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NOAA-TM-NMFS-SWFC-66

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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INTRODUCTION

Two U.S. troll fishing vessels conducted exploratory fishing for albacore and made related scientific observations in the South Pacific during February-March, 1986. A major objective of the survey was to gain experience necessary to evaluate the feasibility of developing a U.S. troll fishery that would operate during about January through May; would be centered about 1500 to 2000 miles southeast of American Samoa; and would utilize the infrastructure in Pago Pago, American Samoa for selling catches to U.S. canneries, refueling, making repairs, and reprovioning.

The development of a U.S. albacore fishery in the South Pacific would significantly benefit the U.S. albacore industry by enabling year-around fishing operations. For example, boats could fish in the North Pacific during boreal spring through early fall months when the fishery traditionally operates there, and shift operations to the South Pacific during austral spring and summer months. In addition, the development of a U. S. fishery in the South Pacific would reduce the amount of imports of albacore required to meet the U.S. consumer demand for white meat tuna. At present all albacore canned by U.S. processors in Pago Pago are caught by

foreign nations. This amounts to more than 20,000 tons annually with an ex-vessel value in excess of \$30 million.

The fishing vessels Day Star, with Captain Carroll Hoepfner, and Bald Eagle, with Captain Terry Hornidge, participated in the exploratory albacore fishing operations. Each vessel received \$60K in financial support from Saltonstall-Kennedy funds that were awarded to the Pacific Fishery Development Foundation in collaboration with the American Fishermen's Research Foundation. In addition to carrying on exploratory fishing, the participating vessels worked in cooperation with the Southwest Fisheries Center (SWFC) of the National Marine Fisheries Service (NMFS) which is part of the National Oceanic and Atmospheric Agency (NOAA), in making scientific observations related to albacore. The NOAA R/V Townsend Cromwell also conducted research operations in support of the exploratory fishing. This report summarizes findings made by the fishing vessels.

BACKGROUND INFORMATION

Albacore has been a principal target of tuna fishing in the South Pacific since Japanese longliners began operating near the Solomon Islands in 1952. The Japanese fleet extended eastward and in 1954 some of these vessels began landing albacore, yellowfin and bigeye tuna at Pago Pago under contract to a U.S. cannery there. The fishery grew steadily and was entered by longliners from Taiwan and the Republic of Korea, which based their operations in Pago Pago. A second U.S. cannery was subsequently opened in Pago Pago, and other bases for foreign tuna longliners were established in the New Hebrides, Fiji, and Tahiti. Beginning in 1973 the

Japanese withdrew from making albacore landings in Pago Pago and now virtually all of their landings are made in Japan.

The longline fishery for albacore is carried out over a wide area from about longitudes 150°E to 120°W, and from equatorial waters to latitudes 40°S. In recent years the South Pacific longline fisheries have caught about 30 to 35 thousand metric tons of albacore annually.

New Zealand has a troll fishery for tuna which began in 1968 and is patterned after the U. S. albacore fishery of the late 1950's. The New Zealand fishery has taken about 1000 to 3500 metric tons in recent years. Albacore are primarily caught between about December and March by vessels fishing within about 75 miles of the coast. Nearly all catches are made off the west coast between about 40° and 45°S, with best catches made in warm summers. The albacore fishery is of growing importance in New Zealand and fishery scientists believe it is capable of considerable expansion both in area and season fished.

There is also a total of up to a few hundred tons of albacore caught incidentally in other fisheries during some years in Australia, South Pacific Island artisanal fisheries and Chile.

CRUISE TRACK

The vessels departed San Diego, California (32°20'N, 117°W) on January 13, 1986. They followed a southerly/southwesterly course transiting to the fishing grounds, with only a brief stop at anchor near Pitcairn Island

to obtain fresh fruit. They commenced fishing for albacore on February 8 near 38°S, 141°W, where there were sharp breaks in sea surface temperature (SST) with temperatures dropping from about 70°F to 66°F over distances of one mile or so. The vessels operated mainly between about 38° to 41°S and 141° to 155°W. On March 12 the vessels explored waters westward of 155°W, reaching 170°W on March 18 where they turned north heading for Pago Pago. They arrived in Pago Pago on March 27 where they unloaded their catches, refueled, and reprovisioned. The vessels departed Pago Pago on April 8 for Honolulu from where they will leave to begin fishing for albacore in the central North Pacific near about 32°N and 175°W in early May.

Figure 1 shows the cruise track followed by the F/V Day Star while carrying on albacore trolling exploration and in transit to Pago Pago. The F/V Bald Eagle operated on a similar track.

SURVEY OPERATIONS

The vessels conducted exploratory fishing for albacore using standard U. S. commercial troll fishing methods as described by Dotson (1980). Both vessels normally fished 12 to 13 lines. However, the Day Star fished only 2 to 3 lines after the vessel was filled and the Captain concentrated on catching albacore for tagging (see section on tagging below). The vessels usually fished about 12 to 14 hours each day, commencing shortly after dawn. They generally operated within about 30 miles of each other. Both vessels were outfitted with sea surface temperature (SST) gauges,

Dotson, Ronald C. 1980. Fishing methods and equipment of the U. S. West Coast albacore fleet. NOAA-TM-NMFS-SWFC-8, 1980, 126 pp.

expendable bathythermographs, and sounders with chromoscopes for use in locating potentially favorable fishing areas. Further information on vessel characteristics for the Day Star and the Bald Eagle is given in Appendix 1.

The vessels also cooperated with the NMFS/SWFC by keeping detailed daily fishing logs, making oceanographic observations including SST and subsurface temperature measurements, conducting albacore tagging operations and making marine weather observations.

ALBACORE CATCHES

Information on albacore catches made by the two vessels is given in Appendix 2, which provides a summary of catches by date and location along with information on fish size, SST, and weather and sea conditions. The geographic distribution of catch per day is shown in Figures 2 and 3 for the Day Star and Bald Eagle, respectively.

The F/V Day Star caught an estimated total of 55 1/2 tons of albacore. The vessel was filled to capacity after 29 days of fishing, and delivered 50.6 tons of albacore to the cannery at Pago Pago. The Day Star also tagged and released an estimated 5 tons of albacore (see comments about tagging below). The F/V Bald Eagle caught about 52 tons of albacore over a 39 day period, including an estimated 0.9 ton that were tagged and released.

The Day Star's best catch for one day's fishing was 1421 albacore with an estimated average fish weight of 17 pounds. This catch amounted to an

estimated total weight of 12.3 tons, which is believed to be an all-time record for one day's catch of albacore made by a U.S. jigboat. Information on catches made by the Day Star during the 29 days of fishing is given in Table 1, which shows that the catch per day was 200 or more 38% of the time. The Captain of the Day Star rated the fishing as good to excellent 35% of the time.

Fishing was carried on within a rather narrow latitudinal band between about 38°30 and 41°S. The area of best fishing was between about 141° to 151°W; westward of 151°W the catches dropped off considerably (see Figures 2 and 3).

TABLE 1. Information on Number of Albacore Caught per Day by F/V Day Star during 29 Days of Fishing.*

No. fish caught	No. days	Percent of days
5 - 100	11	38
138 - 171	7	24
200 - 297	4	14
300 - 394	5	17
> 500	2	7

*The fish hold on the Day Star was filled to very near capacity after 29 days of fishing. After this time only 2 to 3 lines were trolled to catch fish for tagging.

FISH SIZE

The albacore ranged in size from about 4 to over 40 pounds. The range for the average daily size was from about 13 to 22 pounds (Table 1). The trip average weight was 17.75 pounds for the Day Star and 17.40 pounds for the Bald Eagle. Unfortunately, no size measurements were made at the cannery after the fish were unloaded.

The size composition of albacore tagged and released by the fishing vessels and the R/V Townsend Cromwell is shown in Figure 4. This is probably similar to the size composition of albacore caught by the fishing vessels, except the proportion of larger fish may be somewhat under-represented.

ALBACORE TAGGING

There is virtually no information available concerning the migration patterns of albacore in the South Pacific. Only a relatively small number of albacore have been tagged and released, and there are no records of even a single tagged albacore having been recovered in the South Pacific. Judging from what is known about the migratory habits of albacore in the North Pacific and the North Atlantic from tagging studies and other information, the albacore in the South Pacific probably undergo extensive, and perhaps complicated migrations.

Information on the migration patterns of albacore is necessary in order to efficiently and effectively develop a U. S. troll fishery in the South Pacific. Fishery scientists also require information on migration and

on age and growth, which tagging data can provide, for developing an understanding of the biology of the South Pacific albacore population. To help fill these gaps in information, a total of 724 albacore was tagged and released by fishermen on the troll vessels and scientists on board the research vessel; two skipjack were also tagged. The tagging is an extension of the highly successful joint SWFC/AFRF (government/industry) albacore tagging program which has been underway in the North Pacific since 1971.

Great care was exercised to tag and release only fish which were hooked by the upper jaw and judged to be in prime condition. Fish that showed signs of severe bleeding were hooked by the upper jaw or through the roof of the mouth, or showed signs of extreme exhaustion were not tagged. As soon as a fish was brought on board and determined to be in excellent condition, the fork length was measured, and it was tagged with a single spaghetti-dart Floy tag and released.

About one-third of the fish tagged on the Day Star and all the fish tagged on the research vessel were also injected intramuscularly with a 1.5-mL titre of 100 mg/ml oxytetracycline hydrochloride solution for a special ageing study. The fish that were injected with tetracycline were tagged with a red tag which had a printed legend notifying the finder to return the fish with the tag intact. The other fish were tagged with yellow tags with a request only for recovery information. For each fish tagged and released records were kept of the number of the tag, the date of tagging, the fork length to the next lower centimeter, condition of the fish and sea surface temperature.

A total of 602 albacore was tagged on the F/V Day Star of which 179 were injected with tetracycline. Two skipjack were also tagged on the Day Star. After the Day Star caught a full load of albacore it concentrated on tagging, trolling 2 to 3 lines using a no. 6 salmon hook with the barb flattened, and slowing the vessel to about 3 to 3-1/2 knots when a fish struck the lure. About 80% of the fish caught using this technique were suitable for tagging, compared to about 12 to 15% when using conventional albacore fishing methods. One hundred albacore were tagged and released on board the Bald Eagle and 21 on the R/V Cromwell. The size composition of the fish tagged and released is shown in Figure 4.

OCEANOGRAPHIC CONDITIONS

Each of the fishing vessels was equipped with electronic thermometers for continuous measurement of SST and with an expendable bathythermograph (XBT) for measuring vertical profiles of ocean temperature to 1500 feet depth. The SST sensor was monitored and readings were recorded frequently. XBT drops were made usually once each day, except during an equipment malfunction on board the Day Star during the middle one-third of the survey. Marine weather observations were made once each day according to the World Meteorological Organization format. In addition to being used by the fishermen, the weather and XBT data were transmitted to Washington, D.C. automatically via satellite by special equipment placed on the fishing vessels by the NOAA National Ocean Service Office of Ocean Services.

The survey area was characterized by having SST's ranging from about 62.0° to 67.0°F, mixed layer depths to the top of the thermocline ranging from 135 to 170 feet, depths to the middle of the thermocline centered at

about 180 feet, depths to the bottom of the thermocline near 200 feet, and strong thermocline gradients ranging from 5° to 7°F. Well developed sea surface temperature fronts were generally found at the north and slightly to the south of the survey area. Temperatures north of the survey area were warmer than 66° to 67°F and south of the area were cooler than 62°F. Minor sea surface temperature gradients were found within the survey area. There was also an oblong, eddy-like structure of warm water with SST's about 65° to 66°F that was entrained within an area of cooler water centered near 39°N and 144° to about 145°W. Consistently good fishing and high catches were made in the warm-water eddy.

Oceanographic sampling conducted by the R/V Townsend Cromwell (see Figure 5 for cruise track) showed that the survey area was entirely within Subtropical Convergence Zone (SCZ) waters. This region is analogous to the Transition Zone in the North Pacific where the U. S. albacore fishery operates. The upper layer currents were rather weak and generally flowing easterly with some meandering reversals (Figure 6). The water depths were mostly greater than 2000 fathoms and there were no prominent seamounts or shallow regions within the area.

Albacore were caught from waters with SST's ranging from about 62.5° to 66.5°F. Most catches and highest catches were taken from waters with SST's between about 65.0° and 66.0°F, which is about 1°F warmer than SST's where best catches are made in the central North Pacific. Nearly all catches were associated with SST fronts or "edges."

Findings from the research vessel and fishing vessels indicate that the distribution of albacore in the South Pacific is associated with the Subtropical Convergence Zone and that the southern limit to the distribution appears to coincide with the southern boundary of the SCZ.

The pattern of catching albacore experienced during the South Pacific survey suggested that the fish were swimming fairly deep in response to relatively deep thermocline depths. Acoustic tracking studies conducted in the North Pacific have shown that albacore spend most of the time swimming in the vicinity of the thermocline. During the South Pacific survey fishermen noted on numerous occasions that fishing was spotty. Circling jig strikes would often result in all or most of the jiglines being filled for up to several circles, but then catches would then drop off abruptly. Search-trolling would be unproductive for a modest period of time before another jig strike(s) would be made, and then a similar catch pattern would be repeated. A possible explanation for this pattern of fishing is that if fish were swimming in the vicinity of the thermocline, which was generally at 200 feet or deeper in the fishing area, they may have experienced difficulty visually detecting jigs trolled at the surface.

WIND AND SEA CONDITIONS

Weather conditions encountered while transitting from California to the fishing grounds and from the fishing grounds to Samoa were generally good with light trade winds and relatively calm seas. Weather conditions on the fishing grounds were also better than expected and only one day of fishing was lost due to weather. Winds were less than 15 knots about 50% of the time and above 35 knots 13% of the time (Table 2). The average swell

height was less than 4 feet 21% of the time, up to 8 feet 72% of the time, and greater than 15 feet 5% of the time (Table 3). The ocean conditions were rated as calm or light 41% of the time and unworkable 5% of the time (Table 4).

The Captain on the F/V Day Star noted that ". . . The weather on the grounds was much more pleasant than our North Pacific weather. We were seldom cold and it probably averaged 65°F or above. We had much more sunshine, no fog, with one misty day and only occasional showers . . . The winds do not seem to disturb the fishing, possibly because of the strong deep thermocline, and after a blow, fishing seems quite normal. On the other hand, a ten day spell of calm, hot sunny weather heated the surface up to 4°F above the mixed layer temperatures and we could not be sure of finding edges to fish. This is where the use of a bathy was invaluable because a 68° surface temperature may overlay a 64°F mixed layer, which we would be looking for."

TABLE 2. Summary of Wind Conditions Observed by U. S. Fishing Boats Conducting Exploratory Albacore Troll Fishing In the South Pacific during February 8 to March 19, 1986.

Ave. wind speed (Kts)	No. days	Percent of days
3 - 10	11	28
12 - 15	9	23
18 - 25	14	36
35 - 45	5	13

TABLE 3. Summary of Swell Conditions Observed by U. S. Fishing Boats Conducting Exploratory Albacore Troll Fishing in the South Pacific during February 8 to March 19, 1986.

Ave. swell height (Ft)	No. days	Percent of days
< 4	8	21
5 - 8	20	51
9 - 15	9	23
> 15	2	5

TABLE 4. Summary of Wave Conditions Observed by U. S. Fishing Boats Conducting Exploratory Albacore Troll Fishing in the South Pacific during February 8 to March 19, 1986.

Category	No. days	Percent of days
Calm/light chop	16	41
Moderate chop	8	21
Heavy chop	10	26
Rough	3	8
Unworkable	2	5

FUEL CONSUMPTION

The fuel capacities of the F/V Day Star and the F/V Bald Eagle are 12,500 gallons and 17,560 gallons, respectively. The fuel consumption rates for both of the vessels are approximately 8 GPH while cruising and 6 GPH

while fishing (see Appendix 1). Both vessels departed San Diego with full tanks of fuel. Except for 2,460 gallons of fuel which the Bald Eagle transferred to the Day Star while at anchor near Pitcairn Island enroute to the fishing grounds, the vessels did not refuel until they reached Pago Pago at the end of the fishing trip. The Day Star used approximately 10,000 gallons of fuel, including that transferred from the Bald Eagle, and the Bald Eagle used about 11,100 gallons.

PRICE FOR ALBACORE PAID IN PAGO PAGO

The catches of albacore made by the vessels were sold in Pago Pago for the prevailing world price per short ton as follows: Fish 22 pounds and up - \$1560; 15 to 22 pounds - \$1485; 9 to 15 pounds - \$1140; less than 9 pounds - \$740.

SUMMARY

The prospects for establishing a U. S. albacore fishery in the South Pacific appear to be very favorable based on the experience of the two vessels that conducted trolling exploration. The relatively high catch rates and total catches, coupled with relatively good weather conditions and the infrastructure in Pago Pago for selling catches and supporting vessel needs, suggest that it is economically feasible for U. S. vessels to operate in the South Pacific. It also appears from what is known at this time, that the South Pacific albacore population is in good condition and can support a surface fishery. However, substantially more fishery exploration and knowledge of the migration patterns and biology of the

population are required to successfully develop a viable U. S. albacore fishery in the South Pacific.

APPENDICES AND FIGURES

- APPENDIX 1. Vessel characteristics for F/Vs Day Star and Bald Eagle.
- APPENDIX 2. Summary of fish catch, fish size, sea surface temperature, weather, and sea conditions by date and location for F/Vs Day Star and Bald Eagle.
- FIGURE 1. Cruise track followed by F/V Day Star on fishing grounds and transit to Pago Pago, American Samoa.
- FIGURE 2. Distribution of albacore catch per day made by F/V Day Star.
- FIGURE 3. Distribution of albacore catch per day made by F/V Bald Eagle.
- FIGURE 4. Size composition of albacore tagged and released by fishing vessels and research vessel.
- FIGURE 5. Cruise track and area of operations for R/V Townsend Cromwell, area of operations for New Zealand research vessel, and area of albacore catch made by U. S. troll boats.
- FIGURE 6. Upper layer current pattern deduced from dynamic height topography determined from oceanographic measurements made by R/V Townsend Cromwell.

Appendix 1. Vessel Characteristics.

Name	Day Star	<u>Bald Eagle</u>
Crew size	Captain, plus 2	Captain, plus 2
Length	73 feet	78 feet
Beam	22 1/2 feet	21 feet
Construction	Steel	Steel
Fuel capacity	12,500 gallons	17,560 gallons
Fuel consumption	8 GPH cruising 6 GPH fishing	8 GPH cruising 6 GPH fishing
Water capacity	900 gallons, plus watermaker	900 gallons, plus watermaker
Fish hold capacity	50 tons	70 tons
Refrigeration type	Spray brine	Spray brine
Radio equipment	2 SSB, 2 VHF	3 SSB, 1 VHF, 1 CB
Navigation equipment	Loran C with plotter, Sat. nav., Omega, Radar, Sextant	Loran C, Sat. nav., Omega, VHF-Dir. finder 2 Radars, Sextant
Other electronic equipment	Facsimile receiving system, Electronic thermometer, XBT (on loan), Sounder with chromoscope	Facsimile receiving system, Electronic thermometer, XBT (on loan), Sounder

Appendix 2. Summary of fish catch, fish size, sea surface temperature, weather, and sea conditions by date and location for F/Vs Day Star and Bald Eagle.

F/V DAY STAR

DATE	POSITION	ALBACORE NO. SIZE (LBS)	FISH SIGNS & FISHING COND.	NO. FISH TAGGED	SST (°F)	WIND SPD. DIR.	SEA CONDITIONS	WEATHER	REMARKS
2/8	37° 18'S 139° 30'W	0		0	65.5°	20 ENE	Heavy chop	Solid Overcast	1 Skipjack
2/9	38° 15'S 141° 00'W	160 8-35 16 Avg	Spotty strikes Fair fishing	6	66.0°	25 E	Rough		Baitfish
2/10	38° 25'S 141° 20'W	393 6-40 20 Avg	Spotty strikes all lines, good	16	65.8°	15 E	Moderate chop	Overcast	Baitfish
2/11	38° 34'S 141° 41'W	297 6-40 17 Avg	Spotty strikes all lines, good	27	65.0°	12 E	Moderate chop	Sunny	Baitfish
2/12	38° 39'S 141° 54'W	150 4-40 15 Avg	Spotty strikes all lines, fair	11	64.0°	15 E	Light chop	Sunny	Baitfish
2/13	38° 37'S 141° 48'W	138 6-40 15 Avg	Spotty strikes all lines, fair	18	64.0°	20 NE	Heavy chop	Sunny	Baitfish. Moved to 38° 26'S, 143° 00'W
2/14	38° 36'S 143° 23'W	171 6-30 14 Avg	Scattered strikes all lines, fair	13	64.0°	30-40 NW	Rough	Low Overcast	Baitfish. Turned SSW at 143° 45'W
2/15	38° 55'S 144° 48'W	300 12-18 13 Avg	Spotty strikes all lines, good	18	65.5°	25 NE	Heavy chop	Overcast	Baitfish. Fishing In +1° warm pocket
2/16	38° 53'S 144° 45'W	1421 11-30 16 Avg	Scattered strikes excellent fishing	18	65.3°	15 NW	Light chop	Partly cldy	Baitfish & Squid. Circles 100+ fish
2/17	38° 53'S 144° 52'W	293 12-35 14 Avg	Scattered strikes Good fishing	13	65.2°	40 W	Rough	Low Overcast	Baitfish. Tackling due to weather.
2/18	38° 54'S 145° 34'W	86 11-20 14 Avg	Spotty strikes, Slow fishing	11	64.0°	8 N	Calm	Clear	Fishing westward, Fish in pockets
2/19	39° 00'S 146° 40'W	64 10-20 15 Avg	Scattered strikes, Slow fishing	6	63.4°	5 NNW	Calm to Light	Sunny	Baitfish
2/20	38° 50'S 147° 20'W	153 16 Avg	Scattered strikes, Slow fishing	3	64.5°	12 NNE	Light chop	Fair	Scattered circles
2/21	38° 41'S 148° 30'W	80 16-40 22 Avg	Spotty strikes, Slow fishing	0	NR	25 NE	Heavy chop	Fair	Fishing westward 7 spots circled
2/22	38° 56'S 150° 37'W	29 8-40 16 Avg	Spotty strikes, Poor fishing	2	64.0°	25 NNE	Heavy chop	Misty, solid Overcast	Fishing westward, Squids, 4 bites.
2/23	38° 58'S 151° 09'W	32 18-45 20 Avg	Spotty strikes on long lines, poor	3	64.5°	10 N	Light chop	Fair, Broken clouds	Hot surface temp. no signs, 4 bites

2/24	39° 15'S 154° 45'W	2	10-15 13 Avg	Spotty strikes all lines, poor	0	66.5°	8	S	Light chop	Good, Clear sky	Turned East at 12:30/No fish
2/25	39° 32'S 152° 02'W	27	14-20 16 Avg	Spotty strikes all lines, poor	1	64.5°	18	NE	Moderate chop	Fair, Partly cloudy	First bite at 12:00
2/26	40° 21'S 150° 40'W	392	14-25 17 Avg	Spotty strikes all lines, excellent	34	63.3°	10	NE	Light chop	Good, Partly cloudy	Fishing 0.3°F break
2/27	40° 24'S 150° 40'W	358	16-22 17 Avg	Spotty strikes all lines, excellent	55	64.0°	3	NNE	Flat Calm, Glassy	Beautiful	Big schools of breezing fish
2/28	40° 29'S 150° 41'W	200	10-22 17 Avg	Spotty strikes all lines, slow	27	64.5°	5	NE	Calm	Clear and Sunny	Fewer fish in each circle
3/01	40° 34'S 149° 31'W	148	14-30 17 Avg	Spotty strikes all lines, slow	16	65.5°	10	SE	Light chop	Foggy	Fishing eastward, 7 bites for day.
3/02	40° 22'S 148° 31'W	54	14-22 17 Avg	Spotty strikes all lines, slow	6	66.0°	12-15	SE	Light chop	Misty, Low clouds	Baitfish
3/03	39° 49'S 147° 49'W	22	14-20 17 Avg	Spotty strikes all lines, poor	3	65.0°	5-10	SE	Light chop	Misty, Low clouds	Baitfish. 1 bite in morning
3/04	39° 52'S 145° 32'W	156	14-35 17 Avg	Spotty strikes all lines, fair	11	66.0°	15	SW	Moderate chop	Overcast, Squalls	Baitfish. Morning and evening bite
3/05	39° 52'S 144° 53'W	5	14-18 15 Avg	Spotty strikes all lines, poor	0	65.5°	20	SW	Moderate chop	Misty, Low overcast	Near former area of good catches.
3/06	39° 52'S 145° 46'W	311	12-45 17 Avg	Spotty strikes all lines, good	27	65.0°	20	S	Moderate chop	Clear, Ptlly cloudy	Fished in a 4 mi. wide warm strip.
3/07	39° 52'S 145° 40'W	7	14-30 14 Avg	Spotty strikes all lines, poor	0	65.0°	30-45	N	Unworkable	Storm, low Overcast	Shut down and drifted at 10:30
3/08	40° 12'S 145° 48'W	500	14-35 17 Avg	Spotty strikes all lines, excellent	79	65.0°	15	SW	Light chop but Heavy seas	Overcast, clearing	Fished one area, 100 fish/1 Hr Tacks
3/09	40° 19'S 145° 48'W	297	9-40 17 Avg	Spotty strikes all lines, good	62	64.0°	15-20	NE	Heavy chop	Fair, high clouds	Best fishing in warm pocket, Full.
3/10	40° 18'S 147° 26'W	16	8-18 15 Avg	Fishing two lines, Spotty strikes	10	63.7°	20-25	NE	Heavy chop	Blustery, low clouds	Tagging fish as we head westward.
3/11	40° 20'S 149° 22'W	0	NA	NA	0	64.0°	40	SW	Unworkable	Squalls	Making only 4 kts, too slow to fish
3/12	40° 24'S 150° 50'W	49	9-20 14 Avg	Fishing two lines, Scattered strikes	38	63.0°	20	S	Moderate chop	Squalls, low clouds	Birds and heavy bait balls.
3/13	40° 22'S 153° 32'W	7	10-17 15 Avg	Fishing two lines, Scattered strikes	5	63.4°	15-25	SW	Heavy chop	Fair, low clouds	Birds and bait in area.

3/14	40° 20'S 157° 52'W	9	14-17 15 Avg	Fishing two lines, Poor fishing	7	64.0°	18	S	Moderate chop	Sunny, ptly cloudy	No birds or bait
3/15	40° 10'S 160° 17'W	40	3-18 15 Avg	Two lines, spotty strikes, poor	28	63.0°	10	SE	Moderate chop	Good, low clouds	Finished tags, Fish scattered
3/16	40° 25'S 163° 31'W	10	8-19 13 Avg	Two lines, spotty strikes, poor	9	63.5°	5	E	Light chop	Good, low clouds	Meter marks and bait, gillnetter
3/17	40° 27'S 166° 22'W	2	9-14 13 Avg	Two lines, poor	1	65.5°	20-25	NW	Heavy chop	Sunny, high clouds	Water warming, no breaks, no signs.
3/18	39° 33'S 169° 32'W	8	13-24 18 Avg	Three lines, poor, Scattered strikes	6	65.5°	15	SE	Light chop	Sunny, scat. clouds	Turning N to Samoa tomorrow.
3/19	37° 00'S 170° 37'W	0	NA	Three lines, no fish.	0	67.5°	12	NW	Light chop	Sunny, low clouds	Running north on 137° 37'W.
3/20	35° 00'S 170° 37'W	0	NA	Three lines, 2 mahi mahi	0	69.0°	12	NNE	Light chop	Sunny, some low clouds	No signs
3/21	32° 00'S 170° 37'W	0	NA	Three lines, no fish	0	72.5°	12	NE	Light chop	Sunny, some low clouds	No signs
3/22	29° 00'S 170° 37'W	0	NA	Three lines, no fish	0	75.0°	20	ENE	Heavy chop	Squalls	Longliner in area
3/23	27° 00'S 170° 37'W	0	NA	2 mahi mahi, 1 wahoo 2 yellowfin tuna	0	78.0°	15	NW	Moderate chop	Sunny, overcast	No signs
3/24	23° 30'S 170° 38'W	0	NA	2 mahi, 3 skipjack 1 barracuda	0	81.0°	5	NW	Light chop	Sunny	No signs

F/V BALD EAGLE

DATE	POSITION	ALBACORE NO.	SIZE (LBS)	FISH SIGNS & FISHING COND.	NO. FISH TAGGED	SST (°F)	WIND SPD.	DIR.	SEA CONDITIONS	WEATHER	REMARKS
2/8	36° 15'S 137° 45'W	2	18 Avg	First fish	0	67.5°	18	SE	Sloppy, Seas 10-12 ft.	Overcast	Start charter today
2/9	38° 08'S 141° 02'W	114	13-30 17 Avg	Scattered strikes, Excellent fishing	0	66.5°	18	SE	Seas 7 ft. Moderate chop	Overcast	Wind increased to 30 kts. in eve.
2/10	38° 17'S 141° 20'W	196	13-50 17 Avg	Scattered strikes, Excellent fishing	0	66.0°	18	SE	Moderate chop, Sloppy	Overcast	Small Spanish Mackerel (5-6 cm)
2/11	38° 32'S 141° 25'W	253	6-40 16 Avg	Scattered strikes, Excellent fishing	0	65.6°	15	SE	Heavy chop, Seas 6 ft.	Good	
2/12	38° 46'S 141° 57'W	107	6-40 16 Avg	Scattered strikes, Excellent fishing	0	62.9°	15	SE	Heavy chop, Swell 10 ft.	Overcast	Mackerel, octopus
2/13	39° 41'S 141° 57'W	58	12-25 15 Avg	Scattered strikes, Slow fishing	0	63.0°	25	S	Rough seas, 12 ft.	Overcast	Mackerel, squid
2/14	40° 43'S 142° 51'W	111	10-20 14 Avg	Scattered strikes, All lines	0	62.4°	20	S	Rough seas, 10 ft.	Sloppy	Feed the same
2/15	40° 05'S 144° 02'W	188	10-25 15 Avg	Fair fishing, strikes, all lines	14	62.8°	30	N	Rough seas, 8 ft.	Sloppy	
2/16	38° 58'S 144° 29'W	712	10-35 14 Avg	Excellent fishing	9	65.2°	12	E	Light chop	Good	Lots of bait in fish
2/17	38° 59'S 144° 37'W	264	13-40 16 Avg	Strikes on all lines	5	65.5°	25	W	Rough 8 ft.	Clear	
2/18	38° 52'S 144° 39'W	692	13-40 17 Avg	Strikes on all lines	16	65.0°	10	S	Light chop	Fair	
2/19	38° 59'S 144° 47'W	235	13-35 17 Avg	Strikes on all lines	5	65.0°	10	S	Calm with a large lump	Good	
2/20	39° 03'S 144° 53'W	253	13-30 17 Avg	Good fishing	6	65.2°	15	E	Light chop	Fair	
2/21	39° 10'S 144° 54'W	100	13-35 15 Avg	Fish hitting long lines	6	65.2°	25	E	Moderate chop	Fair and clear	Running west tonight
2/22	39° 00'S 147° 45'W	50	13-25 14 Avg	Fish hitting long lines	1	64.2°	-	-	Calm	Good all day	Running west tonight
2/23	39° 25'S 151° 05'W	62	13-30 16 Avg		0	63.8°	10	E	Calm	Good all day	Running SW tonight

2/24	40° 15'S 154° 00'W	23	14-25 15 Avg	Poor fishing	0	65.1°	5	NE	Calm	Fair	Running East tonight
2/25	40° 55'S 152° 04'W	171	13-35 16 Avg	Good fishing	8	63.3°	12	S	Light chop	Good	Bait in area
2/26	40° 55'S 151° 14'W	173	14-40 17 Avg	Jumping alb. Excellent fishing	2	63.3°	0	-	Calm	Good	Baitballs in the area
2/27	40° 25'S 150° 37'W	444	13-40 17 Avg	Baitballs, breezers, Excellent fishing	0	64.1°	0	-	Calm	Good	Lots of breezing albacore, One school est. 100 tons.
2/28	40° 29'S 150° 42'W	96	14-35 17 Avg	Scattered Jlgstrikes	0	64.6°	8	E	Calm	Good	
3/01	40° 51'S 150° 26'W	55	14-25 17 Avg	Slow fishing	0	64.7°	0	-	Calm	Good	
3/02	41° 17'S 148° 59'W	23	13-20 15 Avg	Poor fishing	0	64.8°	-	E	Calm	Good	
3/03	40° 18'S 147° 17'W	142	14-30 17 Avg	Fish hitting long lines	0	65.8°	10	ESE	Calm	Good	
3/04	39° 59'S 146° 20'W	123	15-50 17 Avg	Fair fishing	0	67.1°	6	E	Calm	Good	
3/05	39° 57'S 145° 08'W	60	12-20 15 Avg	Scattered Jlgstrikes	1	65.9°	8	E	Calm	Good	Run East tonight
3/06	39° 10'S 143° 13'W	2	18 Avg	Poor fishing	1	64.6°	20	W	Moderate chop	Sloppy	Pass longliner at night
3/07	39° 53'S 145° 42'W	11	17 Avg	Poor fishing	0	65.6°	30-55	NW	Rough and Unworkable	Bad!!	Drifting due to weather.
3/08	40° 14'S 145° 39'W	469	14-40 17 Avg	Excellent fishing	0	64.8°	15	NW	Moderate chop	Sloppy but fair	
3/09	40° 15'S 145° 57'W	256	12-30 16 Avg	Good fishing	3	64.9°	15	S	Light chop	Fair	Lots of bait on deck, One meatball seen.
3/10	40° 19'S 146° 03'W	301	14-40 18 Avg	Good fishing	14	64.0°	10	S	Moderate chop	Fair	Travel west tonight, Lots of bait on deck
3/11	40° 15'S 148° 08'W	0	-	-	-	64.1°	35	S	Very rough	Bad	No Fishing. Drifting due to weather.
3/12	39° 48'S 151° 21'W	137	14-30 15 Avg	Fair fishing	10	63.3°	25	S	Heavy chop	Fair but sloppy	Traveling west. Bait on deck.
3/13	39° 45'S 152° 55'W	17	15-18 15 Avg	Poor fishing	0	64.1°	25	S	Moderate chop	Bad, sloppy	Alb. eating squid & octopus. Run W tonight

3/14	39° 53'S 156° 10'W	20	12-30 15 Avg	Poor fishing	0	64.0°	10	W	Light chop	Good	Run West tonight.
3/15	40° 00'S 159° 20'W	58	12-20 14 Avg	Poor fishing	0	63.3°	8	SW	Light chop	Good	Run West tonight.
3/16	39° 31'S 162° 48'W	6	14 Avg	Poor fishing	0	64.2°	6	W	Calm seas	Good	Run West tonight. No signs.
3/17	39° 57'S 165° 17'W	11	14 Avg	Poor fishing	0	64.4°	6	W	Calm seas	Good	Running west. No signs
3/18	40° 00'S 168° 15'W	2	18 Avg	Poor fishing	0	65.5°	0	-	Calm seas	Good	Travel tonight. No signs.
3/19	37° 54'S 170° 39'W	0	-	No fish	0	67.9°	0	-	Calm	Good	Travel N tonight
3/20	35° 44'S 170° 38'W	0				69.6°				Good	Travel N.
3/21	32° 08'S 170° 34'W	0				73.0°				Good	Running north.
3/22	29° 38'S 170° 36'W	0				76.3°				Good	
3/23	26° 35'S 170° 38'W	0				77.0°				Good	
3/24	24° 00'S 170° 41'W	0				80.6°				Good	
3/25	21° 03'S 170° 30'W	0				83.7°				Good	
3/26	17° 21'S 170° 40'W	0				85.4°				Good	

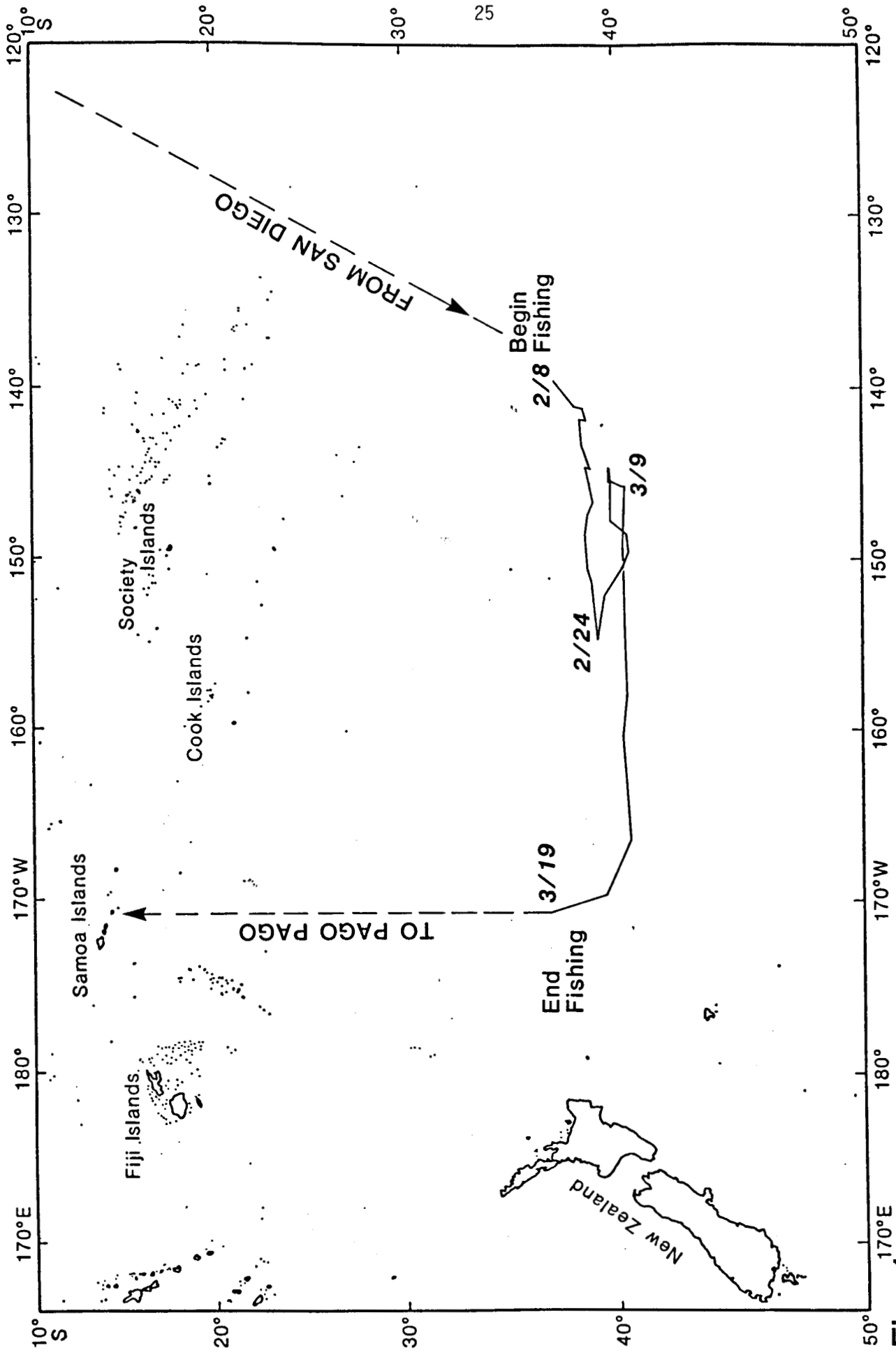


Fig. 1 **CRUISE TRACK OF F/V Day Star DURING SOUTH PACIFIC ALBACORE TROLLING EXPLORATION. F/V Bald Eagle TRACK SIMILAR.**

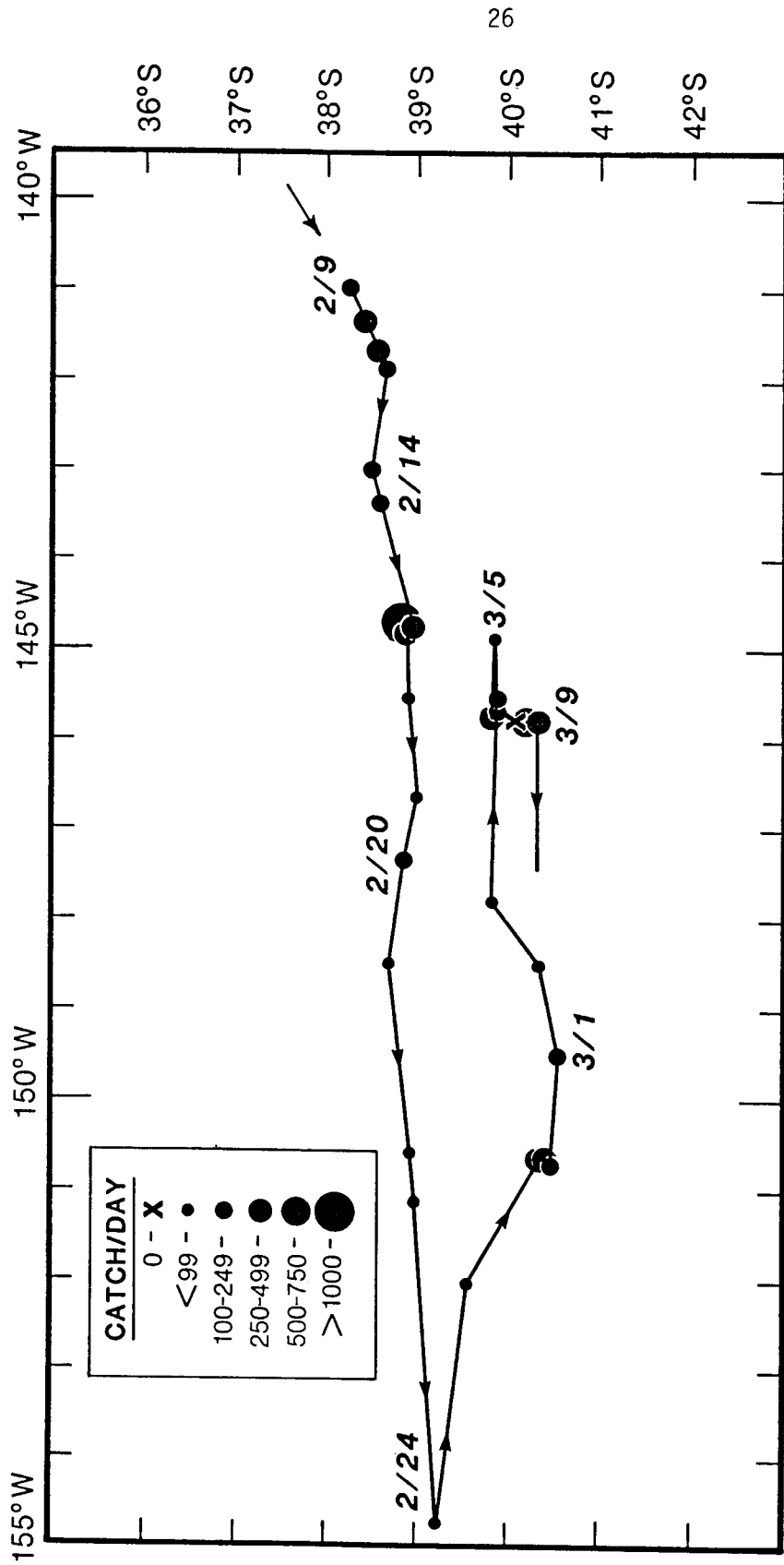


Fig. 2 F/V Day Star ALBACORE CATCH/DAY
 SOUTH PACIFIC ALBACORE TROLLING EXPLORATION, FEB-MAR 1986

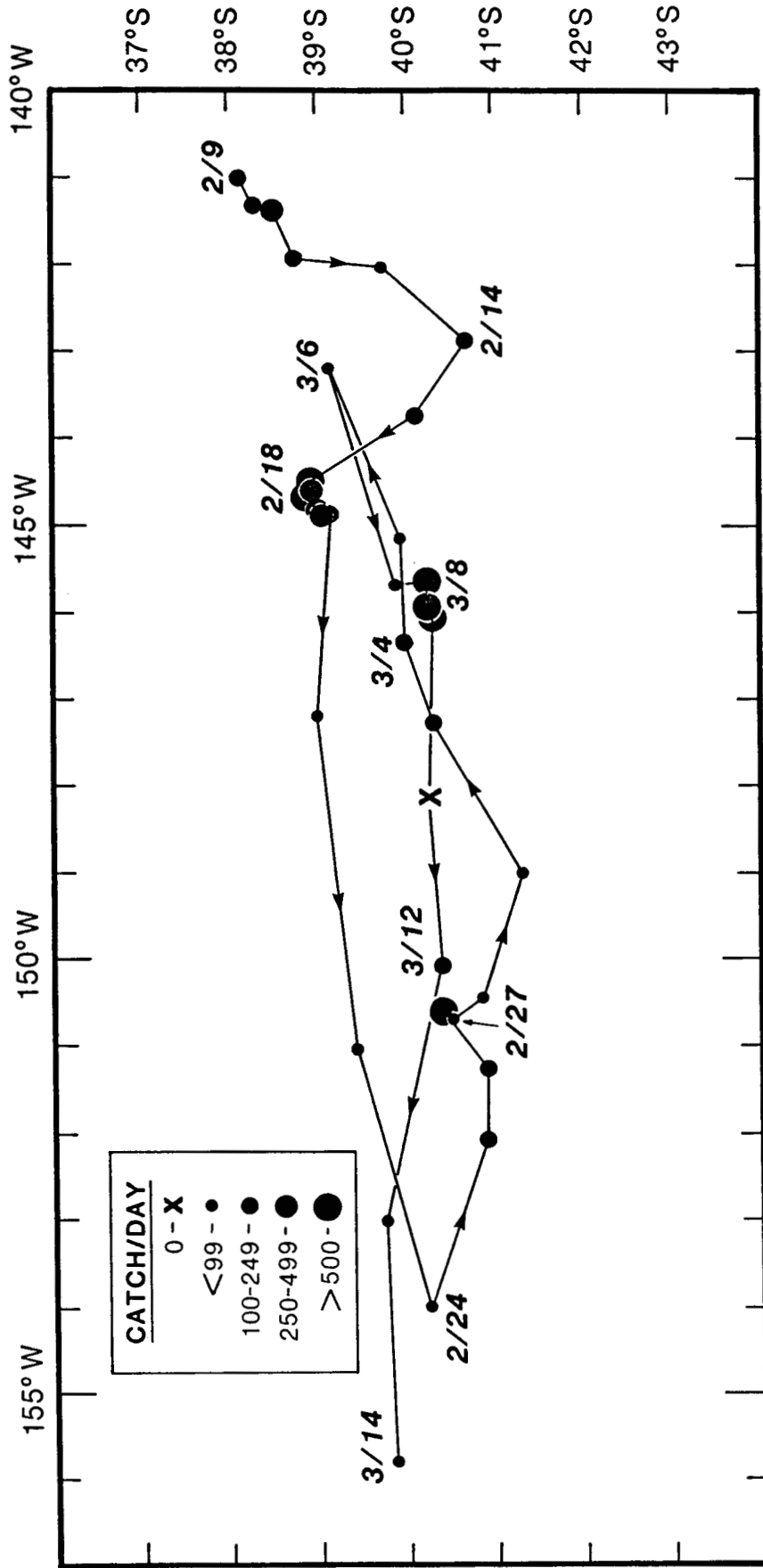
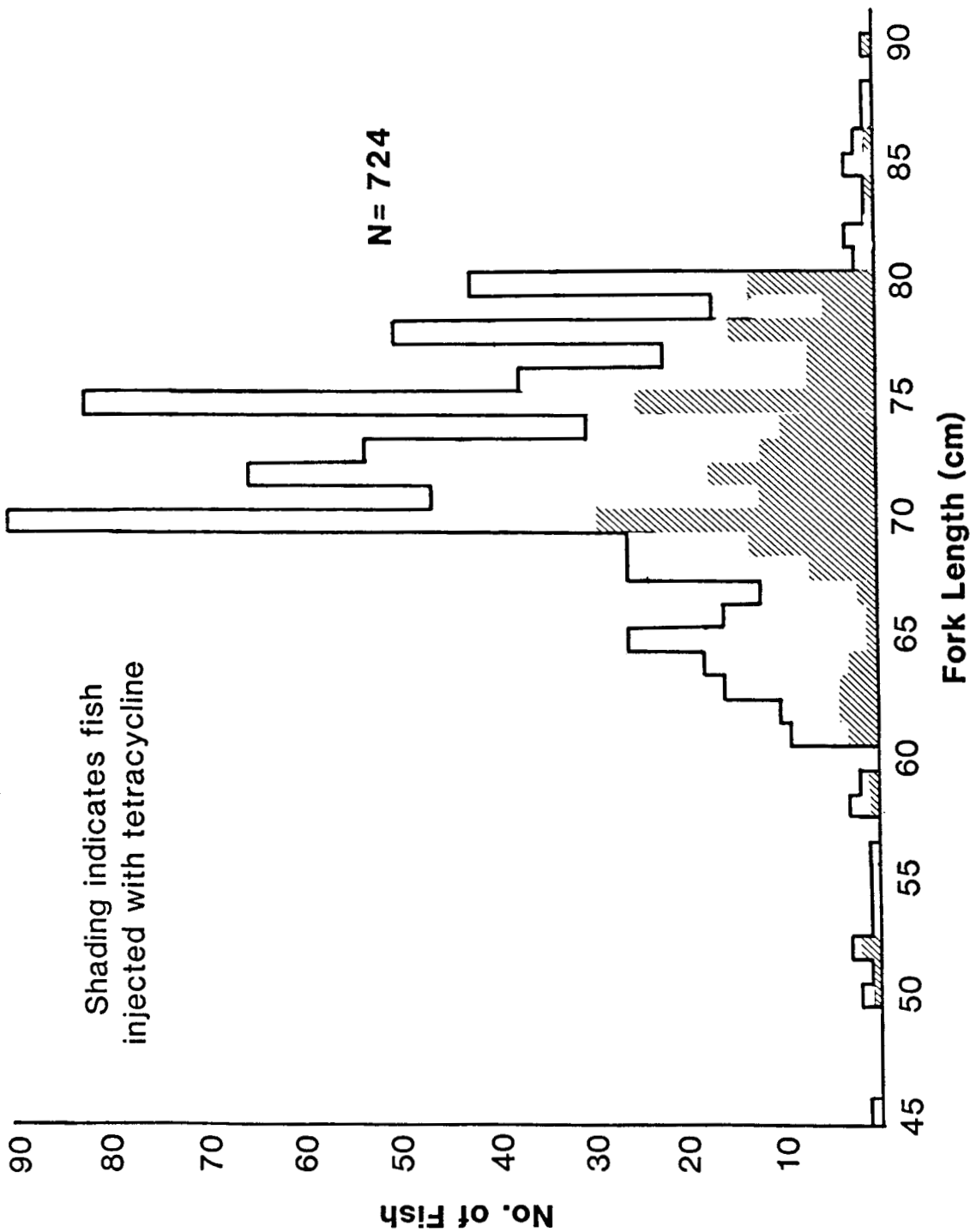


Fig. 3 F/V Bald Eagle ALBACORE CATCH/DAY SOUTH PACIFIC ALBACORE TROLLING EXPLORATION, FEB-MAR 1986

Fig. 4 South Pacific Albacore Trolling Exploration Feb-Mar 1986
Albacore Tagged by I. Cromwell, Day Star and Bald Eagle



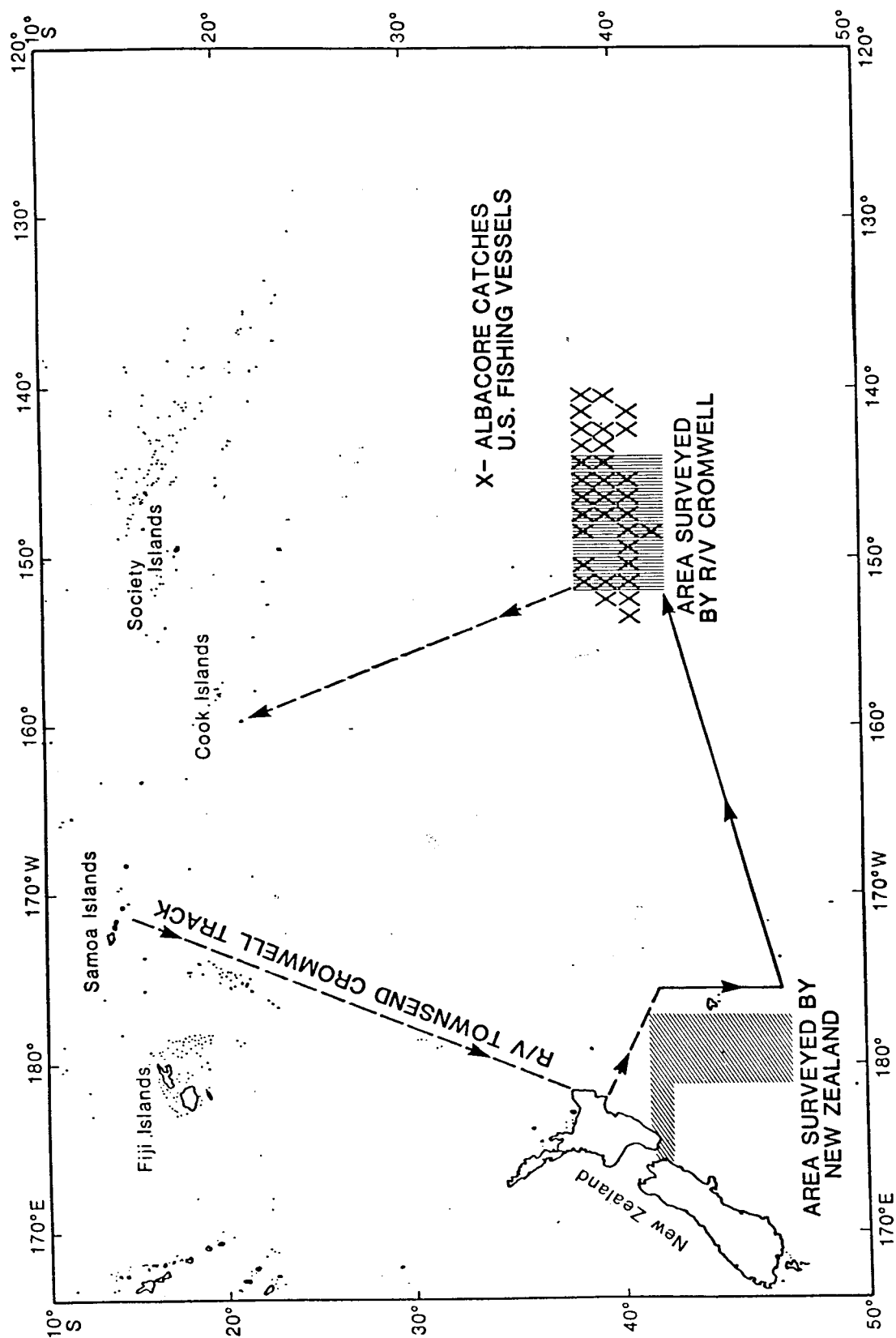


Fig 5 South Pacific albacore troling exploration/research survey conducted in February-March, 1986

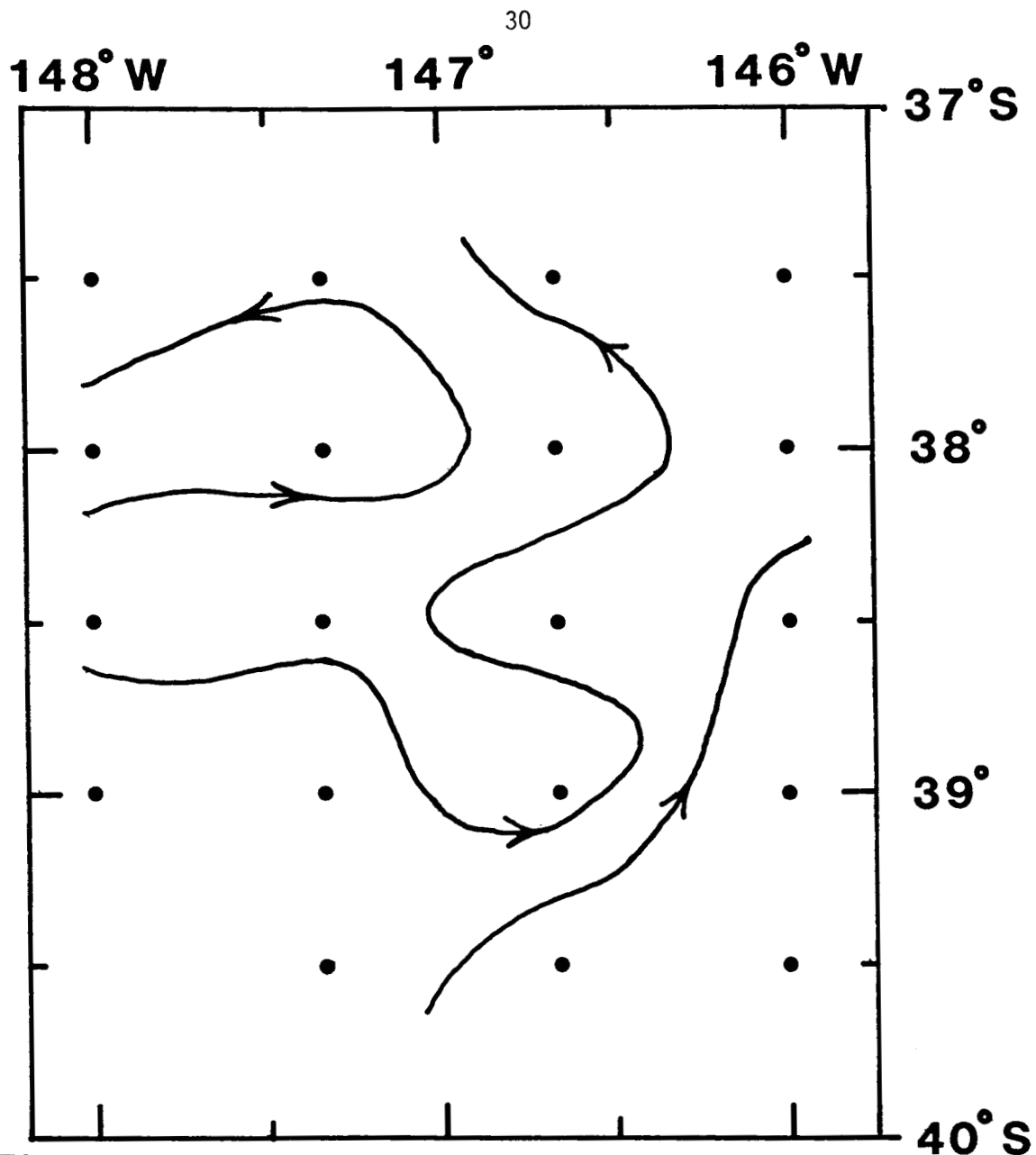


Fig. 6

Near-surface oceanic circulation deduced from oceanographic measurements made on R/V Townsend Cromwell cruise TC 8601. Velocities are 1/4 knot or less.

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