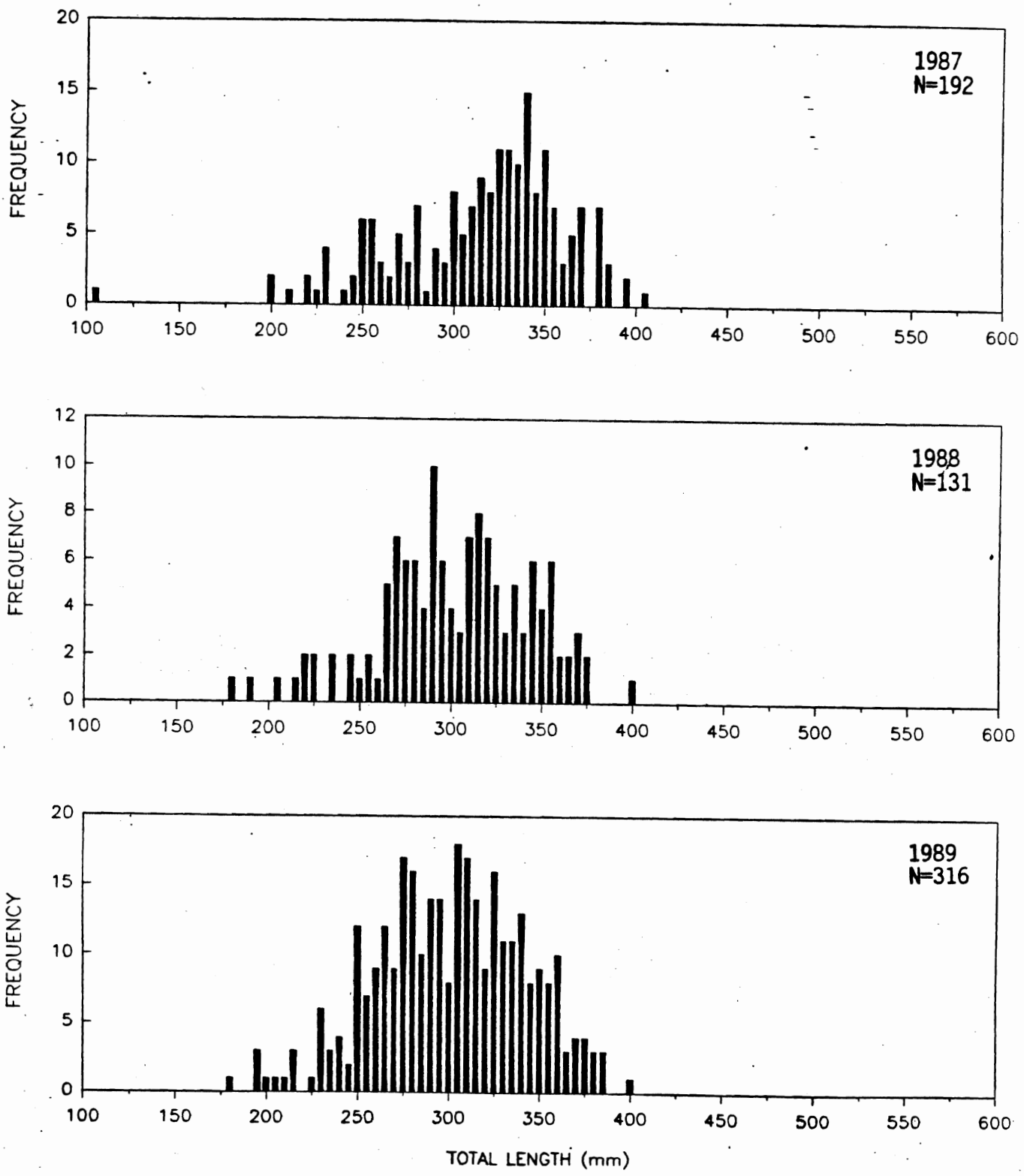

FIGURE 52. Length frequency of starry rockfish from the Monterey area, 1987 to 1991.

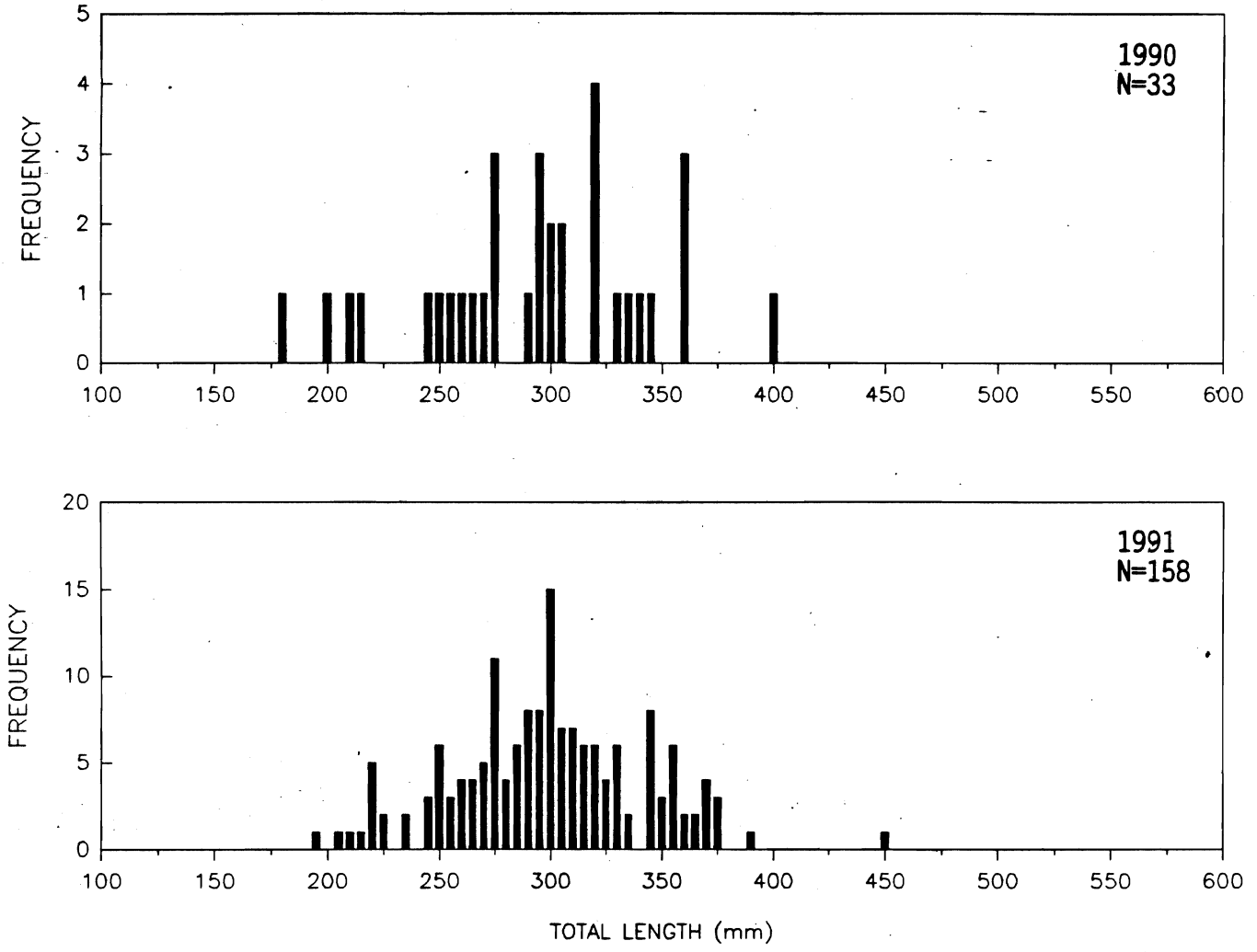

FIGURE 52. (continued).

years, black rockfish did follow the common clinal trend of decreasing mean length with decreasing latitude (Table 56). Only the San Francisco area length samples had sufficient numbers to analyze mean length. A consistent decline, from 368 mm (14.5 in.) in 1988 to 311 mm (12.2 in.) in 1991, coupled with a steady decline in CPAH, indicates a cause for concern in this area due to overutilization.

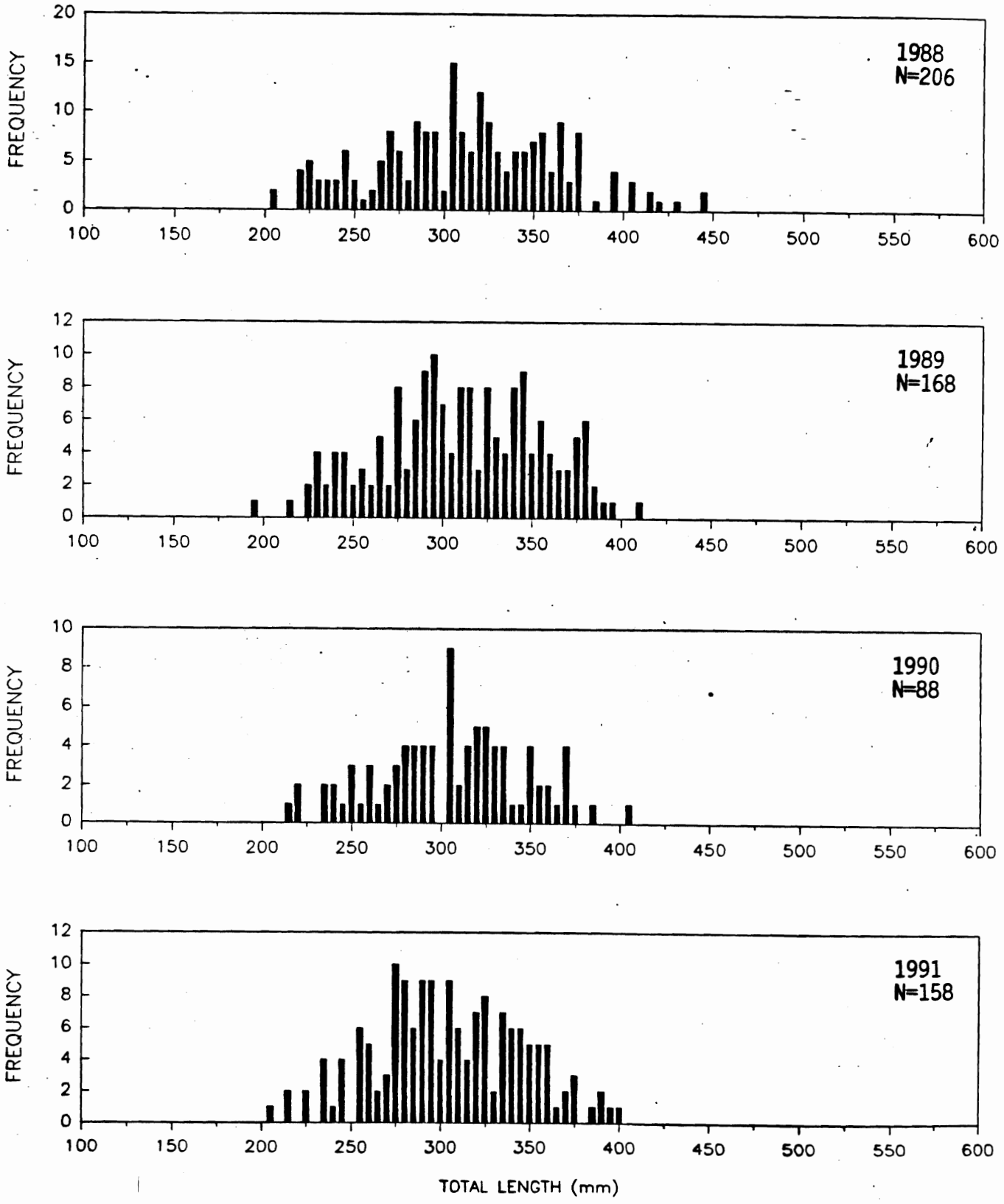

FIGURE 53. Length frequency of starry rockfish from the Morro Bay area, 1988 to 1991.

TABLE 54. Catch Per Angler Day and Catch Per Angler Hour for Black Rockfish by Port and Year.

	Catch per angler day						Catch per angler hour					
Port area	1987	1988	1989	1990-91	1990	1991	1987	1988	1989	1990-91	1990	1991
Fort Bragg	-	-	-	0.62	-	0.72	-	-	-	0.22	-	0.25
Bodega Bay	-	0.17	0.09	-	-	-	-	0.05	0.02	-	-	-
San Francisco	-	0.78	0.75	0.51	0.57	0.43	-	0.22	0.21	0.15	0.17	0.12
Monterey	0.05	0.04	0.01	-	-	-	0.02	0.01	<0.01	-	-	-
Morro Bay	-	-	0.02	0.37	0.12	0.53	-	-	0.01	0.11	0.04	0.17

TABLE 55. Catch Per Angler Hour and Mean Length of Black Rockfish for Near and Distant Locations and Shallow and Deep Locations by Port, All Years Combined.

	Catch per angler hour				Number of fish measured				Mean total length (mm)			
Port area	Near	Distant	Shallow	Deep	Near	Dist	Shal	Deep	Near	Dist	Shal	Deep
Fort Bragg	.15	.10	.20	-	81	-	81	-	336	-	336	-
Bodega Bay	.06	.03	.11	-	3	37	40	-	480	406	411	-
San Francisco	.05	.22	.48	-	20	1804	2011	-	331	360	356	-
Monterey	<.01	.03	.10	-	1	116	117	-	365	314	314	-
Morro Bay	.02	.20	.15	-	125	226	296	-	300	296	299	-

TABLE 56. Mean Length of Black Rockfish Caught by CPFV Anglers by Port and Year.

	Number of fish measured					Mean total length (mm)				
Port area	1987	1988	1989	1990	1991	1987	1988	1989	1990	1991
Fort Bragg	-	-	-	-	81	-	-	-	-	336
Bodega Bay	-	26	26	-	-	-	377	474	-	-
San Francisco	-	811	856	217	146	-	368	359	322	311
Monterey	48	51	18	-	-	320	299	341	-	-
Morro Bay	-	-	13	44	294	-	-	321	287	298

The near and distant location comparison of mean length from the San Francisco area is consistent with the previous indicators of a high rate of local exploitation; fish from distant locations averaged 29 mm (1.1 in.) longer than those from near locations (Table 55).

Black rockfish sampled from the Fort Bragg area in 1991 showed a relatively narrow length frequency distribution with a peak at 326 to 330 mm (12.8 to 13.0 in.) (Figure 54). This corresponds to an age of approximately 5 years (Lea et al. 1993) and is less than the length at 50% sexual maturity for males (350 mm or 13.8 in.) and females (390 mm or 15.4 in.) reported by Wyllie-Echeveria (1987).

The modes of the two small samples from the Bodega Bay area in 1988 and 1989 (Figure 55) are too far apart to represent growth of a single year class; these samples may represent separate stocks.

A dramatic and discouraging trend was evident from the San Francisco area (Figure 56). The 1988 sample was characterized by a multi-modal length frequency distribution, a wide length range, and a substantial proportion of fish above the lengths at 50% sexual maturity. A strong pulse of recruitment was evident in the 246- to 280-mm (9.7- to 11.0-in.) range. The middle of this range corresponds to a 3+ year-old fish (Lea et al. 1993) (1985 year class). By 1989 the mode of recruitment had shifted to the right and the relative proportion of fish exceeding 400 mm (15.7 in.) had decreased. The latter group represented a wide age range of

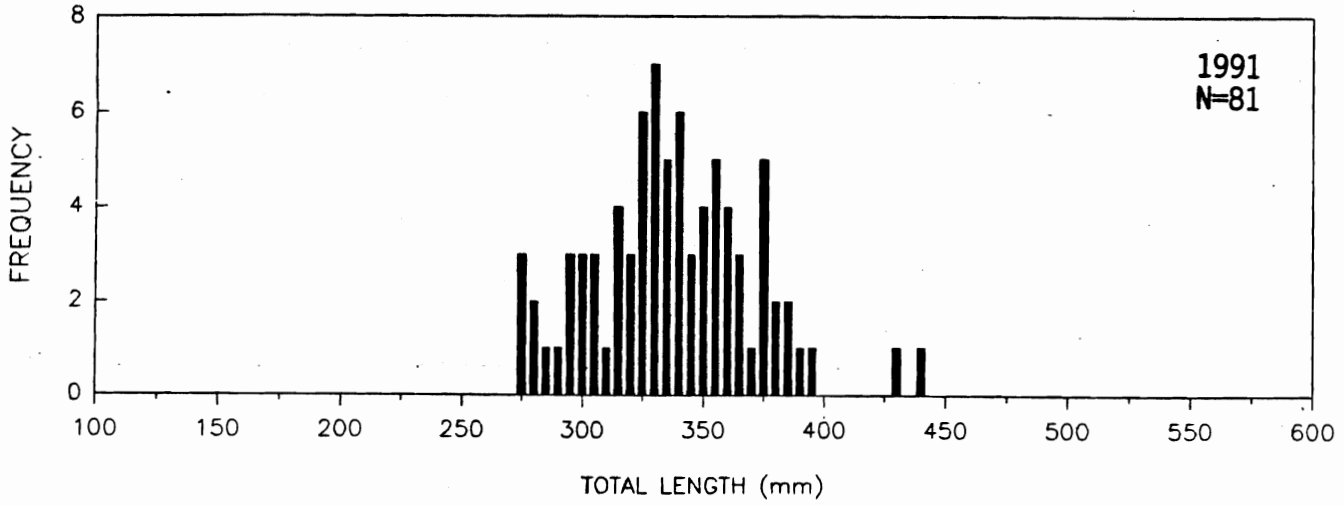

FIGURE 54. Length frequency of black rockfish from the Fort Bragg area in 1991.

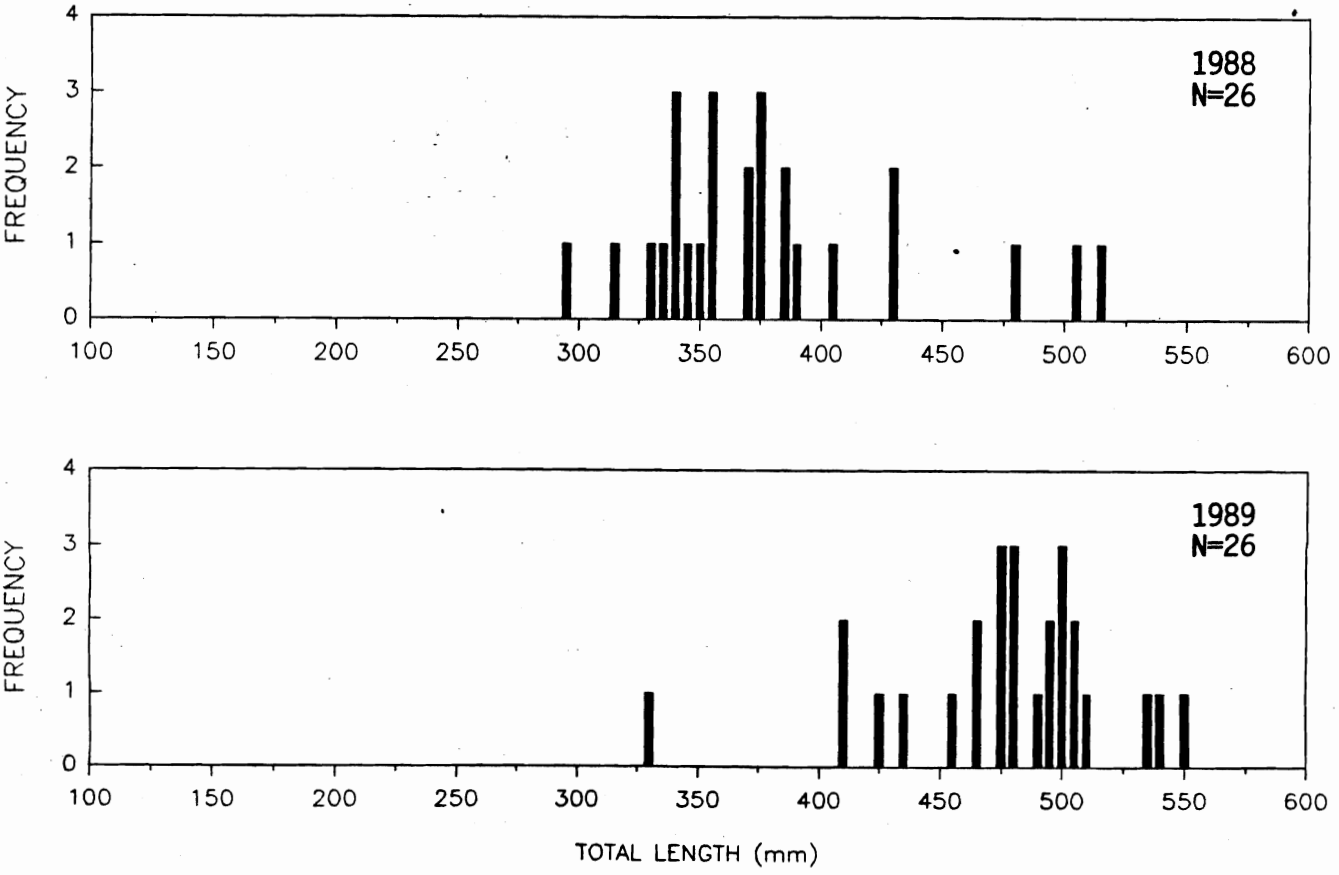

FIGURE 55. Length frequency of black rockfish from the Bodega Bay area in 1988 and 1989.

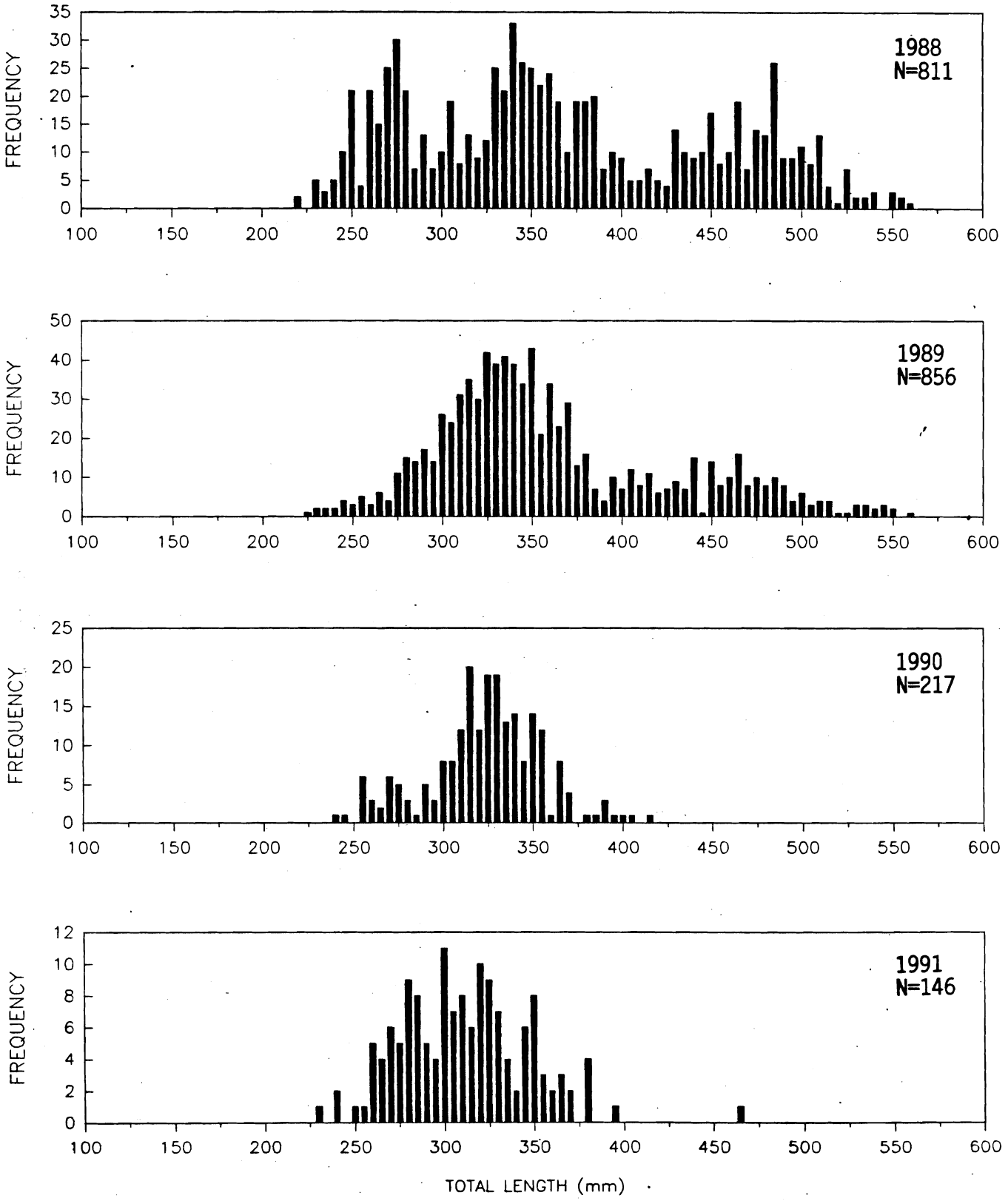

FIGURE 56. Length frequency of black rockfish from the San Francisco area, 1988 to 1991.

from 7+ to at least 13 years, based on data from Lea et al. (1993).

By 1990, the larger fish were essentially absent in samples. The length frequency distribution had shifted to a unimodal one corresponding to a high proportion of sexually immature fish. By 1991 the situation had changed little except for the occurrence of relatively more fish below 296 mm (11.7 in.), an encouraging sign of recruitment.

Since the larger fish in 1988 and 1989 represent many year classes, their disappearance in 1990 cannot be attributed to a single strong year class cycling through the fishery and instead indicates an exceedingly high exploitation rate. Because black rockfish primarily have a shallow distribution, as evidenced by the shallow/deep location catch data (Table 56), little protection of spawning adults is available in deep natural refuges. Black rockfish were not among the most frequently observed species in the commercial hook-and line fishery in the San Francisco area (B. Ota, Dept. Fish and Game, Menlo Park, pers. comm.) and in California are only an important component of the commercial fishery in the Eureka area; thus, they must have experienced a relatively high level of exploitation by sport anglers, both CPFV and skiff, in this area.

The recruitment in 1991 is most likely the 1988 year class. If there is a direct relationship between adult spawning stock size and recruitment, these data indicate that the latter will be poor by 1993, and if fishing pressure

remains heavy, catch rate will continue to decline and few fish will reach sexual maturity.

Samples from the Monterey area in 1987 and 1988 (Figure 57) and from the Morro Bay (Figure 58) area resembled those from 1990 and 1991 in the San Francisco area; i.e. few fish in the length range of sexually mature adults were encountered. Concerns expressed for the San Francisco area stock also apply to these two port areas.

Brown Rockfish

Brown rockfish showed large increases in CPAH in the Bodega Bay and Morro Bay areas from 1988 to 1990-91, while the San Francisco area experienced a small decline (Table 57).

Catch rates at near locations were generally equal to or greater than those at distant locations in all port areas except Morro Bay (Table 58). This species generally is more abundant and widespread in shallower water (Adams 1992a, Miller and Lea 1972), and all CPAH values were higher at shallow locations than at deep locations (Table 58).

No clinal trend of length decreasing with decreasing latitude was apparent for this species. In contrast to all of the other most frequently observed species in this study, mean length of brown rockfish was highest in either the Monterey or Morro Bay area (Table 59). Differences in mean length between the Monterey area and the Bodega Bay area were as great as 60 mm (2.4 in.) in 1991. This situation may be related to differences in fishing pressure. Brown rockfish experience

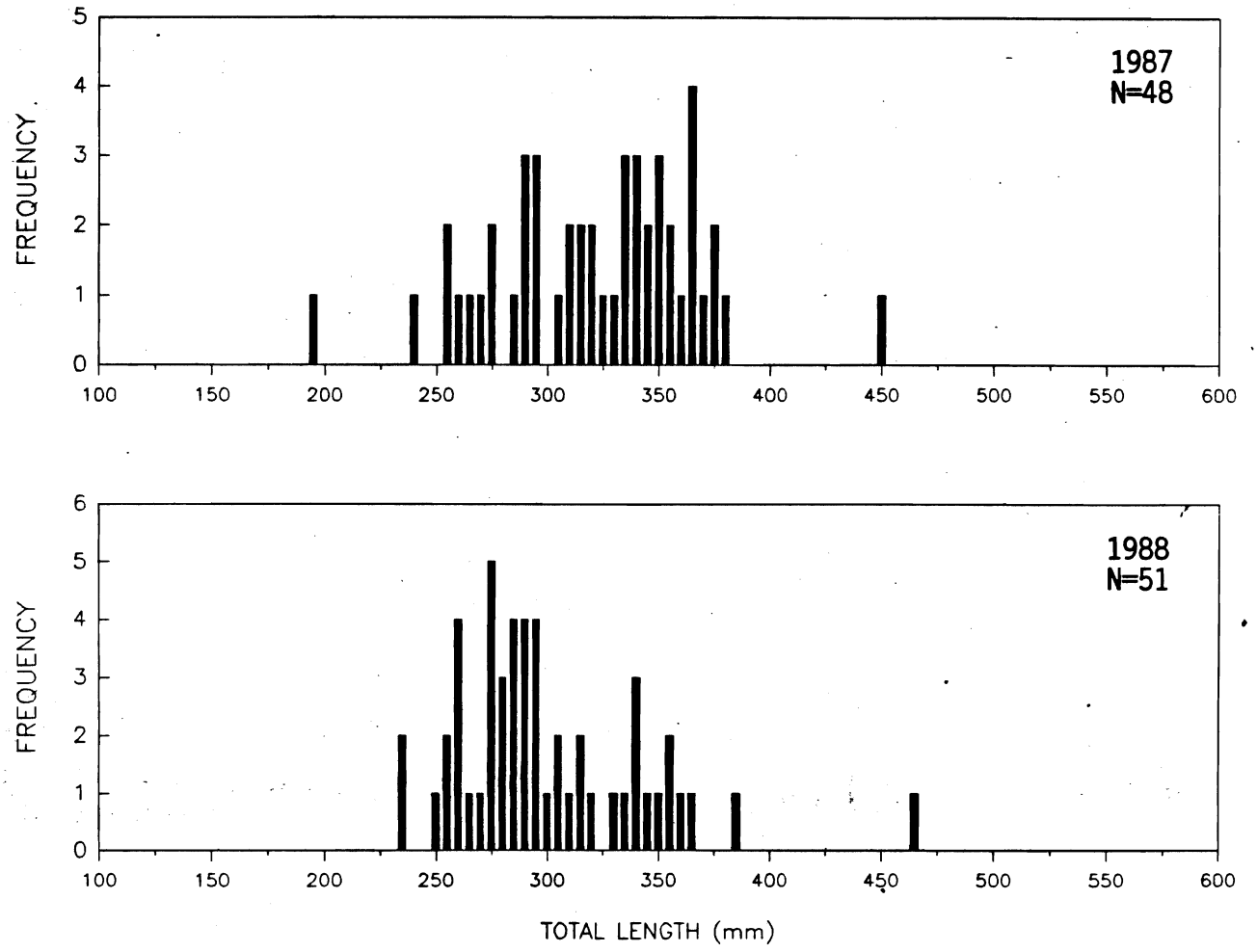

FIGURE 57. Length frequency of black rockfish from the Monterey area in 1987 and 1988.

heavy fishing pressure in the San Francisco and Bodega Bay areas, and in the former area it was the most frequently observed species in commercial hook-and-line samples in 1992 (B. Ota, Dept. Fish and Game, Menlo Park, pers. comm.). Modal length of over 1300 fish sampled from the commercial fishery in 1992 was 255 to 280 mm (10.0 to 11.0 in.) (B. Ota, Dept. Fish and Game, Menlo Park, unpub. data). In contrast, brown rockfish were not

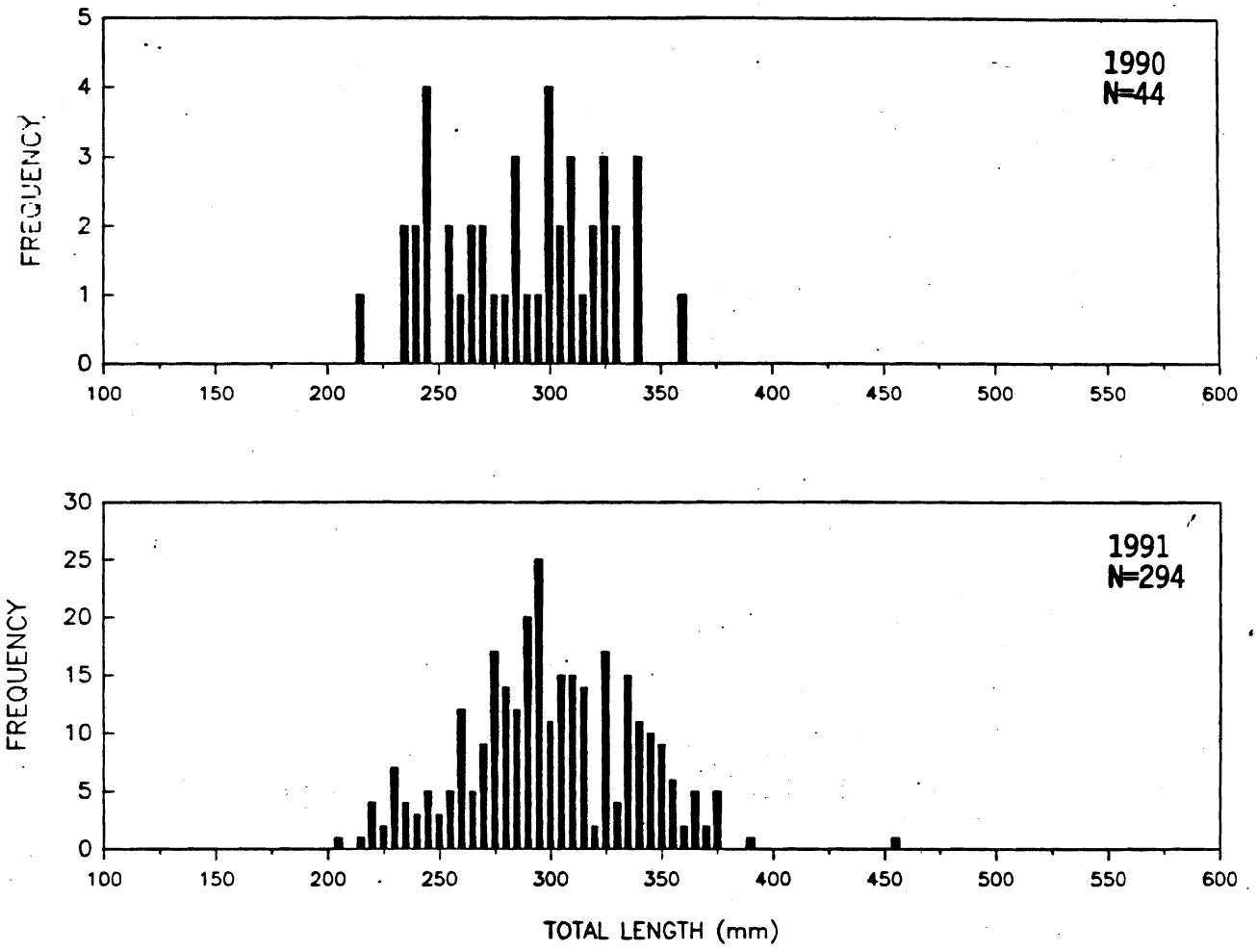

FIGURE 58. Length frequency of black rockfish from the Morro Bay area in 1990 and 1991.

among the most frequently observed species in the Morro Bay commercial hook-and-line fishery in 1992 (S. Owen, Dept. Fish and Game, Morro Bay, pers. comm.) and most likely received considerably less fishing pressure.

Mean length of brown rockfish from the San Francisco area was remarkably similar during the study period (Table 59) and for all port areas showed no consistent trend.

TABLE 57. Catch Per Angler Day and Catch Per Angler Hour for Brown Rockfish by Port and Year.

Port area	Catch per angler day						Catch per angler hour					
	1987	1988	1989	1990-91	1990	1991	1987	1988	1989	1990-91	1990	1991
Fort Bragg	-	-	0.10	-	-	-	-	-	0.04	-	-	-
Bodega Bay	-	0.46	0.83	1.62	-	1.83	-	0.15	0.26	0.51	-	0.59
San Francisco	-	0.50	0.23	0.35	0.47	0.19	-	0.14	0.07	0.10	0.14	0.05
Monterey	0.01	0.01	0.05	0.04	<0.01	0.08	<0.01	<0.01	0.02	0.01	<0.01	0.02
Morro Bay	-	0.05	0.39	0.44	0.23	0.57	-	0.01	0.13	0.13	0.07	0.18

TABLE 58. Catch Per Angler Hour and Mean Length of Brown Rockfish for Near and Distant Locations and Shallow and Deep Locations by Port, All Years Combined.

Port area	Catch per angler hour				Number of fish measured				Mean total length (mm)			
	Near	Distant	Shallow	Deep	Near	Dist	Shal	Deep	Near	Dist	Shal	Deep
Fort Bragg	.01	-	.01	-	-	-	-	-	-	-	-	-
Bodega Bay	1.05	.16	.54	.14	180	197	358	95	336	315	313	358
San Francisco	.14	.09	.23	.06	127	689	874	-	334	332	332	-
Monterey	.01	.01	.05	<.01	43	51	60	10	363	350	352	379
Morro Bay	.02	.54	.31	.01	164	541	560	4	348	364	363	288

TABLE 59. Mean Length of Brown Rockfish Caught by CPFV Anglers by Port and Year.

Port area	Number of fish measured					Mean total length (mm)				
	1987	1988	1989	1990	1991	1987	1988	1989	1990	1991
Fort Bragg	-	-	-	-	-	-	-	-	-	-
Bodega Bay	-	120	212	-	158	-	312	346	-	305
San Francisco	-	508	248	157	44	-	331	332	335	333
Monterey	5	17	55	1	21	335	363	350	330	365
Morro Bay	-	33	261	65	346	-	337	381	361	346

Mean length of brown rockfish from distant locations was greater than that from near locations only in the Morro Bay area (Table 58), indicating the effects of heavier fishing pressure near port. In the Bodega Bay area, mean length from deep locations averaged 45 mm (1.8 in.) greater than that from shallow locations. Eighty-seven percent of all fish measured from deep locations were observed in this area.

Length frequency distributions from the Bodega Bay area exhibited a pronounced shift toward smaller fish from 1989 to 1991 (Figure 59). This in itself is cause for concern, because the majority of sampled fish in 1991 were less than 310 mm (12.2 in.), the length at 50% sexual maturity for both sexes as reported by Wyllie-Echeverria (1987). Adams (1992a) estimated the length of a 10-year old fish at 381 mm (15.0 in.). It is likely that heavy commercial and sport fishing pressure has resulted in the removal of most older fish from the Bodega Bay area stock.

The San Francisco area exhibited little change in length frequency distribution from 1988 to 1991 (Figure 60). In all years, modal length was between 325 and 341 mm (12.8 and 13.4 in.). Because this length range exceeds that of 50% sexual maturity, it is likely that the proportion of adult fish comprising the harvested population could provide steady recruitment. In addition, CPAH in this area averaged 0.10 fish, while in the Bodega Bay area in 1991 the highest rate was observed (0.59) of any port area during the study period. This rate may be too high to have a sustainable sport fishery

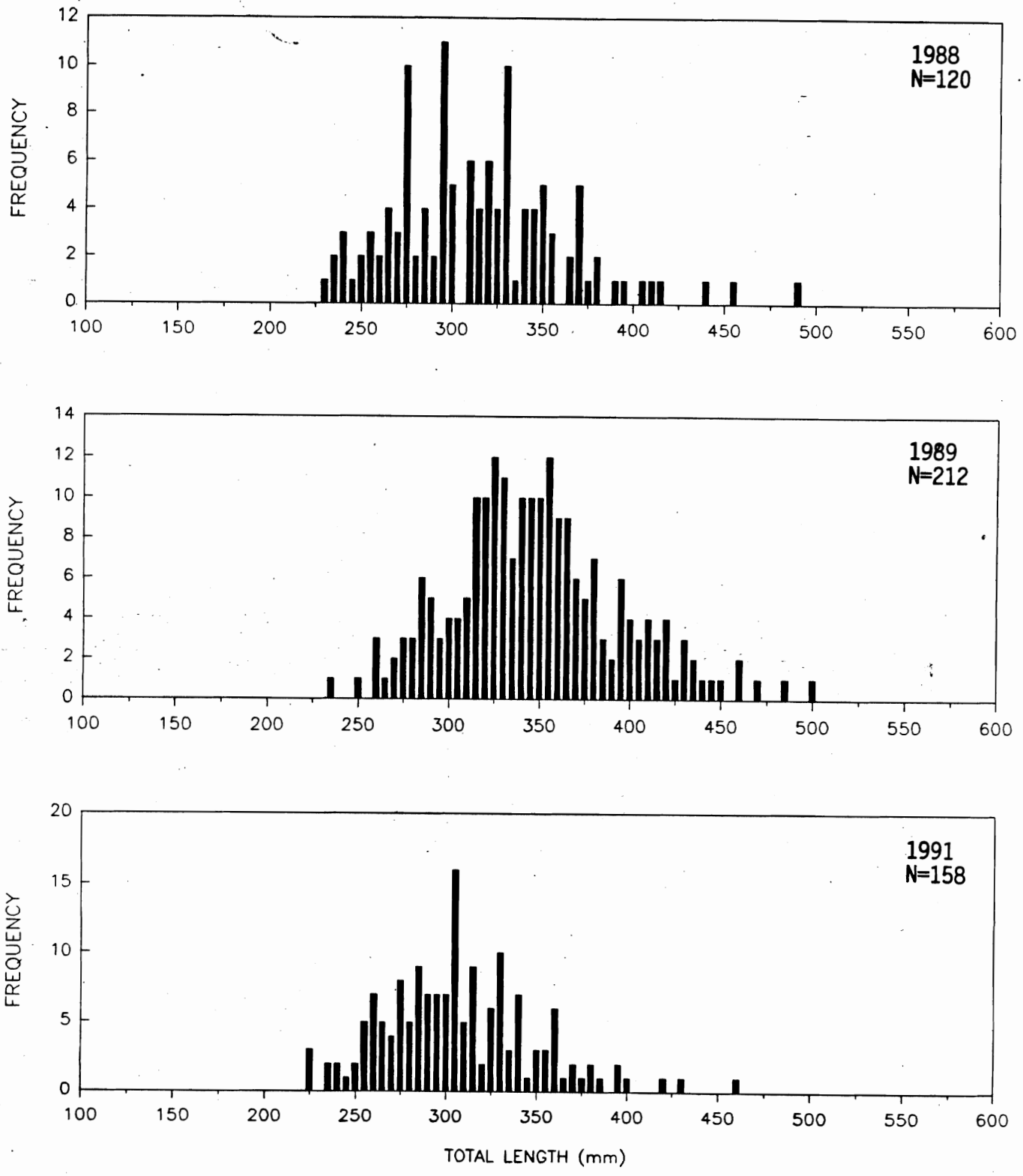

FIGURE 59. Length frequency of brown rockfish from the Bodega Bay area in 1988, 1989, and 1991.

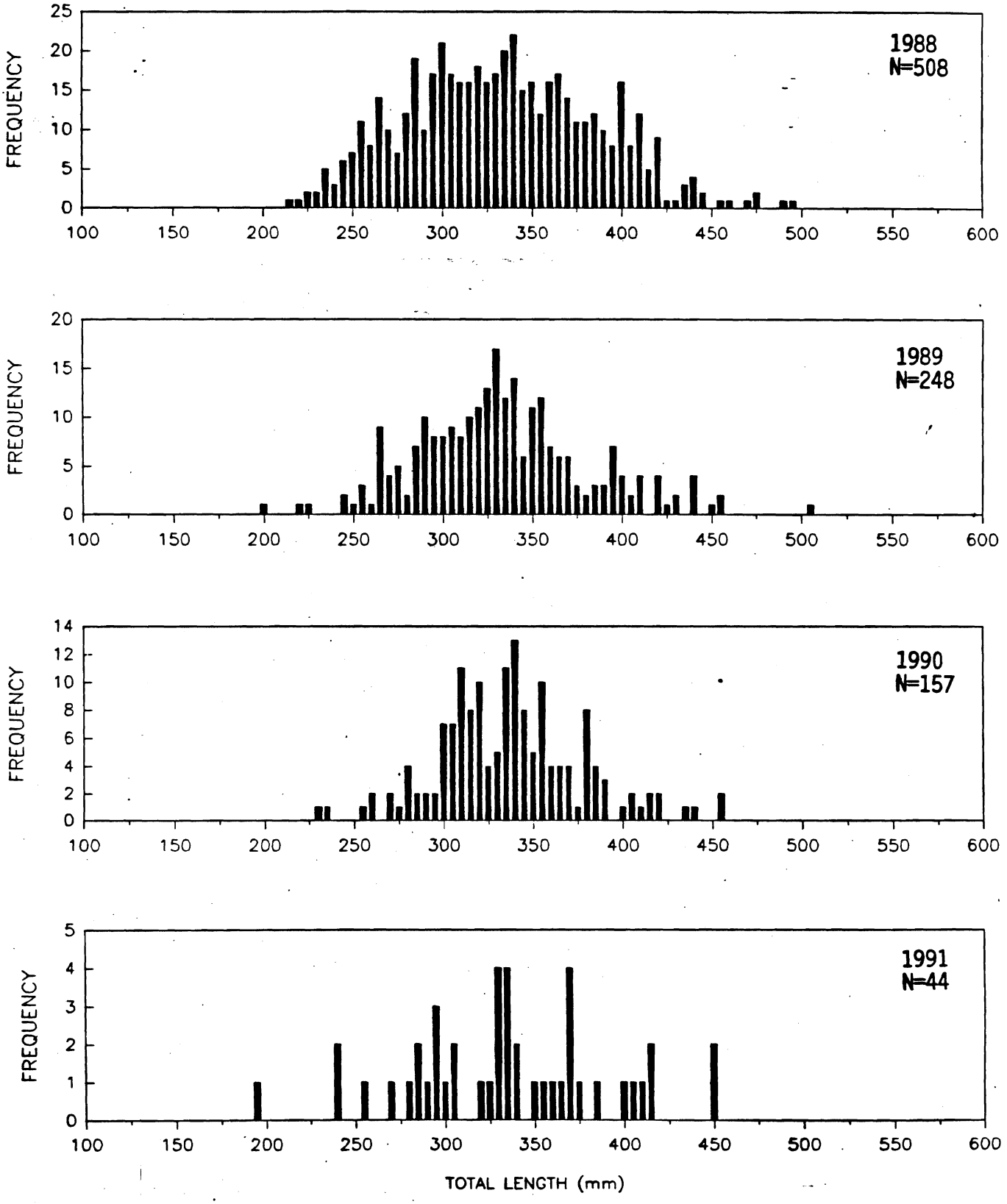

FIGURE 60. Length frequency of brown rockfish from the San Francisco area, 1988 to 1991.

when heavy commercial fishing pressure exists.

The majority of the relatively few brown rockfish sampled in the Monterey Bay area in 1989 and 1991 (Figure 61) were greater in length than that of 50% sexual maturity. Thus, in this area there appears to be little cause for concern as stocks are not heavily fished.

In the Morro Bay area, a wide distribution of lengths characterized samples (Figure 62), and the largest fish observed during the study period were taken here. A moderate shift toward smaller fish occurred from 1989 to 1991, but sufficient numbers of fish were observed in the length range corresponding to 50% as well as 100% sexual maturity (≥ 381 mm or 15.0 in.; Adams 1992a) to indicate a stock in good condition.

Copper Rockfish

Copper rockfish are widely distributed in depth range and latitude and are considered a highly desirable species. Catch rates were generally low in all port areas, consistent with a non-schooling behavior, and generally showed a decrease from 1988 to 1990-91 in the northern port areas and an increase in port areas from San Francisco south (Table 60).

No trend in CPAH relative to distance from port or depth was evident for any port area (Table 61), although the Fort Bragg area had a catch rate at distant locations more than six times that at near locations.

For most years sampled, copper rockfish followed a

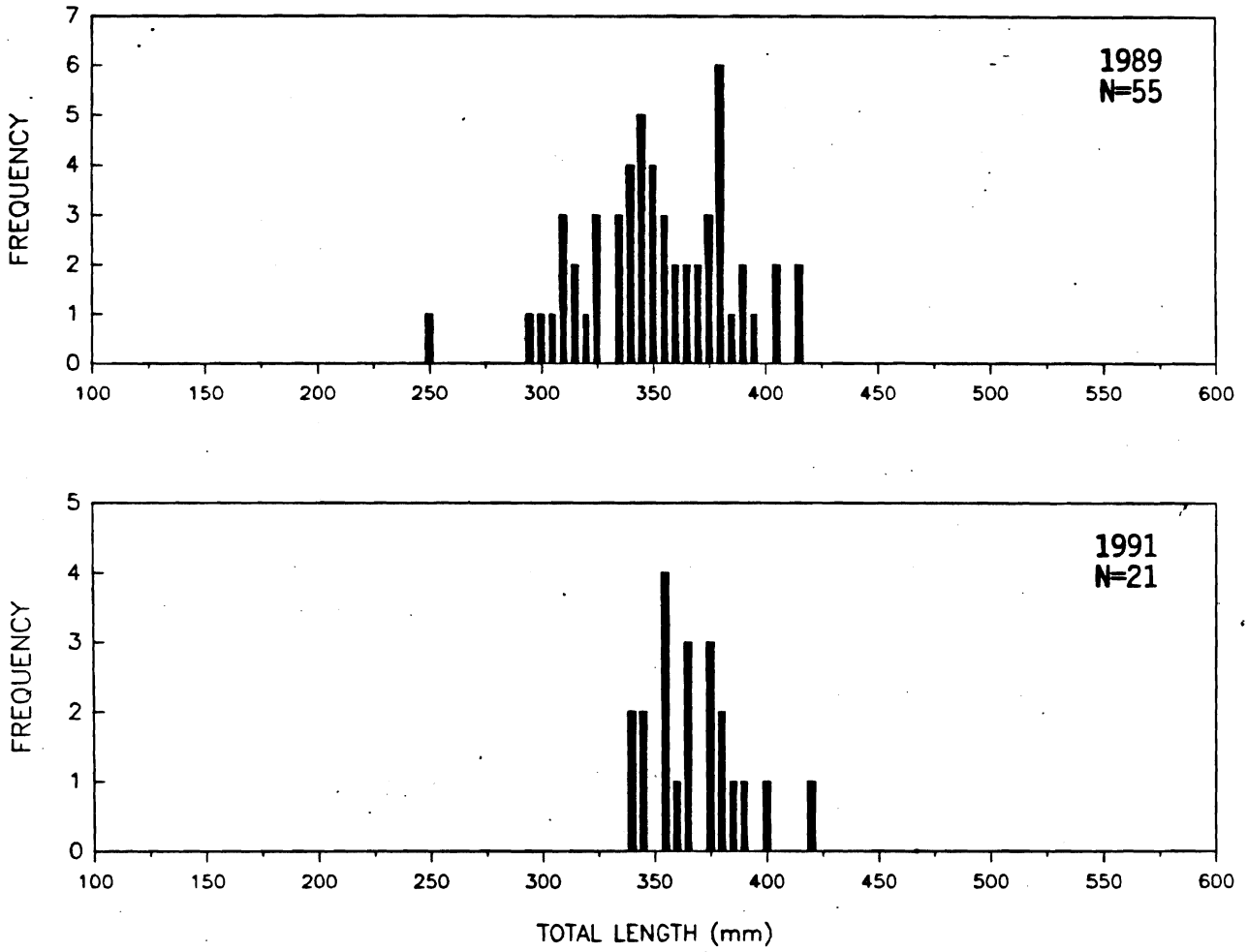

FIGURE 61. Length frequency of brown rockfish from the Monterey area in 1989 and 1991.

general trend of mean length decreasing with decreasing latitude (Table 62). However, fish from the Monterey area usually averaged larger than those from the San Francisco area. As with many other frequently observed species in this study in the Monterey area, a relatively high percentage (51%) of measured fish were from deep locations. Isothermic submergence may explain the greater mean length compared with the San Francisco

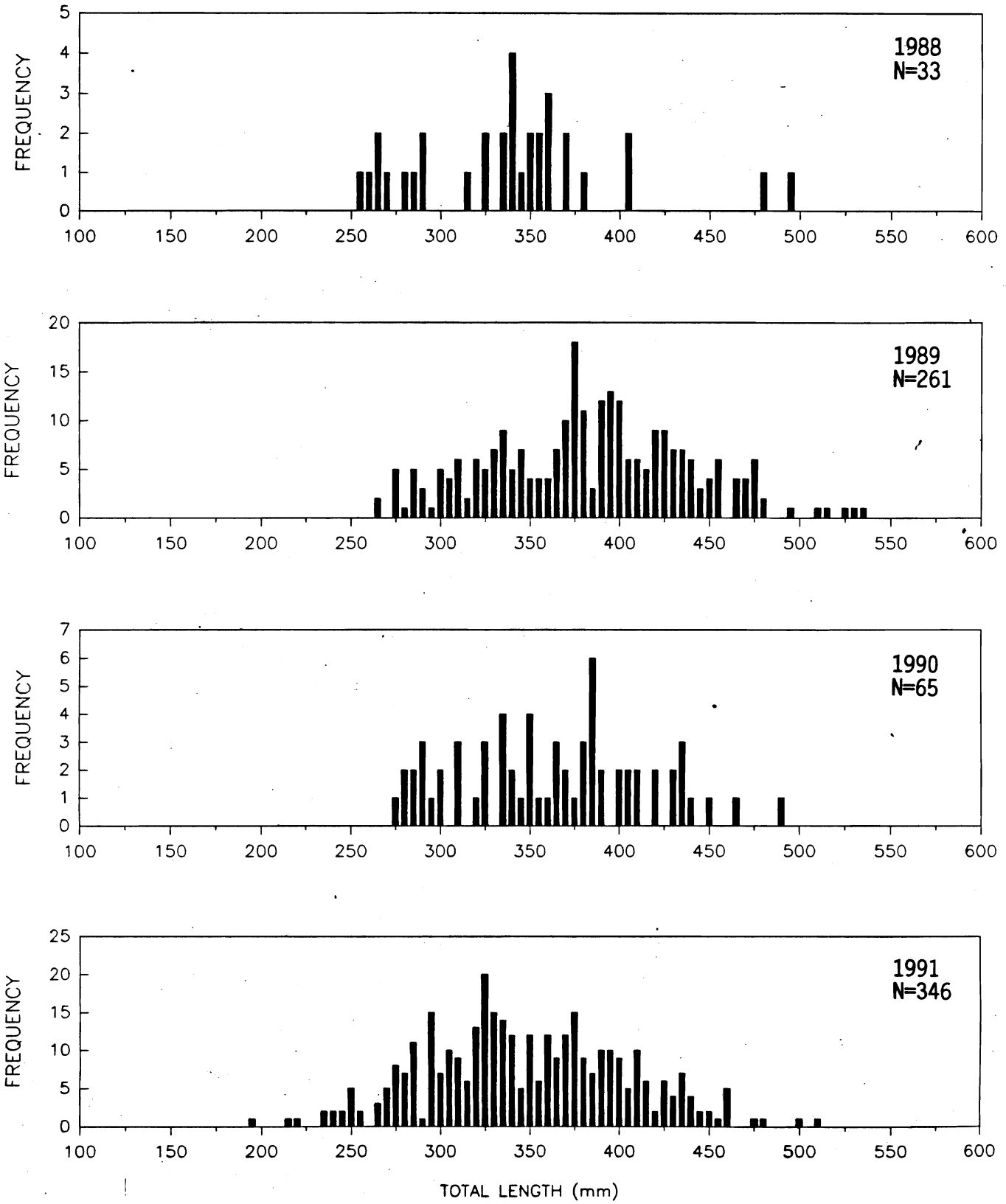

FIGURE 62. Length frequency of brown rockfish from the Morro Bay area, 1988 to 1991.

TABLE 60. Catch Per Angler Day and Catch Per Angler Hour for Copper Rockfish by Port and Year.

Port area	Catch per angler day						Catch per angler hour					
	1987	1988	1989	1990-91	1990	1991	1987	1988	1989	1990-91	1990	1991
Fort Bragg	-	0.46	0.34	0.23	-	0.26	-	0.21	0.13	0.08	-	0.09
Bodega Bay	-	0.18	0.18	0.04	-	0.05	-	0.06	0.04	0.01	-	0.02
San Francisco	-	0.25	0.31	0.43	0.48	0.36	-	0.07	0.09	0.12	0.14	0.10
Monterey	0.03	0.03	0.15	0.08	0.03	0.13	0.01	0.01	0.05	0.03	0.01	0.04
Morro Bay	-	0.31	0.34	0.36	0.60	0.21	-	0.09	0.12	0.11	0.18	0.07

TABLE 61. Catch Per Angler Hour and Mean Length of Copper Rockfish for Near and Distant Locations and Shallow and Deep Locations by Port, All Years Combined.

Port area	Catch per angler hour				Number of fish measured				Mean total length (mm)			
	Near	Distant	Shallow	Deep	Near	Dist	Shal	Deep	Near	Dist	Shal	Deep
Fort Bragg	.07	.45	.08	.26	24	24	9	8	422	411	409	420
Bodega Bay	.04	.05	.16	-	9	74	89	-	439	431	432	-
San Francisco	.20	.07	.06	.07	253	545	185	12	366	374	380	360
Monterey	.02	.04	.04	.02	142	110	27	139	393	389	370	406
Morro Bay	.11	.07	.07	.13	727	59	110	44	352	339	349	399

TABLE 62. Mean Length of Copper Rockfish Caught by CPFV Anglers by Port and Year.

Port area	Number of fish measured					Mean total length (mm)				
	1987	1988	1989	1990	1991	1987	1988	1989	1990	1991
Fort Bragg	-	8	10	-	30	-	452	412	-	408
Bodega Bay	-	42	53	-	3	-	452	414	-	362
San Francisco	-	268	309	161	74	-	387	368	358	375
Monterey	26	26	171	11	38	392	342	403	369	379
Morro Bay	-	207	268	206	131	-	330	340	385	353

area to the north. This is evidenced by mean length comparisons from shallow and deep locations in the Monterey and Morro Bay area; copper rockfish averaged 36 to 50 mm (1.4 to 2.0 in.) longer from deep locations (Table 61). Love et al. (1985) reported a variant of isothermic submergence for this species along the northern Channel Islands in southern California. Copper rockfish were larger toward the western end where water temperatures are colder.

No port area showed a consistent trend in mean length during the study period.

Mean length data from near and distant locations showed no consistent trend (Table 61).

Length samples from the Fort Bragg area in 1991 (Figure 63) and the Bodega Bay area in 1988 (Figure 64) were characterized by a scarcity of smaller fish compared with other port areas and years. Those fish greater than 340 mm (13.4 in.) exceeded the lengths at 50% sexual maturity for males (320 mm or 12.6 in.) and females (340 mm or 13.4 in.) reported by Wyllie-Echeverria (1987) and are approximately 6 years and older (Lea et al. 1993). The recruitment observed in the Bodega Bay area in 1991, indicated by fish less than 326 mm (12.8 in.) corresponds to an age range of 4 to 5 years (Lea et al. 1993).

The San Francisco area length frequency distributions were characterized by a wide, fairly stable range with relatively more recruitment in 1989 (Figure 65). Two fish measured in 1988 at 582 mm (22.9 in.) and 564 mm (22.2 in.)

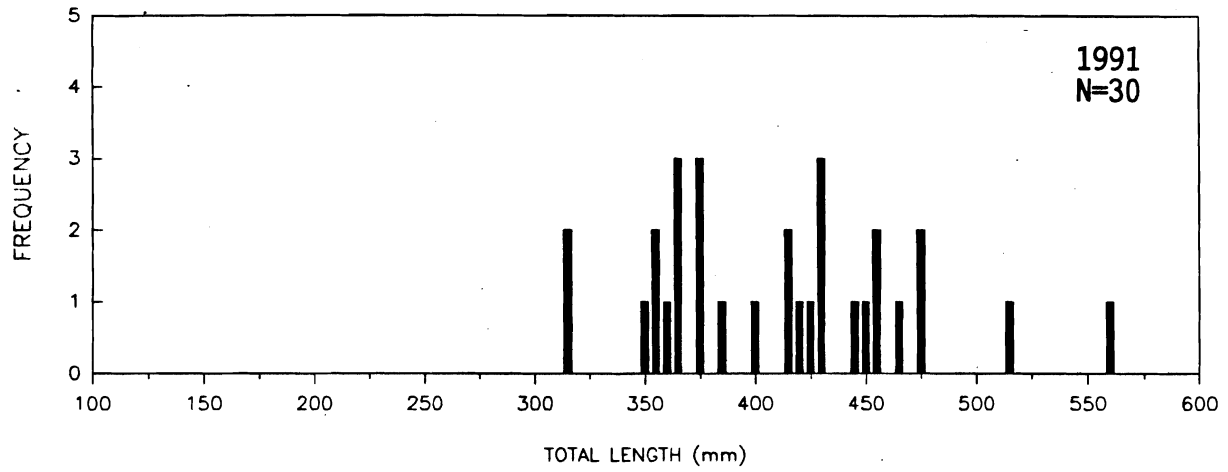

FIGURE 63. Length frequency of copper rockfish from the Fort Bragg area in 1991.

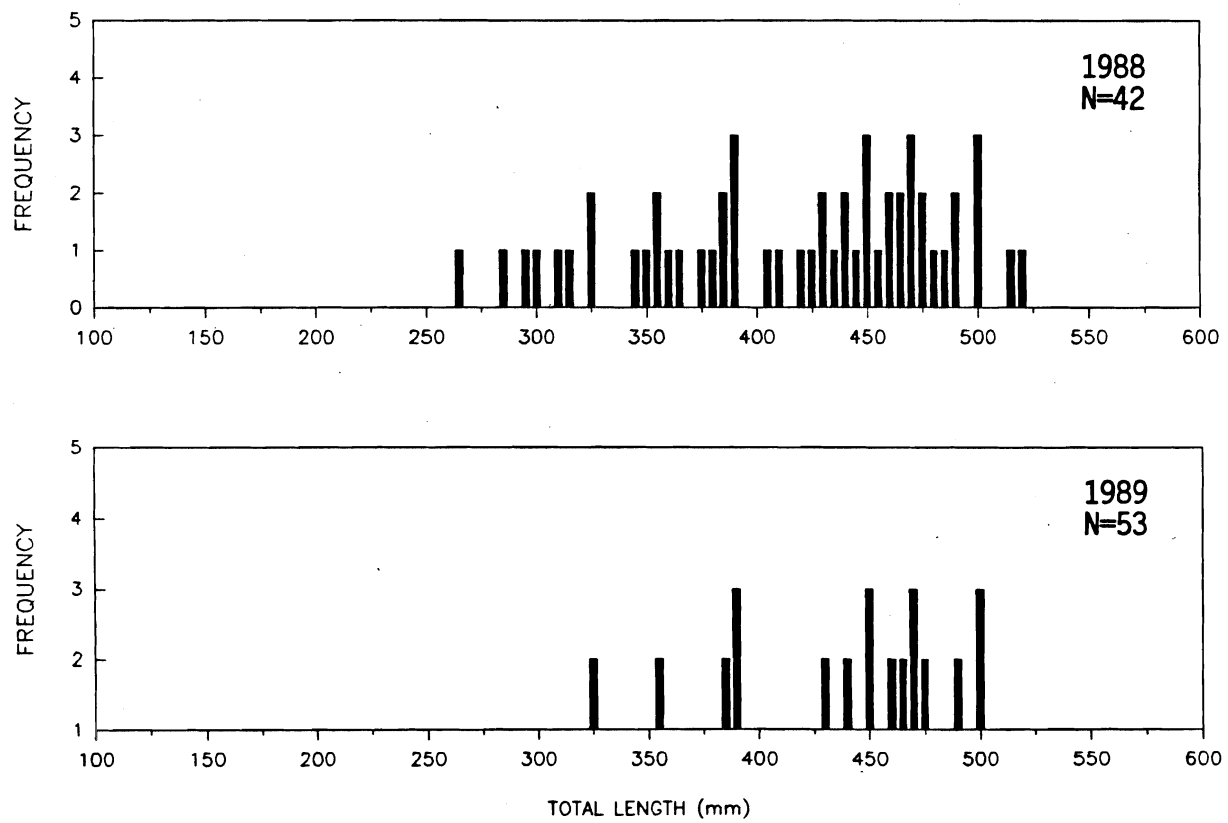

FIGURE 64. Length frequency of copper rockfish from the Bodega Bay area in 1988 and 1989.

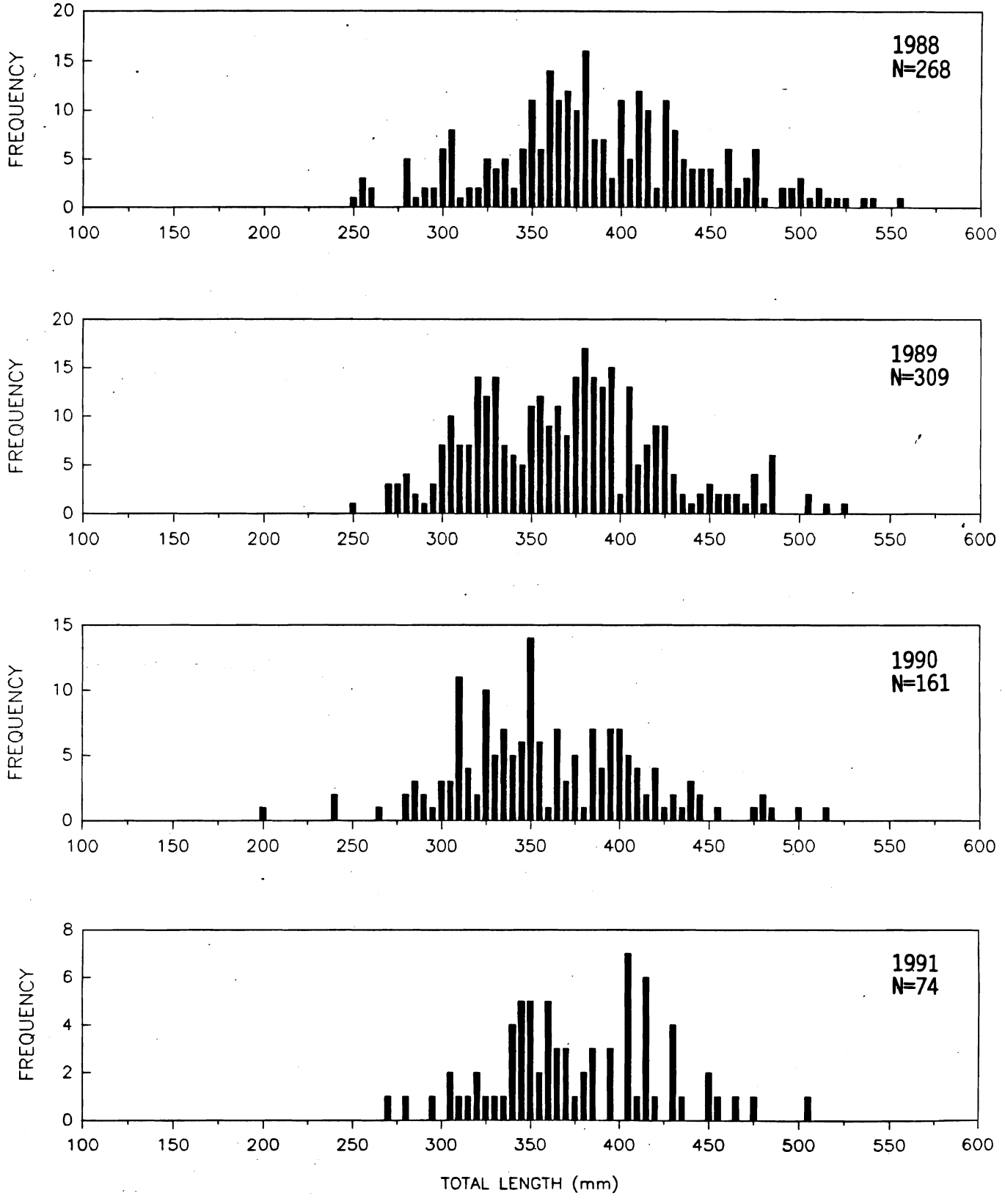

FIGURE 65. Length frequency of copper rockfish from the San Francisco area, 1988 to 1991.

were longer than the oldest fish (28 years) aged by Lea et al. (1993). Catch and length data indicate a local stock in good condition, although the relative contribution of larger fish gradually diminished during the study period. Adams (1992c) found no indication that stocks of this species are overfished in California waters. However, whitebelly rockfish, a morphological variation of the copper rockfish, was considered a separate species by Adams.

The one large sample from the Monterey area in 1989 showed a high proportion of copper rockfish greater than 400 mm (15.7 in.) (Figure 66). This length corresponds approximately to 8 years (Lea et al. 1993). Similar to the San Francisco area, the relatively wide length range indicates a healthy stock.

Mean length of copper rockfish sampled at Central California divers spearfishing meets from 1980 to 1986 at Carmel River State Beach near Monterey ranged from 368 to 401 mm (14.5 to 15.8 in.) and showed no trend (unpublished data, D. VenTresca, CDFG, Monterey). This is within the mean length range for CPFV-caught fish from this study.

Samples from the Morro Bay area indicated that a moderate pulse of recruitment entered the fishery in 1988 (Figure 67). The mode at 256-260 mm (10.1 to 10.2 in.) corresponds to a 3+ year-old fish (1985 year class) (Lea et al. 1993). As this year class grew, progressively few fish less than 301 mm (11.9 in.) comprised the length frequency samples until 1991, when additional recruitment was evident. Periodic recruitment

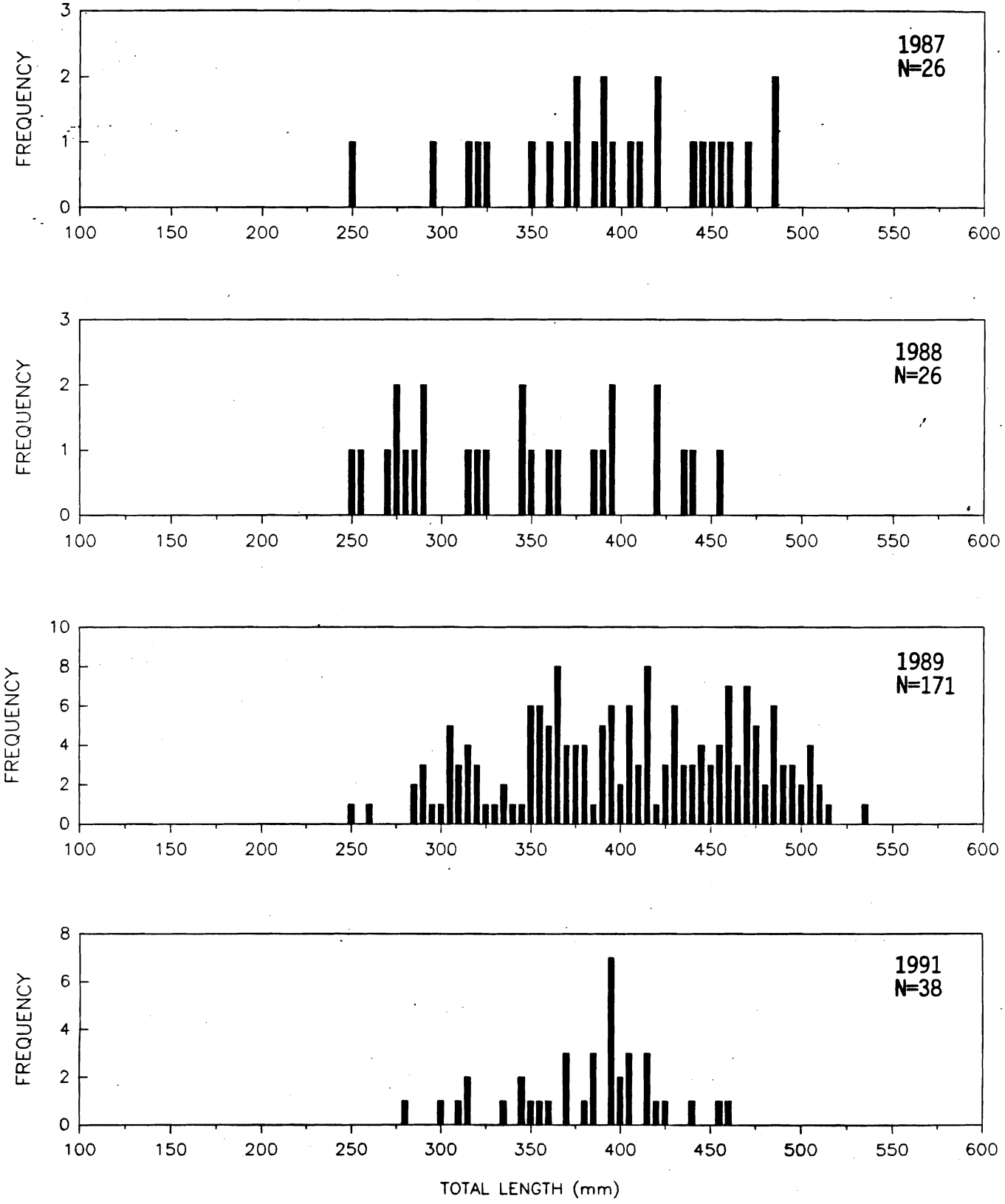

FIGURE 66. Length frequency of copper rockfish from the Monterey area, 1987 to 1989 and 1991.

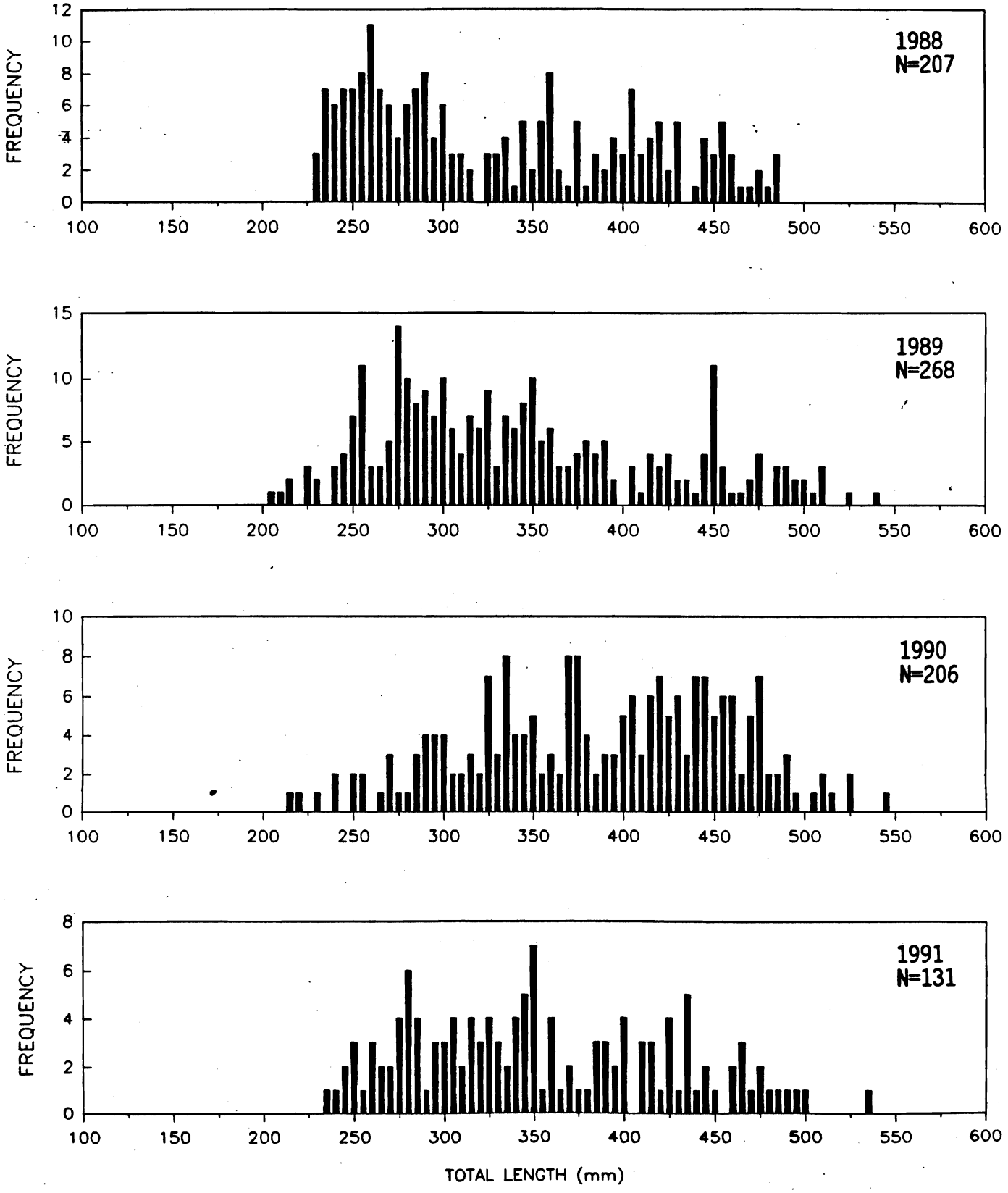

FIGURE 67. Length frequency of copper rockfish from the Morro Bay area, 1988 to 1991.

pulses were more apparent here than in more northern port areas.

Greenstriped Rockfish

Greenstriped rockfish was the only other species besides rosy rockfish among the 20 most frequently observed species that was not considered desirable, due to its smaller size. Catch rates were relatively low and variable among port areas with no trend evident (Table 63); however, the Monterey area showed a consistent increase in mean CPAH from 1987 to 1990-91. Seventy-four percent of all measured fish were from this area.

Greenstriped rockfish usually were caught with greater frequency at distant and deep locations (Table 64).

Mean length of greenstriped rockfish varied by only 21 mm (0.8 in.) during 5 years of sampling in the Monterey area (Table 65). No consistent length trend was evident in this area. However, mean length from the Morro Bay area increased steadily from 257 mm (10.1 in.) in 1988 to 290 mm (11.4 in.) in 1991.

There was no clinal trend evident for mean length in the three most southern port areas. This is to be expected since this species was only caught at the upper limits of a relatively deep depth range, in which temperature and corresponding growth rate would vary little.

Although there is no directed effort for greenstriped rockfish, mean length at distant locations in the Monterey and

TABLE 63. Catch Per Angler Day and Catch Per Angler Hour for Greenstriped Rockfish by Port and Year.

Port area	Catch per angler day						Catch per angler hour					
	1987	1988	1989	1990-91	1990	1991	1987	1988	1989	1990-91	1990	1991
Fort Bragg	-	-	0.10	0.06	0.45	-	-	-	0.04	0.02	0.17	-
Bodega Bay	-	0.21	0.14	0.13	0.12	0.13	-	0.07	0.04	0.04	0.04	0.04
San Francisco	-	0.10	0.06	0.04	0.04	0.04	-	0.03	0.02	0.01	0.01	0.01
Monterey	0.15	0.26	0.40	0.47	0.35	0.60	0.05	0.08	0.13	0.16	0.13	0.19
Morro Bay	-	0.03	0.07	0.06	0.10	0.04	-	0.01	0.02	0.02	0.03	0.01

TABLE 64. Catch Per Angler Hour and Mean Length of Greenstriped Rockfish for Near and Distant Locations and Shallow and Deep Locations by Port, All Years Combined.

Port area	Catch per angler hour				Number of fish measured				Mean total length (mm)			
	Near	Distant	Shallow	Deep	Near	Dist	Shal	Deep	Near	Dist	Shal	Deep
Fort Bragg	.03	-	.01	-	1	-	-	-	285	-	-	-
Bodega Bay	-	.06	-	.12	-	57	-	24	-	304	-	320
San Francisco	-	.02	.01	-	-	176	-	-	-	283	-	-
Monterey	.07	.18	<.01	.16	478	443	5	911	271	285	175	279
Morro Bay	.01	.04	<.01	.04	90	33	-	41	266	287	-	288

TABLE 65. Mean Length of Greenstriped Rockfish Caught by CPFV Anglers by Port and Year.

Port area	Number of fish measured					Mean total length (mm)				
	1987	1988	1989	1990	1991	1987	1988	1989	1990	1991
Fort Bragg	-	-	-	1	-	-	-	-	285	-
Bodega Bay	-	41	14	-	1	-	300	315	-	332
San Francisco	-	79	71	15	11	-	280	289	267	296
Monterey	126	244	448	70	142	266	273	287	282	281
Morro Bay	-	26	57	16	28	-	257	270	274	290

Morro Bay areas was 14-29 mm (0.6-0.8 in.) greater than that at near locations (Table 64), indicating an indirect effect of proportionally more fishing effort for species associated with greenstriped rockfish closer to port.

The 1988 Bodega Bay length frequency sample exhibited a strong mode at 286 to 295 mm (11.3 to 11.6 in.) and a narrow length range (Figure 68). All fish exceeded the reported length at 50% sexual maturity of 230 mm (9.1 in.) for both sexes (Wylllie-Echeverria 1987).

San Francisco area samples indicated a pulse of recruitment in 1988 in the 226- to 265-mm (8.9- to 10.4-in.) length range (Figure 69). The shift to the right the following year most likely indicates this pulse to represent a strong year class.

The Monterey and Morro Bay areas also showed evidence of a pulse of recruitment in 1988, a shift to the right the following year, and little change thereafter (Figures 70-71).

Gopher Rockfish

Gopher rockfish were of primary importance in the Morro Bay area, where 64% of all observed fish were taken and 73% of all measured fish were observed. Mean CPAH was fairly uniform from 1988 to 1990-91, only ranging from 0.15 to 0.22 (Table 66).

Mean catch rate in the Morro Bay area was more than twice as high at distant locations than at near locations (Table 67). Gopher rockfish were taken exclusively at mixed or

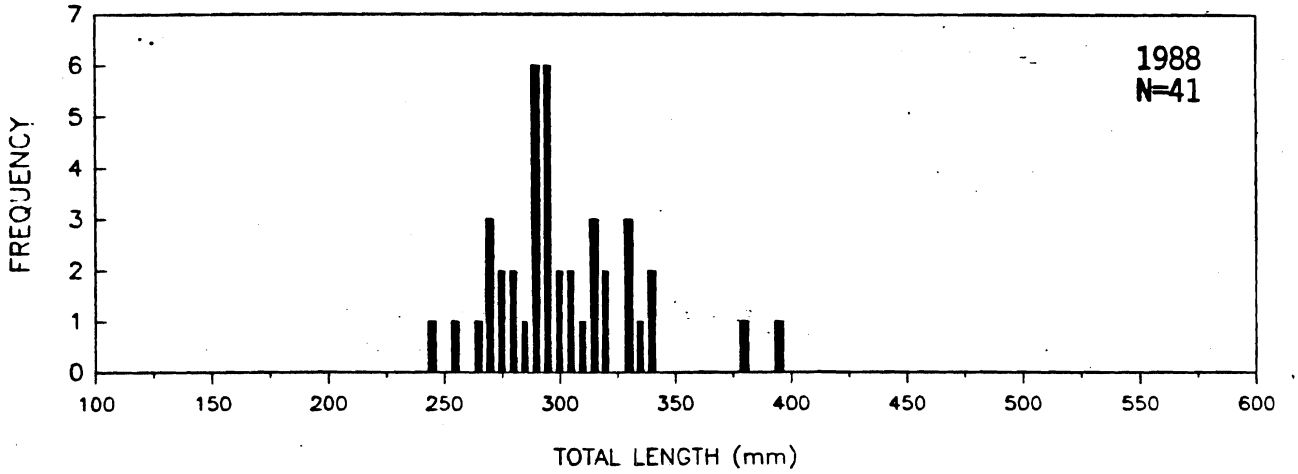

FIGURE 68. Length frequency of greenstriped rockfish from the Bodega Bay area in 1988.

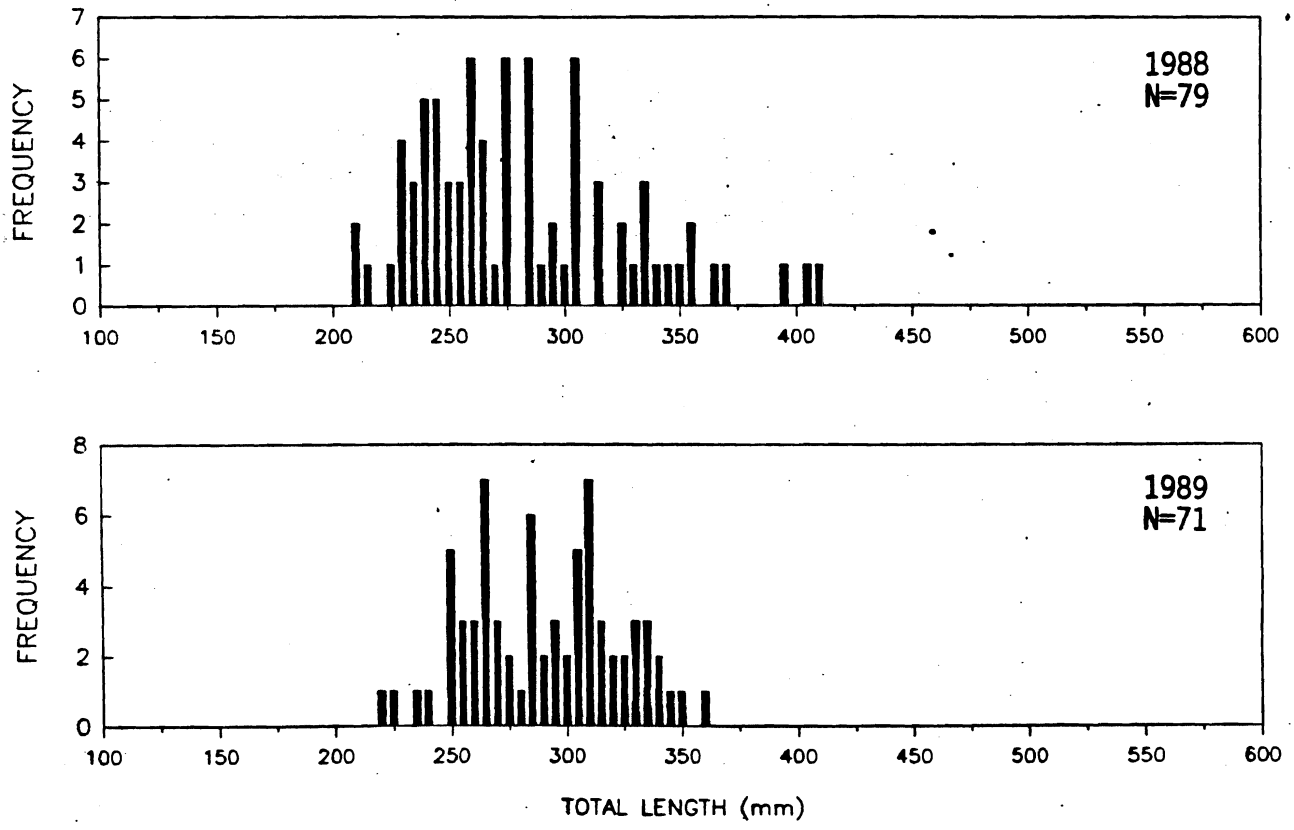

FIGURE 69. Length frequency of greenstriped rockfish from the San Francisco area in 1988 and 1989.

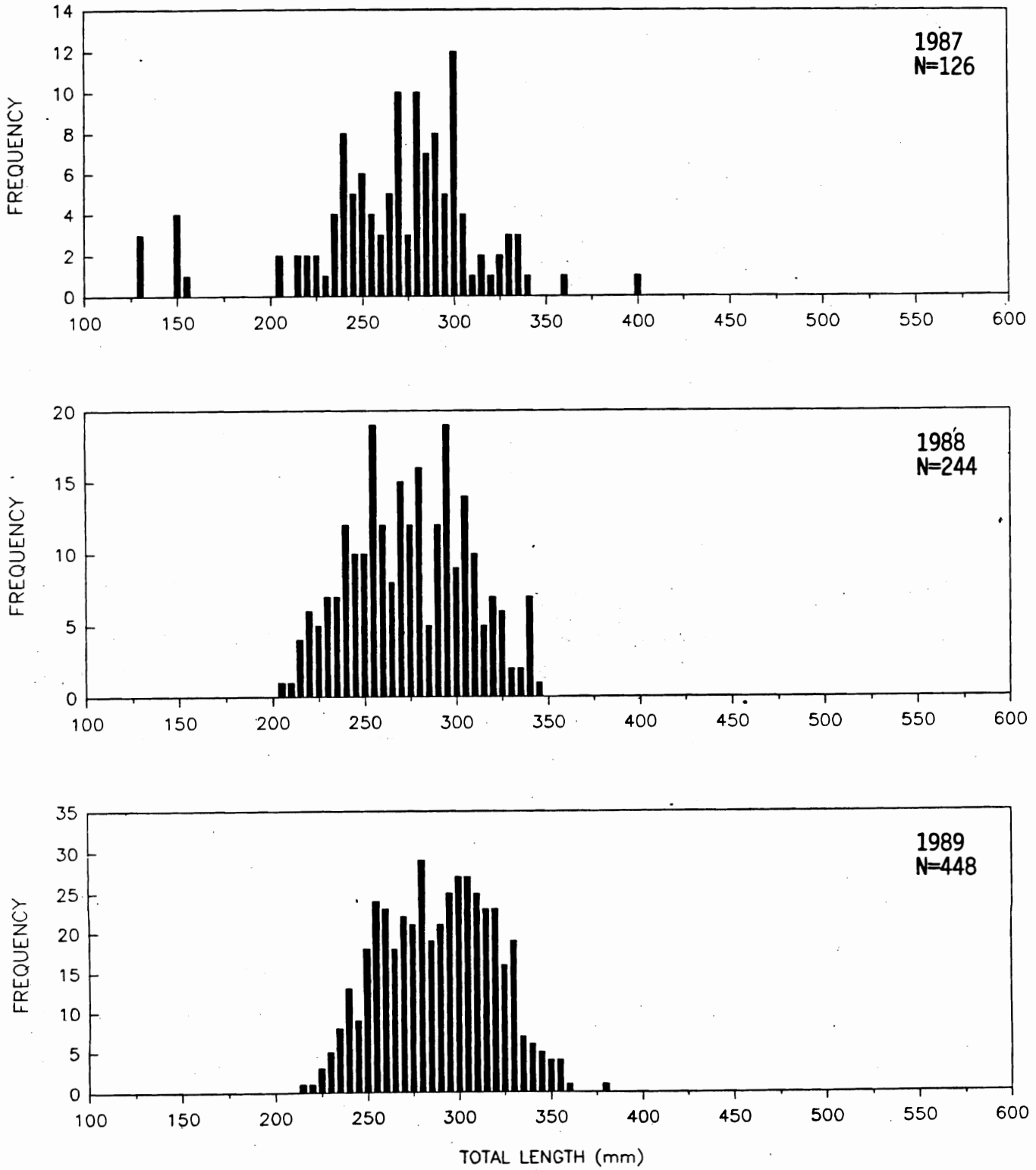

FIGURE 70. Length frequency of greenstriped rockfish from the Monterey area, 1987 to 1991.

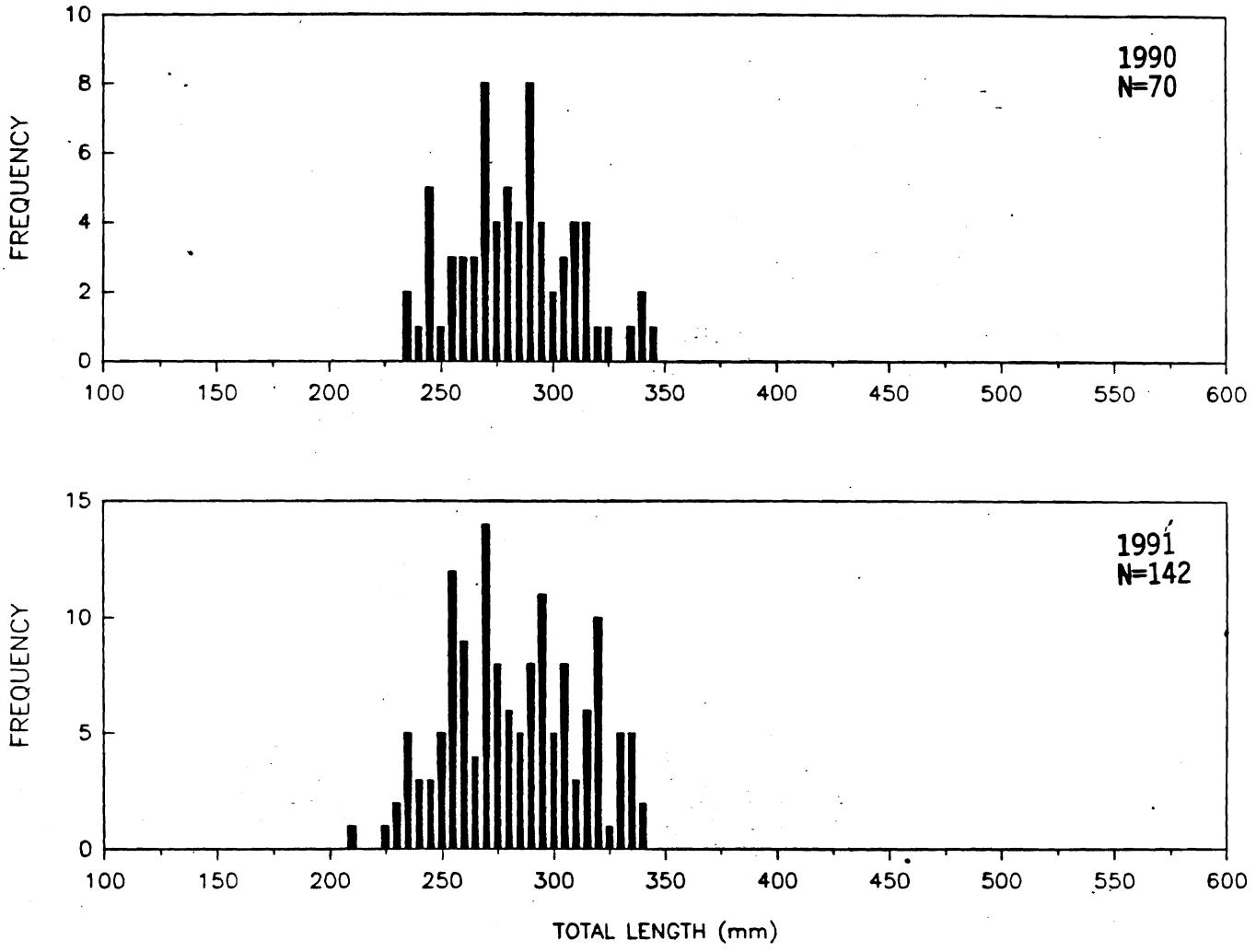

FIGURE 70. (continued).

shallow locations, with the exception of two fish recorded from a deep location in the Monterey area (Table 67).

This species exhibited a relatively narrow range of mean lengths among the three most southern port areas (Table 68). This would be expected for a species with a comparatively small maximum length (425 mm or 16.7 in., this study). Mean length of gopher rockfish for all years sampled ranked 19th (rosy rockfish

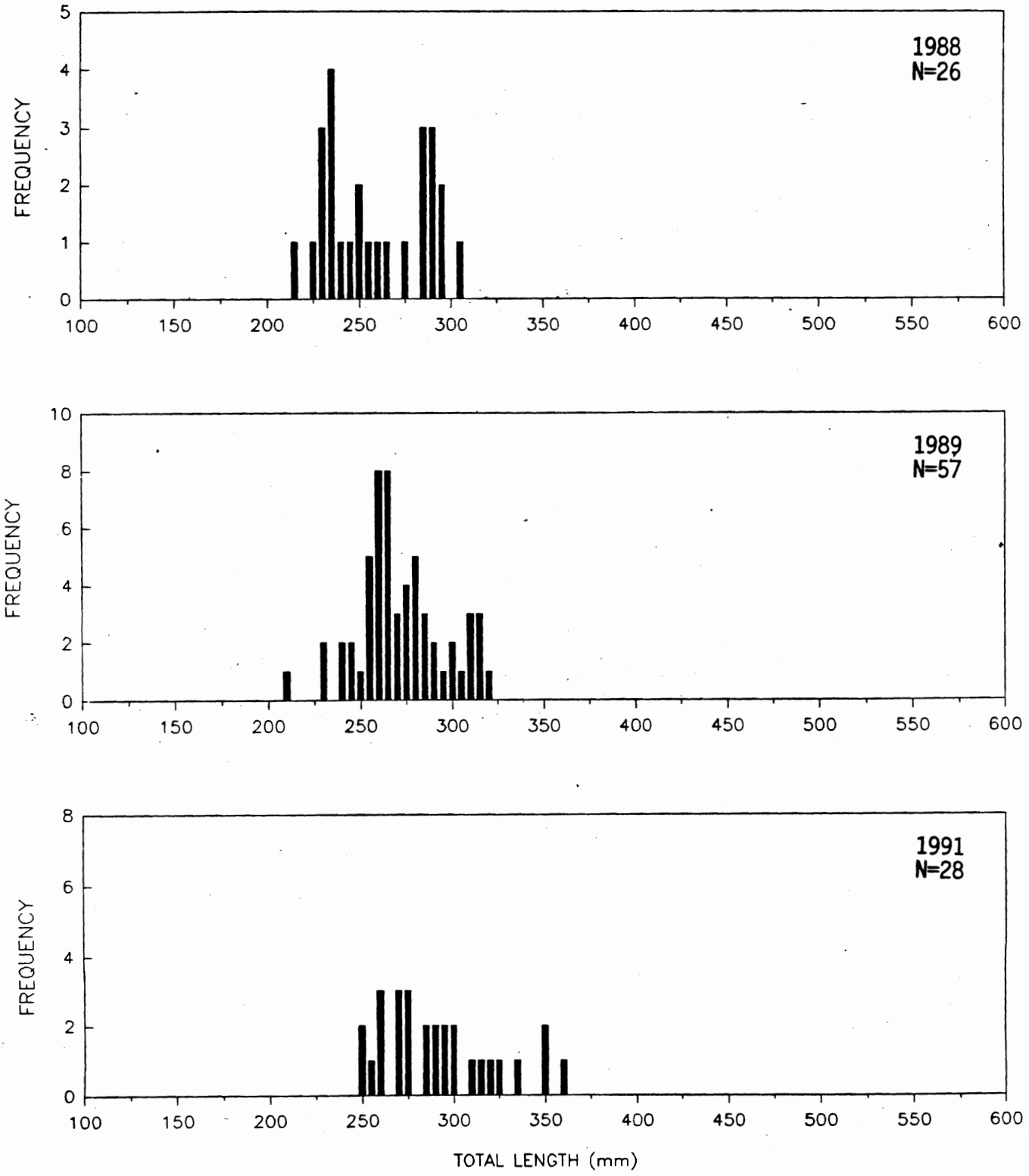

FIGURE 71. Length frequency of greenstriped rockfish from the Morro Bay area in 1988, 1989, and 1991.

TABLE 66. Catch Per Angler Day and Catch Per Angler Hour for Gopher Rockfish by Port and Year.

Port area	Catch per angler day						Catch per angler hour					
	1987	1988	1989	1990-91	1990	1991	1987	1988	1989	1990-91	1990	1991
Fort Bragg	-	-	-	0.09	-	0.10	-	-	-	0.03	-	0.04
Bodega Bay	-	0.05	0.03	0.01	-	0.02	-	0.02	0.01	<0.01	-	0.01
San Francisco	-	0.15	0.17	0.07	0.10	0.04	-	0.04	0.05	0.02	0.03	0.01
Monterey	0.07	0.04	0.03	0.06	0.04	0.09	0.02	0.01	0.01	0.02	0.01	0.03
Morro Bay	-	0.51	0.64	0.63	0.18	0.92	-	0.15	0.22	0.19	0.05	0.29

TABLE 67. Catch Per Angler Hour and Mean Length of Gopher Rockfish for Near and Distant Locations and Shallow and Deep Locations by Port, All Years Combined.

Port area	Catch per angler hour				Number of fish measured				Mean total length (mm)			
	Near	Distant	Shallow	Deep	Near	Dist	Shal	Deep	Near	Dist	Shal	Deep
Fort Bragg	.02	-	.03	-	14	-	14	-	306	-	306	-
Bodega Bay	.06	.01	.04	-	4	1	6	-	285	270	282	-
San Francisco	.03	.04	.09	-	15	341	386	-	260	272	271	-
Monterey	.01	.03	.08	<.01	72	92	88	-	262	295	294	-
Morro Bay	.16	.35	.35	-	1186	414	667	-	268	283	280	-

TABLE 68. Mean Length of Gopher Rockfish Caught by CPFV Anglers by Port and Year.

Port area	Number of fish measured					Mean total length (mm)				
	1987	1988	1989	1990	1991	1987	1988	1989	1990	1991
Fort Bragg	-	-	-	-	14	-	-	-	-	306
Bodega Bay	-	4	6	-	-	-	285	264	-	-
San Francisco	-	190	164	44	14	-	273	269	269	278
Monterey	71	37	29	11	16	283	282	287	262	267
Morro Bay	-	401	516	54	667	-	264	271	287	276

was 20th) among the 20 most frequently observed species in the Bodega Bay, San Francisco, and Morro Bay areas. A clinal relationship of length decreasing with decreasing latitude was not evident for the three most southern port areas. No port area demonstrated a consistent mean length trend during the study period. However, mean length from distant locations in the Monterey and Morro Bay area was 33 and 15 mm (1.3 and 0.6 in.), respectively, greater than that from near locations (Table 67).

Length frequency distributions from the San Francisco, Monterey and Morro Bay areas were unimodal and relatively stable during the study period (Figures 72-74), although a decline in the number of fish greater than 300 mm (11.8 in.) was evident in the San Francisco area samples. This species has the smallest length at 50% sexual maturity (170 mm or 6.7 in.) (Wyllie-Echeverria 1987) among all 19 species discussed in this report. This is less than the length at which gopher rockfish recruited to the fishery in all port areas sampled. The mode at 256-260 mm (10.1-10.2 in.) in 1988 in the San Francisco and Morro Bay areas corresponds to a 5+ year-old fish (Lea et al. 1993). The largest fish aged by Lea et al., 348 mm (13.7 in.) was 14 years. Thus the sampled population was characterized by a relatively wide correponding age range and a majority of fish in the length range of sexually mature adults.

No strong pulses of recruitment were evident from 1987 to 1991 in any port area. Although this is a shallow water

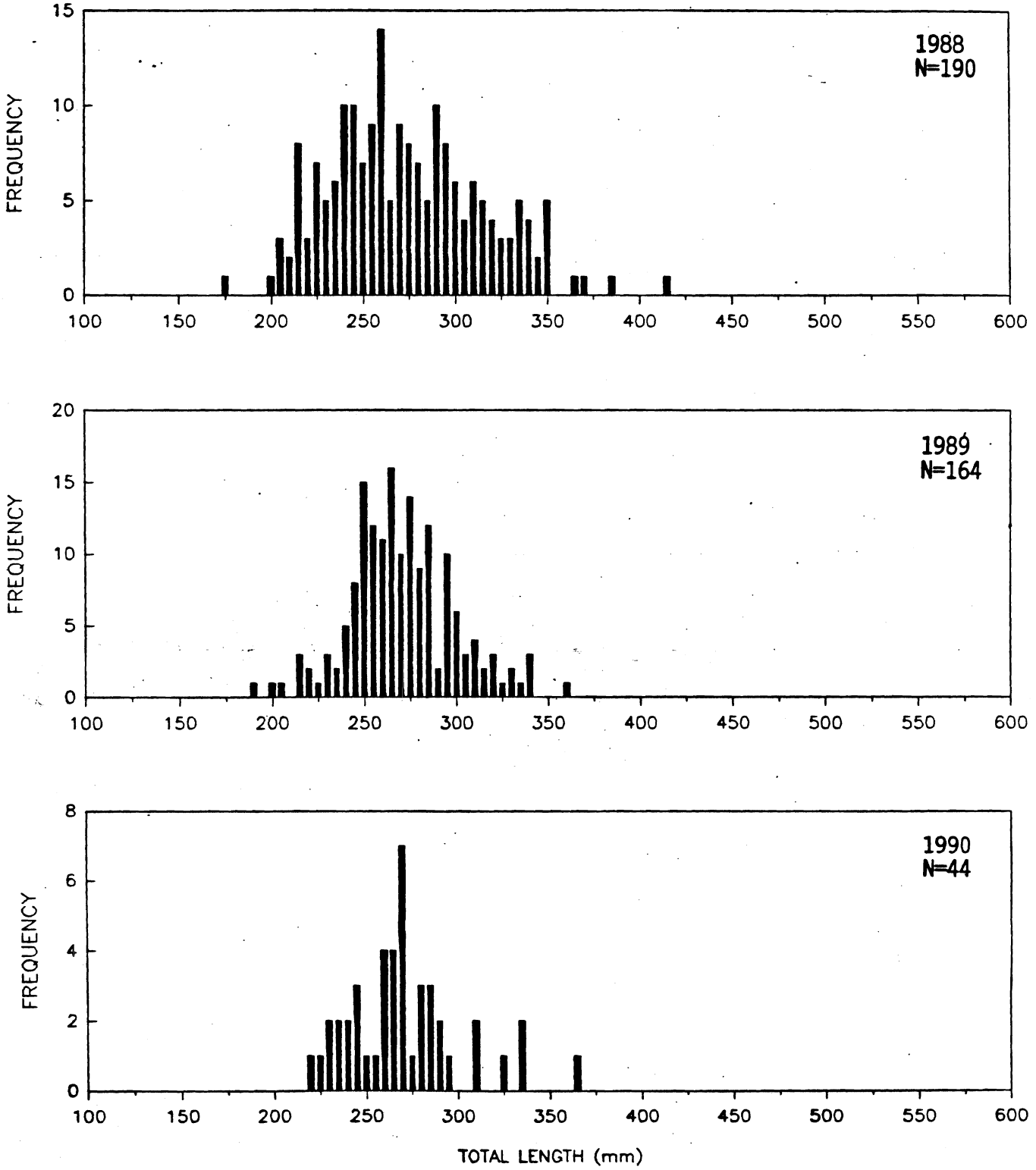

FIGURE 72. Length frequency of gopher rockfish from the San Francisco area, 1988 to 1990.

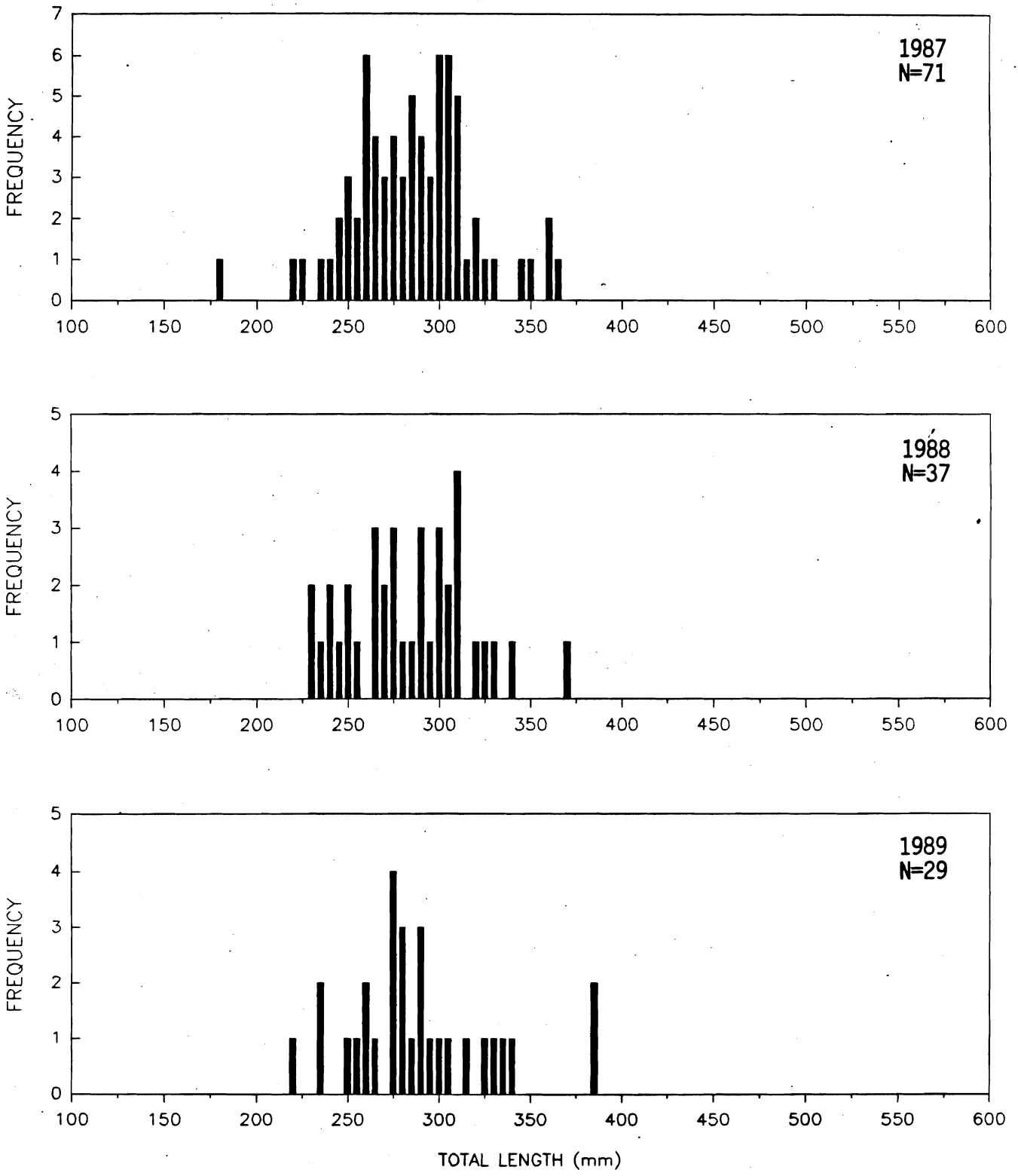

FIGURE 73. Length frequency of gopher rockfish from the Monterey area, 1987 to 1989.

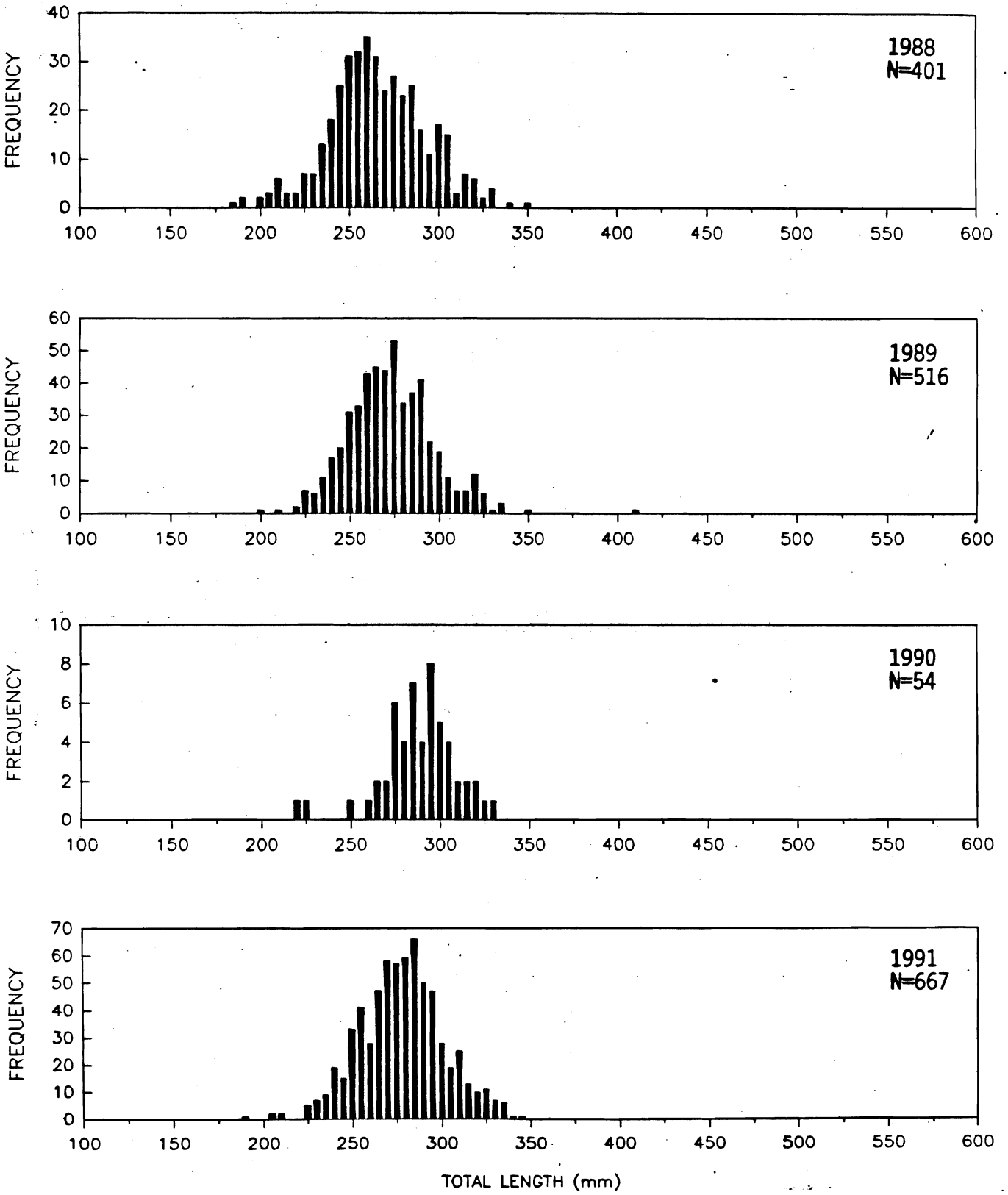

FIGURE 74. Length frequency of gopher rockfish from the Morro Bay area, 1988 to 1991.

species, its non-schooling behavior and habitat preference, in contrast to black rockfish, lends it some degree of protection from potential overharvest.

China Rockfish

China rockfish were taken most frequently in the San Francisco area, where 61% of all observed fish occurred and 64% of all measured fish were observed. CPAH was relatively stable in the Monterey and Morro Bay areas and showed a decline in the San Francisco area from 1988 to 1990-91 (Table 69).

In port areas from San Francisco south, catch rates were higher at distant than at near locations, and in all port areas CPAH was much higher at shallow than at deep locations (Table 70).

Mean length of China rockfish was remarkably constant in the San Francisco area from 1988 to 1990 (Table 71). The Morro Bay area also showed no consistent trend of mean length with time. In 1989 sufficient numbers of fish were measured from the four most southern port areas to detect a clinal trend of decreasing mean length with decreasing latitude.

Near and distant location data from the San Francisco and Monterey areas indicated heavier fishing pressure in the near locations where mean lengths were 26 to 27 mm (1.0 to 1.1 in.) less than mean lengths from distant locations (Table 70). No difference was evident in the Morro Bay area.

Almost all China rockfish in the small length sample from

TABLE 69. Catch Per Angler Day and Catch Per Angler Hour for China Rockfish by Port and Year.

Port area	Catch per angler day						Catch per angler hour					
	1987	1988	1989	1990-91	1990	1991	1987	1988	1989	1990-91	1990	1991
Fort Bragg	-	-	-	0.14	-	0.16	-	-	-	0.05	-	0.06
Bodega Bay	-	0.06	0.08	0.04	-	0.05	-	0.02	0.03	0.01	-	0.02
San Francsico	-	0.32	0.21	0.21	0.29	0.08	-	0.09	0.06	0.06	0.09	0.02
Monterey	0.03	0.02	0.03	0.04	0.01	0.08	0.01	0.01	0.01	0.01	<0.01	0.03
Morro Bay	-	0.13	0.08	0.12	0.06	0.17	-	0.04	0.03	0.04	0.02	0.05

TABLE 70. Catch Per Angler Hour and Mean Length of China Rockfish for Near and Distant Locations and Shallow and Deep Locations by Port, All Years Combined.

Port area	Catch per angler hour				Number of fish measured				Mean total length (mm)			
	Near	Distant	Shallow	Deep	Near	Dist	Shal	Deep	Near	Dist	Shal	Deep
Fort Bragg	.03	-	.04	-	22	-	21	-	317	-	319	-
Bodega Bay	.05	.02	.06	-	-	30	31	-	-	335	332	-
San Francisco	.04	.07	.12	.01	37	637	452	1	274	300	293	289
Monterey	.01	.02	.06	<.01	41	34	46	1	274	301	295	268
Morro Bay	.03	.08	.08	<.01	180	74	117	1	287	286	287	247

TABLE 71. Mean Length of China Rockfish Caught by CPFV Anglers by Port and Year.

Port area	Number of fish measured					Mean total length (mm)				
	1987	1988	1989	1990	1991	1987	1988	1989	1990	1991
Fort Bragg	-	-	-	-	22	-	-	-	-	317
Bodega Bay	-	6	26	-	3	-	341	334	-	273
San Francisco	-	349	228	101	17	-	299	298	298	287
Monterey	15	15	34	2	9	279	274	293	274	295
Morro Bay	-	79	72	16	87	-	285	282	285	293

the Fort Bragg area in 1991 were greater than 270 mm (10.6 in.) (Figure 75). This is the length reported by Wyllie-Echeverria (1987) for 50% sexual maturity for both sexes.

A similar situation existed in the 1989 Bodega Bay sample, although average length of fish was greater in this area (Figure 76). China rockfish as large as 416 mm (16.4 in.) were observed; this length exceeds the calculated maximum asymptotic length for aged fish by Lea et al. (1993) and most likely corresponds to an age exceeding 20 years.

San Francisco area length frequency distributions from 1988 to 1990 were fairly consistent (Figure 77), similar to mean length. The mode from 286 to 310 mm (11.3 to 12.2 in.) roughly corresponds to an age of 8 to 10 years (Lea et al. 1993).

The small sample from the Monterey area in 1989 resembled a subsample from the San Francisco area the same year with a correspondingly narrower length range (Figure 78), indicating the likelihood of a shared stock.

Length frequency distributions from the Morro Bay area in 1988, 1989, and 1991 exhibited a progressively narrower length range (Figure 79). The progression of the mode from 251 to 275 mm (9.9 to 10.8 in.) in 1989 to 276 to 300 mm (10.9 to 11.8 in.) in 1991 is close to the calculated growth for a 2-year period for fish in this length range (Lea et al. 1993); this most likely indicates a dominant (1984) year class. The relatively narrow length and corresponding age range in this area could signal a problem, but the majority of fish were in

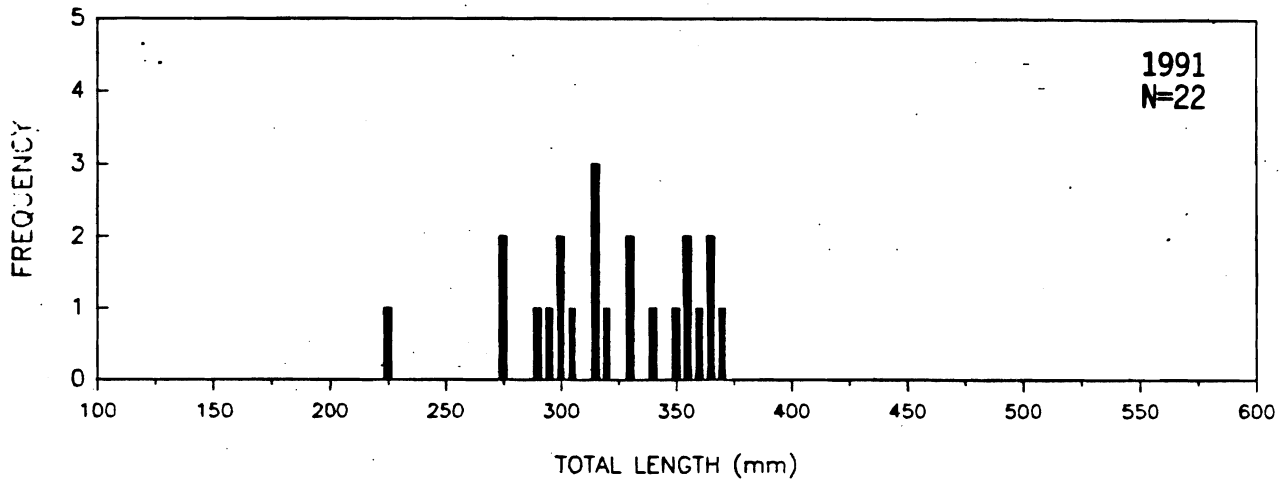

FIGURE 75. Length frequency of China rockfish from the Fort Bragg area in 1991.

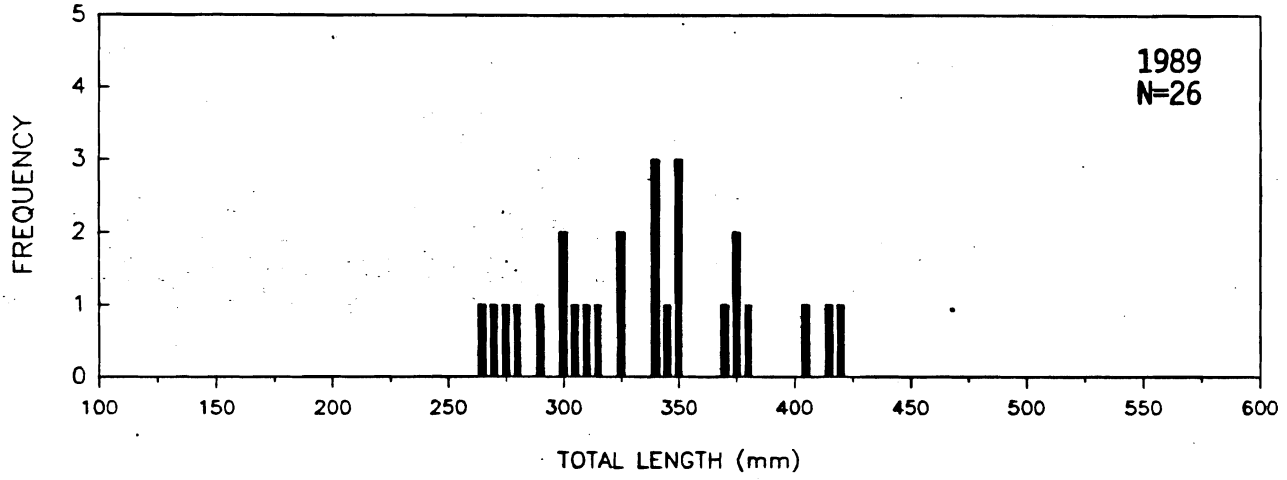

FIGURE 76. Length frequency of China rockfish from the Bodega Bay area in 1989.

the length range of sexually mature adults and therefore the recruitment potential remains high.

Yelloweye Rockfish

Yelloweye rockfish are a highly desirable species with generally low catch rates due to their deep, non-schooling distribution. CPAH in all port areas was fairly stable

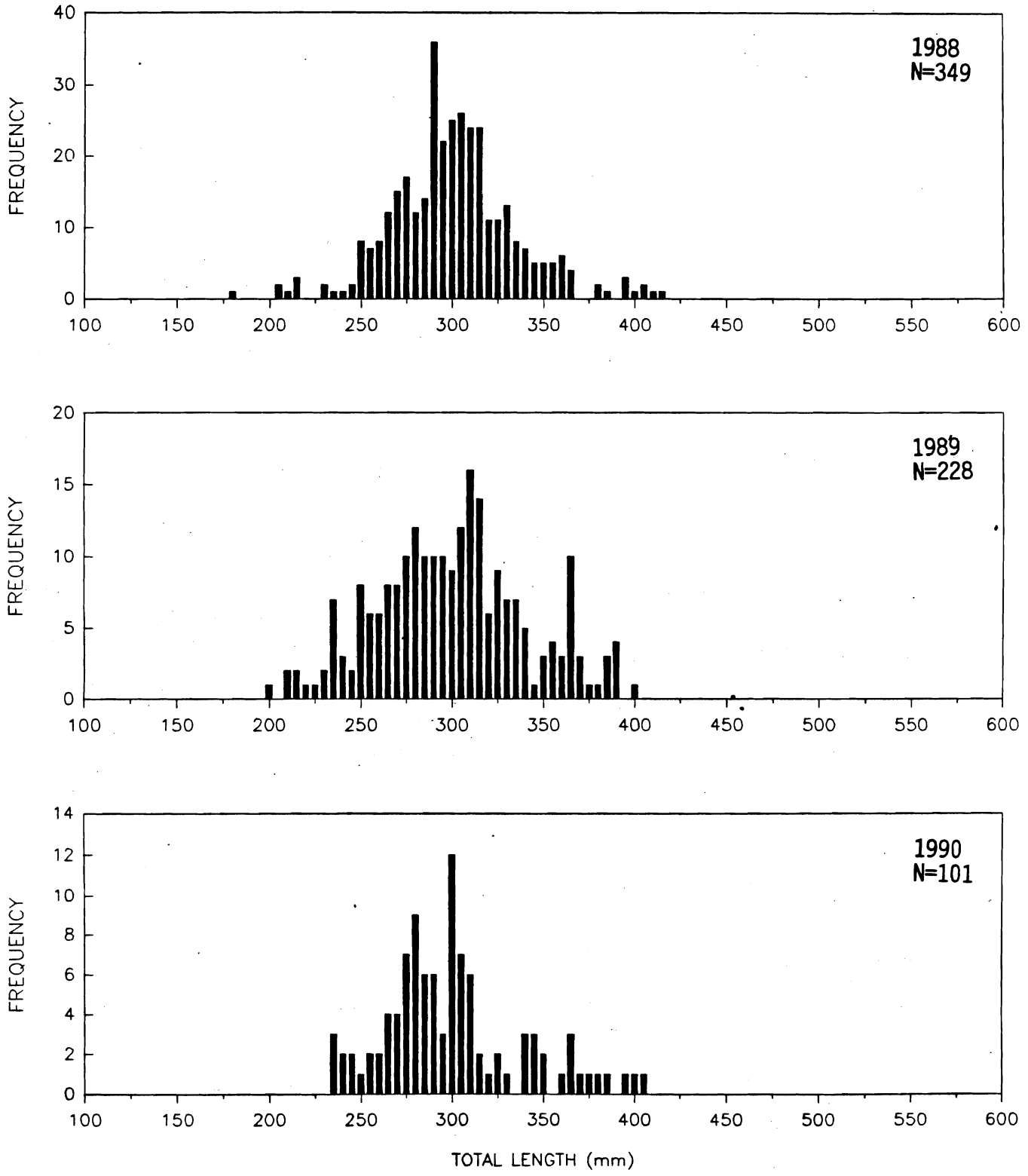

FIGURE 77. Length frequency of China rockfish from the San Francisco area, 1988 to 1990.

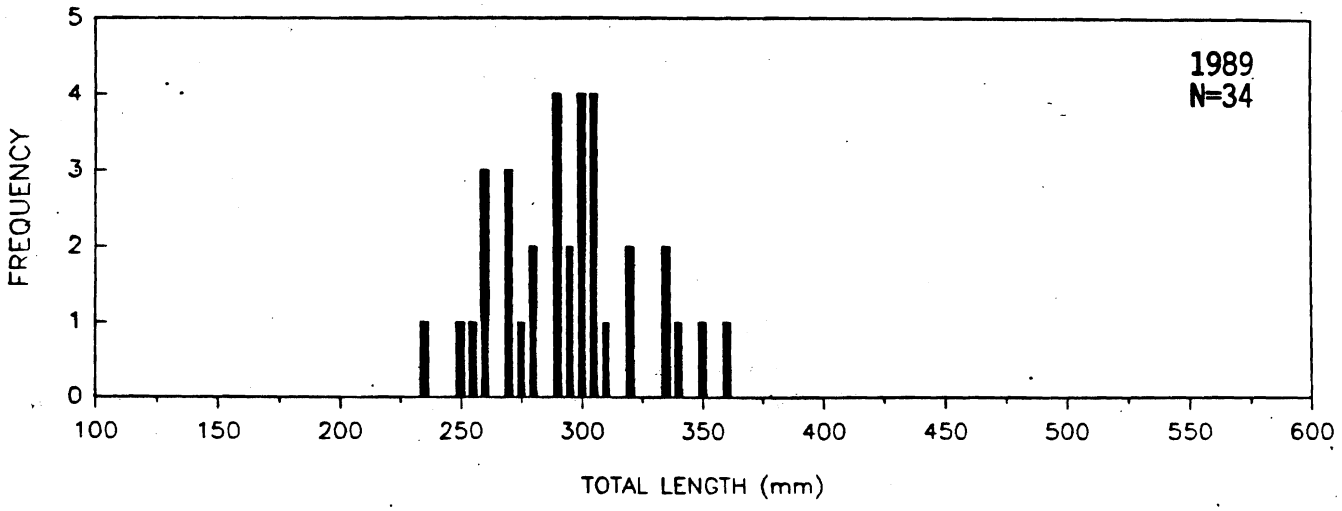

FIGURE 78. Length frequency of China rockfish from the Monterey area in 1989.

throughout the study period, with only slight declines in the Fort Bragg and Bodega Bay areas (Table 72).

However, evidence of a high exploitation rate appeared in the data for near locations. All port areas showed higher catch rates at distant locations, ranging from two to five times higher than those at near locations (Table 73). As expected, CPAH at deep locations was higher than at shallow locations in all port areas (Table 73).

Mean length of yelloweye rockfish varied considerably among years for all port areas except San Francisco (Table 74). This may be due in part to the larger sample size in this area. For years in which sample size was at least 20, mean length decreased with decreasing latitude from the Bodega Bay to the Morro Bay area; for example, in 1988 yelloweye rockfish averaged 509 mm (20.0 in.) from the Bodega Bay area and 336 mm (13.2 in.) from the Morro Bay area. No port area showed a consistent trend of

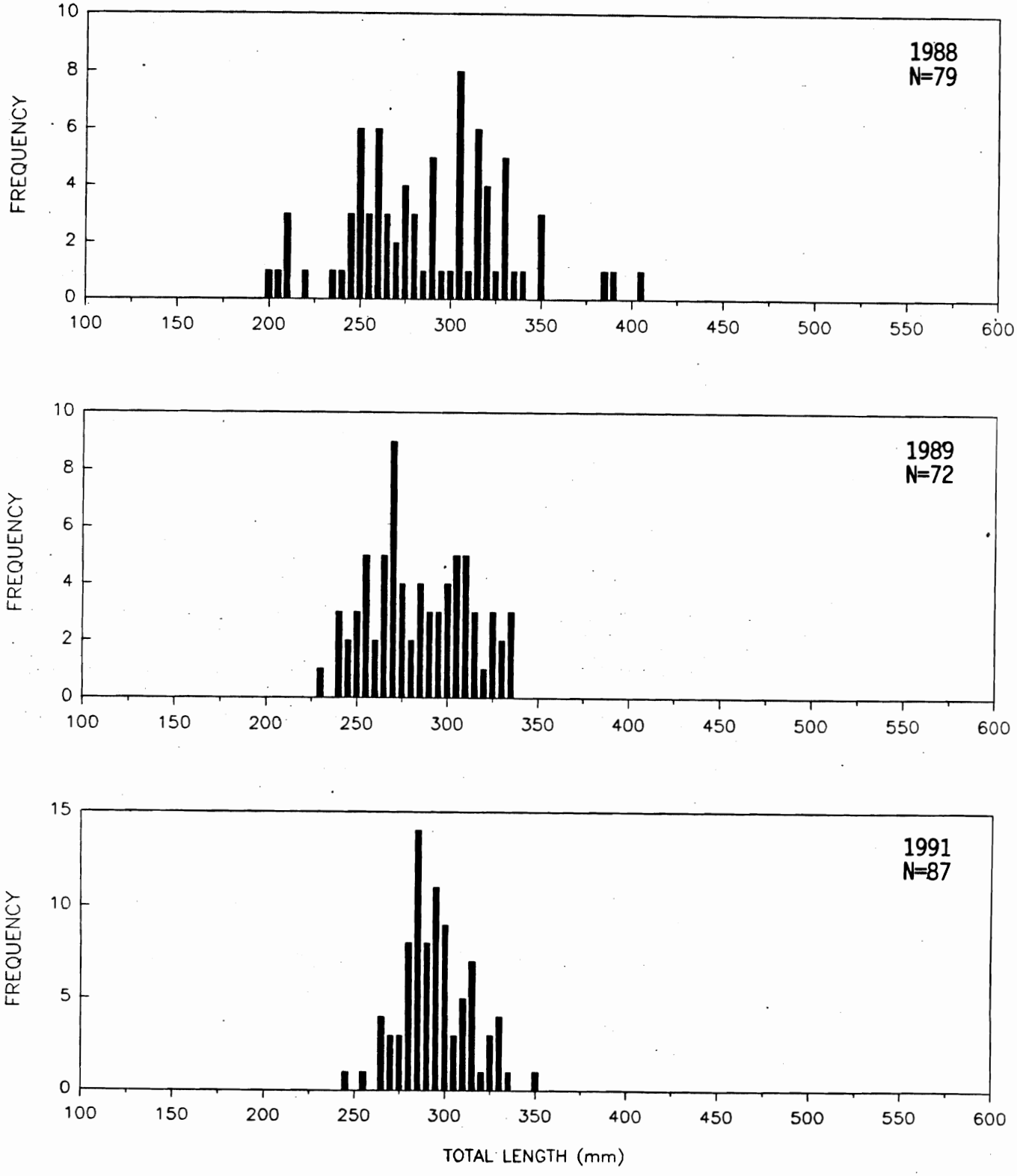

FIGURE 79. Length frequency of China rockfish from the Morro Bay area in 1988, 1989, and 1991.

TABLE 72. Catch Per Angler Day and Catch Per Angler Hour for Yelloweye Rockfish by Port and Year.

	Catch per angler day						Catch per angler hour					
Port area	1987	1988	1989	1990-91	1990	1991	1987	1988	1989	1990-91	1990	1991
Fort Bragg	-	0.27	0.31	0.29	0.55	0.25	-	0.12	0.12	0.10	0.20	0.09
Bodega Bay	-	0.29	0.27	0.21	0.25	0.20	-	0.09	0.08	0.07	0.07	0.06
San Francisco	-	0.18	0.12	0.19	0.18	0.21	-	0.05	0.03	0.06	0.05	0.06
Monterey	0.03	0.02	0.04	0.06	0.02	0.11	0.01	<0.01	0.01	0.02	0.01	0.03
Morro Bay	-	0.03	0.06	0.02	0.04	0.01	-	0.01	0.02	0.01	0.01	<0.01

TABLE 73. Catch Per Angler Hour and Mean Length of Yelloweye Rockfish for Near and Distant Locations and Shallow and Deep Locations by Port, All Years Combined.

	Catch per angler hour				Number of fish measured				Mean total length (mm)			
Port area	Near	Distant	Shallow	Deep	Near	Dist	Shal	Deep	Near	Dist	Shal	Deep
Fort Bragg	.09	.22	.10	.17	29	10	22	1	406	353	417	348
Bodega Bay	.05	.09	.05	.09	6	133	40	30	329	473	390	455
San Francisco	.01	.05	.01	.11	18	373	21	28	352	412	347	400
Monterey	.01	.02	<.01	.01	52	52	3	72	404	426	374	397
Morro Bay	.01	.02	.01	.03	69	17	14	23	362	377	311	380

TABLE 74. Mean Length of Yelloweye Rockfish Caught by CPFV Anglers by Port and Year.

	Number of fish measured					Mean total length (mm)				
Port area	1987	1988	1989	1990	1991	1987	1988	1989	1990	1991
Fort Bragg	-	4	5	5	25	-	386	458	366	386
Bodega Bay	-	59	75	1	12	-	509	424	339	494
San Francisco	-	169	109	64	49	-	401	421	404	414
Monterey	23	15	40	8	25	442	370	401	395	447
Morro Bay	-	29	43	11	9	-	336	371	416	399

increasing or decreasing mean length during the study period.

Although sample size was small in some areas, mean length of yelloweye rockfish from distant locations was greater than that from near locations for all port areas except Fort Bragg (Table 73), an indication of relatively heavy local fishing pressure. Mean length from deep locations ranged from 53 to 65 mm (2.1 to 2.6 in.) greater than that from shallow locations in the Bodega Bay and San Francisco areas (sample size at least 20) (Table 73).

The 1991 length frequency distribution from the Fort Bragg area included a significant proportion of fish less than 401 mm (15.8 in.) (Figure 80). Lea et al. (1993) noted the smallest sexually mature female in central California which they observed was 408 mm (16.1 in.), while Wyllie-Echeverria (1987) reported length at 50% sexual maturity for both sexes to be 400 mm (15.7 in.). This species is slow growing, and a 400-mm (15.7-in.) fish was calculated to be 8 to 9 years old (Lea et al. (1993).

Bodega Bay length frequency distributions differed greatly in 1988 and 1989 (Figure 81). The former year showed primarily adult fish as long as 671 to 680 mm (26.4 to 26.8 in.) and had the highest mean length of any year and port sampled. The following year showed a high proportion of juvenile fish and a length frequency distribution spanning almost 500 mm (19.7 in.). This length range corresponded to an age range of approximately 4 to more than 30 years (Lea et al. 1993; Wyllie-Echeverria 1987).

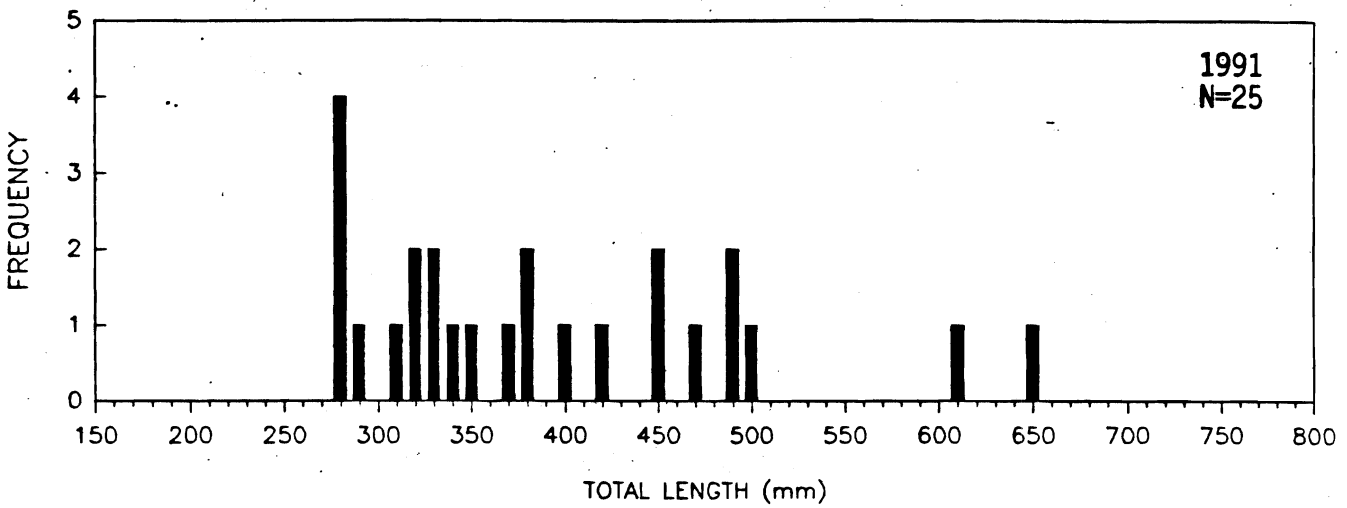

FIGURE 80. Length frequency of yelloweye rockfish from the Fort Bragg area in 1991.

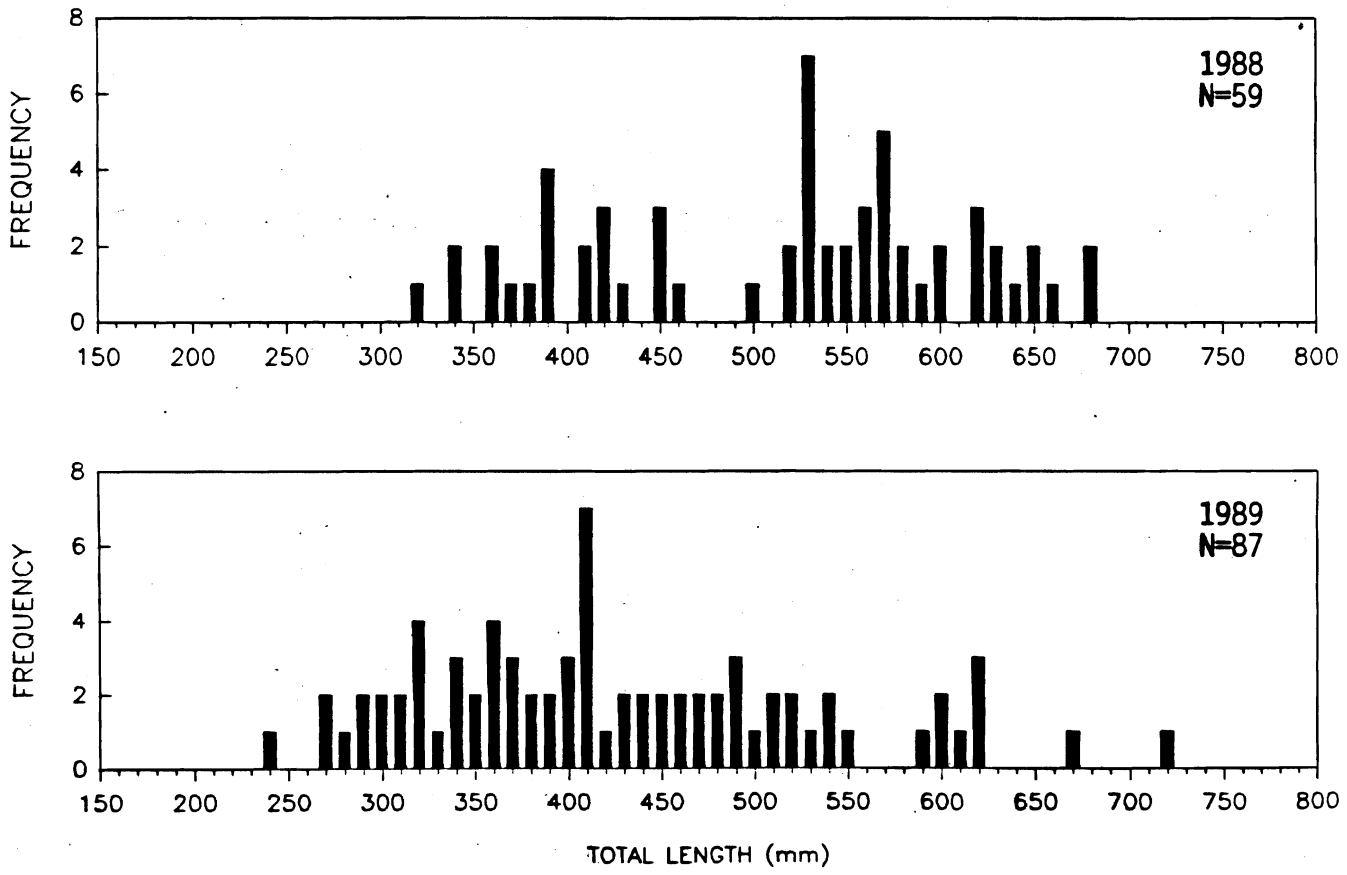

FIGURE 81. Length frequency of yelloweye rockfish from the Bodega Bay area in 1988 and 1989.

The San Francisco area showed a fairly consistent length frequency distribution during the 4 years sampled (Figure 82). A high proportion of juveniles and a wide length range characterized samples.

Monterey and Morro Bay yelloweye rockfish samples were small and in 1988 and 1989 were composed of a high proportion of juvenile fish (Figures 83 and 84). This situation is a cause for concern in all areas sampled. Similar to canary rockfish, it is possible that enough spawning adults exist in deeper water to provide periodic recruitment to shallower areas. However, this may not provide the large adults desired by most anglers if fishing pressure continues at present levels.

Estimated Total Catch and Effort

Logbook Data

The criteria for excluding trips which caught salmon, striped bass, or sturgeon resulted in the elimination of 265 trips in 1987, 344 trips in 1988, 257 trips in 1989, 370 trips in 1990, and 241 trips in 1991 from the original data base. Logbook data from 1987 to 1991 indicated that 1990 was a banner year for CPFV anglers (Table 75). Total fish caught and effort, measured as number of anglers and hours fished, were highest in 1990 for each port area except Monterey and for all port areas combined. Total annual catch averaged 1,385,700 fish and 93 to 96 percent of the catch was rockfishes.

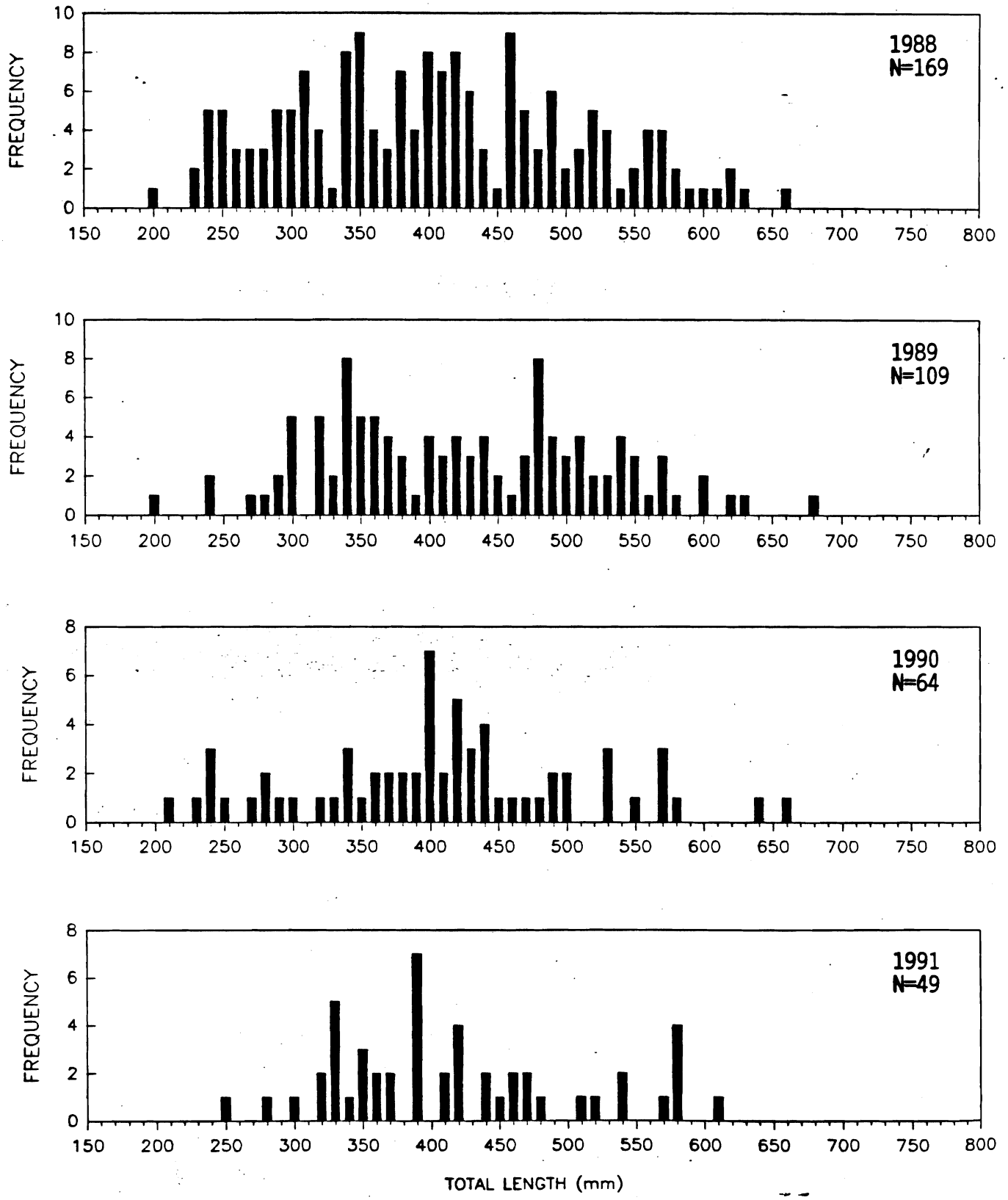

FIGURE 82. Length frequency of yelloweye rockfish from the San Francisco area, 1988 to 1991.

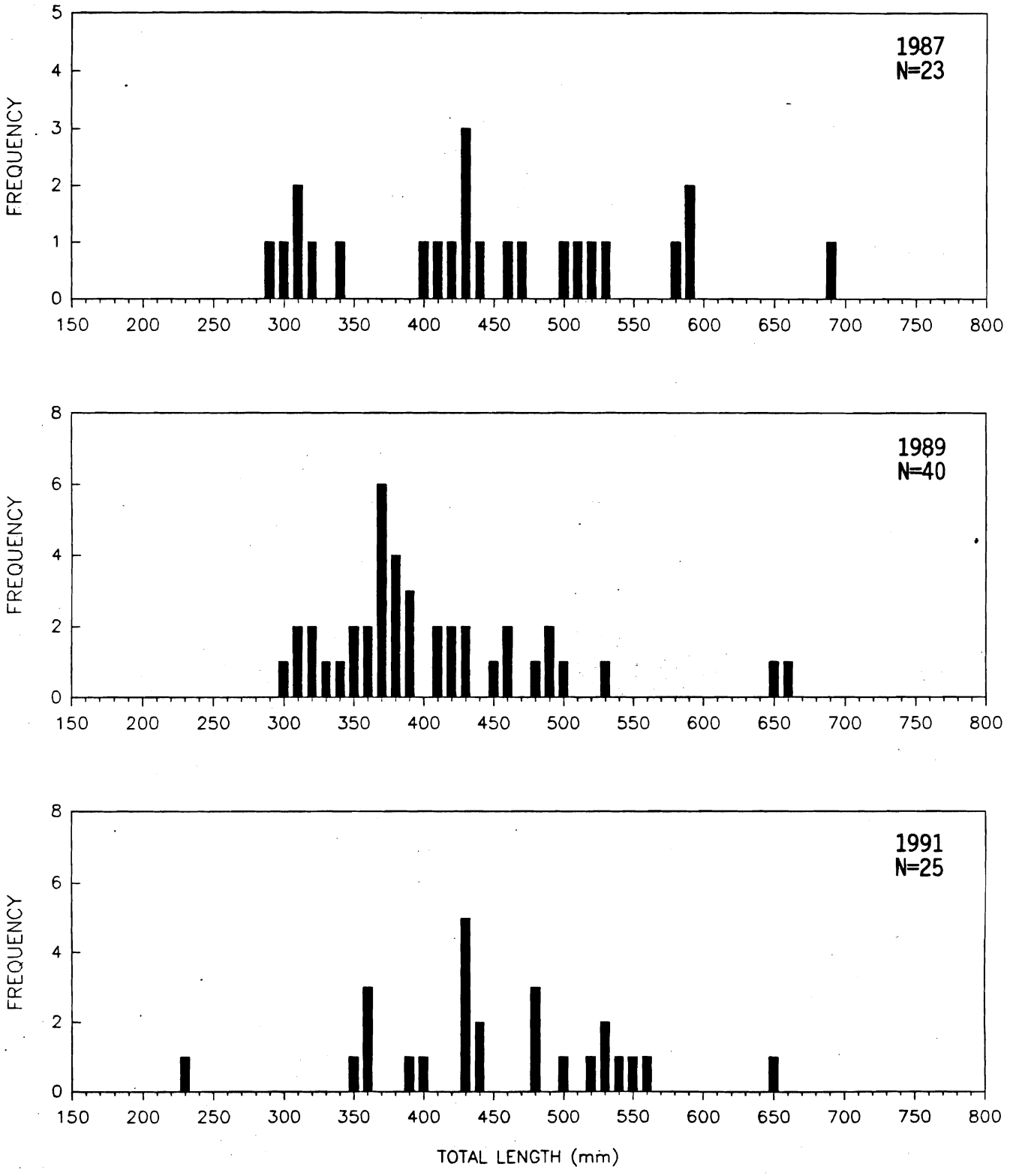

FIGURE 83. Length frequency of yelloweye rockfish from the Monterey area in 1987, 1989, and 1991.

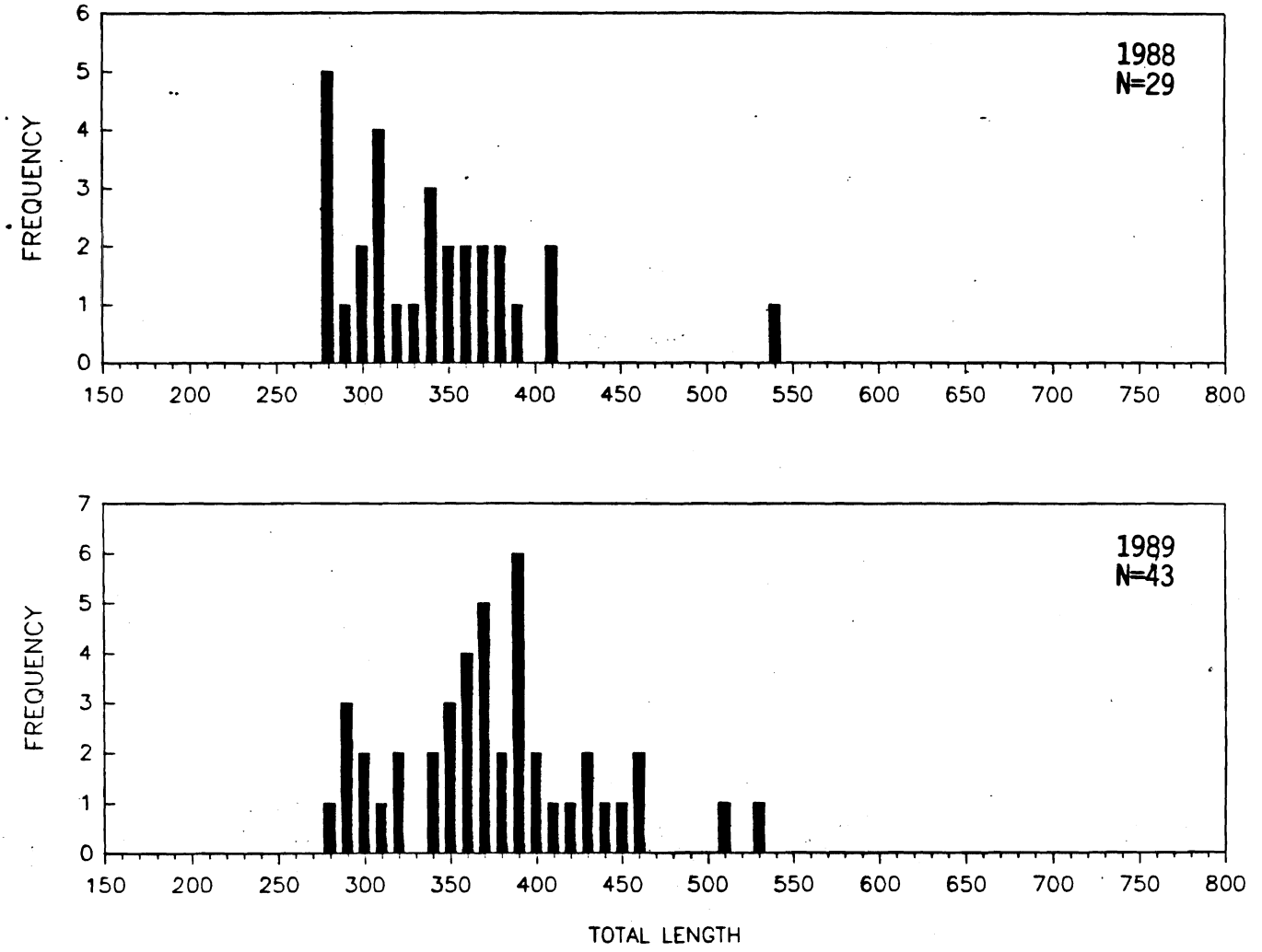

FIGURE 84. Length frequency of yelloweye rockfish from the Morro Bay area in 1988 and 1989.

Although northern California ports (Humboldt and Del Norte Counties) made up only a small proportion of the total catch, fishing effort more than doubled here during the 5-year period. Number of anglers and hours spent fishing were highest in 1990 and 1991, and, accordingly, total catch was highest during those years. Fishing success did not follow the same trend, however; CPAD and CPAH increased until 1990 then declined

TABLE 75. Summary of Total Catch and Effort Estimates for CPFV Anglers in Northern and Central California from Logbook Data, 1987 to 1991.

	Port Area						
	Northern California	Fort Bragg	Bodega Bay	San Francisco	Monterey	Morro Bay	Total All Ports
1987							
Total no. trips	162	171	503	915	1630	1551	4932
No. fish kept	10,325	28,772	150,328	240,122	404,106	388,339	1,221,992
No. angler days	1190	2437	12,821	22,334	33,009	36,067	107,858
No. hours fished	803	701	2054	4300	7767	6960	22,585
Average CPAD	8.7	11.8	11.7	10.8	12.2	10.9	11.4
Average CPAH	1.65	2.88	2.88	2.24	2.58	2.43	2.48
Total rockfish	9717	27,983	146,867	222,257	373,452	372,327	1,152,603
Total lingcod	443	741	2542	9706	11,087	13,129	37,648
Total other fish	165	48	919	8159	19,567	2883	31,741
1988							
Total no. trips	106	275	494	960	2044	1424	5303
No. fish kept	9274	37,943	150,654	231,039	485,720	296,485	1,211,115
No. angler days	920	3177	12,353	22,769	41,075	29,841	110,135
No. hours fished	526	1109	1964	4583	9178	6311	23,670
Average CPAD	10.1	12.3	12.2	10.5	11.8	9.9	11.0
Average CPAH	1.94	3.12	3.42	2.44	2.61	2.07	2.44
Total rockfish	8972	36,884	146,313	210,956	435,696	284,111	1,122,586
Total lingcod	242	606	3813	13,724	18,972	10,587	47,904
Total other fish	60	453	528	6359	31,052	1787	40,625

TABLE 75. (continued)

	Port Area						
	Northern California	Fort Bragg	Bodega Bay	San Francisco	Monterey	Morro Bay	Total All Ports
1989							
Total no. trips	150	474	689	1033	1753	2027	6126
No. fish kept	8465	62,483	220,719	275,964	416,039	541,484	1,525,154
No. angler days	826	4836	16,944	23,155	35,357	44,407	125,525
No. hours fished	637	1868	2913	4653	7744	8786	26,602
Average CPAD	10.2	12.9	13.0	11.9	11.8	12.2	12.1
Average CPAH	2.20	3.24	3.10	2.60	2.63	2.57	2.74
Total rockfish	7487	60,662	211,752	256,733	377,629	519,696	1,433,959
Total lingcod	720	1117	7875	13,564	19,278	18,453	61,007
Total other fish	258	704	1092	5667	19,132	3335	30,188
1990							
Total no. trips	309	554	737	1394	1507	2138	6639
No. fish kept	26,379	76,587	247,946	368,550	347,178	547,532	1,614,172
No. angler days	2224	5977	18,521	30,712	30,673	44,623	132,730
No. hours fished	1454	2159	3073	6483	7088	9331	29,589
Average CPAD	11.9	12.8	13.4	12.0	11.3	12.3	12.1
Average CPAH	2.47	3.31	3.21	2.56	2.37	2.55	2.61
Total rockfish	24,642	75,251	238,207	342,463	328,205	526,781	1,535,549
Total lingcod	1198	1022	8658	12,739	8231	15,780	47,628
Total other fish	539	314	1081	13,348	10,742	4971	30,995

TABLE 75. (continued)

	Port Area						
	Northern California	Fort Bragg	Bodega Bay	San Francisco	Monterey	Morro Bay	Total All Ports
1991							
Total no. trips	314	348	652	1338	1273	2010	5935
No. fish kept	21,744	40,235	211,783	290,645	293,773	497,887	1,356,067
No. angler days	2335	3497	16,164	27,346	25,034	42,638	117,014
No. hours fished	1547	1427	2915	6618	5898	9049	27,475
Average CPAD	9.3	11.5	13.1	10.6	11.7	11.6	11.6
Average CPAH	1.84	2.84	2.90	2.12	2.56	2.54	2.45
Total rockfish	20,725	39,345	205,737	276,201	276,237	485,785	1,304,030
Total lingcod	545	779	5854	10,763	7177	10,734	35,852
Total other fish	474	111	192	3681	10,359	1368	16,185

to intermediate levels compared with 1987.

In general, trends in catch and effort were similar for the Fort Bragg, Bodega Bay and Morro Bay areas although actual values varied substantially. With one exception, the number of trips, number of angler days, and total catch increased steadily during the study period, peaking in 1990. Number of trips, angler days, and total catch increased substantially with decreasing latitude. However, number of trips and total catch in 1987 and 1988, and angler days in 1988, were greater in the Monterey area than in the Morro Bay area. In 1989, one CPFV operator moved four vessels from Monterey to San Simeon. This was primarily responsible for the significant decline in number of trips in the Monterey area and the significant increase in number of trips in the Morro Bay area from 1988 to 1989.

Salmon fishing during 1988 was excellent for recreational anglers. This may explain the diminished groundfish catch, effort, and number of trips during 1988 in the Morro Bay area, where anglers are usually at the southern limit of abundance of California's salmon stocks. In contrast, reported fishing effort and catch of rockfish and lingcod and fishing effort peaked in Monterey during the same year. It is not known why fishing effort decreased in the Monterey area from 1989 to 1991.

The San Francisco Bay area exhibited no consistent trends during the 5-year period.

CPAH was always highest in the Fort Bragg and/or Bodega

Bay areas. CPAH values from logbook data were lower than values calculated from observed trips because CPFV operators record total time on the water rather than actual fishing times. The highest annual average CPAD for rockfish only, 12.9 in 1990 in the Bodega Bay area, was 86% of the 15-rockfish bag limit.

Adjusted Logbook Data

Compliance rate for logbook submission for observed CPFV trips was consistently less than 100 percent. Annual calculated compliance rates from the Bodega Bay, San Francisco, Monterey and Morro Bay areas ranged from 61% to 92% for a particular port and year.

Most trends observed in the unadjusted data for the Monterey, San Francisco, and Morro Bay areas did not change when the data were adjusted (Table 76). Total reported catch averaged approximately 87% of adjusted catch, but not all adjusted catch values by port and year were higher than reported catches. In the Morro Bay area in 1988 and 1989, and in the San Francisco area in 1988, logbook data apparently over-estimated total catch. Morro Bay and Bodega Bay area CPFVs consistently over-estimated CPAD while the San Francisco and Monterey areas varied and had no consistent trend. In general, CPFV operators tended to be optimistic in their estimates, compared with adjusted data.

Monterey was the only port area sampled for all 5 years. Trends in the adjusted data were consistent with those

TABLE 76. Summary of Total Catch and Effort Estimates for CPFV Anglers in Northern and Central California from Logbook Data, 1987 to 1991, Adjusted by Sampling Information.

	Port Area				
	Bodega Bay	San Francisco	Monterey	Morro Bay	Total All Ports[1]
1987					
Number of fish kept	-	-	568,518	-	-
Number of angler days	-	-	42,094	-	-
Average CPAD	-	-	13.5	-	-
1988					
Number of fish kept	237,640	224,577	662,694	331,761	1,503,889
Number of angler days	20,222	25,883	46,961	38,743	135,906
Average CPAD	11.8	8.7	14.1	8.6	11.1
1989					
Number of fish kept	239,120	320,930	597,977	501,792	1,730,767
Number of angler days	19,159	24,946	46,964	47,572	144,303
Average CPAD	12.5	12.9	12.7	10.5	12.0
1990					
Number of fish kept	-	434,293	493,858	578,342	1,857,405
Number of angler days	-	31,892	49,473	50,067	158,154
Average CPAD	-	13.6	10.0	11.6	11.7
1991					
Number of fish kept	-	342,491	417,889	525,903	1,560,045
Number of angler days		28,397	40,377	47,840	138,610
Average CPAD		12.1	10.4	11.0	11.3

[1] includes unadjusted catch data from northern California and Fort Bragg areas.

discussed above for unadjusted data, with angling success decreasing from 1988 to 1991.

As expected, many trends in adjusted total catch estimates by species and port area (Tables 77 to 81) were consistent with trends in CPAD and CPAH from sampling data. For example, estimated total catch of chilipepper for all port areas declined each year from 1988 to 1991; landings decreased 60% overall from approximately 247,000 lb to approximately 99,000 lb. Although estimated total lingcod catch declined only 13% during the same period and was highest in 1989, estimated total catch in the Bodega Bay, San Francisco, and Monterey areas declined 57%, 27%, and 46%, respectively. In the San Francisco area, estimated total catch of black rockfish declined each year from 1989 to 1991 with an overall decrease of 30%.

Several species showed considerable fluctuations in total catch estimates within a port area but trends were inconsistent among areas. For example, blue rockfish catch estimates in the Monterey area declined each year from 1988 to 1991 with an overall decrease of 73%. Conversely, catch estimates of blue rockfish in the Morro Bay area increased 73% from 1988 to 1990 and in 1991 was 58% higher than in 1988 . Total catch estimates of canary rockfish increased each year from either 1987 or 1988 to 1990 in the Monterey and San Francisco areas but showed no trend in the Bodega Bay and Morro Bay areas during the same period. Undoubtedly, targeted effort for these species also varied considerably, but this

TABLE 77. Estimate of Total CPFV Catch of Rockfishes and Lingcod, Based on Log Data Adjusted by Sampling, from the Port of Fort Bragg, 1988 to 1991.

Species	Number in thousands 1988	1989	1990	1991
Chilipepper	-	-	-	-
Blue rockfish	21.6	12.9	24.6	12.9
Yellowtail rockfish	3.5	28.6	24.0	12.6
Widow rockfish	0.1	-	1.6	0.8
Bocaccio	0.2	1.2	0.2	0.1
Rosy rockfish	2.4	4.6	5.3	2.8
Canary rockfish	3.0	7.8	7.1	3.7
Greenspotted rockfish	-	0.2	0.5	0.3
Vermilion rockfish	-	-	0.6	0.3
Olive rockfish	3.9	-	0.9	0.5
Starry rockfish	-	-	0.1	<0.1
Black rockfish	-	-	4.0	2.1
Brown rockfish	-	0.5	-	-
Copper rockfish	1.4	1.7	1.5	0.8
Greenstriped rockfish	-	0.5	0.4	0.2
Gopher rockfish	-	-	0.5	0.3
China rockfish	-	-	0.9	0.5
Yelloweye rockfish	0.8	1.5	1.8	1.0
Other rockfish	0.6	2.2	0.3	0.2
Total rockfish	36.8	61.6	74.5	39.1
Lingcod	0.6	0.2	1.5	0.8

TABLE 78. Estimate of Total CPFV Catch of Rockfishes and Lingcod, Based on Log Data Adjusted by Sampling, from the Ports of Bodega Bay and Dillon Beach, 1988 to 1991.

	Number in thousands			
Species	1988	1989	1990	1991
Chilipepper	53.7	34.9	16.1	13.8
Blue rockfish	52.3	44.0	0.5	0.4
Yellowtail rockfish	29.0	61.7	108.8	93.0
Widow rockfish	2.4	1.9	7.9	6.8
Bocaccio	10.0	9.6	39.9	34.1
Rosy rockfish	8.3	8.4	5.7	4.9
Canary rockfish	14.7	24.9	11.4	9.7
Greenspotted rockfish	23.8	13.2	5.2	4.4
Vermilion rockfish	1.0	1.0	1.5	1.3
Olive rockfish	3.1	0.1	6.0	5.1
Starry rockfish	0.7	0.7	1.2	1.1
Black rockfish	3.3	1.4	-	-
Brown rockfish	9.0	15.5	28.3	24.1
Copper rockfish	3.6	3.3	0.7	0.6
Greenstriped rockfish	4.3	2.6	2.3	1.9
Gopher rockfish	1.0	0.5	0.2	0.2
China rockfish	1.2	1.4	0.7	0.6
Yelloweye rockfish	5.7	4.8	3.7	3.2
Other rockfish	0.7	2.4	2.0	1.7
Total rockfish	225.5	231.9	242.2	206.9
Lingcod	8.8	5.7	4.5	3.8

TABLE 79. Estimate of Total CPFV Catch of Rockfishes and Lingcod, Based on Log Data Adjusted by Sampling, from the Ports of Princeton, Berkeley, Emeryville, and Richmond, 1988 to 1991.

Species	Number in thousands 1988	1989	1990	1991
Chilipepper	0.1	0.3	2.1	1.7
Blue rockfish	52.3	41.7	67.3	53.1
Yellowtail rockfish	25.8	80.9	98.1	77.4
Widow rockfish	8.5	24.1	16.5	13.0
Bocaccio	2.9	6.4	8.7	6.8
Rosy rockfish	22.0	38.2	66.0	52.1
Canary rockfish	8.8	14.4	21.7	17.1
Greenspotted rockfish	5.6	7.7	10.9	8.6
Vermilion rockfish	2.7	3.2	6.1	4.8
Olive rockfish	0.2	9.6	11.3	8.9
Starry rockfish	5.4	4.2	14.3	11.3
Black rockfish	17.5	20.9	18.7	14.7
Brown rockfish	11.5	6.4	13.0	10.3
Copper rockfish	5.6	8.7	15.6	12.3
Greenstriped rockfish	2.2	1.6	1.3	1.0
Gopher rockfish	3.4	4.8	2.6	2.1
China rockfish	7.2	6.1	7.8	6.2
Yelloweye rockfish	4.0	3.2	6.9	5.5
Other rockfish	3.4	5.1	9.1	7.2
Total rockfish	189.1	287.6	398.2	314.1
Lingcod	22.0	20.5	20.4	16.1

TABLE 80. Estimate of Total CPFV Catch of Rockfishes and Lingcod, Based on Log Data Adjusted by Sampling, from the Ports of Santa Cruz and Monterey, 1987 to 1991.

	Number in thousands				
Species	1987	1988	1989	1990	1991
Chilipepper	208.1	193.5	182.4	84.5	80.7
Blue rockfish	95.5	144.5	86.1	46.4	39.3
Yellowtail rockfish	62.0	77.5	81.3	84.4	71.5
Widow rockfish	29.6	72.2	23.9	48.9	41.4
Bocaccio	45.5	32.5	34.1	66.2	56.0
Rosy rockfish	14.8	11.9	21.5	21.2	18.0
Canary rockfish	5.1	6.6	8.9	16.8	14.2
Greenspotted rockfish	6.3	6.0	26.3	22.7	19.2
Vermilion rockfish	3.4	3.3	6.0	8.4	7.1
Olive rockfish	4.5	15.2	16.1	8.9	7.5
Starry rockfish	9.1	6.0	14.9	14.8	12.5
Black rockfish	1.7	2.0	0.6	-	-
Brown rockfish	0.6	0.7	2.4	1.5	1.3
Copper rockfish	1.1	1.3	7.2	3.5	2.9
Greenstriped rockfish	5.7	10.6	18.5	19.3	16.3
Gopher rockfish	2.8	1.3	1.2	2.5	2.1
China rockfish	1.1	0.7	1.2	2.0	1.7
Yelloweye rockfish	1.1	0.7	1.8	2.5	2.1
Other rockfish	10.2	14.6	12.6	11.9	10.0
Total rockfish	507.7	601.1	548.3	466.2	394.5
Lingcod	18.8	13.9	17.9	8.9	7.5

TABLE 81. Estimate of Total CPFV Catch of Rockfishes and Lingcod, Based on Log Data Adjusted by Sampling, from the Ports of San Simeon, Morro Bay, and Port San Luis, 1988 to 1991.

	Number in thousands			
Species	1988	1989	1990	1991
Chilipepper	-	14.6	2.9	2.6
Blue rockfish	59.4	76.8	102.9	93.6
Yellowtail rockfish	74.0	124.9	123.8	112.5
Widow rockfish	22.2	9.0	28.9	26.3
Bocaccio	14.6	22.6	41.6	37.9
Rosy rockfish	21.6	29.1	23.1	21.0
Canary rockfish	21.6	23.1	16.8	15.3
Greenspotted rockfish	3.6	6.0	6.4	5.8
Vermilion rockfish	27.9	59.2	45.1	41.0
Olive rockfish	1.3	1.5	32.4	29.5
Starry rockfish	15.3	9.5	12.7	11.6
Black rockfish	-	1.0	18.5	16.8
Brown rockfish	2.0	19.1	21.4	19.5
Copper rockfish	13.9	16.6	17.4	15.8
Greenstriped rockfish	1.7	3.5	2.9	2.6
Gopher rockfish	22.2	31.6	31.2	28.4
China rockfish	5.6	4.0	6.4	5.8
Yelloweye rockfish	1.3	3.0	1.2	1.1
Other rockfish	1.9	3.0	4.6	4.2
Total rockfish	309.9	457.0	540.2	491.2
Lingcod	18.2	31.6	26.6	24.2

type of data was not available.

Species such as widow rockfish exhibited wide fluctuations in total catch within a port area which were not consistent among areas. Widow rockfish catch estimates varied by more than a factor of three in the Morro Bay area and by a factor of 2.8 in the San Francisco area, yet the year of the lowest catch in the former area was the year of the highest catch in the latter area.

Trends in total catch alone were not always valid indicators of the health of the resource. For example, black rockfish total catch estimates in the San Francisco area declined only 16% from 1988 to 1991, but the sampled catch in the latter year consisted primarily of fish in the length range of juveniles.

Recreational Fishing Survey Data

MRFSS telephone survey data provided an independent estimate of fishing effort for groundfish during 1987, 1988 and 1989. These values for number of angler days were combined with adjusted CPAD data from Table 76 to estimate catch by port and year from 1987 to 1989 when data were available and total catch for 1988 and 1989. Total catch estimates for 1988 and 1989 were approximately twice that of adjusted values (Table 82). On a port basis, MRFSS effort data combined with adjusted CPAD resulted in catch estimates up to five times higher than adjusted logbook values for all ports except Bodega Bay. In this area MRFSS data resulted in

TABLE 82. Summary of Total Catch and Effort Estimates for CPFV Anglers in Northern and Central from MRFSS Telephone Survey Data, 1987 to 1989.

	Port Area				
	Bodega Bay	San Francisco	Monterey	Morro Bay	Total All Ports
1987					
Number of fish kept	-	-	629,800	-	-
Number of angler days	-	-	47,000	-	-
1988					
Number of fish kept	212,400	896,100	1,536,900	427,500	3,089,800
Number of angler days	18,000	103,000	109,000	57,000	291,000
1989					
Number of fish kept	375,000	1,586,700	825,500	524,300	3,133,900
Number of angler days	3000	12,300	65,000	49,000	259,000

underestimates of catch up to 20% of adjusted logbook data. Catch estimates for Monterey and Morro Bay areas were closer to adjusted values than those for other ports. The San Francisco area yielded catch values approximately four times greater than adjusted values.

Total catch estimates based on MRFSS telephone survey data are questionable for two reasons. First, results are based on angler memory of fishing effort over a prolonged time period rather than actual field surveys. Second, effort estimates are extrapolations of interview data using county population estimates and are not corrected for demographic variability.

SUMMARY

The previous 19 species discussed here in detail and Pacific hake were the 20 most frequently observed species in the CPFV catch from 1987 to 1991, all port areas combined. Several significant changes in relative abundance have occurred during the past 30 years since Miller and Gotshall (1965) sampled the CPFV bottom fish catch in 1960 from the California-Oregon border to Point Arguello. Chilipepper and Pacific hake ranked 19 and 45, respectively but ranked 1 and 10, respectively, in this study, largely due to the Bodega Bay and Monterey area catches and to a shift to deeper fishing locations. Greenspotted, widow, and rosy rockfishes have increased in relative importance, also due primarily to a shift to deeper fishing locations. In contrast, olive,

vermilion, copper, and canary rockfish have decreased in relative importance. These species are found primarily in shallow locations (olive, copper, and vermilion rockfishes) and/or are non-schooling and specifically targeted.

However, the overall species composition of the CPFV catch has changed little in three decades. Of the 20 most frequently observed species in Miller and Gotshall's study, all but two (speckled and flag rockfishes) were among the 20 most frequently observed species in this study. Yelloweye rockfish ranked 20 in this study and 27 in 1960; Pacific hake were mentioned previously.

Three primary concerns of CPFV anglers were addressed in this study. First, anglers felt that the average size of fish has decreased due to the increasing scarcity of large fish. This belief is substantiated by historical data for certain species such as blue and vermilion rockfishes. This is indicative of relatively heavy fishing pressure in all areas, but the decreases were most dramatic in shallow areas near ports. Among the 19 species discussed in the relatively narrow time frame of this study, a decrease in mean length each year throughout the study period occurred for only three species: starry rockfish in the Morro Bay area; China rockfish in the San Francisco area; and black rockfish in the San Francisco area. Declines for starry and China rockfish from 1988 to 1991 were only 7 and 12 mm (0.3 and 0.5 in.), respectively. The substantial decline in black rockfish mean length is a cause for concern.

In general, mean length of sport fishes caught by CPFV anglers in northern and central California did not decline from 1988 to 1991. However, long-term data are needed to determine if length frequency distributions of fished stocks have stabilized or are continuing to indicate decreases in the relative number of large fish available to anglers.

It appears that some species are dependent on episodic strong recruitment. Examples of this included chilipepper in the Bodega Bay area and vermilion rockfish in the Morro Bay area. In addition, CPFV operators continue to find previously unfished or lightly fished areas in which fish are larger. Chilipepper, vermilion rockfish, and four other species demonstrated steady increases in mean length at a particular port during the study period: yellowtail rockfish in the Morro Bay area; widow rockfish in the San Francisco and Monterey areas, greenspotted rockfish in the Morro Bay area; and greenstriped rockfish in the Morro Bay area. These increases are more likely due to one or more strong year classes in the fishery rather than a decrease in fishing effort. The net result is a temporary increase in the number of fish that reach sexual maturity, a positive sign for the maintenance of viable populations.

Twenty-eight comparisons of mean length by species and port were possible for shallow and deep locations in which sample size for each was at least 20. Of these, all but two (bocaccio in the Monterey area and starry rockfish in the Morro Bay area) showed a greater mean length at deep

locations. The reasons for this are not entirely clear. The phenomenom of isothermic submergence, in which fish move to deeper water as they develop from juveniles to adults, no doubt partly explains these results. However, the effects of relatively more fishing pressure in shallow water also must be considered. The establishment of marine reserves in shallow water may answer this question. Only then will the effects of fishing pressure be removed, allowing size structure of mature populations to be compared between shallow and deep areas.

It is also difficult to separate the clinal trend of decreasing mean length with decreasing latitude from the effects of fishing pressure. For most of the species discussed here, mean lengths were smallest in the Morro Bay area, where CPFV effort was highest from 1989 to 1991. Conversely, mean lengths for most species were greatest in the Bodega Bay or Fort Bragg area, where total CPFV angler effort was approximately one third of that in the Morro Bay area.

When considering near and distant locations, 59 comparisons of mean length were possible for a particular port area and species; 35 (59%) showed a greater mean length at distant locations. Species for which mean length at near locations was never equal to or greater than that at distant locations for all port areas included vermilion, greenstriped, gopher, and yelloweye rockfish. Thus, although both near and shallow locations demonstrated effects of locally heavier fishing pressure, these effects were more important relative to fishing depth rather than distance from port.

Increased travel time, fuel costs, line tangles, and time spent paying out and reeling in lines are drawbacks of fishing in deeper water. However, the rewards of a higher CPAH (as seen primarily in the Monterey and Morro Bay areas) and generally larger fish, compensate for these drawbacks.

The second concern from CPFV anglers was that catch per angler hour has decreased. Results from this study showed that mean CPAH for all fish neither increased nor decreased from 1988 to the 1990-91 period. However, the Monterey area showed a 20% decline and the Morro Bay area showed a 64% increase. Consistent increases in CPAH for particular port areas occurred for ten species in this study, while consistent decreases in CPAH occurred for eight species; the lists are not mutually exclusive. Blue, greenspotted, copper, and greenstriped rockfishes showed both increases and decreases in CPAH, and bocaccio and yellowtail, widow, rosy, canary, and brown rockfishes showed increases only. Only chilipepper (Bodega Bay and Monterey areas), lingcod (Bodega Bay and San Francisco areas), black rockfish (Bodega Bay, San Francisco, and Monterey areas), and yelloweye (Bodega Bay area) demonstrated consistent decreases in CPAH. These were identified as areas of concern.

The third concern expressed by CPFV anglers was that boats had to travel farther from port or fish deeper to achieve bag limits of quality fish. This was not addressed directly because the number of observed anglers with and without bag limits was not recorded. The definition of

"quality" fish most likely varies considerably among sport anglers. Veteran anglers who have fished for several decades may be satisfied only with larger fish compared with novices who are not particular about the size of their catch. This study indicated that bag limits were not achieved by all or most anglers. The overall average catch was 11.8 fish per angler day and only exceeded 15 in the Monterey area in 1988.

There was no trend of CPFVs traveling to distant locations on a more frequent basis during the study period. However, a trend of greater distance traveled did begin several decades ago and appears to have reached a maximum; CPFVs usually are restricted to a distance traveled within one day of port. This study did find a trend of an increasing proportion of trips to deeper locations, particularly in the Bodega Bay, San Francisco, and Monterey areas.

Additional concerns continue to exist about competition for the same resource with the commercial rockfish and lingcod fisheries. Recent commercial sampling indicated that most sport-caught rockfish species are also taken by commercial hook-and-line gear in northern and central California. In the late 1980s, hook-and-line fishing replaced gill-netting for rockfishes in much of tne nearshore area. Little is known about commercial fishing locations. A long-term data base does not exist for which hook-and-line market landings in categories such as "rockfish, unspecified" and "red rockfish" can be partitioned by species; thus, the total commercial rockfish harvest cannot be estimated by species and analyzed

over time. In addition, no minimum size exists for commercially-caught lingcod. Until these concerns are addressed, it would be premature to recommend changes in sport fish regulations to protect and enhance our nearshore resources without a committment to do the same for commercial fisheries.

This study has identified areas of concern in the CPFV fishery for chilipepper, lingcod, and black, brown, canary, vermilion, yelloweye, olive, and widow rockfishes. Primary areas of concern were a consistent decrease in mean length or mean CPAH or the occurrence of a high percentage of sexually immature fish in the sampled catch. It is critical to continue to monitor the CPFV fishery to determine if the previously identified areas of concern are primarily related to fishing pressure, are largely influenced by environmental factors, or a combination of both. In addition, if sport/commercial conflicts in California's lingcod and rockfish fisheries continue, it is imperative to identify specific locations important to sport anglers.

The Department is investigating the use of marine reserves as a tool for enhancing nearshore fish populations by insuring stocks of spawning adults which can provide recruitment for future fisheries. If the reserve concept is proven successful in California, this will ultimately benefit both anglers and non-anglers and complement wise and prudent management practices to provide a healthy marine resource and environment in perpetuity.

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NOCAL CPFV SPORTFISH SURVEY

LOCATION SUMMARY

Location	Fishing Time(Min)	Min. Depth(Fm)	Max. Depth(Fm)	Fishing Type	Fishing Tackle

Yr Mo Day
Boat Number
Depart Time
Return Time
Port
Landing
Type of Trip
Paid Anglers
Free Anglers
ObsvAnglers
Sampler

Fishing Time		Total Time (Min)	Fishing Type	Fishing Tackle	Location		Bottom Depth (Fm)	
Start	End				Code	Description	Minimum	Maximum

Notes:

Boat name:

Sampler's name:

APPENDIX B. Sample Species Count Form

Sampler	DepTime	Boat Number	Port	Yr Mo Day	Trip No	Samp

Species	Code	Kept	Released/Fate

APPENDIX C. Sample Length Form

Sampler | DepTime | Boat Number | Port | Yr Mo Day | Trip No Samp

South Location ____ to ____ North Location

SPECIES CODE ____ FATE ____

SPECIES COMMON NAME

Length / Freq		Length / Freq		Length / Freq		Length / Freq		Length / Freq	

SPECIES CODE ____ FATE ____

SPECIES COMMON NAME

Length / Freq		Length / Freq		Length / Freq		Length / Freq		Length / Freq	

SPECIES CODE ____ FATE ____

SPECIES COMMON NAME

Length / Freq		Length / Freq		Length / Freq		Length / Freq		Length / Freq	

SPECIES CODE ____ FATE ____

SPECIES COMMON NAME

Length / Freq		Length / Freq		Length / Freq		Length / Freq		Length / Freq	

SPECIES CODE ____ FATE ____

SPECIES COMMON NAME

Length / Freq		Length / Freq		Length / Freq		Length / Freq		Length / Freq	

APPENDIX D. List of Species Caught by Observed CPFV Anglers in Northern and Central California, 1987 to 1991.

Common name	Scientific name	Occurrence [1] 1987	1988	1989	1990	1991
Rockfishes						
Aurora rockfish	Sebastes aurora		I			
Bank rockfish	Sebastes rufus	I	I	I		
Black rockfish	Sebastes melanops	I	C	C	C	C
Black-and-yellow rockfish	Sebastes chrysomelas	I	I	I		I
Blue rockfish	Sebastes mystinus	C	C	C	C	C
Bocaccio	Sebastes paucispinis	C	C	C	C	C
Brown rockfish	Sebastes auriculatus	I	C	C	C	C
Calico rockfish	Sebastes dalli		I	I		
Canary rockfish	Sebastes pinniger	I	C	C	C	C
Chameleon rockfish	Sebastes phillipsi			R		
Chilipepper	Sebastes goodei	C	C	C	C	C
China rockfish	Sebastes nebulosus	I	I	I	C	C
Copper rockfish	Sebastes caurinus	I	C	C	C	C
Cowcod	Sebastes levis	I	I	I	I	I
Flag rockfish	Sebastes rubrivinctus	I	I	I	I	I
Gopher rockfish	Sebastes carnatus	I	C	C	I	C
Grass rockfish	Sebastes rastrelliger	I	I	I		I
Greenblotched rockfish	Sebastes rosenblatti	I	I			
Greenspotted rockfish	Sebastes chlorostictus	C	C	C	C	C
Greenstriped rockfish	Sebastes elongatus	C	C	C	C	C
Halfbanded rockfish	Sebastes semicinctus	R	I			
Kelp rockfish	Sebastes atrovirens		I	I		I
Olive rockfish	Sebastes serranoides	I	C	C	C	C
Quillback rockfish	Sebastes maliger	I	I	I	I	I
Redstripe rockfish	Sebastes proriger	R				R
Rosethorn rockfish	Sebastes helvomaculatus	I	I	I	I	I
Rosy rockfish	Sebastes rosaceus	C	C	C	C	C
Sharpchin rockfish	Sebastes zacentrus		R			
Shortbelly rockfish	Sebastes jordani	I	I	I	I	I
Speckled rockfish	Sebastes ovalis	I	I	I	I	I
Splitnose rockfish	Sebastes diploproa	I	I	I	I	
Squarespot rockfish	Sebastes hopkinsi	I	C	I	I	R

APPENDIX D. (continued).

Common name	Scientific name	Occurrence [1] 1987	1988	1989	1990	1991
Starry rockfish	Sebastes constellatus	C	C	C	C	C
Stripetail rockfish	Sebastes saxicola	I	I	I	I	
Swordspine rockfish	Sebastes ensifer	I	I	I		I
Tiger rockfish	Sebastes nigrocinctus					I
Treefish	Sebastes serriceps					I
Vermilion rockfish	Sebastes miniatus	C	C	C	C	C
Widow rockfish	Sebastes entomelas	C	C	C	C	C
Yelloweye rockfish	Sebastes ruberrimus	I	I	I	I	I
Yellowtail rockfish	Sebastes flavidus	C	C	C	C	C
Other fishes						
Blue shark	Prionace glauca	R		I		I
Butter sole	Iopsetta isolepis			R		
Cabezon	Scorpaenichthys marmoratus	I	I	I	I	I
California halibut	Paralichthys californicus		R		I	I
California lizardfish	Synodus lucioceps		R	I		
English sole	Parophrys vetulus		R			
Fantail sole	Xystreurys liolepis	R				
Irish lord	Hemilepidotus sp.			R		
Jack mackerel	Trachurus symmetricus	I	I	I	I	
Jacksmelt	Atherinopsis californiensis	I				
Kelp greenling	Hexagrammos decagrammus	I	I	I	I	I
King salmon	Oncorhynchus tshawytscha	I	I	I	I	I
Lingcod	Ophiodon elongatus	C	C	C	C	C
Ocean whitefish	Caulolatilus princeps					I
Pacific bonito	Sarda chiliensis	R				
Pacific mackerel	Scomber japonicus	C	I	I	I	I
Pacific sardine	Sardinops sagax	R	I			
Pacific hake	Merluccius productus	C	C	C	C	C
Pacific sanddab	Citharichthys sordidus	I	I	I	I	C
Petrale sole	Eopsetta jordani	I	I	I	I	I
Ratfish	Hydrolagus colliei		R			
Rock sole	Lepidopsetta bilineata	I	I	I	I	I
Sablefish	Anoplopoma fimbria	C	I	I	I	I

APPENDIX D. (continued).

Common name	Scientific name	Occurrence [1] 1987	1988	1989	1990	1991
Silver salmon	Oncorhynchus kisutch			I		
Soupfin shark	Galeorhinus zyopterus			R		
Speckled sanddab	Citharichthys stigmaeus	I		I	R	
Spiny dogfish	Squalus acanthias	I	I	I	I	I
Starry skate	Raja stellulata	R			R	
Striped surfperch	Embiotoca lateralis					R
White croaker	Genyonemus lineatus	I	I	I		I
Wolf-eel	Anarrhichthys ocellatus		R	I	I	
Yellowfin croaker	Umbrina roncador			I		

[1] Legend: C-common, ≥ 1.0% of observed catch; I-incidental, < 1.0% of observed catch; R-rare, one occurrence.

APPENDIX E. List of Rockfishes Known to Occur in Both Sport and Commercial Fisheries in California.[1]

COMMON NAME	SCIENTIFIC NAME
Species important in both sport and commercial fishery.	
Black rockfish	Sebastes melanops
Black-and-yellow rockfish	Sebastes chrysomelas
Blue rockfish	Sebastes mystinus
Bocaccio	Sebastes paucispinis
Brown rockfish	Sebastes auriculatus
Canary rockfish	Sebastes pinniger
Chilipepper	Sebastes goodei
China rockfish	Sebastes nebulosus
Copper rockfish	Sebastes caurinus
Cowcod	Sebastes levis
Flag rockfish	Sebastes rubrivinctus
Gopher rockfish	Sebastes carnatus
Greenspotted rockfish	Sebastes chlorostictus
Kelp rockfish	Sebastes atrovirens
Olive rockfish	Sebastes serranoides
Rosy rockfish	Sebastes rosaceus
Speckled rockfish	Sebastes ovalis
Starry rockfish	Sebastes constellatus
Vermilion rockfish	Sebastes miniatus
Yelloweye rockfish	Sebastes ruberrimus
Yellowtail rockfish	Sebastes flavidus
Species important in sport fishery but not commercial fishery.	
Calico rockfish	Sebastes dalli
Grass rockfish	Sebastes rastrelliger
Greenstriped rockfish	Sebastes elongatus
Quillback rockfish	Sebastes maliger
Species important in commercial fishery but not sport fishery.	
Aurora rockfish	Sebastes aurora
Bank rockfish	Sebastes rufus
Blackgill rockfish	Sebastes melanostomus
Darkblotched rockfish	Sebastes crameri
Pink rockfish	Sebastes eos
Splitnose rockfish	Sebastes diploproa

[1] Data from Lea (1992)

[1] Data from Lea (1992)

APPENDIX E. (continued)

COMMON NAME	SCIENTIFIC NAME
Species taken only occasionally or rarely in both sport and commercial fishery.	
Bronzespotted rockfish	Sebastes gilli
Mexican rockfish	Sebastes macdonaldi
Pinkrose rockfish	Sebastes simulator
Redbanded rockfish	Sebastes babcocki
Redstripe rockfish	Sebastes proriger
Rosethorn rockfish	Sebastes helvomaculatus
Sharpchin rockfish	Sebastes zacentrus
Stripetail rockfish	Sebastes saxicola
Tiger rockfish	Sebastes nigrocinctus

Appendix F. Maximum Total Length, by Port Area, of Most Frequently Observed Fishes (N ≥ 25) in CPFV Catch, 1987 to 1991.

Common name	Observed max. length (mm) FB	BB	SF	MT	MB	Observed max. length (in.) FB	BB	SF	MT	MB	Known max.[1] length (in.)
Rockfishes											
Bank rockfish	-	-	503	-	-	-	-	17.9	-		20.1
Black rockfish	437	550	575	465	455	17.2	21.7	22.6	18.3	17.9	23.75
Black-and-yellow rockfish	-	-	345	-	-	-	-	13.6	-	-	15.25
Blue rockfish	468	491	527	457	500	18.4	19.3	20.7	18.0	19.7	21.0
Bocaccio	-	800	840	836	755	-	31.5	33.1	32.9	29.7	36.0
Brown rockfish	-	497	504	451	532	-	19.6	19.8	17.8	20.9	21.5
Canary rockfish	487	687	635	574	473	19.2	27.0	25.0	22.6	18.6	30.0
Chilipepper	-	556	530	535	495	-	21.9	20.9	21.0	19.5	22.0
China rockfish	369	416	412	359	401	14.5	16.4	16.2	14.1	15.8	17.0
Copper rockfish	560	519	582*	533	541	22.0	20.4	22.9*	21.0	21.3	22.5
Cowcod	-	-	-	710	-	-	-	-	28.0	-	37.0
Flag rockfish	-	-	462	451	440	-	-	18.2	17.8	17.3	25.0
Gopher rockfish	-	-	425*	385	410*	-	-	16.7*	15.2	16.1*	15.6
Greenspotted rockfish	-	479	473	461	463	15.7	18.9	18.6	18.1	18.2	19.75
Greenstriped rockfish	285	392*	408*	397*	356	11.2	15.4*	16.1*	15.6*	14.0	15.0
Olive rockfish	460	503	514	557	547	18.1	19.8	20.2	21.9	21.5	24.0

APPENDIX F. (continued)

Common name	Observed max. length (mm) FB	BB	SF	MT	MB	Observed max. length (in.) FB	BB	SF	MT	MB	Known max.[1] length (in.)
Quillback	-	-	480	-	-	-	-	18.9	-	-	24.0
Rosy rockfish	335	346	353	344	352	13.2	13.6	13.9	13.5	13.9	14.2
Rosethorn rockfish	-	-	263	279	-	-	-	10.4	11.0	-	16.0
Shortbelly rockfish	-	-	-	326*	-	-	-	-	12.8*	-	12.0
Speckled rockfish	-	-	447	463	-	-	-	17.6	18.2	-	22.0
Squarespot rockfish	-	280	285	287*	241	-	11.0	11.2	11.3*	9.5	11.25
Starry rockfish	304	423	439	449		12.0	16.7	17.3	17.7		18.0
Stripetail rockfish	-	-	-	313	-	-	-	-	12.3	-	15.3
Vermilion rockfish	-	723	662	653	613	-	28.5	26.1	25.7	24.1	30.0
Widow rockfish	-	526	520	548	530	-	20.7	20.5	21.6	20.9	23.6
Yelloweye rockfish	649	715	673	688	610	25.6	28.1	26.5	27.1	24.0	36.0
Yellowtail rockfish	544	571	573	557	539	21.4	22.5	22.6	21.9	21.2	26.0
Other fishes											
Cabezon	-	-	661	628	593	-	-	26.0	24.7	23.3	39.0
Jack mackerel	-	-	-	674	411	-	-	-	26.5	16.2	32.0
Kelp greenling	-	-	438	-	375	-	-	17.2	-	14.8	21.0
Lingcod	843	1085	1097	1028	916	33.2	42.7	43.2	40.5	36.1	52.0

APPENDIX F. (continued)

Common name	Observed max. length (mm) FB	BB	SF	MT	MB	Observed max. length (in.) FB	BB	SF	MT	MB	Known max.[1] length (in.)
Pacific hake	-	-	504	736	-	-	-	19.8	29.0	-	36.0
Pacific mackerel	-	-	477	521	-	-	-	18.8	20.5	-	25.0
Pacific sanddab	-	-	415*	369	343	-	-	16.3*	14.5	13.5	16.0
Petrale sole	-	-	495	494	-	-	-	19.5	19.4	-	27.5
Rock sole	-	-	478	499	473	-	-	18.8	19.6	18.6	23.5
Sablefish	-	-	-	630	-	-	-	-	24.8	-	40.0

[1] Maximum length as reported in Miller and Lea (1972)

* Exceeds maximum length as reported in Miller and Lea (1972)