

# REVIEW OF THE MOVEMENT OF ALBACORE TUNA OFF THE PACIFIC COAST IN 1963

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## ABSTRACT

Troll catches by U. S. Navy radar picket vessels monitoring fixed, continuously-manned stations off the Pacific coast revealed the seasonal movement of albacore tuna (*Thunnus alalunga* Bonnaterre) in 1963. Inshore and northward migration of albacore in relation to sea surface temperatures is reviewed. Onset, termination of fishing at each station, and similarity of movement to the schematic migration model presented last year for 1962 is examined.

## INTRODUCTION

In furtherance of the cooperative trolling program which was started in 1960, the U. S. Navy continued to log albacore catches in 1963 at each of its radar early warning surveillance stations off the west coast of the United States. As before, coverage extended from latitude 31° N. to 50° N. at a distance of 200-550 miles from shore. Stations were continuously manned by a fleet of several vessels participating in a rotation schedule placing each ship on a given station for 20- to 30-day intervals. (For a brief description of equipment used and general fishing strategy, see Flittner 1961 and Johnson 1960.)

Fishing commenced on April 1 and terminated November 1. When catch records indicated that a late-season flurry of activity might take place at the southern stations, vessels were asked to continue fishing through the months of November and December.

| Station Number and Year | Approximate Latitude | Approximate Longitude | Date of First Catch | Water Temperature (°F) |
|-------------------------|----------------------|-----------------------|---------------------|------------------------|
| 1<br>1960               | 49°N.                | 129°W.                | (none caught)       | -                      |
| 1961                    | 47°N.                | 130°W.                | August 13           | 60                     |
| 1962                    | 50°N.                | 134°W.                | August 6            | 62                     |
| 1963                    | 50°N.                | 136°W.                | July 23             | 55                     |
| 2<br>1960               | 45°N.                | 130°W.                | July 15             | 60                     |
| 1961                    | 43°N.                | 130°W.                | July 7              | 63                     |
| 1962                    | 45°N.                | 135°W.                | August 7            | 63                     |
| 1963                    | 46°N.                | 135°W.                | July 23             | 58                     |
| 3<br>1960               | 40°N.                | 129°W.                | July 10             | 58                     |
| 1961                    | 40°N.                | 133°W.                | June 29             | 59                     |
| 1962                    | 42°N.                | 129°W.                | July 6              | 59                     |
| 1963                    | 41°N.                | 134°W.                | June 16             | 62                     |
| 4<br>1960               | 36°N.                | 128°W.                | June 14             | 65                     |
| 1961                    | 35°N.                | 132°W.                | June 17             | 64                     |
| 1962                    | 40°N.                | 133°W.                | June 17             | 59                     |
| 1963                    | 36°N.                | 132°W.                | July 17             | 65                     |
| 5<br>1960               | 32°N.                | 124°W.                | June 5              | 62                     |
| 1961                    | 32°N.                | 124°W.                | June 8              | 64                     |
| 1962                    | 35°N.                | 132°W.                | June 11             | 59                     |
| 1963                    | 31°N.                | 129°W.                | July 25             | 64                     |
| 1/6<br>1960             | 2/x                  | x                     | x                   | -                      |
| 1961                    | x                    | x                     | x                   | -                      |
| 1962                    | 30°N.                | 128°W.                | July 19             | 64                     |
| 1963                    | 36°N.                | 124°W.                | July 23             | 64                     |

1/ Fishing intermittent during season.  
2/x - Station not fished.

## RESULTS

The 1963 catch was the highest for any one year since inception of the program. A total of 1,041 albacore was taken by the picket fleet. The estimated weight of that catch was about 10,858 pounds, or 5.4 tons.

The first catch of the 1963 season was reported at Station 3 on June 16 (table 1, fig. 1). The appearance of albacore at that station was about 2 weeks earlier than in previous years. Fishing continued with few interruptions through the season, and the last catch was logged on October 4. Water temperatures ranged from 61°-62° F. at the beginning to 68°-69° F. at the termination of fishing. Albacore appeared at Station 4 on July 17, about 4 weeks later than a year prior, and were first taken at Station 5 on July 25, more than 6 weeks later than in 1962<sup>1/</sup>. Stations 1 and 2 recorded their first catches of the year on July 23. Water temperatures at those locations ranged from 55°-58° F. at the commencement of fishing to a maximum of 64°-65° F. at the end of September.

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<sup>1/</sup> Comparisons are drawn with 1962 ship stations nearest to present stations, but 1962 locations, having the same numbers may differ from current positions by as much as 150 miles.

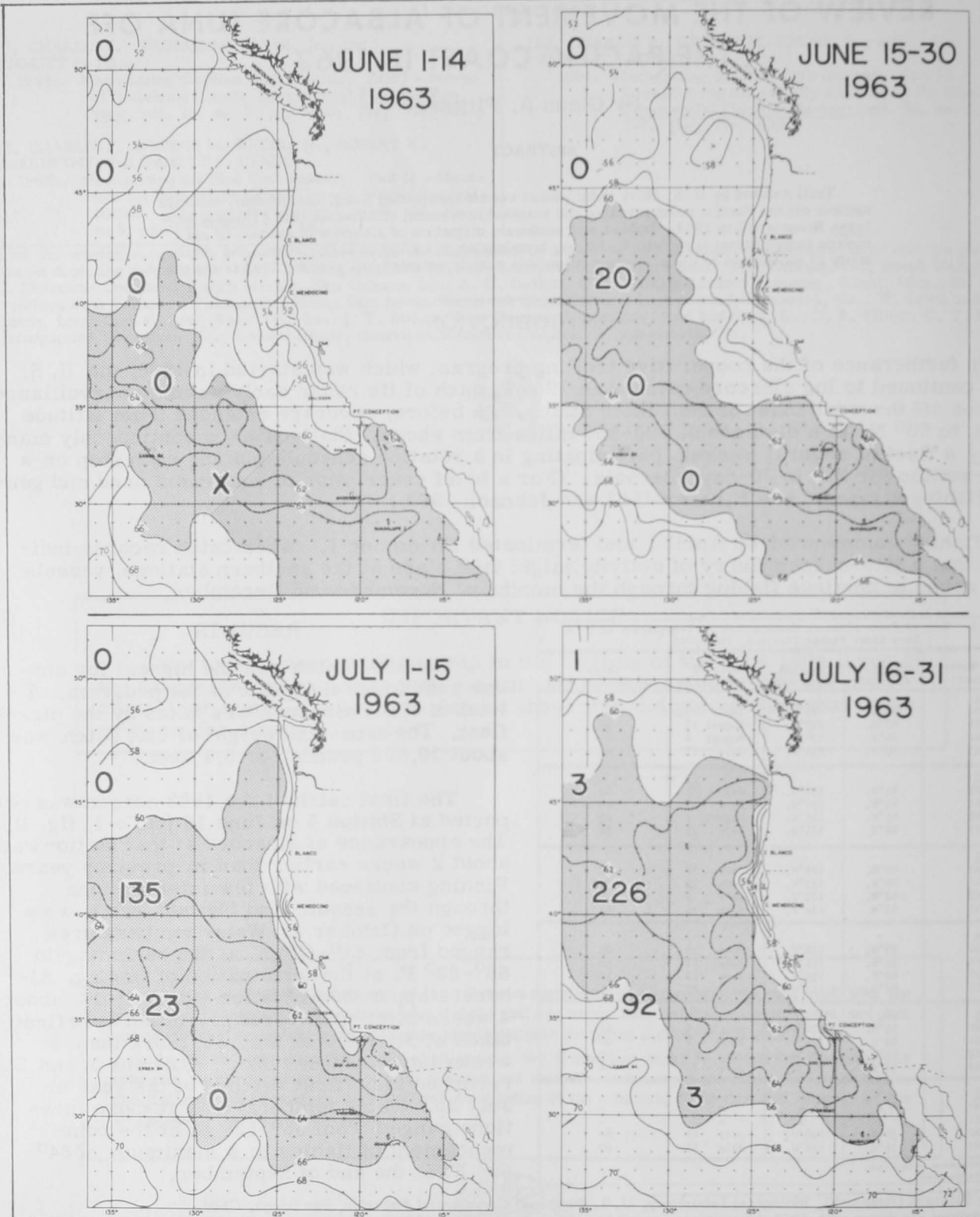


Fig. 1 - Albacore catch by U. S. Navy radar picket vessels in June-July 1963. Large numerals represent the catch at each station; small numerals indicate water temperature; and "x" indicates no fishing during the period. Shaded area delimits the 60°-66° F. temperature zone. More than two-thirds of the 1954-1958 California commercial albacore landings for June-September were taken from waters within those temperature limits.

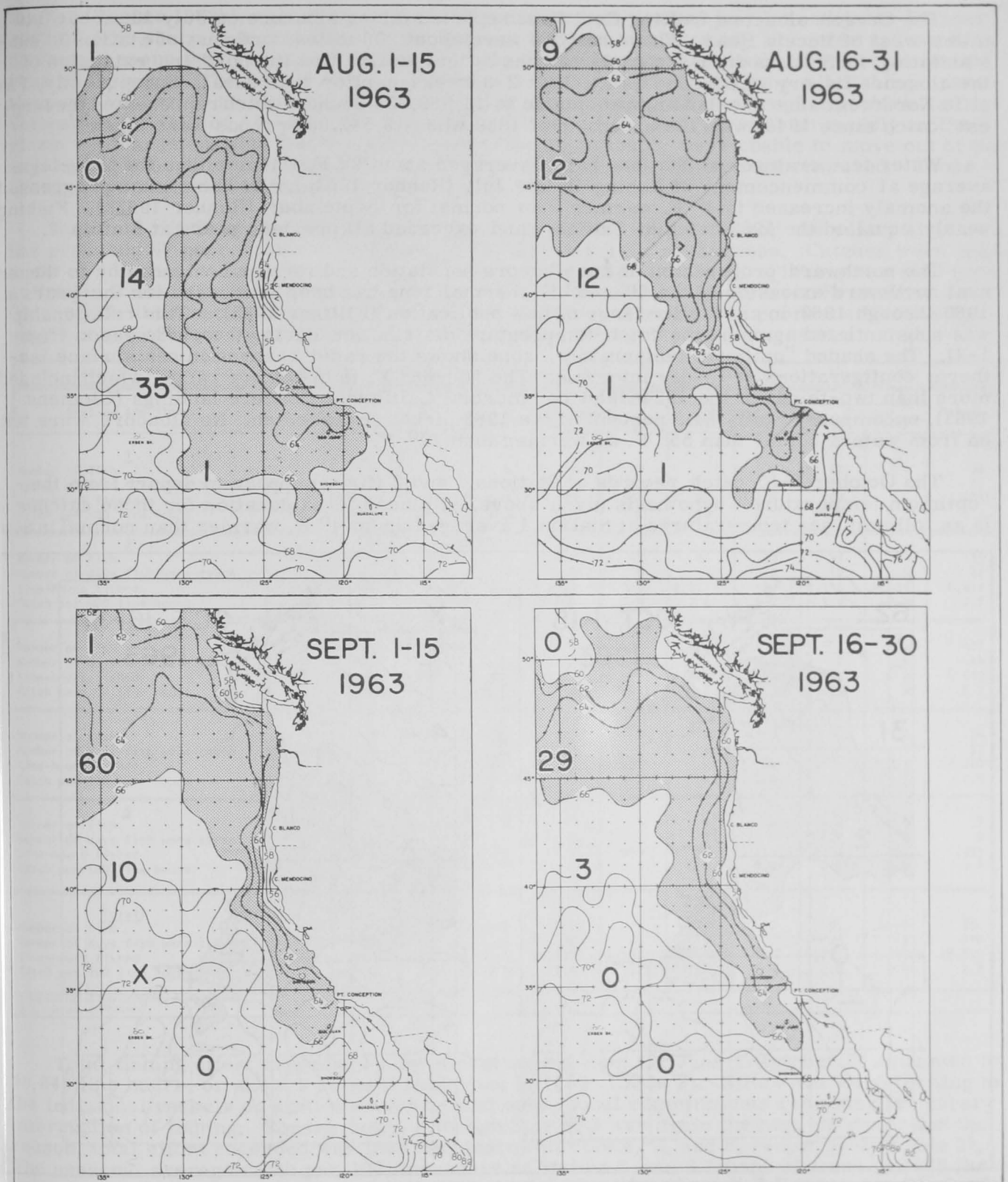


Fig. 2 - Albacore catch by U. S. Navy radar picket vessels in August-September 1962. Large numerals represent the catch at each station; small numerals indicate water temperature; and "x" indicates no fishing during the period. Shaded area delimits the 60°-66° F. temperature zone. More than two-thirds of the 1954-1958 California commercial albacore landings for June-September were taken from waters within those temperature limits.

The Oregon albacore trolling fleet first reported taking albacore on July 13, about 140 miles west of Heceta Head. Those catches were about 200 miles northeast of Station 3, substantiating indications from the early catches at that station that the northern extension of the albacore fishery was indeed as much as 2-3 weeks earlier than usual. Subsequently, Pacific Northwest albacore landings amounted to 11,868,978 pounds, which represented the largest catch since 1948, with the exception of 1959 when 13,542,804 pounds were taken<sup>2/</sup>.

Water temperatures at Stations 1 and 2 averaged about 2° F. warmer than the long-term average at commencement of fishing in late July (Renner 1963a). As the season progressed the anomaly increased to 4° F. warmer than normal for September (Renner 1963b). Fishing nearly equalled the 1962 catch at Station 1 and exceeded all previous years at Station 2.

The northward progression of the albacore population and its apparent relation to the annual northward extension of the 60°-66° F. thermal zone has been discussed for the years 1960 through 1963 in an earlier issue of this publication (Flittner 1963). This relationship was substantiated again by the catch-temperature distribution during the 1963 season (figs. 1-3). The shaded "optimum temperature" zone shows the rapid changes in sea surface isotherm configurations at 15-day intervals. The 60°-66° F. temperature range, which included more than two-thirds of the 1954-1958 commercial California albacore landings (Clemens 1961), encompassed fully 84.5 percent of the 1963 picket vessel catch. No albacore were taken from waters colder than 55° F. or warmer than 70° F.

The October 1-15 catch records at Stations 1 and 2 (fig. 3) appear to depart from the "optimum temperature" hypothesis given above. A plausible explanation for those catches is as follows: sea temperatures at Station 1 averaged up to 4° F. warmer than normal in Sep-

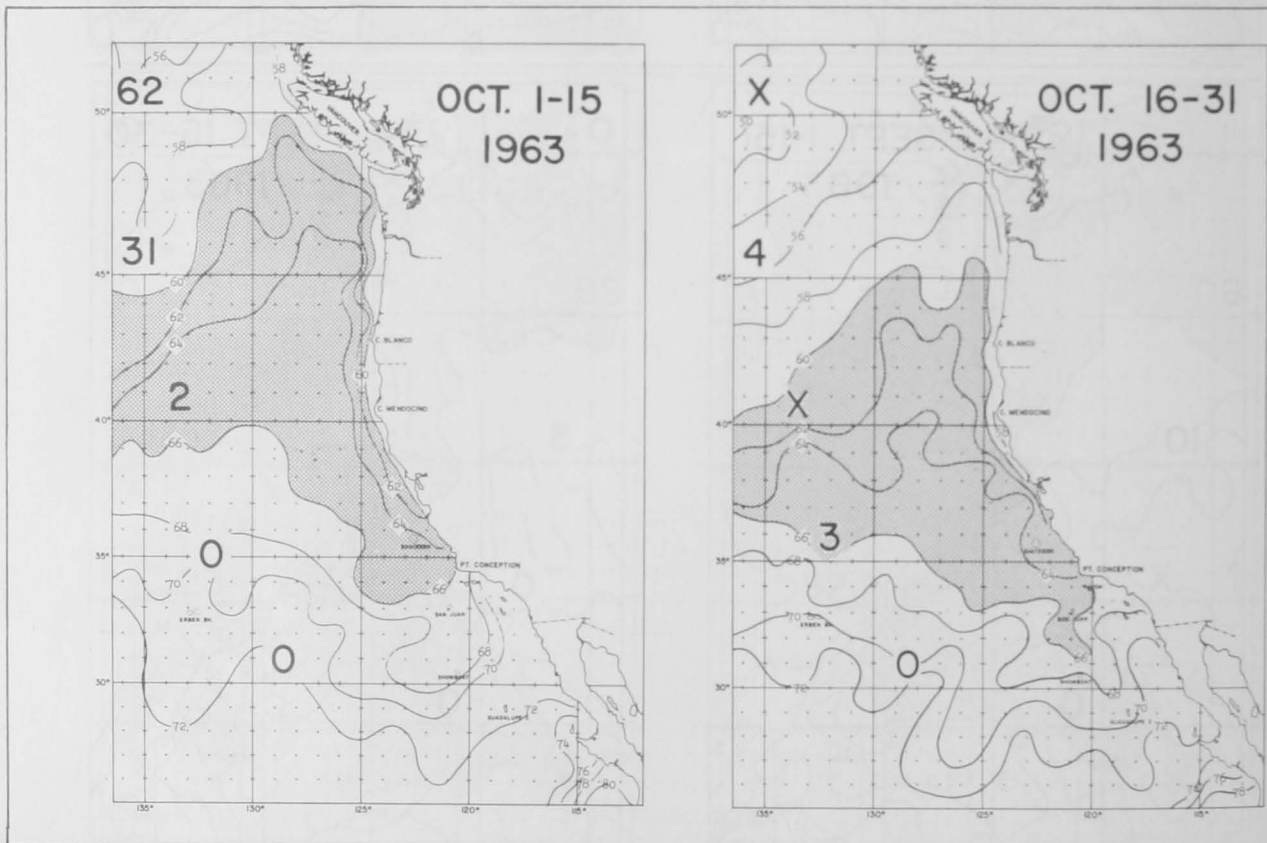


Fig. 3 - Albacore catch by U. S. Navy radar picket vessels in October 1963. Large numerals represent the catch at each station; small numerals indicate water temperature; and "x" indicates no fishing during the period. Shaded area delimits the 60°-66° F. temperature zone. More than two-thirds of the 1954-1958 California commercial albacore landings for June-September were taken from waters within those temperature limits.

<sup>2/</sup> Pacific Fisherman Yearbook, 1964.



tember (Renner 1963b), whereas they were 3° F. colder than normal just 1 month later (Renner 1963c). The sharp 7-degree drop in sea surface temperature anomaly occurred in less than 30 days at more than two times the normal rate of cooling characteristic of the region at that time of the year. The vessel fishing on Station 1 reported having to stop all fishing operations on October 15 as a result of heavy weather from an intense storm system which had developed in the Gulf of Alaska. The upper mixed layer of the sea lost heat so rapidly as the storm system intensified that the schools of albacore probably were unable to move out of the region fast enough to avoid the suboptimal thermal conditions which were observed. Those changes are reflected in the 15-day charts (fig. 3).

Station 3 off Cape Mendocino again logged the highest total catch for the year. That area has produced 47 percent of the combined 1960-1963 catch for all stations. Catches were made on 32 of 46 consecutive days from June 16-July 31 in 1963 (table 2). Fishing was also good at Station 2 where catches were logged on 35 of 45 consecutive days between September 1 and October 15, thus establishing a new record for the area. Fishing was poorest at Station 5, where only 5 albacore were taken on 5 separate days during the entire season.

Table 2 - Albacore Catch and Effort Data for U.S. Navy Radar Picket Vessels Trolling on Station, June-October 1963

| Station and item               | Period |       |       |       |        |       |           |       |         |       | Totals |  |
|--------------------------------|--------|-------|-------|-------|--------|-------|-----------|-------|---------|-------|--------|--|
|                                | June   |       | July  |       | August |       | September |       | October |       |        |  |
|                                | 1-15   | 16-30 | 1-15  | 16-31 | 1-15   | 16-31 | 1-15      | 16-30 | 1-15    | 16-31 |        |  |
| <u>1</u>                       |        |       |       |       |        |       |           |       |         |       |        |  |
| Number of fish                 | 1/0    | 1/0   | 0     | 1     | 1      | 9     | 1         | 1/0   | 62      | 2/x   | 74     |  |
| Number of days fish were taken | 0      | 0     | 0     | 1     | 1      | 2     | 1         | 0     | 12      | x     | 17     |  |
| Line-hours fished              | 18     | 32    | 448   | 512   | 737    | 861   | 168       | 108   | 589     | x     | 3,473  |  |
| Catch per 100 line hours       | 0.0    | 0.0   | 0.0   | 0.2   | 0.1    | 1.0   | 0.6       | 0.0   | 10.5    | x     | 2.1    |  |
| <u>2</u>                       |        |       |       |       |        |       |           |       |         |       |        |  |
| Number of fish                 | 1/0    | 0     | 0     | 3     | 1/0    | 12    | 60        | 29    | 31      | 4     | 139    |  |
| Number of days fish were taken | 0      | 0     | 0     | 2     | 0      | 6     | 14        | 9     | 12      | 4     | 47     |  |
| Line-hours fished              | 0.0    | 424   | 304   | 256   | 0      | 1,221 | 2,321     | 513   | 1,116   | 456   | 6,611  |  |
| Catch per 100 line hours       | 0      | 0.0   | 0.0   | 1.2   | 0.0    | 1.0   | 2.6       | 5.7   | 2.8     | 0.9   | 2.1    |  |
| <u>3</u>                       |        |       |       |       |        |       |           |       |         |       |        |  |
| Number of fish                 | 0      | 20    | 135   | 226   | 1/14   | 1/12  | 10        | 3     | 1/2     | 2/x   | 422    |  |
| Number of days fish were taken | 0      | 7     | 10    | 15    | 3      | 3     | 3         | 1     | 2       | x     | 44     |  |
| Line-hours fished              | 368    | 714   | 814   | 787   | 44     | 114   | 860       | 944   | 184     | x     | 4,829  |  |
| Catch per 100 line hours       | 0.0    | 2.8   | 16.6  | 28.7  | 31.8   | 10.5  | 1.2       | 0.3   | 1.1     | x     | 8.7    |  |
| <u>4</u>                       |        |       |       |       |        |       |           |       |         |       |        |  |
| Number of fish                 | 0      | 1/0   | 23    | 92    | 35     | 1/1   | 2/x       | 1/0   | 0       | 3     | 154    |  |
| Number of days fish were taken | 0      | 0     | 6     | 14    | 11     | 1     | x         | 0     | 0       | 1     | 37     |  |
| Line-hours fished              | 930    | 192   | 424   | 1,054 | 910    | 437   | x         | 84    | 2,696   | 1,273 | 8,000  |  |
| Catch per 100 line hours       | 0.0    | 0.0   | 5.4   | 8.7   | 3.8    | 0.2   | x         | 0.0   | 0.0     | 0.2   | 1.9    |  |
| <u>5</u>                       |        |       |       |       |        |       |           |       |         |       |        |  |
| Number of fish                 | 1/0    | 0     | 0     | 3     | 1      | 1     | 0         | 0     | 1/0     | 0     | 5      |  |
| Number of days fish were taken | 0      | 0     | 0     | 3     | 1      | 1     | 0         | 0     | 0       | 0     | 5      |  |
| Line-hours fished              | 18     | 564   | 577   | 763   | 814    | 649   | 1,198     | 612   | 138     | 600   | 5,933  |  |
| Catch per 100 line hours       | 0.0    | 0.0   | 0.0   | 0.4   | 0.1    | 0.2   | 0.0       | 0.0   | 0.0     | 0.0   | 0.1    |  |
| <b>Totals</b>                  |        |       |       |       |        |       |           |       |         |       |        |  |
| Number of fish                 | 0      | 20    | 158   | 325   | 51     | 35    | 71        | 32    | 95      | 7     | 794    |  |
| Number of days fish were taken | 0      | 7     | 16    | 35    | 16     | 13    | 18        | 10    | 26      | 5     | 150    |  |
| Line-hours fished              | 1,334  | 1,926 | 2,567 | 3,372 | 2,505  | 3,282 | 4,547     | 2,261 | 4,723   | 1,729 | 28,846 |  |
| Catch per 100 line hours       | 0.0    | 1.0   | 6.2   | 9.6   | 2.0    | 1.1   | 1.6       | 1.4   | 2.0     | 0.4   | 2.8    |  |

1/Station fished intermittently during period.

2/X - Station not fished.

Total fishing effort expended by the picket vessel fleet for June 1-October 31 amounted to 28,846 line hours, or about 8 percent less than in 1962 (table 2). Effort varied according to the individual vessels on station, weather, and operational commitments requiring temporary interruption of fishing. Consequently, although Station 3 was again the high producer for the season, total effort expended was less than that on Stations 4, 2, and 5, respectively (table 2). The seasonal average catch per 100 line-hours at Station 3 was 8.7 fish, whereas in 1962 the average for the same station was 6.6 fish. In both years, the average catch per 100 line-hours at Station 3 has exceeded the average combined catch of all stations by a factor of 3.

Although the peak of the commercial fishing activity occurred in September, the highest catches were recorded by Navy vessels during the July 16-31 interval (table 2). Catch per

100 line-hours averaged 9.6 fish. Highest catch rates were attained at Station 3, where during the July 16-31 period, 28.7 albacore were landed per 100 line-hours of trolling; 31.8 fish were taken per 100 line-hours in the August 1-15 interval<sup>3/</sup>.

As in previous years, catch-effort data were tabulated for all stations up to October 31 in accordance with the original fishing time limit (April 1-October 31) set up at the inception of the trolling program in 1960. When the 1963 season appeared to persist much later than usual, the vessels occupying Stations 4 and 5 were asked to continue fishing. Those vessels were able to fish well into December before heavy weather swept away their trolling gear.

Evidence of late-season activity was noted in 1962 at 40° N., 133° W. where 16 albacore from 7-11 pounds were taken November 1 through 10. In 1963, 247 albacore were taken at Station 4 (36° N., 131° W.) between November 1 and December 17. Catches reached a peak in the November 1-15 interval and declined thereafter (table 3). The vessel on Station 4 reported losing an additional 40 albacore because of inclement weather and heavy seas between November 1 and 8. Station 5 produced no catch.

| Item                           | November |       | December |       | Totals |
|--------------------------------|----------|-------|----------|-------|--------|
|                                | 1-15     | 16-30 | 1-15     | 16-31 |        |
| Number of fish                 | 194      | 40    | 11       | 1/2   | 247    |
| Number of days fish were taken | 14       | 14    | 6        | 1     | 35     |
| Line-hours fished              | 1,111    | 718   | 374      | 44    | 2,247  |
| Catch per 100 line hours       | 17.5     | 5.6   | 2.9      | 4.5   | 11.0   |

1/ Station not fished entire period due to loss of fishing gear.

One noteworthy feature of the late-season catch is that for the second year the picket vessels apparently observed the offshore migration of the albacore population. Heavy commercial landings of small fish were reported at Monterey and Morro Bay during the week ending October 25. Catches declined in the November 1-15 interval, and bad weather terminated the fishery in the week ending November 22, coincident with the increased catches observed at Station 4.

The modal length of the November-December catch at Station 4 was 59 centimeters (23.2 inches, 9.5 pounds). No fish larger than 64 centimeters (25.2 inches, 12 pounds) were taken. Eight albacore were less than 40 centimeters long; the smallest, a 32-centimeter fish (12.6 inches, about 1 $\frac{3}{4}$  pounds), was caught November 22 in 68°-F. water.

Comparison of albacore movements in 1963 to last year's generalized schematic model of migration (Flittner 1963) demonstrated close agreement on the broad scale. Albacore entered the coastal region and turned north about 3 weeks earlier than in the preceding 3 years, whereas migration into southern waters was up to 6 weeks later than usual. Onshore and northward movements appeared to follow the model and were limited by the distribution of "optimum" sea temperatures. The development of a good nearshore fishery in Central California and Oregon waters came early in July (fig. 1) and persisted through October as favorable sea temperatures developed in a narrow north-south zone well within reach of the albacore fishing fleet (figs. 2-3).

U.S.S. Picket carried off the honors in total catch for the second consecutive year: 360 albacore were landed of a grand total of 1,041 fish for all vessels combined; of that total, 357 were taken on Station 5 in a single patrol (fig. 4). U. S. S. Scanner was second highest vessel with a total catch of 284 albacore. Picket logged the highest catch in one day at Station 5 on July 19 when 52 albacore were taken; 46 had been caught on the previous day. Scanner landed 42 fish on November 12 at Station 7, and took 33 albacore 2 days later.

<sup>3/</sup>Although the effort expended on the station was minimal during this time, fishing occurred at intervals throughout the entire 15-day period. Fish were taken on each day the lines were out.

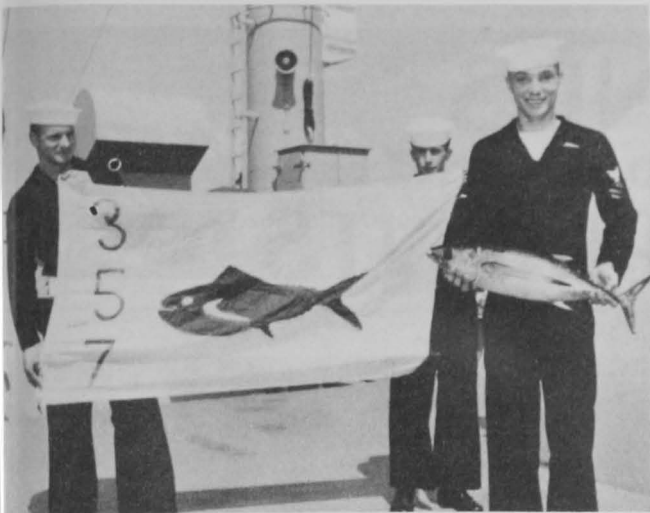


Fig. 4 - Men of the U.S.S. *Picket* display a sample of their record catch made on a single patrol at Station 5.

Age-group representation of the 1963 picket vessel catch was similar to 1962. The 22-inch group (56 cm.) comprised 42 percent of the catch, whereas the 25-inch group (62-64 cm.) made up about 48 percent of the total (fig. 5). The remainder of the catch consisted of very small fish (about 2 percent) and fish 30 inches or longer (about 8 percent). The largest fish taken was a 36-inch, 34-pound albacore which was caught on July 23 at Station 1.

For the fourth consecutive year, distribution and availability of albacore off the U.S. west coast exhibited a striking correlation with prevailing sea surface temperatures as revealed by the 15-day charts prepared by the Biological Laboratory, San Diego. The rapid northward progression of the "optimum temperature" zone with the advance of each summer season offers substantial evidence concerning one of the factors bringing about the rapid seasonal shifting of the centers of albacore abundance.

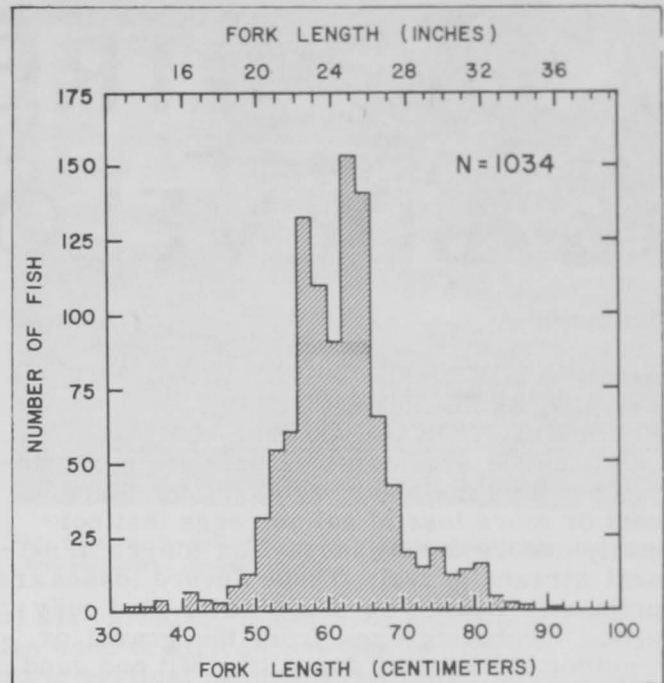


Fig. 5 - Length-frequency distribution of albacore taken by U. S. Navy radar picket vessels trolling on station, June-December, 1963. All stations combined.

LITERATURE CITED

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Note: Personnel of Radar Picket Squadron One are again to be congratulated for their participation in a cooperative program which has proven its worth to fishery scientists and to the albacore fishing industry, and has provided recreation to the picket vessel crew members. Tuna research workers and albacore fishermen alike are grateful to the officers and men of the squadron for their continued and enthusiastic participation in the trolling program.

