

REVIEW OF SOME CALIFORNIA FISHERIES FOR 1983

Total California landings of fishes, crustaceans, and mollusks during 1983 have been estimated by the California Department of Fish and Game to have dropped 25% from the 1982 level and 32% from the average of the past six years. Landings of pelagic wet fishes during 1983 were almost half that of the previous year (Table 1).

The commercial sector seemed to take the brunt of changing oceanographic conditions during 1983, most notably in poundage: anchovy dropped 90%, squid 89%, salmon 86%, ocean shrimp 74%, Dungeness crab 70%, rockfish 35%, and jack mackerel 30%. The only significant increases in landings were for albacore, yellowfin tuna, and skipjack.

Meanwhile, California's sportfishing industry seemed to benefit during 1983 because of the migration of more southerly "big game" species into local waters. However, the northern and central California ports that depend primarily on salmon and rockfish had a poor year.

PACIFIC SARDINE

The moratorium on commercial fishing of Pacific sardines, *Sardinops sagax caeruleus*, remained in effect during 1983 because the spawning biomass was assessed as remaining well below the 20,000 tons necessary to initiate a directed fishery. However, good signs of a possible recovery of the sardine resource were evident. Sardines were observed and caught

more frequently during 1983 than any other time since the moratorium was enacted ten years ago.

During 1983 an estimated 388 tons of sardines were landed with mackerel. This represents a three-fold increase over the incidental catch of sardines in 1982 and a twelve-fold increase over 1981. In dockside interviews, fishermen described increasing occurrences of sardines mixed with mackerel; several instances of dumping pure schools of sardines have been reported, but are unverified. Sardines were observed by port samplers in mackerel landings during all months of the year, and landings of 10 tons or more occurred in all but three months of the year. In the eight years prior to 1982, monthly landings of 10 tons or more of sardines occurred only five times. The frequency of occurrence of sardines in observed mackerel landings climbed to 30% in 1983, almost double that of the previous year. Length frequencies of sardines showed a bimodal distribution, with the 1983 year class represented by the smaller mode (115–145 mm SL), and the 1982 year class and older fish represented by the larger mode (160–250 mm SL).

The 1983 fall midwater trawl survey captured 1,600 sardines in 37 of 133 trawls (28%). This represents a substantial increase over previous years in both number of fish and percent occurrence. Young-of-the-year fish occurred in 25 of 133 of the trawls (19%) and constituted the majority of the catch by number. In an additional trawl survey in November, 230 sardines

TABLE 1
 Landings of Pelagic Wet Fishes in California in Short Tons from 1964-83

Year	Pacific sardine	Northern anchovy	Pacific mackerel	Jack mackerel	Pacific herring	Market squid	Total
1964	6,569	2,488	13,414	44,846	175	8,217	75,709
1965	962	2,866	3,525	33,333	258	9,310	50,254
1966	439	31,140	2,315	20,431	121	9,512	63,958
1967	74	34,805	583	19,090	136	9,801	64,489
1968	62	15,538	1,567	27,834	179	12,466	57,646
1969	53	67,639	1,179	26,961	85	10,390	105,307
1970	221	96,243	311	23,873	158	12,295	133,101
1971	149	44,853	78	29,941	120	15,756	90,947
1972	186	69,101	54	25,559	63	10,303	104,993
1973	76	132,636	28	10,308	1,410	6,031	150,489
1974	7	82,691	67	12,729	2,630	14,452	112,576
1975	3	158,510	144	18,390	1,217	11,811	190,075
1976	27	124,919	328	22,274	2,410	10,153	160,115
1977	6	111,477	5,975	50,163	5,827	14,122	187,570
1978	5	12,607	12,540	34,456	4,930	19,899	84,437
1979	18	53,874	30,471	18,300	4,681	22,025	129,369
1980*	38	47,339	32,645	22,428	8,886	16,957	128,293
1981	31	57,593	42,913	15,673	6,558	25,715	148,483
1982	145	46,364	31,275	29,110	11,322	17,951	136,167
1983*	388	4,740	35,882	20,272	8,829	2,001	72,112

*Preliminary

(40–233 mm SL) were captured in 9 of 99 trawls (9%). One catch of small sardines (40–70 mm SL) at Santa Catalina Island indicated a possible fall spawning, which may have been produced by a southern subpopulation of sardines that had moved north.

Pacific sardines continued to appear in the incidental catches of live-bait fishermen. The percent occurrence by day of sardines from voluntary bait logs remained about the same in 1983 (27%), compared to 23% in 1982. Reports of small sardines (1983 year class) in live-bait catches were frequent.

As a result of concern about the increased availability and incidental take of sardines, two pieces of legislation were enacted in 1983. Assembly Bill 394, passed in April and enacted as urgency legislation, requires the California Department of Fish and Game to monitor the incidental catch of sardines and allows the percentage of sardines that may be taken incidentally to be increased or decreased in accordance with a specified formula. This is an attempt to lessen the impact of an impending recovery of the sardine population on other fisheries, primarily mackerel.

The second bill, AB 457, takes effect in January 1984. It allows the first 250 tons per year of incidentally landed sardines to be used for any purpose, not just canning and reduction as required by previous regulations. After the first 250 tons are landed, the allowable uses of incidentally caught sardines are restricted to canning, reduction, and live bait for the remainder of the calendar year. This bill allows fresh fish dealers without cannery or reduction facilities to utilize incidental catches of sardines during a portion of the year. It also eliminates the need for market fishermen to “dump” loads containing sardines for a portion of the year, and legalizes the use of incidentally taken sardines as live bait.

Most sources of information about the relative abundance of Pacific sardines continue to indicate a moderate increase in the biomass off California.

NORTHERN ANCHOVY

By January 1983, in the southern permit area, only 1,958 tons had been landed since the 1982–83 anchovy season opened the previous September. Bad weather, low availability of commercial-sized schools, poor market conditions, and good mackerel fishing resulted in no landings for January. Similarly, in the northern permit area, conditions for fishing were poor, and only 381 tons were landed between the season’s opening the previous August and the interseason closure (February–March).

In the northern area, after the closure, an estimated 191 tons were landed during April at a price of \$44.75

per ton. In the southern area, no landings occurred in April, and May landings were only 250 tons, all at Port Hueneme. Fishing continued sporadically in June, with 2,484 tons landed, mostly at Port Hueneme, where the price fell from \$46.00 to \$44.00 per ton by the end of the season (June 30). At Terminal Island, only two landings were reported during the spring. San Pedro fishermen complained of small, unfishable schools in the area. At the end of the 1982–83 anchovy fishing season (June 30) an estimated 4,925 tons were landed in the south (Table 2), far short of the southern area quota of 140,000 tons. In the northern area, 1,270 tons were landed for the 1982–83 season (quota: 10,000 tons).

For the 1983–84 fishing season, a preliminary biomass estimate of 1,549,000 tons (1,405,000 MT) of northern anchovy was made by the National Marine Fisheries Service using a “larval census equivalent” based on an egg production estimate of 652,000 MT. The optimum yield was established at 128,100 tons. The total U.S. reduction fishery harvest limit was set at 115,500 tons, reserving 12,600 tons for nonreduction fisheries. An initial allocation for reduction was set at 56,800 tons. Allocation of the rest would be considered when 25% of the total quota (28,875 tons) had been landed. Initial allocations of 5,800 and 52,000 tons were set for the area north and south of Point Buchon, respectively.

The Pacific Fishery Management Council (PFMC) met in San Diego on September 28–29, 1983, and recommended options for several amendments to the Anchovy Management Plan. Major options included (1) 70% (U.S.)–30% (Mexico) OY allocation; (2) a

TABLE 2
Anchovy Landings for Reduction Seasons in the Southern and Northern Areas from 1966–83, in Short Tons

Season	Southern Area	Northern Area	Total
1966–67	29,589	8,021	37,610
1967–68	852	5,651	6,503
1968–69	25,314	2,736	28,050
1969–70	81,453	2,020	83,473
1970–71	80,095	657	80,752
1971–72	52,052	1,314	53,426
1972–73	73,167	2,352	75,519
1973–74	109,207	11,380	120,587
1974–75	109,918	6,669	116,587
1975–76	135,619	5,291	140,910
1976–77	101,434	5,007	106,441
1977–78	68,476	7,212	75,688
1978–79	52,696	1,174	53,870
1979–80	33,383	2,365	35,748
1980–81	62,161	4,736	66,897
1981–82	45,149	4,953	50,102
1982–83*	4,925	1,270	6,195

*Preliminary

reduction quota (OY) formula of 100% of the excess spawning biomass over 300,000 MT, with a limit of 200,000 MT; (3) a season of August 1–June 30 (north) and September 15–June 30 (south) with *no closure* for February–March; and (4) no size limit, but a 10/16-in.-mesh size restriction. The recommended options were forwarded to the Department of Commerce, Washington, D.C., with implementation expected in time for the opening of the 1984–85 season.

No reduction landings were reported through the end of the year in the northern permit area, and only 17 tons were landed in the southern permit area. Boats in the northern area fished for mackerel and did not find fishable concentrations of anchovies. Many of these fishermen did well fishing for salmon in Alaska and were not willing to spend a large amount of effort on anchovies, in spite of a disastrous year for squid and the reduction facility's apparent willingness to take anchovies. A similar situation occurred in the southern area, where good mackerel fishing occurred through mid-October, but market conditions remained poor for anchovy. While fishing for mackerel, fishermen reported no significant concentrations of anchovies. During October, the Oxnard reduction facility did place orders for anchovies, but aerial spotters were unable to locate fishable concentrations. The major facility for reduction in southern California at Terminal Island has shown little, if any, interest in taking anchovies since the spring of 1982.

The total reduction landings for 1983 statewide were 3,124 tons. Additionally, 6,409 tons were estimated to have been used for live bait and 1,616 tons for other nonreduction purposes. During 1983 the price of anchovies for reduction ranged from \$39.00 to \$49.00 per ton.

JACK MACKEREL

For the fifth consecutive year, jack mackerel (*Trachurus symmetricus*) contributed less than Pacific mackerel (*Scomber japonicus*) to California's mackerel fishery. Jack mackerel had been the dominant species landed in all but seven years since the 1947 inception of the jack mackerel fishery. The estimated 1983 landings of 20,272 tons accounted for 36% of all mackerel landings.

Jack mackerel were dominant in landings during only three months of the year: April, May, and June. No restrictions on Pacific mackerel were in effect during this time. However, jack mackerel became largely unavailable during August and remained so for the rest of the year. Landings declined dramatically, and most catches of this species for the remainder of the year took place around Monterey Bay. During August, September, and October, jack mackerel landings

accounted for only 10% of all mackerel landings. From September through December over 83% of jack mackerel landings occurred off Monterey.

Jack mackerel have traditionally been considered an underutilized species. It is doubtful that the unprecedented low availability of this species during late 1983 was associated with drastically reduced biomass levels. It seems more likely that behavioral responses to warm water, which reduced their availability to purse seines, had a larger effect.

PACIFIC MACKEREL

The year began with approximately 10,000 tons remaining on the 1982–83 season (July 1–June 30) quota of 29,000 tons. For the first time in several years, the season quota was not increased prior to the February 1 deadline for quota adjustments, partly as a result of information suggesting weak recruitment of Pacific mackerel (*Scomber japonicus*) in recent years. Landings during the first three months of the year were extremely poor, partly because of a prolonged period of inclement weather during February and March. However, these landings were also indicative of a fishery dominated by older year classes, and continued a pattern begun the previous year. From July 1982 through March 1983, the 1978 and older year classes accounted for an estimated 65% of the tonnage landed.

Landings increased dramatically during April and May as weather improved. In addition, age composition of Pacific mackerel samples showed a reversal in the trend of a fishery dominated by older fish: 1980 and 1981 year classes constituted 47% of the tonnage landed during the spring. Cannery interest in mackerel improved following the meager landings of the first part of the year, and resulted in an April price jump from \$174 to \$200 per ton at Terminal Island. However, negotiations for a new price formula in May returned the ex-vessel price per ton to \$174, where it remained for the rest of the calendar year. The season was closed on June 23, when it was determined that the 29,000-ton quota had been reached.

The 1983–84 season opened on July 1 with a quota of 22,000 tons based on a total biomass assessment of 130,000 tons. This was lower than assessments of the previous two years, and resulted from lower estimated levels of recruitment. Fishing was good during the summer off both southern and central California.

Although it is difficult to assess any impacts attributable to El Niño, several circumstances developed over the summer and early fall that may have been related. First, the trend of increasing recruitment of the 1981 year class that occurred during the spring and early summer was steadily reversed into the fall.

These two-year-old fish contributed 44% of the tonnage landed in July, but only 11% in October. Second, Pacific mackerel began to dominate mackerel landings in July. Beginning in August and continuing into December, Pacific mackerel made up virtually 100% of all mackerel landings. This is unprecedented in the history of this dual-species fishery. Also, by late October, Pacific mackerel became largely unavailable south of Monterey, with only scattered and intermittent landings from the Southern California Bight. In November and December, Monterey landings accounted for 23% and 62% of all landings of Pacific mackerel, respectively. This represented a steady decline, beginning in July, in the percentage of landings occurring in southern California. During the first six months of 1983 nearly 100% of Pacific mackerel landings were at San Pedro or Terminal Island.

It is becoming more and more apparent that the Pacific mackerel population is in need of another strong year class. The appearance of 1983 year-class fish (125–150 mm FL) in late June was the earliest in a year that 0-age-class fish have been sampled. Evidence of spawning from late February (indicated by these early young-of-the-year fish) through at least June raised hopes for a strong 1983 year class. However, trawl survey results in the fall did not reinforce this hope. Meanwhile, the 1982 year class has contributed only trace amounts to landings as one-year-olds; the trend shown by the 1981 year class is not encouraging. The fishery may thus be faced with dealing with two or three consecutive years of poor recruitment.

By the end of December, the seasonal catch of Pacific mackerel was just short of the 22,000-ton quota, with six months still remaining in the 1983–84 season, and with poor prospects for good availability of jack mackerel during the interseason.

Annual landings of Pacific mackerel for 1983 are estimated at 35,882 tons, a slight increase over the previous year (Table 1). This brings the average landings over the last five years to 34,000 tons, with a low of 29,000 tons (1979) and a high of 42,000 tons (1981). The last time a five-year average surpassed this was the 1940–44 average of 41,000 tons, with a low of 26,000 tons (1942) and a high of 60,000 tons (1940).

Monterey landings for the year exceeded 3,000 tons and contributed approximately 10% of the total landings. This was the largest annual take for Monterey since the beginning of California's Pacific mackerel fishery, more than five decades ago, and partially reflects increased effort expended by the displaced southern California fleet. Several San Pedro boats actually made trips as far north as Santa Cruz after early October, and delivered their catches all the way

back to Los Angeles Harbor. Therefore, catches in the Monterey Bay area were substantially higher than landing data suggests.

MARKET SQUID

Both of California's market squid, *Loligo opalescens*, fisheries failed during 1983. Fishermen and biologists alike blamed El Niño.

The northern California squid fishery experienced the second poorest season on record. Landings of only 1,052 tons were recorded, and about half were caught near Half Moon Bay, resulting in an even lower catch figure for traditional fishing grounds near Monterey. The disastrous season came at a time when demand for squid was increasing, as well as the price, which was raised to \$400 per ton. Local demand for squid was met with imports and Atlantic Coast species for the first time.

The poor season was not entirely unexpected. California Department of Fish and Game biologists predicted that the El Niño phenomenon that began in 1982 and caused the ocean temperature off central California to rise as much as 5°F above normal would have a serious effect on the availability of market squid to Monterey fishermen. In 1961 and 1973 less intense warm-water episodes occurred, but they also coincided with poor squid catches. However, biologists did not expect 1983 catches to be as poor as they were.

As for the 1984 season, the ocean temperature off central California has declined, and if squid respond favorably to the more normal conditions, the fishery can be expected to improve during the coming year.

The southern California fishery suffered through its worst year since it first became viable during the early 1960s. Landings for the year were just less than 1,000 tons. Ninety-nine percent of landings were made during January and February, capping off a 1982–83 winter season that fishermen described as dismal. The worst was yet to come. During November, the usual beginning of southern California's season, squid failed to show on the traditional fishing grounds off the south side of Santa Catalina Island. Only one ton was landed during the last three months of the year.

Because of poor catches and continued high demand, fishermen received record prices for landings made. During recent seasons ex-vessel prices fluctuated between \$140–\$160 per ton. During early 1983, fishermen received an average price of \$345 per ton at San Pedro fresh fish markets.

The failure of the 1982–83 and 1983–84 southern California winter squid fishery was less predictable than the failure in Monterey Bay. Although moderate warm-water events have occurred since the early

1960s, fluctuations in landings seem to have been more closely tied to market demand. Since the fishery did not exist during a more comparable event, the 1957-59 El Niño, comparisons could not be made.

PACIFIC HERRING

The 1983 herring catch was 8,829 tons (Table 1). This represents a decline of over 2,000 tons from the 1982 catch and is primarily due to the poor herring catch at the start of the 1983-84 season. The major component of the catch comes from the seasonal herring roe fisheries in Tomales and San Francisco bays. Small fresh fish and bait fisheries also exist. The roe fishery begins in December and usually ends in February or when the quotas are taken.

Regulation changes for the 1982-83 season included elimination of the platoon system in Tomales Bay, which was possible after 16 permittees were allowed to transfer to San Francisco Bay. Quotas, adjusted because of the transfer of permittees, were set at 1,000 tons and 10,400 tons, respectively, for Tomales and San Francisco bays.

The 1982-83 seasonal catch was 10,551 tons, down slightly from the 1981-82 catch of 11,321 tons. The season was a success even though the overall quota of 11,400 tons was not taken. Weekend closures in San Francisco Bay contributed to lower catches. In Tomales Bay the largest spawning run of the season occurred in an area that was inaccessible to the fleet and was the major reason for the quota shortfall in this area.

The 1983 Tomales Bay herring spawning biomass was estimated to be 11,000 tons, one of the highest estimates recorded. The 1983 San Francisco Bay herring spawning biomass was estimated to be 59,200 tons, a 40% decline from the previous year. Recruitment of the 1981 year class was poor and contributed to the lower estimates. However, deep-water spawning was reported by fishermen in San Francisco Bay, and because the magnitude could not be determined with present sampling techniques, the biomass estimate may be artificially low.

In 1983 acoustic techniques were experimentally used for the first time to estimate the spawning biomass of herring in San Francisco Bay. Although this method needs refinement, the 1983 acoustic estimate of 77,000 tons was higher than that obtained by sampling herring spawns in shallow-water areas.

The 1983-84 herring season began slowly with poor December catches. While it is felt that El Niño has had a negative impact on herring abundance, it remains to be seen how the 1984 fishery will be affected by changes in recruitment, mortality, or distribution of adults.

GROUND FISH

California's 1983 commercial groundfish industry experienced a difficult year. The commercial groundfish harvest declined 24% to 43,446 tons from the 1982 harvest level (Table 3). The California El Niño seemed to have a widespread and negative impact on most groundfish fisheries. Restrictive species quotas, lower levels of fishing effort, and reduced market demand contributed to decreased commercial harvests of several key species. However, the recreational groundfish harvest remained essentially unchanged, with an estimated catch of 3,500 tons, primarily rockfish, *Sebastes* spp.

Commercial rockfish landings—principally widow (*S. entomelas*), bocaccio (*S. paucispinis*), and chili-pepper (*S. goodei*)—were 19,510 tons. The widow rockfish catch declined from 11,297 tons in 1982 to 3,800 tons in 1983 because of decreased abundance and more restrictive management measures. The Pacific Fishery Management Council established a coast-wide optimum yield (OY) for 1983 of 11,550 tons for widow rockfish. A 75,000-pound trip limit was imposed in March to distribute widow rockfish landings over a longer fishing season; but by September, because of greater-than-projected coastwide widow rockfish landings, a 1,000-pound trip limit was imposed for the remainder of the year. As widow rockfish declined in availability, so did the capture efficiency of midwater trawls for this species. During the fall the fishery became economically nonviable for numerous midwater trawl vessels, which then switched to multispecies bottom trawling or quit California's groundfish industry for the season. Contrary to the trend for other gear types, gill net-captured rockfish increased from 1,699 tons in 1982 to 1,846 tons in 1983 because of more intensive gill net activity off San Francisco, Monterey Bay, and southern California.

TABLE 3
 California Groundfish Landings (Short Tons)

Species	1982	1983*	Percent Change
Dover sole	10,967	9,242	-16%
English sole	1,586	1,278	-20%
Petrale sole	859	619	-18%
Rex sole	728	689	-5%
Thornyheads	—	1,842	—
Widow rockfish	11,297	3,800	-66%
Other rockfish	17,483	15,709	—
Lingcod	1,498	973	-35%
Sablefish	10,446	7,160	-31%
Pacific whiting	1,123	1,078	-4%
Other groundfish	1,466	1,056	-28%
TOTALS	57,454	43,446	-24%

*Preliminary

Landings of the major flatfish species decreased moderately for the year. Anomalous oceanographic conditions and decreased fishing effort seemed to contribute to these declines.

Sablefish, *Anoplopoma fimbria*, landings in 1983 were particularly sensitive to market fluctuations. In recent years, increased demand for trawl-caught small sablefish, to be marketed in fillet form and in the round, drove commercial landings to record levels. Depressed foreign and domestic markets contributed substantially to the 31% decline in 1983 landings.

Despite the lower supply of groundfish, the price structure for most groundfish species remained relatively stable. The notable exceptions were rockfish prices, which were impacted because of imports of inexpensive rockfish from other northeastern Pacific fisheries.

DUNGENESS CRAB

California Dungeness crab, *Cancer magister*, landings were only 5.3 million pounds for the 1982-83 season compared to 10.5 million pounds landed during the previous season. The statewide total was dominated by the landings of northern California. Actually the San Francisco area (central California) showed an opposite trend: landings for 1982-83 were more than double those of the previous season.

In Crescent City, Trinidad, Eureka, and Fort Bragg, 3.43, 0.36, 0.91, and 0.06 million pounds, respectively, came across the docks. Bodega Bay, San Francisco, and Half Moon Bay landings were 0.29, 0.13, and 0.15 million pounds, respectively.

The 1982-83 season opened November 9 in central California, with an opening price of \$1.35 per pound to the fishermen. Favorable weather contributed to fishing success. Northern California crabbers faced exceptionally hazardous sea conditions when their season opened December 1, but were motivated by a record opening price of \$0.90 per pound. In response to the northern California opening, the San Francisco crab price dropped to \$1.00, but recovered to \$1.30 by midmonth.

Responding to poor catches in deeper water and improving weather in late December, many northern California crab fishermen moved their gear to well inside the 10-fathom isobath. By mid-January, 90% of the season's production was met, and the price had risen to \$1.53 per pound. During this time, however, the weather had worsened, and vast quantities of crab gear had been lost.

In central California, 76% of the San Francisco area landings were reported by the end of December. By season's end, the price paid to San Francisco fishermen had reached \$2.00 per pound. During the season,

432 vessels had engaged in the fishery in the area from Crescent City to Fort Bragg. Approximately 125 boats participated in the San Francisco area fishery, which includes the landing sites from Bodega Bay to Half Moon Bay.

PACIFIC OCEAN SHRIMP

Historically, California's fishery for ocean shrimp, also known as pink shrimp (*Pandalus jordani*), has occurred almost exclusively off northern California in waters designated as "Area A" by state regulations. In more recent years, a fishery off Morro Bay-Avila has grown in significance.

The 1983 Area A shrimp season was an unmitigated failure: only 833 pounds were landed. An additional 221,219 pounds were caught by California shrimpers off Oregon (PMFC areas 86 and 88) and landed in Crescent City. The ex-vessel price was \$0.62-\$0.64 per pound at the beginning of the season and gradually increased to \$0.77-\$0.80 per pound in July depending upon the dealer.

To give perspective to this catastrophe, since 1958 the lowest poundage landed was 0.98 million pounds (1973), and the highest was 13 million pounds (1977). Although the cause of the failure is not known for certain, an El Niño effect cannot be ignored. The fishery to the south, however, fared much better.

Landings of 944,695 pounds of ocean shrimp were recorded in the ports of Morro Bay and Avila (PFMC area 98) during the 1983 season. This was nearly double the poundage landed in 1982, the poorest season since 1979 when the Morro Bay fishery began in earnest. Sixteen trawlers (5 single-rig and 11 double-rig) participated in the 1983 fishery, making a total of 187 trips. The season ended somewhat prematurely in September when concentrations of pelagic red crabs (*Pleuroncodes planipes*) became so dense that trawlers could not reach the shrimp before jamming their nets with crabs. Single hauls in excess of 20,000 pounds of crabs were reported. Unfortunately, there is no market for these pelagic red crabs.

The ex-vessel price for shrimp delivered to Morro Bay reached a record high of \$0.80 per pound early in the season. It remained stable until season's end, probably because of the scarcity of shrimp from northern California.

From data extracted from fishermen's log books, catch per unit of effort (CPUE) remained fairly strong through August. Generally, both single- and double-rig vessels had CPUE in excess of 200 pounds per hour trawled. For the season, single-rig boats averaged 197 pounds per hour, whereas double-rig vessels averaged 231 pounds per hour. Combined CPUE averaged 221 pounds per hour for the season.

The monthly count of shrimp per pound averaged 79.3, from 211 samples taken during the course of the season. This compares to previous season averages below 65 per pound, indicating that 1983 yielded a much smaller average grade of shrimp. Monthly sex composition was also different in 1983 compared to previous seasons. In general, male composition was comparable to past seasons, but transitionals were appreciably higher and females correspondingly lower. This may indicate a slower rate of transition to female in 1983, which may also explain the higher average count-per-pound values. The overall smaller size of shrimp may reflect slower growth.

The forecast for the 1984 shrimp fishery appears bleak at this time owing to poor market conditions. Because of new foreign competition from Norway and Chile, the 1984 ex-vessel price for pink shrimp is projected to begin at around \$0.40 per pound. At this price, California trawlers may not be able to fish at all, especially if shrimp availability remains low.

PELAGIC SHARK AND SWORDFISH

During 1983, 249 permits were issued to harpoon fishermen to take swordfish; 228 drift gill net permits were issued for taking pelagic sharks and swordfish. The season for harpoon fishermen is year-round; the season for drift gill netters extends from May 1 to January 31.

Harpoon fishermen suffered through their worst season since 1950, reporting, on logbooks, landings of only 422 fish. In 1950 the reported catch was less than 400. While some might be tempted to blame the recent failures in the harpoon fishery on the growing success enjoyed by the drift gill net fleet, it should be noted that the harpoon fishery has historically been subject to extreme fluctuations, and that the failure of the 1983 harpoon fishery occurred despite the creation of harpoon-only areas off southern California.

Drift gill net permittees ended 1983 with a record season for swordfish, with landings exceeding 2.6 million pounds. The previous high was in 1978, when landings were just under 2.6 million pounds, but that catch was entirely by harpoon. In numbers, drift gill netters reported 1983 landings of close to 21,000 swordfish. The season finished on a strong note, with 4,500 fish reported taken in January. The previous reported high for a January was only 400 fish.

Common thresher shark (*Alopias vulpinus*) landings were down in 1983 from the two previous seasons, amounting to just over 1.6 million pounds. Catches for 1981 and 1982 were 2.0 and 2.3 million pounds, respectively. During 1983, however, there were indications of an emigration of fish to the north of traditional

fishing grounds, possibly in response to the 1982-83 warm-water episode.

The gill net fishery detected other biological events possibly related to this warm-water episode. Of particular interest was the first recorded occurrence in California waters of the pelagic thresher shark (*Alopias pelagicus*). Its distribution has been previously described as occurring entirely within subtropical and tropical waters; it is commonly taken on hook and line during the winter sport fishery off lower Baja California. It appears from catch records that during the summer of 1983 the pelagic thresher may have largely displaced the common thresher in waters off southern California.

In addition, during the past several years the log books kept by nearshore set-gill net fishermen have indicated frequent catches of young-of-the-year common threshers in their summer landings along the Los Angeles, Ventura, and Santa Barbara county coastlines. This has not been the case in 1983. Instead, these fish are being captured by gill nets in nearshore waters as far north as Point Reyes.

Further expansion of the California drift gill net fishery into northern waters was witnessed again this year. As many as 20 vessels from southern California ports spent most of the summer operating out of ports as far north as San Francisco, with most effort in the area off Monterey Bay. During the late summer, when weather conditions allowed, these vessels made substantial swordfish landings.

An official of the Washington State Department of Fisheries reported that one drift gill net vessel operating in water 80-90 miles outside Puget Sound had a very successful season targeting on the common thresher shark.

RECREATIONAL FISHERY

During 1983, southern California anglers experienced one of their most extraordinary years. The El Niño condition evident in the eastern Pacific was responsible. Biological evidence of the phenomenon was observed off southern California as early as September 1982, and physical evidence (increased sea-surface temperature) was available by November. Since changes in fish distributions were noted prior to 1983, a review of the fall 1982 sportfishery is included here.

Beginning in September 1982, sportfishermen in southern California noted a change in the availability of large (5-8-pound) Pacific bonito, *Sarda chiliensis*. The fish were first taken off San Diego, and catches progressed north as the month passed. Remarkable catches persisted through early December, at which

time a series of storms curtailed the fishery. During mid-September, an unprecedented late run of albacore (*Thunnus alalunga*) developed close to San Diego. The fish were large: many weighed 50 to 60 pounds, and some occasionally exceeded 70 pounds. The run lasted for 10 days, stopped, but resumed in November farther offshore. November's run produced good catches with many albacore in the 60–70-pound class. In addition, striped marlin (*Tetrapturus audax*) fishing in November was the best on record, with over 190 fish reported at local sportfishing clubs.

January 1983 was characterized by good weather during the first half of the month, which allowed anglers to catch many large bonito. Poor weather during the next 2½ months precluded most sportfishing activity off California. During this period, isolated commercial landings of bluefin tuna (*Thunnus thynnus*) off southern California, combined with bonito and California barracuda (*Sphyræna argentea*) off central California evidenced unusual northerly shifts in the availability of these fishes.

It wasn't until May that sport-fish catches again began to reflect the occurrence of a warm-water event. Fishermen in southern California were then greeted by remarkably good fishing for yellowtail (*Seriola lalandei*) and barracuda in Santa Monica Bay, as well as yellowtail off the Coronado islands. Additionally, long-range boats caught large (50–100 pound) bigeye tuna (*Thunnus obesus*) off Cedros Island, Baja California. During June, excellent albacore fishing occurred in an area 50 miles north of Guadalupe Island: catches of 100–200 fish per day, with the albacore averaging 22 pounds, were reported.

July marked the beginning of the summer season and continuing good yellowtail fishing at the Coronado islands. The first striped marlin of the year was taken on July 10, and by month's end over 100 had been landed. Marlin catches centered around Santa Catalina and Santa Barbara islands, an early indication of how far north the fish would go. By mid-July good fishing for bigeye tuna was occurring off San Diego, and at month's end the sportfishing fleet began catching yellowfin tuna (*Thunnus albacares*) and skipjack tuna (*Euthynnus pelamis*).

August ushered in a period that has been called the "100 golden days" in southern California sportfishing. Fishing for yellowfin tuna and skipjack tuna was phenomenal, with anglers averaging 2.5 and 1.6 fish per day, respectively, for trips on commercial passenger-carrying fishing vessels (CPFVs) operating from San Diego. Boats as far north as Ventura enjoyed similar success, although their season was much shorter. Half-day CPFVs operating nearshore from Dana Point to San Diego experienced unprecedented periods

of excellent yellowfin and skipjack tuna fishing. Bigeye tuna were also available during this period, and over 1,700 were reported landed by CPFVs. Yellowtail fishing continued to improve, especially at the offshore islands and under drifting kelp. Dolphinfish (*Coryphaena hippurus*) appeared by mid-August, and sporadic catches occurred through September.

During September, the best marlin fishing ever recorded off southern California occurred in the vicinity of Santa Rosa Island. Catches of 10 fish per day per boat were common, while one angler tagged and released 16 marlin in a three-day period. Yellowfin tuna fishing was also exceptional in the same area, with several fish over 150 pounds landed. In October a bluefin tuna weighing 364 pounds was taken by hook and line; it was the largest tuna ever taken by an angler off California.

During the fall of 1983, northern and central California anglers also experienced unusual sportfishing success on more "southern" species. Albacore were taken in Monterey Bay during September, and bonito were commonly taken into November. Large bonito (> 10 pounds) were taken by shore fishermen off Crescent City, and large schools of bonito were reported off Fort Bragg. One striped marlin was landed in Monterey during September, and others were reported hooked as far north as San Francisco. Boats (CPFVs) operating from Avila and Morro Bay were catching marlin on fall albacore trips. Apparently, the most available concentration of marlin was north of Point Conception during the fall—out of range of southern California anglers. This precluded a predicted exceptional marlin season off southern California. The fish seemed to bypass southern California and remain off the northern part of the state for most of the fall.

During mid-November a series of Arctic-spawned storms ended the exceptional sportfishing season off southern California. Surface water temperatures decreased to within 3°–4°F of normal, causing most anglers to give up as success rates declined. However, 29 striped marlin were landed in November, and 7 were taken in December, a month in which they had never previously been reported caught. Fishing for large bonito did improve somewhat during late November and December, with fish in the 10–12-pound range providing notable action.

The 1983 sportfishing season off southern California easily qualifies as a success when historical CPFV landings are compared. Catches of selected species on these vessels reflect some of the exceptional biological consequences of El Niño off California. Over 99,000 yellowfin tuna and 92,500 skipjack tuna were reported landed. The previous state record for yellowfin tuna

was 10,801 (1967), and the skipjack tuna record stood at 21,423 (1977). Bigeye tuna landings increased dramatically, with 1,773 reported; the previous record was 288 (1981). Dolphin fish landings represented an all-time high, with over 997 fish reported taken in southern California waters. One truly remarkable thing about these records is that they were all set concurrently in a relatively short (100-day) period. This El Niño apparently allowed large quantities of several highly esteemed sportfish species to move much farther north than normal, thus becoming available to southern and northern California anglers.

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