

## Warm Water and Southern California Recreational Fishing: A Brief Review and Prospects for 1983

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In June 1982 anomalous warming of the Pacific Ocean equatorial area was detected and in the months following, this warming has intensified. The periodic warming of the eastern Pacific Ocean in the equatorial area is called an "El Niño," and this warming in turn results in effects on climate and fisheries. In the past, El Niños have occurred in 1891, 1925, 1931, 1941, 1957-1958, 1972-1973 and 1976-1977.

Recent data (March 1983) show sea surface temperatures (SST's) of up to and slightly greater than 3.0°C (5.4°F) above the 20-year temperature mean in the equatorial area. Figure 1 shows the isotherm patterns and temperatures for the equatorial area. The largest recent El Niño occurred in 1957-58; the warming in the eastern tropical Pacific spread into the northeast Pacific and appears to be associated with substantial changes in fish catches by the recreational fishery off southern California.

Off southern California in 1957-58 above average temperatures were noted from January 1957 to June 1958 (18-month period), with temperatures of 4-6°F+ above the long-term mean observed in August and September 1957. Warm water periods have also occurred in 1972-73 and 1976-77; however, the magnitude and persistency of these warm water episodes was less intense than that observed for 1957-58. The 1972-73 episode had more effect on sea surface temperature in the northeast Pacific

than did the one of 1976-77, exhibiting about twice the intensity. The major effects of the 1972-73 warming in the equatorial area were evident from about June 1972 through March 1973 (10-month period). The 1976 warming lasted from about June 1976 through March 1977 (10-month period).

The relation of this warming of sea surface temperatures off southern California and the offshore areas in the northeast Pacific is not well understood. Off southern California in 1972-73, above-normal temperatures were noted from January 1972 through March 1973 (14 months) with temperatures of greater than 4°F above normal noted in October 1972. In 1976, temperatures off southern California, offshore and to the southwest were greater than normal from June 1976 through April 1977 (11 months); however, only temperatures of slightly greater than 2°F above normal were recorded.

The dramatic El Niño warming now occurring in the equatorial area started in mid-1982 and has caused a sharp rise in sea surface temperatures in the area from off Peru west to the international dateline (long. 180°), more or less simultaneously. Associated with this appears to be a warming off the northeast Pacific coast to temperatures higher than the 20-year mean. Figure 2 shows the sea surface temperature chart for 16-31 March 1983 and Figure 3 is an anomaly chart showing temperatures above and below the 20-year mean for the same period.

Off southern California, current temperatures (16-31 March 1983) are 2°F above the mean, about the same

level of increase as observed since November 1982. The extent of warming (amount of area that is warmer than the mean) increased in January 1983 and has remained about the same through February and into March 1983.

History indicates that with the anomalous warm temperatures off the west coast such as occurred in 1957-58, fish species more common to the tropics move into the waters off southern California and further north. Dolphin or mahi-mahi, *Coryphaena hippurus*; bullet mackerel or bullet tuna, *Auxis rochei*; shortbill spearfish, *Tetrapturus angustirostris*; finescale triggerfish, *Balistes polyplepis*; middling thread herring, *Opisthonema mediastre*; spiny boxfish or trunkfish, *Ostracion diaphanum*; pilotfish, *Naucrates ductor*; and green jacks, *Caranx caballus*; are some of the species rarely observed off California, except during the warm periods. During past El Niño events, many species common to California were observed far to the north of their normal range: Pacific barracuda, *Sphyrna argentea*, were taken off the Farallon Islands (off San Francisco); white seabass, *Atractoscion nobilis*, caught off Juneau, Alaska; bluefin tuna, *Thunnus thynnus*, off Vancouver Island, B.C.; yellowfin tuna, *Thunnus albacares*, off Monterey Bay, Calif.; and skipjack tuna, *Euthynnus pelamis*, taken off Pt. Arguello, Calif.

Although the occurrence of these species in the more northern latitudes is of scientific interest, and might provide some angling opportunities not normally available, the fishermen operating off southern California are interested in what effect El Niño might have on the fish catch.

Higher sea surface temperatures and the associated changes in both the physical and biological environment cause the marine environment to shift northward, bringing the important commercial and sport species associated with it. The reverse condition also occurs: During cool water years the total environment shifts southward, though this phenomenon

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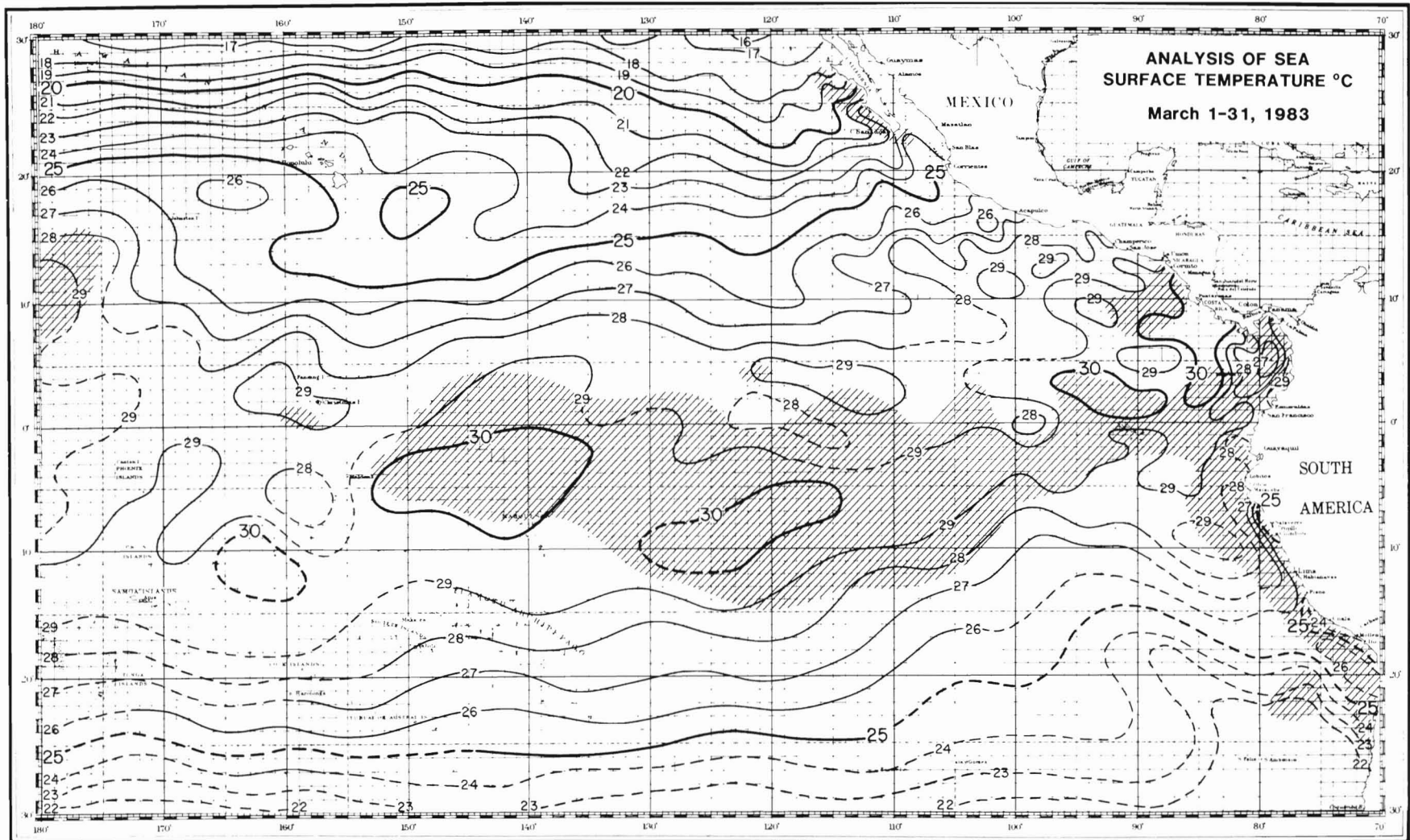


Figure 1.—Sea surface temperatures for the eastern tropical Pacific, 1-31 March 1983. Hatching indicates areas 2°C or greater above normal.

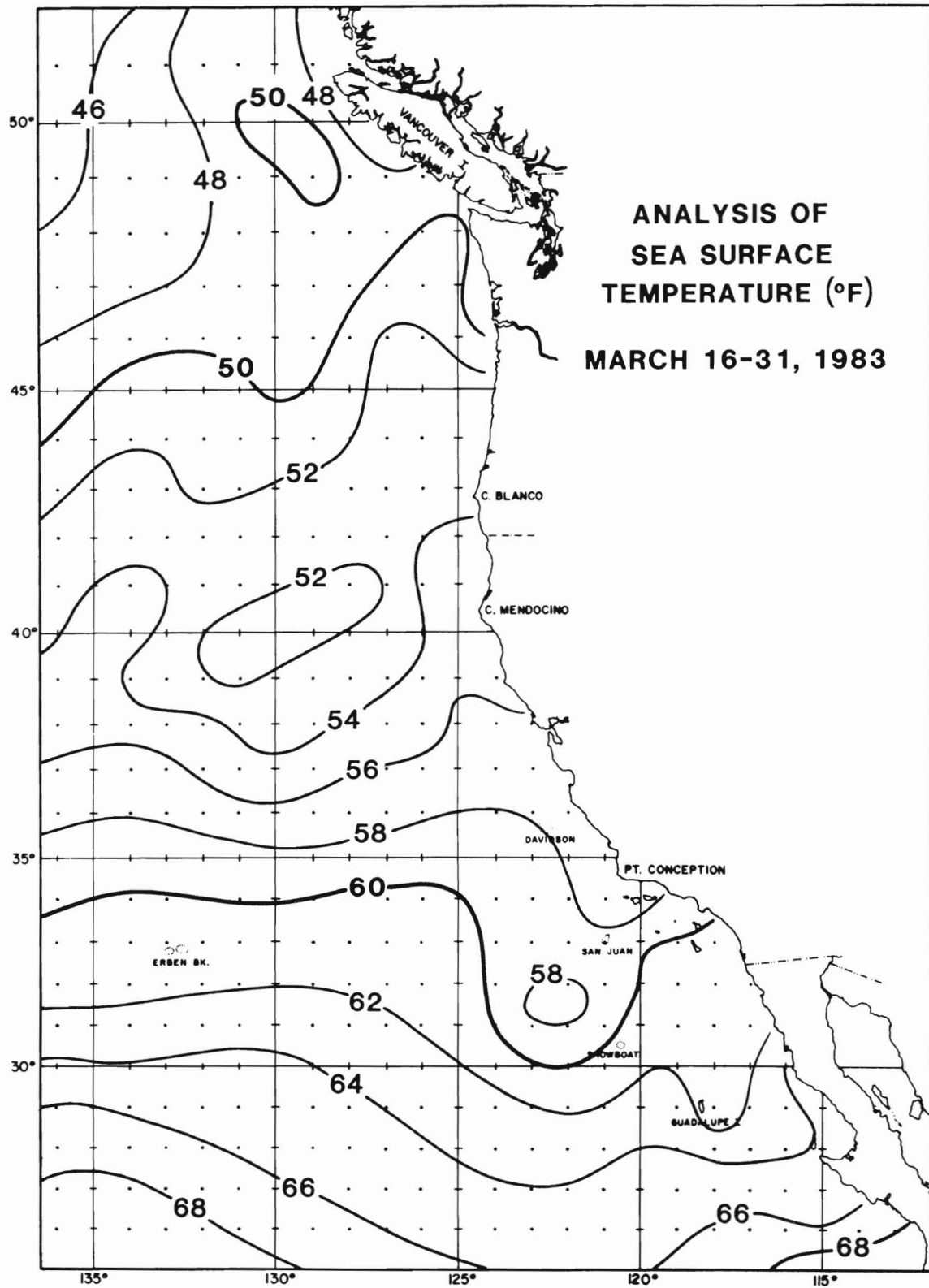


Figure 2.—West coast sea surface temperatures, 16-31 March 1983.

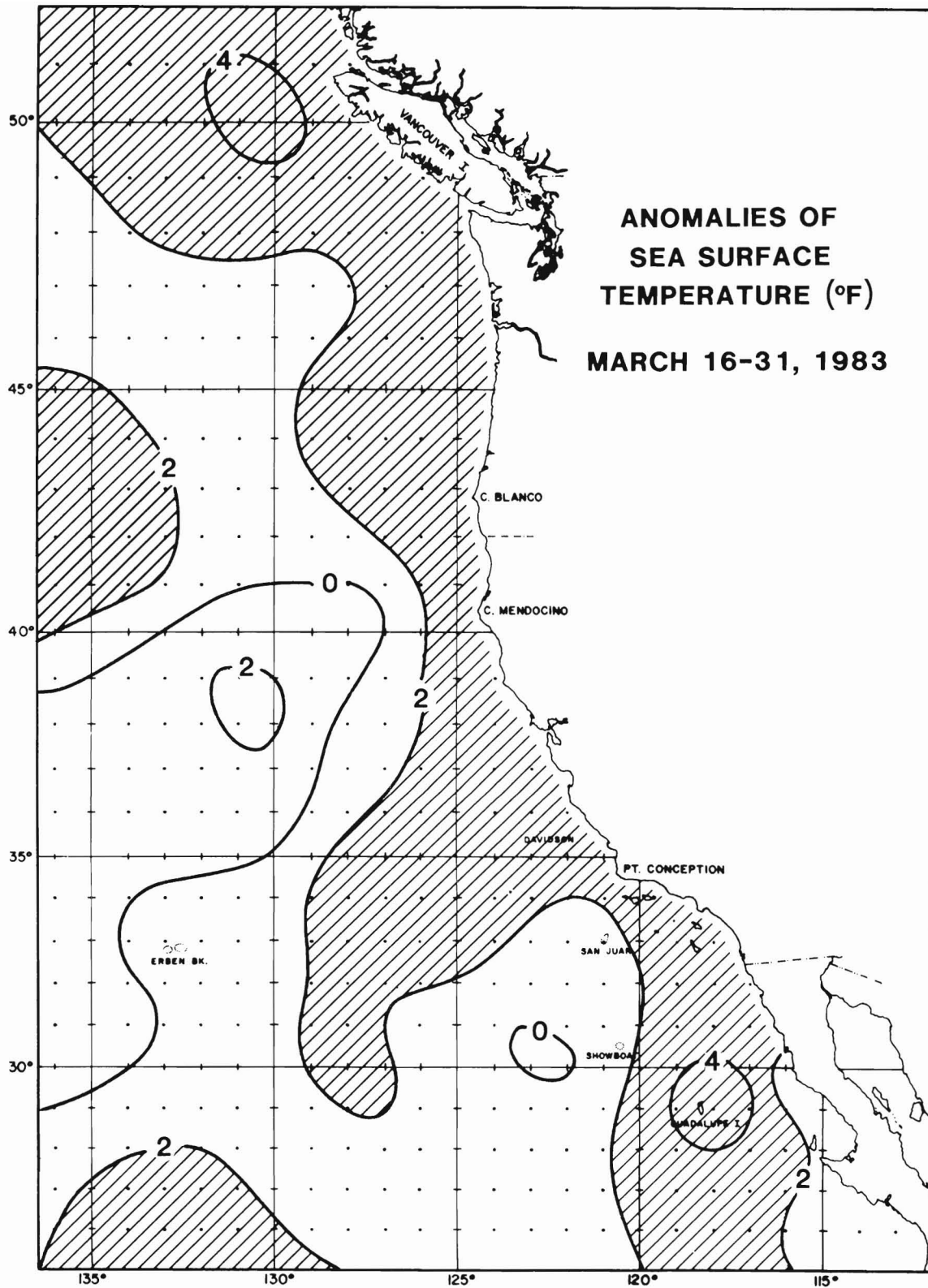


Figure 3.—West coast sea surface temperature anomalies for 16-31 March 1983. Hatching indicates areas 2°F or greater above normal.

appears to create less interest than warm water periods.

Considerable information is available on optimum catch temperatures off southern California for such species as yellowtail, *Seriola lalandei*; Pacific bonito, *Sarda chiliensis*; Pacific barracuda; albacore, *Thunnus alalunga*; white seabass; and striped marlin, *Tetrapturus audax*, some of the more desirable commercial and sport species. The results of fishing for these important species during previous warm water years are available from historical records, which could offer an indication of the quality of fishing that might be expected during the 1983 fishing season, providing conditions similar to those observed in 1957-58 continue to develop off the northeast Pacific coast in 1983.

The catches for the following species relative to catches during warm periods are reviewed as follows: Recreational sport fishing boat and commercial catches for the years preceding the warm years of 1957-58, 1972-73, 1976-77 and 1-2 years following the warm period were examined (Fig. 4a-f). Data would indicate the following changes for species of yellowtail, Pacific bonito, white seabass, Pacific barracuda, albacore, striped marlin, and swordfish, *Xiphias gladius*. In addition, comments are given regarding the recreational fishing possibilities for skipjack tuna, dolphin, northern anchovy, *Engraulis mordax*; Pacific sardine, *Sardinops sagax*; and chub or Pacific mackerel, *Scomber japonicus*.

#### Yellowtail (Fig. 4a)

The area near Coronado Islands, Mexico, is the major sportfishing site for this desirable sport species. Yellowtail are also frequently taken near the kelp beds off Pt. Loma, Calif., north to La Jolla, Calif.; near Catalina Island; and sometimes off the Palos Verdes peninsula near Los Angeles, Calif.

One of the first indications of the strong warming period of 1957-58 was the excellent catch of yellowtail made

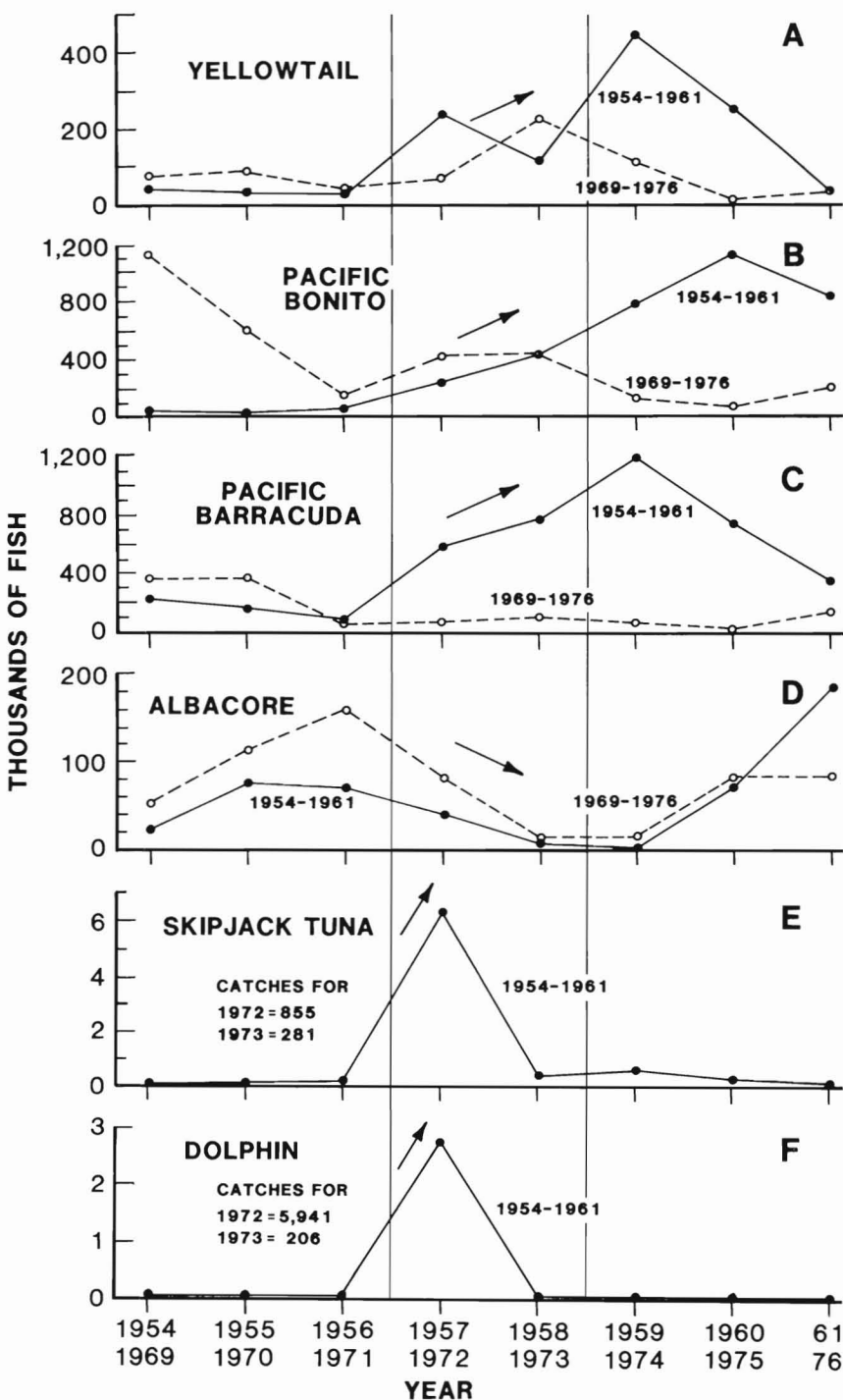


Figure 4.—California commercial sportfishing boat catches during warm water periods.

at the Coronado Islands in March 1957, a fishery which normally peaks

in late May or early June. Catches increased from 29,000 fish in 1956 to

243,000 in 1957, an eightfold increase. The catch per angler day also increased from 0.49 fish/angler day in 1956 to 1.9 fish/angler day in 1957, a fourfold increase in catch rate. The 1957 total catch was 3 times greater than the 20-year mean catch for the period 1947-67 (77,000 fish). Catches declined to 123,000 fish in 1958, still well above the 20-year mean, but increased sharply to a record high of 457,000 fish in 1959, 6 times greater than the 1947-67 mean catch. Catch rates were down slightly in 1958 (1.3 fish/angler day) but increased in 1959 to an all-time record of 4.3 fish/angler day.

During the warm period of 1972-73, yellowtail catches increased from 44,000 fish in 1971 to 59,000 fish in 1972. The angler catch rate increased from 0.32 fish/angler day (1971) to 0.45 fish/angler day in 1972. The period following the warm year (as observed during the 1957-58 period) produced a greater catch. The warm period ended in March 1973, but the catch increased to a 221,000 fish total in 1973, an increase of 3.7 times the 1972 catch. The angler catch rate increased from 0.45 fish/angler day in 1972 to 1.4 fish/angler day in 1973.

The 1976 warm period, a much weaker episode than that observed in 1957-58 or 1972-73 saw only a small increase, from 19,000 fish in 1975 to 28,000 fish in 1976. Catches continued to increase in 1977 to 34,000 fish and to 38,000 fish in 1978.

#### **Pacific Bonito (Fig. 4b)**

From 1947 to 1956 the average annual catch of Pacific bonito was 24,000 fish. In 1956, the year prior to the 1957 warm year, the catch totaled 61,000 fish. In 1957 a fourfold increase was noted, to a catch of 259,000 fish. An increase in catch was again noted in 1958 and for several years following the warm period. In 1958 the catch was 423,000 fish, increasing in 1959 to 776,000 fish, then further increasing to a record high of 1.2 million fish in 1960, thereafter declining to a catch of 806,000 fish in 1961. The catch/angler day also in-

creased sharply. In 1956 it was 0.12/angler day increasing in 1976 to 0.48/angler day. Further increases occurred in 1958 (0.82 fish/angler day) 1959 (1.39), and 1960 (2.32).

Prior to 1972 the Pacific bonito catch in southern California had been declining. In the warm year of 1972 the catch increased from 153,000 fish to 419,000 fish. Again the catch continued to increase following the warm period and the catch in 1973 totaled 473,000 fish. The bonito catch declined in 1974.

In 1976 records indicate a catch increase to 197,000 fish from 80,000 fish caught in 1975. The catch in 1977 increased to 161,000 fish and increased again the year following the warm period (1978) to 316,000 fish.

#### **Pacific Barracuda (Fig. 4c)**

The warm years of 1957-58 had a pronounced effect on the catch of Pacific barracuda. Catches were 6.5 times greater, increasing from 88,000 fish in 1956 to 577,000 fish in 1957. Catches further increased (by 1.4 times) in 1958 to 783,000 fish. The barracuda catch increased the year following the warm period (similar to the bonito and yellowtail catch), to a record high of 1.2 million fish. In the years 1953-56 the angler catch rate was 0.2 to 0.3 fish/angler day; in 1957 this increased to 0.82, in 1958 to 1.35, and to a high in 1959 of 1.9 fish/angler day. In 1960 the catch declined to 755,000 fish, then further declined to 392,000 fish in 1961.

#### **Albacore (Fig. 4d)**

The recreational fishery catch of albacore appears to be negatively affected by the major warm water periods. During the 1947-67 period, the mean catch of albacore was 81,000 fish. In 1957-58 the albacore catch declined to 42,000 fish in 1957, when compared with a 66,000 fish catch in 1956. In 1958 the catch further declined to 6,000 fish, a fourteenfold reduction from the 1947-67 mean. Catches continued to decline in the year following the warm period (1959)

to an all-time record low of 39 fish. Catch increased the following year (1960) to 76,000 fish, near the 20-year average, then increased again in 1961 to 185,000 fish.

Prior to the warm year of 1972 catches totaled 160,000 fish (1971). In 1972 catches declined to 87,000 fish. They further declined in 1973, the season following the warm period, to a catch of 10,000 fish. Catches increased slightly in 1974 to 12,000 fish, then rose sharply to 81,000 fish in 1975.

During the weak El Niño period of 1976 and the related warming in the northeast Pacific, little change occurred in the albacore catch. Catches were 82,000 in 1975, 85,000 in 1976, declining to 70,000 in 1977, and then increasing the year following the warm period (1978) to 93,000 fish.

#### **White Seabass**

Prior to the 1957-58 warm period, about 19,000 fish were landed in 1956. In 1957 the catch remained about the same as in 1956 (19,000 fish). However, in 1958 the catch increased to 34,000 fish, a 44 percent increase. The catch/angler day also increased in 1958 from 0.03 in 1956 and 0.02 in 1957, to 0.05 in 1958. The year following the warm period (1959) evidenced a decline in catch to 10,000 fish and a decline in catch/angler day to 0.01 fish.

By 1972 the stocks of white seabass were much reduced and a reduction in catch from about 5,000 fish in 1971 to 4,000 fish in 1972 was recorded. Catches increased in 1973 to 7,000 fish then declined in 1974 to 4,000 fish.

#### **Striped Marlin**

The long-term average catch of striped marlin off southern California is about 850 fish per year. In 1956 the catch was about 700 fish. In 1957 (the first year of the warm period) there was a slight decline in catch to 600 fish. The remainder of the warm period (1958) saw a large increase in catch, totaling 1,700 fish. The year after the warm period (1959) the catch increased to an all-time record high of

2,300 fish, then declined in 1960 to about 700 fish.

In 1972 little change was evident between catches in 1971 and 1972 (about 500 fish each year). Catches declined in 1973.

In 1976 catches declined from about 700 fish in 1975 to 350 fish, then increased to about 300 fish in 1977.

### Swordfish (Commercial Catch)

The historical mean commercial catch of swordfish off California is about 4,500 fish or about 421 metric tons (t) per year. During the warm period of 1957-58, an increase in swordfish catch was observed. In 1954, a low catch (50 t $\pm$ ) was recorded; catches increased in 1955 to about 150 t and increased again in 1956 to 180 t. Catches increased to 210 t in 1957, and to 280 t in 1958; they then declined slightly in 1959 and 1960.

For the warm periods of 1972 and 1976, catches were at or near low points. The 1972 catch was 180 t, up only 70 t from a low point observed in 1971. The 1976 catch was a low point in catch, 80 t.

### Possible Effects on Other Species

In addition to the species listed there is considerable interest in other species associated with the recreational and commercial fisheries off southern California.

### Pacific Sardine

The Pacific sardine resource appeared to have greater success during warm year periods (successive years of slightly warmer water). A small reduction in larval mortality during the 1957-58 period was suggested by the data. Spawning was shifted northward during the warm period. Spawning during the warm period of 1957-58 did not result in a large increase in year-class strength.

### Northern Anchovy

Fluctuations in landings of the northern anchovy were market-

related during the warm years of 1957-58. In 1956, commercial landings were 28,000 tons, declining in 1957 to 20,000 tons, and in 1958 to 6,000 tons. Reports on the anchovy fishery indicate this reduction was due to economic conditions, and an upsurge of sardine availability in 1958. Census estimates show an increase in the numbers of anchovy larvae in the years 1956 through 1958. The bait fishery showed a decline in catch, dropping from 6,000 tons in 1956 to 4,000 tons in 1957 and 1958. Warm water periods appear unfavorable to the inshore live-bait anchovy fishery.

The commercial reduction purse seine fishery appeared not to be greatly affected by the 1972-73 warm period. Catches for the period 1970 through 1973 were 96,000, 44,000, 69,000, and 132,000 tons per year, respectively. However, the aerial index of apparent abundance determined from the flight logs of commercial aerial fish spotters was low in 1972, declining from a high in 1970. This would indicate that the northern anchovy was less available in the commercial fishing areas in 1972, but not to the extent that commercial catches were reduced. The aerial abundance index increased sharply to a record high in 1973.

### Chub Mackerel

The chub or Pacific mackerel, *Scomber japonicus*, resource's total biomass declined sharply in the middle and late 1940's and biomass fluctuated until 1964 when it dropped to a very low level. Catches of Pacific mackerel were about 55,000 tons in 1940, 35,000 tons in 1941 (an El Niño period), and 25,000 tons in 1942. Catches declined during the 1957-58 warm period from 40,000 tons in 1956 to 35,000 in 1957, and 15,000 in 1958. Catches increased in the years 1959 through 1963. The biomass of Pacific mackerel was at a very low level in 1972 and no changes were detected. In 1976 the aerial index of apparent abundance increased slightly, further increasing to a high level in 1977. The influence of the warm period on this increase is not known.

### Skipjack Tuna (Fig. 4e)

During the 10-year period preceding the 1957-58 warm period the average annual catch of skipjack tuna off southern California was 166 fish. In 1957 the catch increased to 6,428 fish. However, in 1958 the catch dropped to 491 fish.

### Dolphin (Fig. 4f)

The largest catch for the 10-year period prior to 1957 was 15 fish (1947). In 1957 the catch was recorded at 2,805 fish, and in 1958 no catches of dolphin were recorded. Both skipjack tuna and dolphin are tropical species, and by late summer 1958 the warming period was on the decline and cooler temperatures off southern California, compared with late summer temperatures of 1957, restricted their occurrence in southern California waters. In the warm year of 1972, catches rose to a record 5,941 fish.

### Summary

The warm years of the 1957-58 period were more intense, lasted longer, and had a greater effect on southern California fishing than did the warm periods of the 1970's. The sea surface temperature isotherm charts of the equatorial and northeast Pacific in January 1983 resemble closely those of January 1958. Temperatures of up to 30°C (86°F) are common to the major areas of warming during both January 1958 and 1983. If the current warm water conditions continue in 1983 through the spring and summer period, thermal conditions in the northeast Pacific not unlike those observed in 1957-58 should be evident. The 1957-58 warm period lasted about 18 months; the 1972-73 and 1976-77 periods both lasted about 1 year. At the present time we are about 9 months into a strong El Niño period. If the El Niño phenomenon and its effect on the northeast Pacific continues it will have significant effects on the 1983 and possibly 1984 catches of coastal migratory species. The following predictions are based on historical data.

## Yellowtail

Catches should increase substantially in 1983 and catches as high or higher might be expected the year after the tropical warming period subsides. In 1959 an abundance of small yellowtail were taken, indicating that this species had probably spawned successfully off southern California. At the present time the yellowtail population is much reduced from levels common to the late 1950's; therefore, although catches may be higher, this will not necessarily indicate an improvement in the size of the yellowtail population.

## Pacific Barracuda

Stock size is currently very small compared with that of the late 1950's. Increases in catch should be expected though the totals will not approach the catch levels of the 1950's; higher catches following the warm period could be expected.

## White Seabass

Stock size is low and, though a slight increase in catch is possible in 1983, the total numbers of fish caught will remain low.

## Pacific Bonito

Catches off southern California respond positively to warm periods and though the stock size is reduced, increased catches could be expected. The recreational fishery increased during the warm periods of 1957-58 and in 1972-73 peak catches are recorded one and two years after the "El Niño" period.

Prior to 1957-58 the abundance of Pacific bonito was low off southern California. The 1957-58 warm period moved bonito into the southern California Bight where they were re-

ported to have spawned. Abundance in southern California waters remained high until 1964-65 when they became a major target species for the purse seine fishery.

## Albacore

Recreational fishery catches during the warm period of 1957-58 and in 1972-73 declined substantially, reaching their lows 1 year after the warm period. This reduction in catch is not evident in the commercial catches of 1957-58, and only a small reduction in catch was recorded in 1972. The mobility of the commercial albacore fleet enables it to fish distant water areas compared with the recreational fleet.

It may be expected that the recreational albacore fishery will experience a decline in catch if the influence of the warm period is evident during the summer and fall of 1983.

Much has been written on the El Niño, an equatorial phenomenon, and its effects on marine fishes and birds off Peru. The effects of the warm periods off California on the smaller pelagics such as the Pacific sardine, northern anchovy and Pacific or chub mackerel are not well understood. The effects on the anchovy off Peru by the El Niño are well documented; indications are that off California the inshore bait fishery for the northern anchovy has a more difficult time in warm years, although the commercial fishery may not be greatly affected. Apparently the catches of Pacific mackerel and its resource were not substantially influenced by the warm years of 1972 or 1976.

Off southern California the effects of the El Niño are evident but not to the magnitude that is seen off Peru. The important fact is that in the El Niño area, sea surface temperature

anomalies of up to and slightly greater than 4°-6°C (5.40°-10.8°F) are recorded, while off southern California sea surface temperature anomalies rarely reach 3.3°C (6.0°F), or a level only slightly greater than half the increase that is observed for the El Niño area. Therefore, the fishery resources off southern California are not subjected to the extremes of temperatures as those inhabiting the eastern tropical Pacific and tend to respond less dramatically.

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