Evidence of Interactions Between High Seas Driftnet Fisheries and the North American Troll Fishery for Albacore

by

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I. ABSTRACT

During the 1990 North American albacore troll fishery, observers aboard United States troll vessels examined 19,526 albacore for evidence of driftnet damage. Results indicate that 13.4% of the albacore caught encountered driftnets. Proportions varied by area fished.

II. INTRODUCTION

The Southwest Fisheries Science Center (SWFSC) in cooperation with members of the Western Fishboat Owners Association (WFOA) placed fisheries observers on U.S. trollers fishing in the North Pacific in 1990. This was part of a comprehensive impact assessment program on the effects of the high seas driftnet fisheries on the North Pacific albacore (*Thunnus alalunga*) stocks and other fisheries. Albacore which escape driftnets bear some external marks that provide direct evidence of interaction. Throughout this report, we refer to these external marks from driftnet encounters as damage. Damage may be minor or severe, and may include marks on the skin, bruising, and cuts and broken skin (loss of scales), missing areas of skin, and scars from any of the foregoing. This report describes the results of the 1990 observer project.

1. Background

Catches and catch-per-effort from the U.S. albacore troll and pole-and-line fisheries in the North Pacific have declined since the mid-1970's (Coan *et al.* 1991; Kleiber and Perrin In Press). In addition to the U.S. fishery, Japan and Taiwan each have a surface fleet and a longline fleet catching albacore in the North Pacific. Three high seas driftnet fleets also catch albacore in the North Pacific (Anon. 1989).

The small mesh (90 - 120 mm stretched mesh) driftnet fleets are made up of vessels from Japan, Taiwan and the Republic of Korea (ROK). The Japanese and Taiwanese fleets fish for flying squid (*Ommastrephes bartrami*) in the North Pacific Transition Zone from about May through December. The ROK fleet operates there the entire year. The incidental catches of albacore by these driftnet fisheries are not precisely known.

The large mesh (160 - 180 mm stretched mesh, Bartoo and Holts 1991) driftnet fleet is made up of vessels from Japan and Taiwan. Albacore is a major component of that catch. Taiwan has a developing large mesh fishery for albacore. The impact of these fleets on albacore is largely unknown. Taiwan and Japan have imposed internal regulations on their driftnet fleets to limit fishing effort in the higher latitudes and minimize interceptions of high seas salmon.

Although driftnet catches and landings for North Pacific albacore are incomplete and unreported for some fleets, the aggregate reported annual landings for driftnet fisheries exceeded 20,000 mt in 1988 (Tsuji *et al.* 1992). In the mid-1980's U.S. albacore fishermen began reporting increasing numbers of albacore injured or scarred by encounters with high seas driftnets. Concerns focused on the impact of driftnet fisheries on the North Pacific albacore stock and the direct interaction with the U.S. albacore troll fleet.

2. Troll Observer Project

In 1990, SWFSC biotechnicians observed 6 complete fishing trips aboard 5 different troll vessels. Vessels were selected to provide data over the entire season and cover the entire fishing area. The cruise tracks of the observed vessels are shown with the entire catch distribution of the troll fleet in Figure 1. The fishery followed eastward migrating albacore beginning north of Hawaii in June, moved eastward to 135°W in July, and remained east of 135°W in August and September (Coan *et al.* 1991). Operations and observations covered a wide area of the North Pacific Ocean. The project goals were to document and estimate the interaction between high seas driftnet and North American troll fisheries, and to provide biological information from which delayed mortality of albacore due to net encounters might be inferred. Specific objectives are as follows:

A. Describe the type and severity of driftnet damage on troll-caught albacore.
B. Estimate the relative frequency of undamaged albacore and damaged albacore.
C. Estimate the size-frequency of undamaged albacore and damaged albacore.
D. Determine the relative physiological condition of troll-caught albacore that show gillnet damage.

Here, we report results relating to the first 3 objectives.

III. METHODS

Driftnet marks are most visible when the fish is boated. Most marks disappear or are rendered indistinguishible once the fish is frozen or dies on deck. Observers examined each fish landed and noted net scars or marks using a set of reference photographs detailing the type and severity of injuries (Figure 2). These were coded as:

Code	Damage Description
0	No gill net damage to fish.
1	Minor damage along side(s) of fish, pattern of stripes due to minor scale loss where fish forces its way through or along the net.
2	Minor damage to head, chiefly forwards of pectoral fins, brush-like pattern of scale loss.
3	Severe damage with bruising or scraping away of parts of the skin, primarily in area of greatest girth and mostly on dorsal surface.
4	Old gill net damage of any degree that is partially or completely healed. These are assumed to have occurred previously.

Observers photographed, for later analysis, fish which showed damage but could not be classified on board.

In addition to damage code, observers collected information on fork lengths, maximum girth, and weights for as many fish as possible. Fishing operations usually continued all day from first light to just after dark.

IV. RESULTS

Six cruises, totalling 377 observed sea-days were completed between the end of May and the end of October 1990. A total of 25,177 albacore were caught and boated during the cruises. Seventy-eight percent of these (19,526) were examined for driftnet related injuries and measured for fork length and maximum girth. A total of 8,720 fish were weighed to the nearest pound (transformed to kg). Catch-per-fishing-day averaged 66.8 fish-per-day but varied considerably between cruises (Table 1). One vessel (Cruise 5) was on a charter with WFOA as a scout boat and did not fish routinely.

Albacore of three distinct size modes were caught throughout the North Pacific apparently representing 2, 3, and 4 year old fish (Bartoo and Foreman In Press; Fig. 3). Length modes were at 54, 65 and 80 cm corresponding to weights of 3.5, 5.7, and 10.6 kg.

Overall, 86.6% of the observed catch showed no evidence of net related damage (Table 2). Recently damaged albacore (damage codes 1,2 & 3) totalled 9.2%, while an additional 4.2% had healed scars, possibly from net encounters during the previous fishing season (code 4). Within the recently damaged albacore, 3.5% had minor damage; 5.2% had moderate injuries on the head, gill covers and fins; while 0.5% had severe bruising with significant loss of scales with skin damage to their head, sides and fins.

Observers measured fork lengths (FL) of 11,868 albacore east of 140°W in July, August and September and 7,658 albacore west of 140°W in June and July. The catch taken west of 140°W had larger fish than the catch east of 140°W (Fig. 4). These large fish averaged 9 - 11 kg (20 to 25 lbs). Although the sample size was small, injuries from recent encounters with driftnets were observed on nearly 18% of the catch.

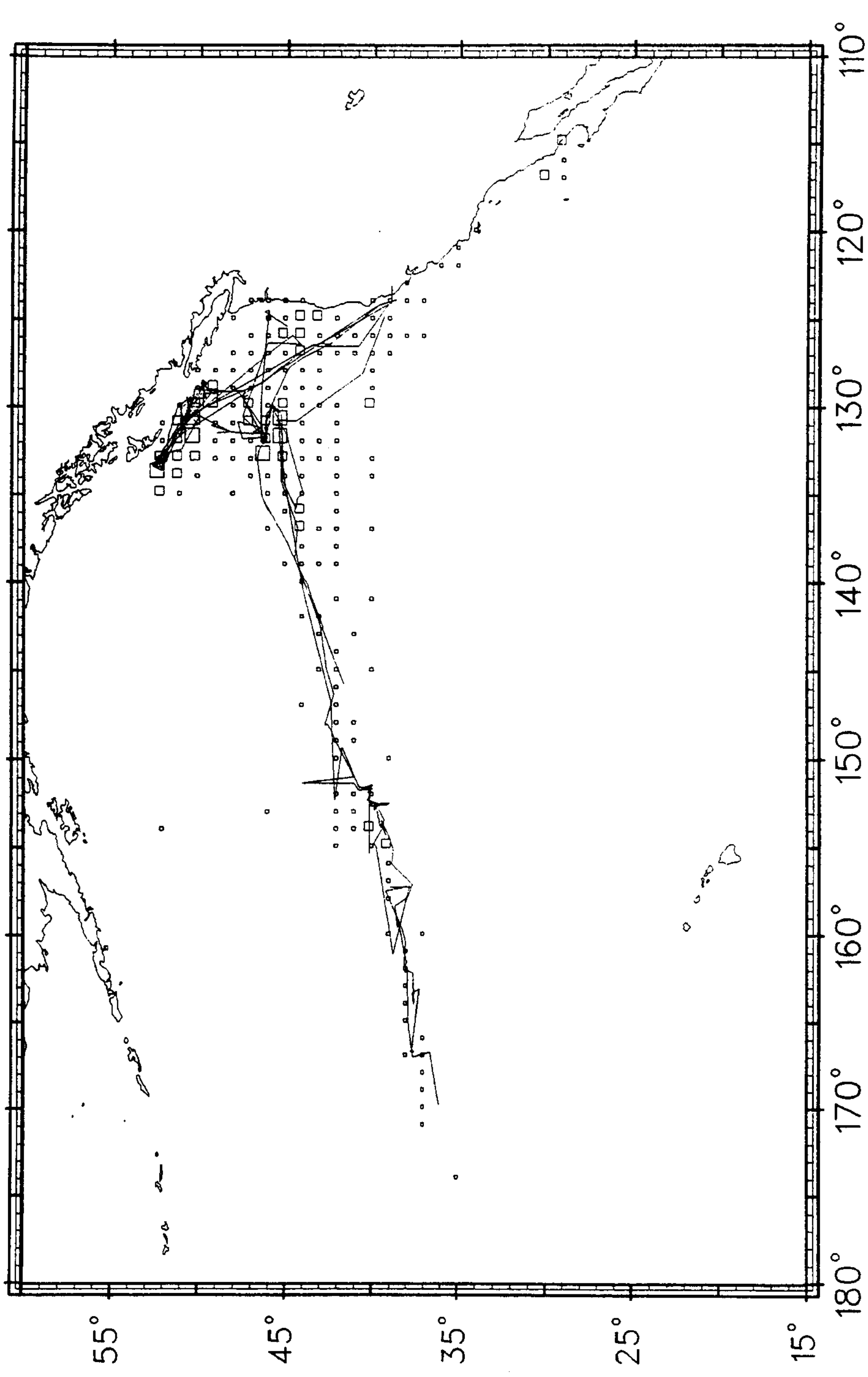

Figure 1. Cruise tracks for the observed albacore troll vessels and the distribution of the 1990 U.S. troll catch (squares). (small squares are catches of 1-1000 fish, medium = 1001-10000 fish, large = +10000 fish). Three vessels departed Honolulu and three departed from the mainland. All cruises terminated on the west coast of United States.

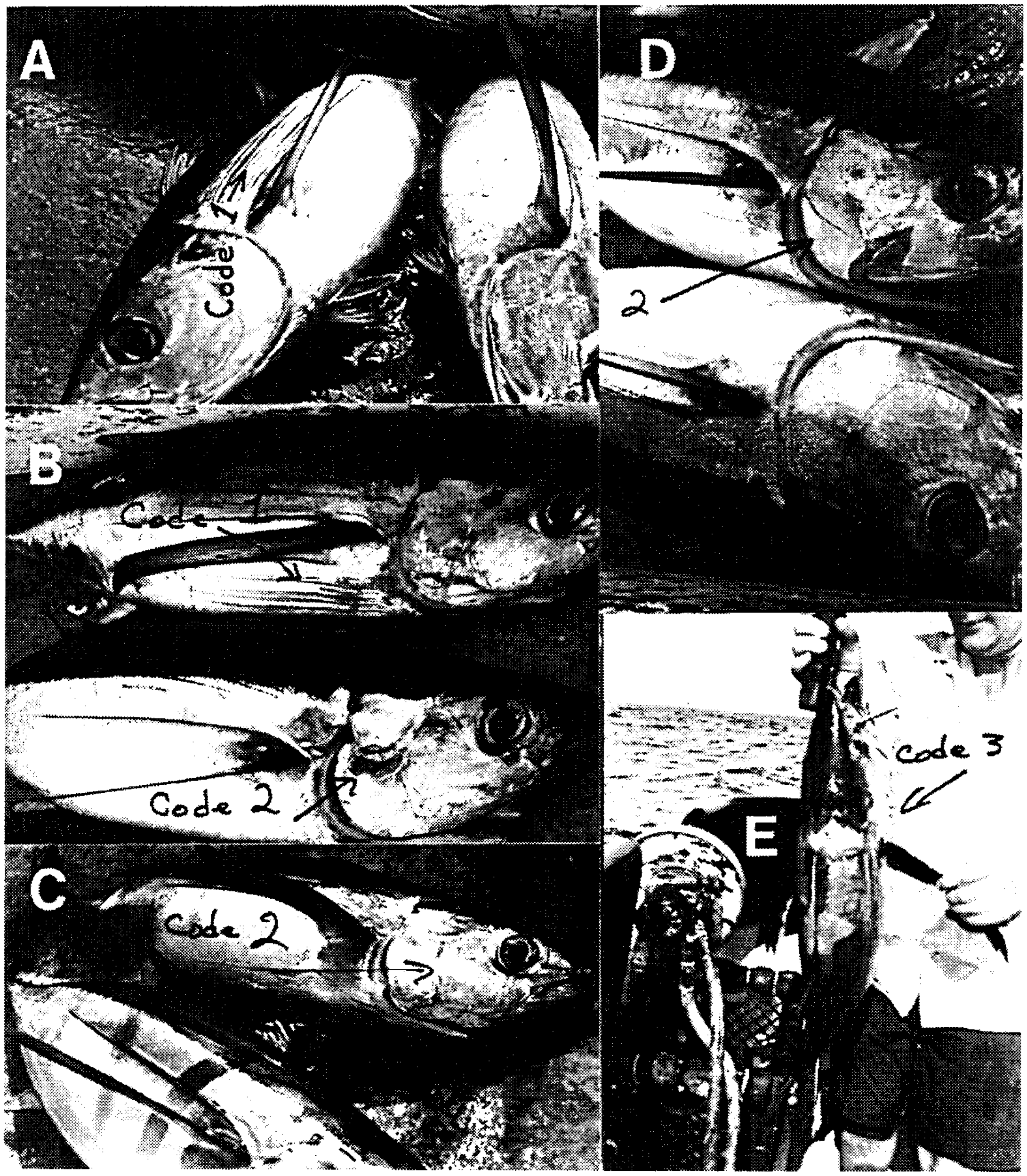

Figure 2. Pacific albacore damaged by high seas driftnets. Damage code 1 indicates minor scratches and scale loss (A & B). Damage code 2 shows moderate damage on the head (B, C & D). Damage code 3 indicates significant loss of scales or skin (E).

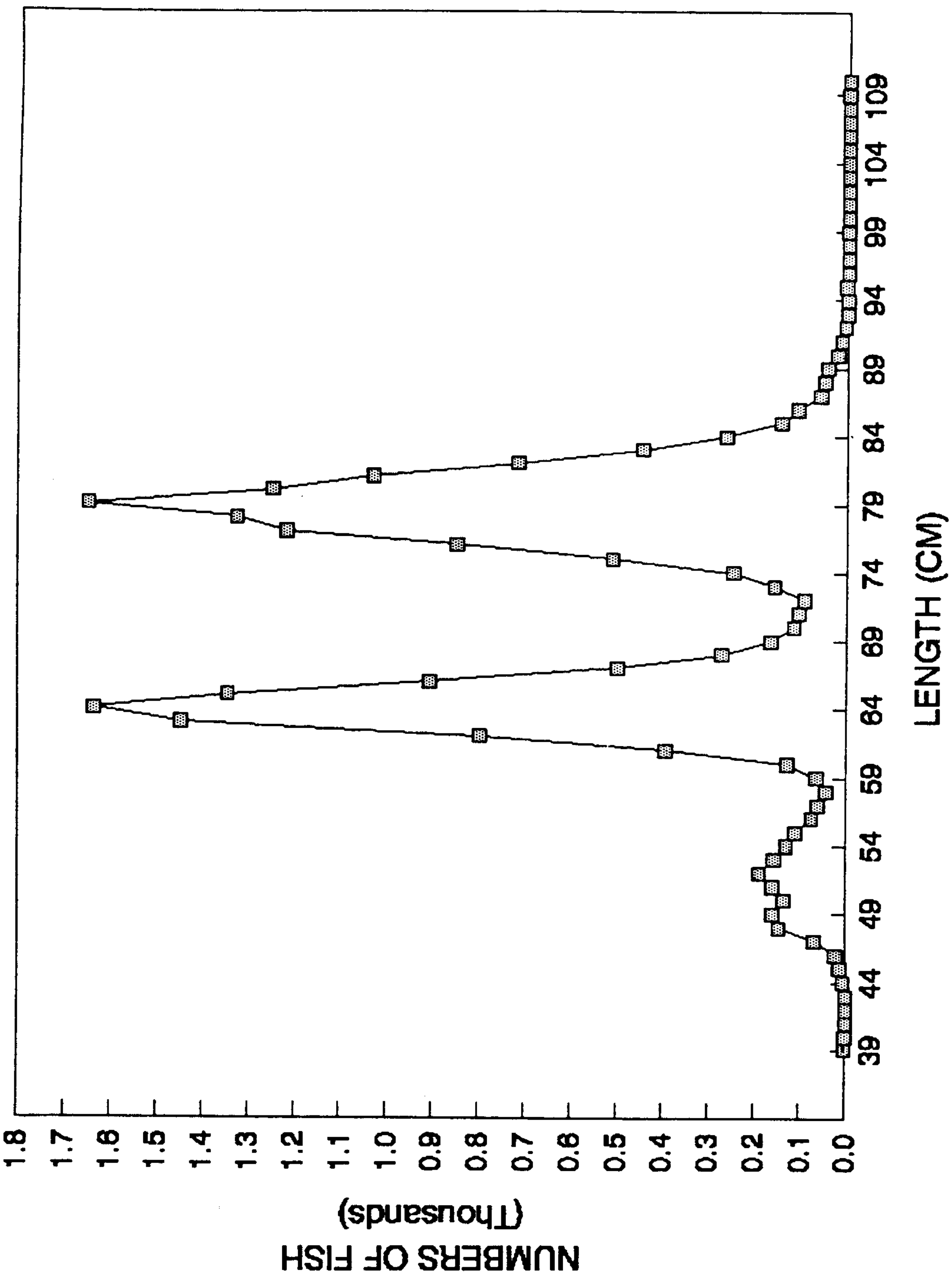

Figure 3. Length frequency of 19,526 albacore measured during the 1990 troll fleet observer program.

Table 1. Albacore CPUE (fish/day) by cruise.

Cruise	Mean	Range	SD	95% C.I.
Cruise 1	108	0 - 634	146.3	76.01 - 139.9
Cruise 2	68	0 - 363	91.3	48.47 - 88.1
Cruise 3	88	0 - 291	58.5	74.02 - 101.3
Cruise 4	48	1 - 122	30.1	39.20 - 56.5
Cruise 5	10	0 - 100	22.8	2.63 - 18.3
Cruise 6	58	0 - 375	82.7	20.02 - 95.3

Table 2. Percent of albacore by fishing area damaged during encounters with driftnets and caught by troll vessels.

	FISHING AREA				
DAMAGE TYPE	WEST OF 160°W	160°W TO 140°W	NORTH OF 50°N	EAST OF 140°W AND SOUTH OF 50°N	µ ALL AREAS
NO DAMAGE	81.2	82.8	94.1	88.4	86.6
NEW DAMAGE					
CODE 1	6.0	4.9	0.0	3.0	3.5
CODE 2	11.4	6.3	0.4	2.7	5.2
CODE 3	0.5	0.5	0.0	1.0	0.5
TOTAL NEW DAMAGE	17.9	11.7	0.4	6.7	9.2
OLD DAMAGE	0.9	5.5	5.5	4.9	4.2
SAMPLE SIZE, n	218	7,440	4,800	7,068	19,526

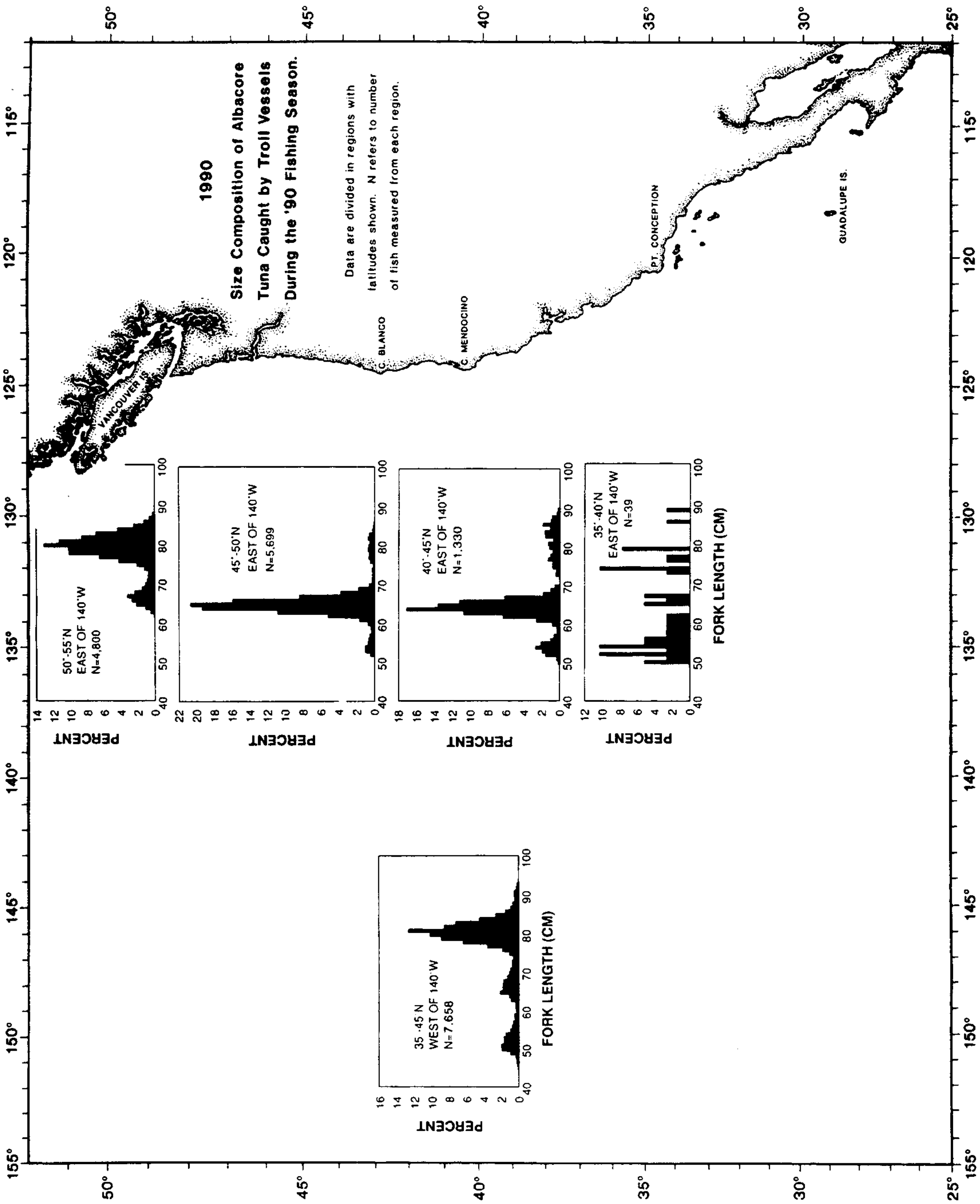

Figure 4. Albacore length frequencies by fishing areas of the North Pacific.

Old and healed scars, from a previous time, appeared on less than one percent of the catch west of 160°W but increased to about 5% east of 160°W (Table 2).

By the end of July, all observed vessels were fishing east of 140°W and south of 50°N, catching fish weighing 5 - 9 kg (12 to 20 lbs). These fish were caught throughout the month of August and early September. The incidence of fresh injuries remained at about 6.7% in the coastal areas and the incidence of old injuries remained fairly constant at about 5 percent.

Albacore taken north of 50°N had a higher proportion of large (80 cm FL) fish than those caught east of 140°W and south of 50°N (Figure 4). No fish less than 63 cm FL were sampled north of 50°N. Fishing remained moderately good north of 50°N until seasonal storms out of the Gulf of Alaska forced many fishing vessels to return home by the end of September. Few recently damaged fish were observed north of 50°N although the proportion of old and healed damage changed little from that seen just off Washington and Oregon (5.5% to 4.9% respectively).

The observed length frequencies varied considerably in different fishing locations. Length frequencies of injured fish did not vary greatly from uninjured fish within each area examined. The length frequencies, by area, for undamaged (code 0), recently damaged (codes 1-3) and old damage (code 4) are shown in Figures 5, 6 and 7 respectively. No previous damage estimates are available from the 1989 season that could help describe survival of fish sampled (code 4) in the 1990 fishing season.

The length-weight relationship for all 8,720 weighed albacore is shown in Figure 8.

V. DISCUSSION

Our results show that 13.4% of the albacore caught encountered driftnets. These proportions are less than some reports from fishermen which ranged from 40% to 90% of the catch. Our data do indicate considerable variation in damage on a daily basis, ranging from none to 100% of the catch. Our results are consistent with those reported for albacore in the south Pacific which ranged from 4.5% to 14.5% of the catch in 1989 and 1990 (Hampton *et al.* 1991).

Our results show that 9.2% of the 1990 catch evidenced new damage and that higher proportions were found to the west. The apparent "gradient" in proportion of net marked fish from west to east may be explained by the migration pattern of albacore and the timing and location of the driftnet and troll fisheries. Additionally increased short-term mortality of a few days or weeks due to net damage may contribute.

Based on tag information the migration pattern of juvenile North Pacific albacore of the size caught by the driftnet and troll fisheries is predominately east-west (Otsu and Uchida 1963, Clemens 1961). The fish move from waters off Japan in the spring across the Pacific in the Subarctic Transition Zone (STZ) and enter the coastal waters of North America in July. In late September albacore leave the east Pacific and return to waters off Japan. This annual pattern may be repeated until age 5 or 6. Although some portion of the population makes the complete trip across the Pacific in just a few months it is apparent that a considerable proportion of the population is not available at the extreme ends of the population distribution (Bartoo and Foreman in press).

The troll fishery as shown in Figure 1 begins near the mid-Pacific in May or June and moves with the advancing albacore to the east. Both small and large mesh driftnet fisheries in 1990 were distributed as shown in Figure 9 with most of the effort centered between 170°E and 170°W and becoming less east of 170°W. Collectively these fisheries operate the year around with considerably higher effort east of 170°E after May.

Higher proportions of marked fish are seen west of 140°W where the driftnet and troll fisheries overlap in area and time. Lower proportions of marks are seen east of 140°W, outside the distribution of the driftnet fisheries. Additionally, some albacore may migrate into the troll fishery from areas south of the driftnet fishery distribution (Laurs and Lynn 1977) and dilute the marked portion of the population.

The proportions of marked fish in the east may also be decreased by an increase in mortality associated with encountering and escaping a driftnet (alive) which reduces the number of albacore available to be recaptured in the troll fishery. This would logically seem to increase directly with the severity of injury and passage of time (as the albacore move eastward).

VI. ACKNOWLEDGEMENTS

We wish to thank the Western Fishboat Owners Association for their help in locating owners of fishing vessels for placement of our observers. We also want to thank the owners of those vessels for their support. We are truly indebted to the observers who examined and measured the nearly 20,000 albacore. Finally, thanks to the reviewers whose suggestions greatly improved this manuscript.

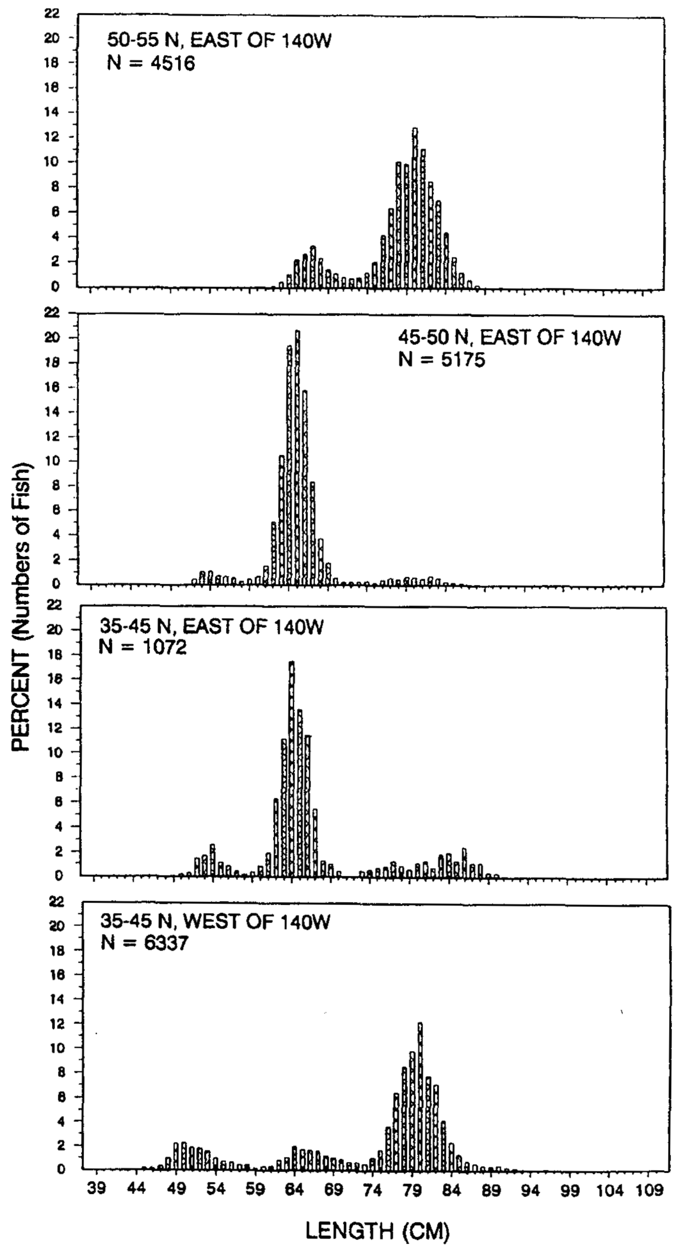

Figure 5. Length frequencies of undamaged albacore (Code 0) from the four fishing areas of the North Pacific.

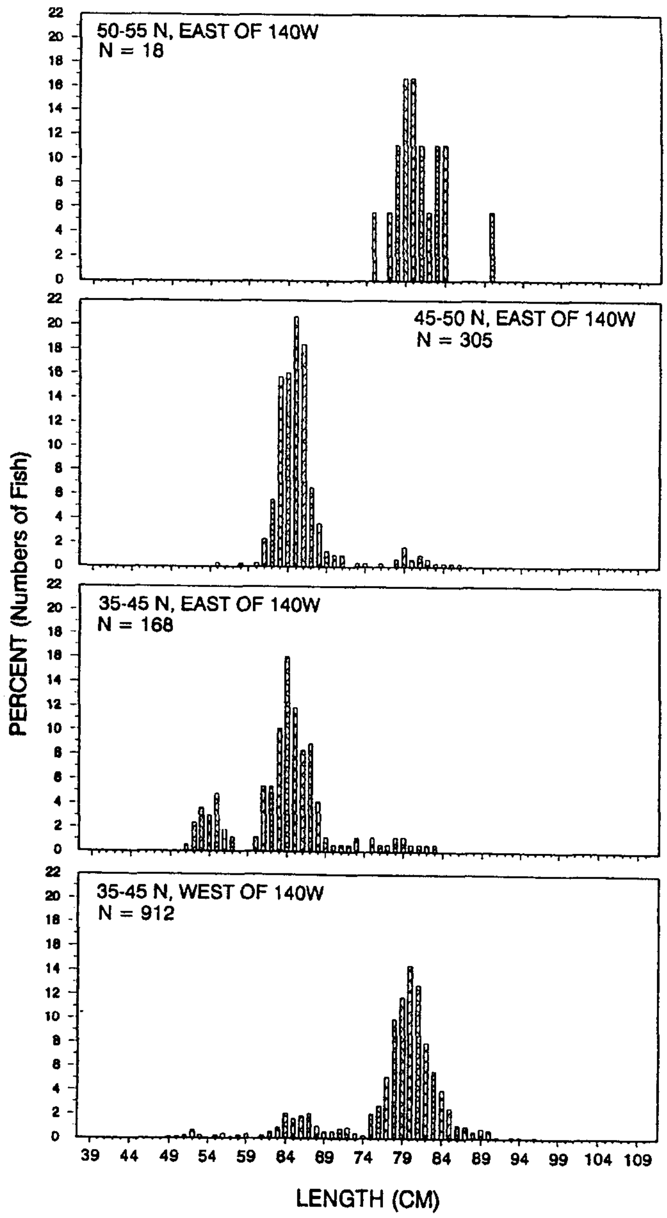

Figure 6. Length frequencies of recently damaged albacore (Codes 1, 2, and 3).

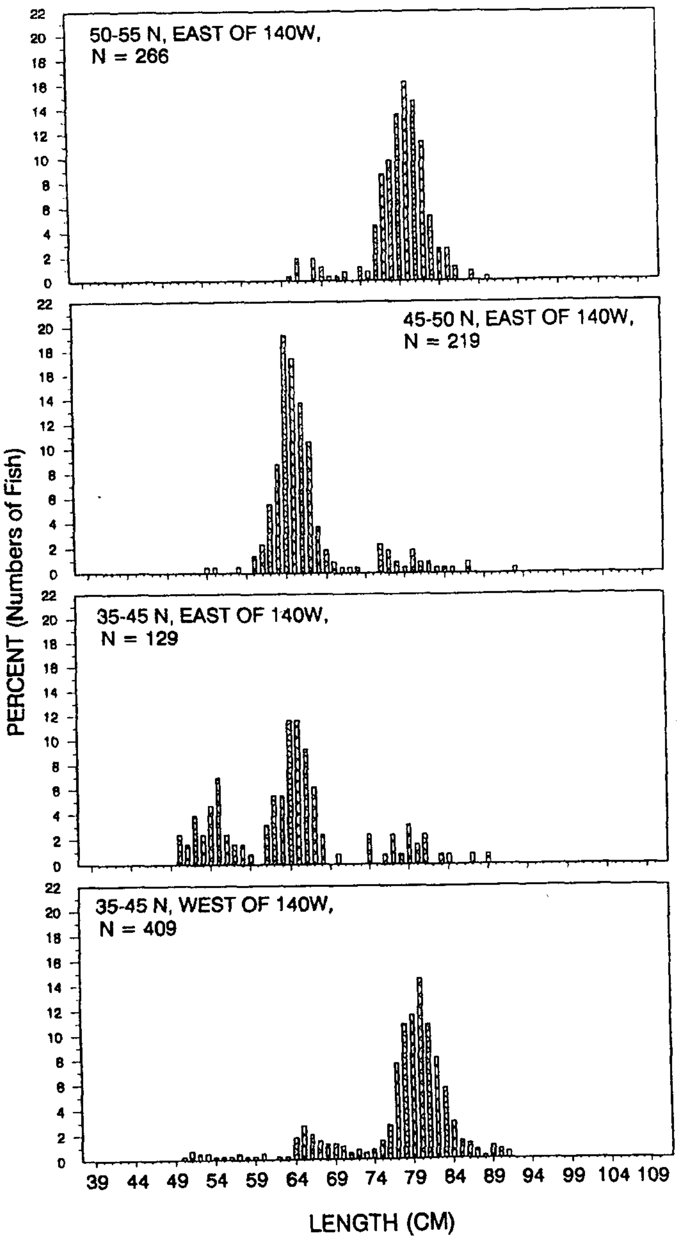

Figure 7. Length frequencies of albacore with old injuries (Code 4).

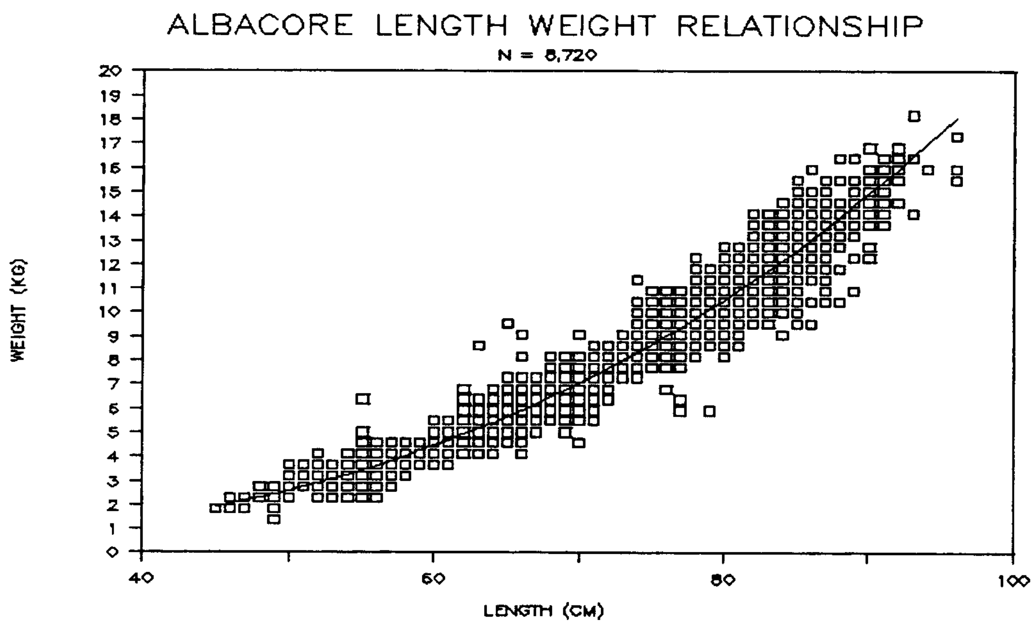

Figure 8. Length-weight relationship of albacore weighed during the troll fleet observer program.

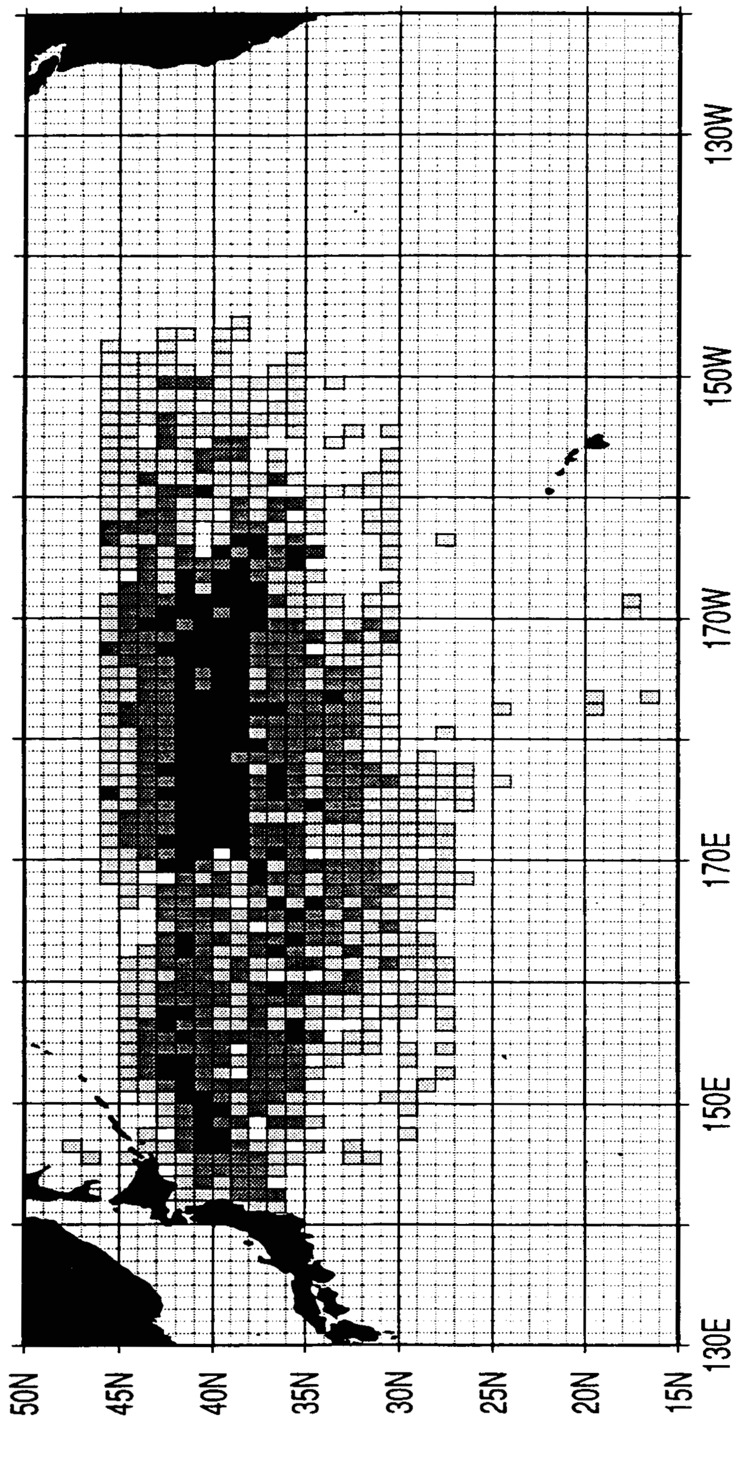

Figure 9. Distribution of observed driftnet effort in the North Pacific Ocean in 1990 for both large and small mesh fisheries. Intensity of effort is shown by shading. (Personal Communication, J. Wetherall, Nat. Mar. Fish. Serv., Honolulu, HI.)

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