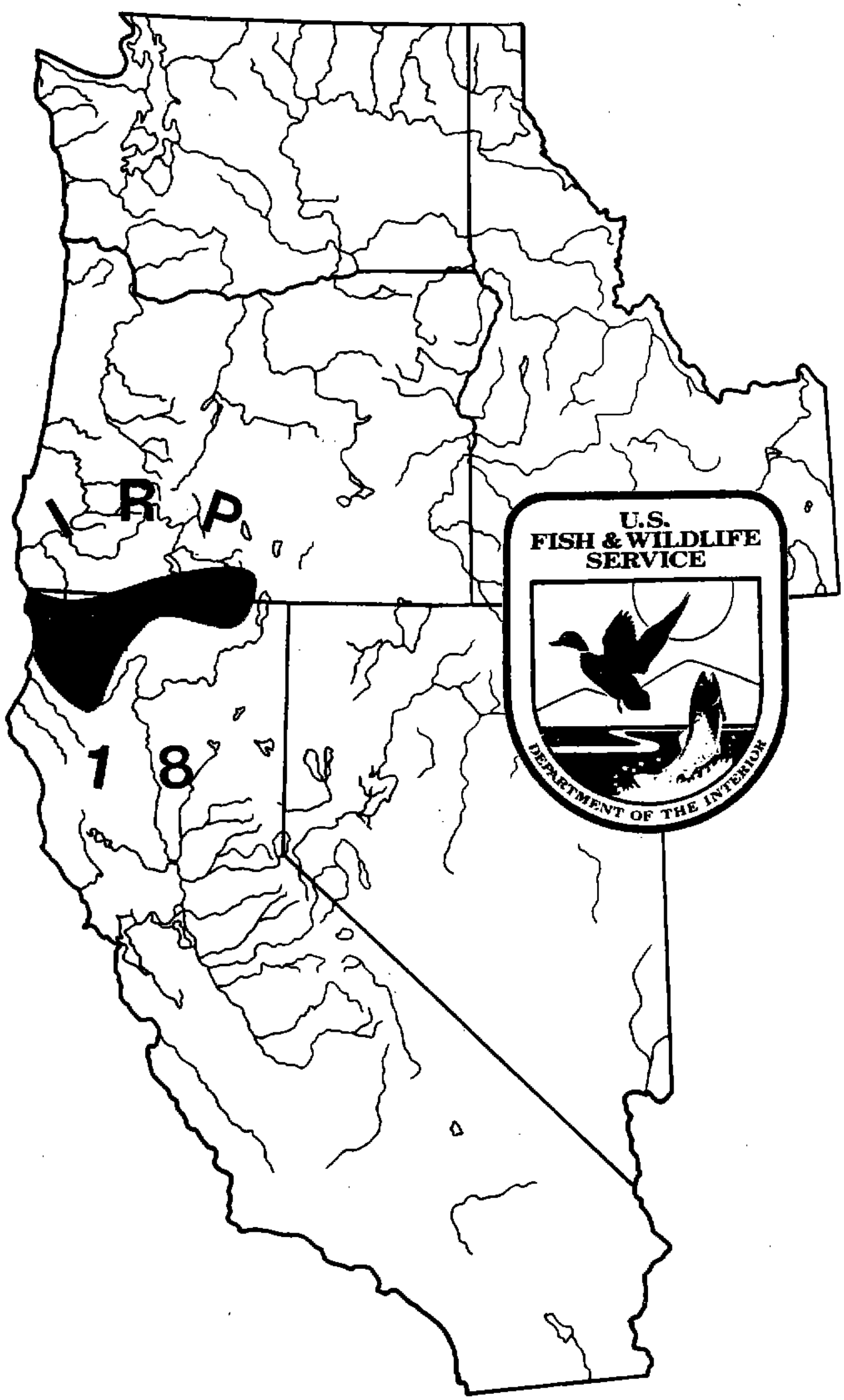
KLAMATH RIVER FISHERIES INVESTIGATION PROGRAM



ANNUAL REPORT - 1981

ANNUAL REPORT

KLAMATH RIVER FISHERIES INVESTIGATION PROGRAM

1981

U.S. Fish and Wildlife Service
Fisheries Assistance Office
Arcata, California

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April 1, 1982

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ACKNOWLEDGEMENTS

The authors express their deepest thanks to the following persons, whose efforts were invaluable in the completion of 1981 field studies and preparation of this report:

-- Rhonda Watson, clerk-typist, for patience and diligence in administrative matters, for valuable editorial assistance, and for typing the many drafts of this report;

-- members of the Arcata Fisheries Assistance Office field staff - Don Bremm, Chris Dalcour, Paul Dalka, David Dennis, Steve Eggers, Steve Klemp, Fred Klose, Pete Lara, Keith Lutz, Mike Messenger, Ken Norton, Mike Orcutt, Russ Slotnick, Mark Smith, and Lavina Williams - for the enthusiasm, self-motivation, and professionalism displayed in performing assigned tasks, often under difficult circumstances. Steve Klemp is further acknowledged for his scale analysis work and assistance in preparing the graphics for this report;

-- Indian fishers of the Hoopa Valley Reservation for their hospitality and cooperation in data collection efforts.

We also wish to acknowledge the Young Adult Conservation Corps, in its final year of operation, for the valuable manpower and material support provided over the years; and biologists of the California Department of Fish and Game - notably, Bill Heubach, Jim Hopelain, Joe Lesh, Jim Lytle, and Ivan Paulson - for providing data, advice, access to various equipment, and invitations to observe field projects.

Finally, we wish to acknowledge the Bureau of Indian Affairs for funding the Fisheries Investigation Program, and the many Bureau personnel who have cooperated with us over the years in its development.

ANNUAL REPORT

KLAMATH RIVER FISHERIES INVESTIGATION PROGRAM

1981

FORWARD

The Klamath River watershed (Figure 1) drains approximately 40,400 sq km in Oregon and California, including about 26,000 sq km in California, most included within the boundaries of the Six Rivers, Klamath, Shasta, and Trinity National Forests. The Hoopa Valley Indian Reservation, comprising approximately 583 sq km in Humboldt and Del Norte counties, borders the lower 68 km of the Klamath River and lower 26 km of the Trinity River, the largest tributary in the drainage. The most important anadromous salmonid spawning streams in the basin include the Trinity River, draining approximately 7,690 sq km, and the Shasta, Scott, and Salmon rivers, each draining approximately 2,070 sq km. Iron Gate Dam on the Klamath River and Lewiston Dam on the Trinity River represent the upper limits of anadromous salmonid migration in the basin, and hatcheries located near the base of each dam (Iron Gate and Trinity River hatcheries) attempt to mitigate for lost natural fish production resulting from each project.

The Klamath River basin has historically supported large runs of chinook salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*Salmo gairdneri*), which have contributed considerably to subsistence, sport, and commercial fisheries in California. Generations of Indians have utilized fishing grounds in the drainage, and their fisheries for salmon, steelhead, and sturgeon have historically provided the mainstay of Indian economy in the area. Sport fishing for salmon and steelhead in the drainage may exceed 200,000 angler days annually, and Klamath River stocks may account for 40 percent of commercial chinook salmon landings in northern California and southern Oregon, landings which have averaged approximately 400,000 per year over the last decade. The U.S. Forest Service (USFS) estimated an annual net economic value of salmon and steelhead fisheries attributable to the Klamath River basin of $25 million, and mean annual net economic values per kilometer of chinook salmon, coho salmon (*Oncorhynchus kisutch*), and steelhead trout habitat in the basin of $15,500, $1,400, and $2,800, respectively. The Department of the Interior recently included the Klamath and Trinity rivers in the National Wild and Scenic Rivers System.

Concern about the depletion of anadromous salmonid resources in the basin emerged around the turn of the century, and has accelerated in recent decades coincident with expanded logging and fishing operations and dam building activity. As in other river systems of the Pacific Northwest, chinook salmon of the Klamath River basin have experienced the continued effects of habitat degradation and exploitation, as reflected by declining runs in recent decades. Since passage of the Fishery Conservation and Management Act of 1976, and promulgation of the first set of federal fishing regulations governing Indian fishing on the Hoopa Valley Reservation in 1977, considerable attention has focused on the depressed chinook salmon runs and associated fisheries, notably the ocean troll fishery and Indian gill net fishery on the Klamath and Trinity rivers.

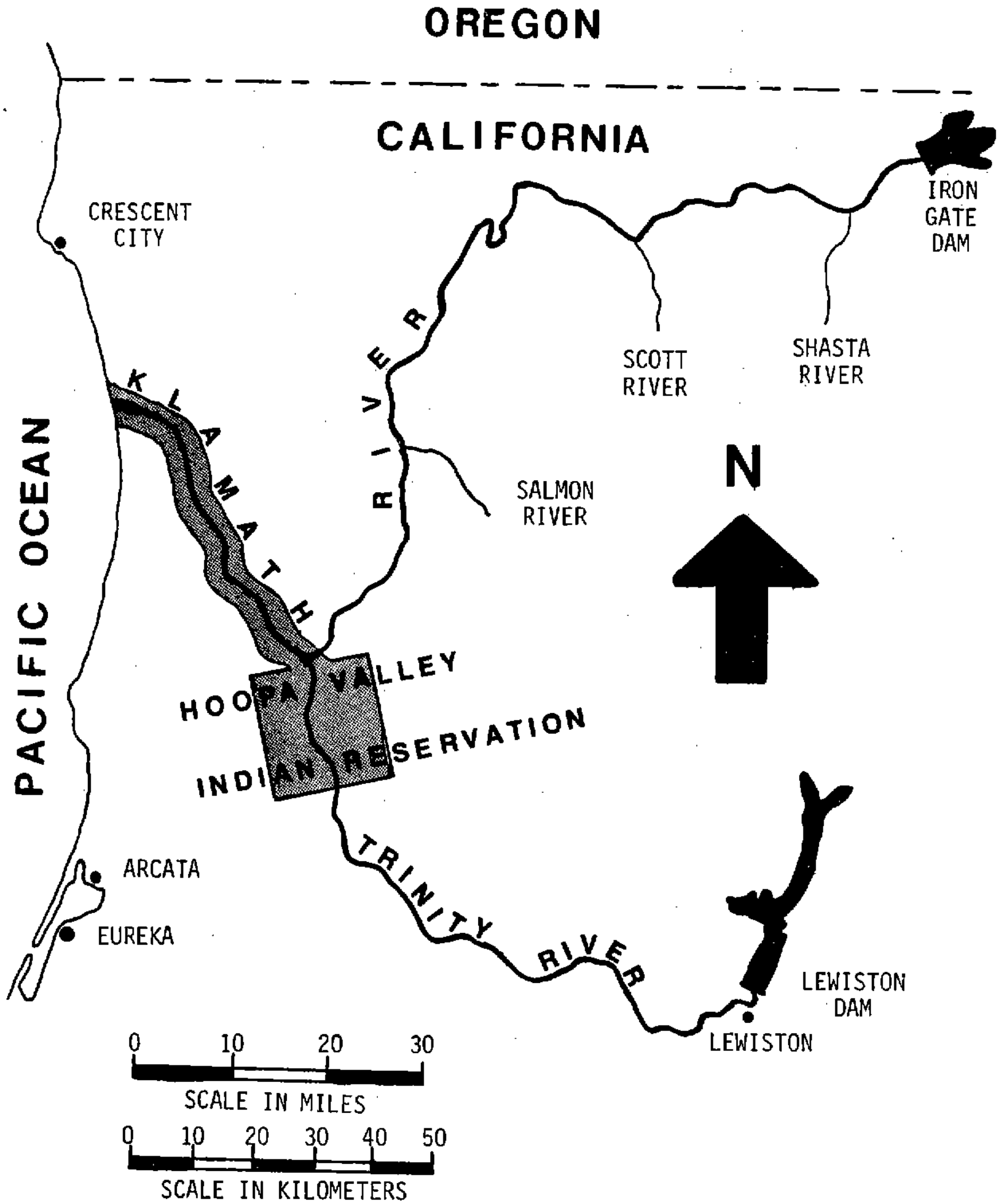


FIGURE 1. The Klamath River basin and Hoopa Valley Indian Reservation.

The U.S. Fish and Wildlife Service (USFWS) ranked anadromous salmonid problems of the Klamath River basin Number 18 of 78 "Important Resource Problems" (IRP's) in the United States (USFWS 1980*a*). The Assistant Secretaries of Indian Affairs and Fish, Wildlife, and Parks, in addressing Departmental resource and Indian Trust responsibilities concerning the Klamath River basin and Hoopa Valley Reservation, entered into memoranda of understanding (MOU's) providing for, among other things, a fisheries investigation program, focusing on the monitoring and evaluation of chinook salmon runs in the Klamath River, and the monitoring of Indian net harvest levels on the Hoopa Valley Reservation. This is the third annual report covering the Klamath River Fisheries Investigation Program, conducted through the Fisheries Assistance Office, Arcata, California (FAO-Arcata).

The program consists of six major groupings of related activities:

(1) Beach Seining Operations, in conjunction with data collected through the net harvest monitoring effort, focus on (a) the annual estimation of fall chinook run size on an in-season basis, and (b) the annual monitoring of fall chinook runs to evaluate wild/hatchery and adult/grilse components, to assess hook scarring incidences, and to collect age-growth, length-frequency, and length-weight data.

(2) Harvest Monitoring and Evaluation Efforts focus on (a) the annual estimation of Indian net harvest levels on the Hoopa Valley Reservation involving chinook salmon (spring and fall runs), steelhead trout (fall and winter runs), coho salmon, green sturgeon (*Acipenser medirostris*), and white sturgeon (*Acipenser transmontanus*); (b) an annual evaluation of the contributions of Klamath River stocks to the fisheries which operate on them through analyses of harvest levels, coded-wire tag (CWT) returns, and hook scarring incidences; (c) the annual estimation of fall chinook run size on an in-season basis (in conjunction with data collected through the beach seining effort); and (d) the annual monitoring of chinook and coho salmon, steelhead trout, and green sturgeon runs to evaluate wild and hatchery components, and to assess length-frequency, age-growth, and length-weight relationships (in conjunction with data collected through the beach seining effort).

(3) Scale Analyses involve the mounting and interpretation of chinook salmon scales obtained through the beach seining and net harvest monitoring programs to assess age and racial compositions of the runs, and to evaluate the impacts of ocean hooking on growth rates.

(4) Sturgeon Investigations, in conjunction with the net harvest monitoring program, focus on the collection of a variety of baseline data concerning the life history, abundance, and harvest of Klamath River green and white sturgeon, populations about which little is known.

(5) Juvenile Investigations have involved the collection of juvenile salmonids through beach seining, trawling, and push netting to determine hatchery and wild chinook rearing and out-migration patterns, to obtain scales for early life history identification, and to explore the possibility of establishing smolt-grilse relationships.

(6) Program Planning, Direction, and Coordination involves keeping abreast of program direction received from the USFWS and Interior Department, annual budgeting, and coordinating the program with a

variety of concerned agencies, interest groups, and the general public.

Methods utilized and results obtained in 1981 through beach seining, harvest monitoring, and scale analysis operations are detailed in the next section of the report involving chinook salmon. Sections summarizing data collected on coho salmon and steelhead trout, sturgeon, and juveniles, follow. The final section of the report addresses the direction of the FAO-Arcata program in response to USFWS and Departmental policy, and a variety of external factors. Abstracts are included, covering the primary points contained in each of the five major sections of this report.

CHINOOK SALMON INVESTIGATIONS

PLATE 1. Chinook salmon captured through beach seining operations.

CHINOOK SALMON INVESTIGATIONS

ABSTRACT

A total of 1,774 chinook salmon, including 579 grilse, were captured during 1981 seining operations in the Klamath River estuary. Adipose fin-clipped chinook comprised 8.7% of the sample, and a respective 4.2 and 40.8% of the chinook exhibited gill net markings and ocean hook scars. Scales were collected from 1,090 chinook for age analysis.

Based on nearly 4,500 contacts with Indian fishers, we estimate that the 1981 gill net harvest on the Hoopa Valley Reservation approximated 2,900 spring and 35,500 fall chinook. As in previous years, most chinook were harvested in the Estuary Area, where netting effort and catch-effort values approximately doubled from 1980 levels. A total of 655 coded-wire tags (CWT's) were recovered in the net fishery.

Catch-effort data collected through beach seining and harvest monitoring operations suggest that the 1981 fall chinook run exceeded in magnitude the 1980 run by an approximate factor of 2. These run-predictive statistics appear to become established during seasonal run peak periods (weeks before chinook cease entering the river), thereby providing a mechanism for in-season fisheries management through late-season harvest manipulation.

Beach seining and harvest monitoring data reflect an increased proportionate contribution of 3-year-olds in the 1981 (versus 1980) fall chinook run. Preliminary scale analysis reveals that the 1981 spring and fall runs included four age groups dominated by chinook in their third year. Preliminary evaluation of 542 fall chinook scale samples suggests that the run consisted of 32, 52, 14, and 2% of respective 2-, 3-, 4-, and 5-year-old fish.

Ocean hook scars designated as minor, moderate, and major comprised 43.2, 29.0, and 27.8% of the beach seining sample, and of all scars observed, 49.6% were found on the upper jaw area. The incidence of hook-scarred fish sampled through the season increased at a rate of 2.18% per week.

Returns from 16 fall and 13 spring chinook CWT release groups were sampled in the Indian net fishery, including six groups released from the Cole Rivers Hatchery on the Rogue River. Individuals of the groups generally returned to the net fishery at higher rates the longer they were held (i.e., the larger the size at release), and, as a rule, an inverse relationship existed between the size of fish at release and the mean length of respective CWT returns. In-river and preliminary ocean CWT return data suggest that the overall ratio of ocean to Indian gill net landings of tagged Klamath River fall chinook decreased from approximately 8:1 in 1980 to 3:1 in 1981.

Considering available harvest data, and applying factors to account for the contribution of Klamath River stocks to the ocean fisheries (including associated non-catch mortality), it appears that approximately 6.6 Klamath River chinook were lost through fishing for each one having spawned in the basin since 1979. The ratio between ocean fishing losses and river returns during these three years is estimated at 3.8:1.

BEACH SEINING PROGRAM

INTRODUCTION

In response to perceived inadequacies in the data base involving Klamath River populations, FAO-Arcata biologists initiated a beach seining program in the Klamath River estuary in 1979, focusing on fall chinook salmon. The intent of the program was to explore the potential for developing in-season and post-season run size estimates utilizing catch-effort and mark-recapture techniques, and to collect important biological data on the runs. Problems encountered in developing post-season run size estimates through mark-recapture methodology in 1979 and 1980 (see USFWS 1979a and USFWS 1981a) resulted in a decision not to tag chinook in 1981, but, rather, to focus efforts on developing the catch-effort component of the program. Problems in developing a reliable mark-recapture run size estimation program for the basin have also been encountered by biologists of the California Department of Fish and Game (CDFG) in recent years.

METHODS

As in previous years, 1981 beach seining operations were conducted on the south spit near the mouth of the Klamath River, adjacent to one of two deep holes in the main channel of the lower estuary (Figure 2). Site selection was based on our previous experience (indicating that fall chinook tend to migrate through deeper areas of relatively cool, highly saline water), and on depth, temperature, and salinity profile data collected in June, 1981.

Methods utilized were similar to those of 1979 and 1980. Seining was conducted 5 days per week during daylight hours at various tidal stages by a seven-man crew of biologists and enrollees of the Young Adult Conservation Corps (YACC). An average of six semi-circular sets per day were made from a Valco river boat. The 150 m long by 6 m deep seine of 8.9 cm stretched-mesh webbing was retrieved utilizing a three-horsepower gasoline winch at each end.

Once crowded, fish were transferred into holding cages (Plates 2 and 3), and then examined in a padded cradle for tags, fin clips, hook scars, seal bites, gill net marks, and other distinguishing characteristics (Plate 4). Salmonids were measured to the nearest centimeter fork length, and a 9.5 mm (3/8-inch) or 6.4 mm (1/4-inch) hole was punched through the upper lobe of the caudal fin of each chinook to identify recaptured fish. Fish were individually handled after examination to ensure proper recovery prior to release. As in previous years, scale samples were taken for further evaluation of length-age relationships.

Special circumstances developed in 1981, complicating the fish handling process. Large groups of northern anchovy (*Engraulis mordax*), which entered the estuary in July, August, and early September, initially posed no problem to seining, as most entrapped fish succeeded in escaping through the relatively large mesh. Later, however, massive die-offs occurred, presumably as a result of the lower salinity of estuarine waters. On August 17, it became necessary to relocate our seining site approximately 45 m north to avoid a detritus accumulation that rendered net retrieval virtually impossible. Be-

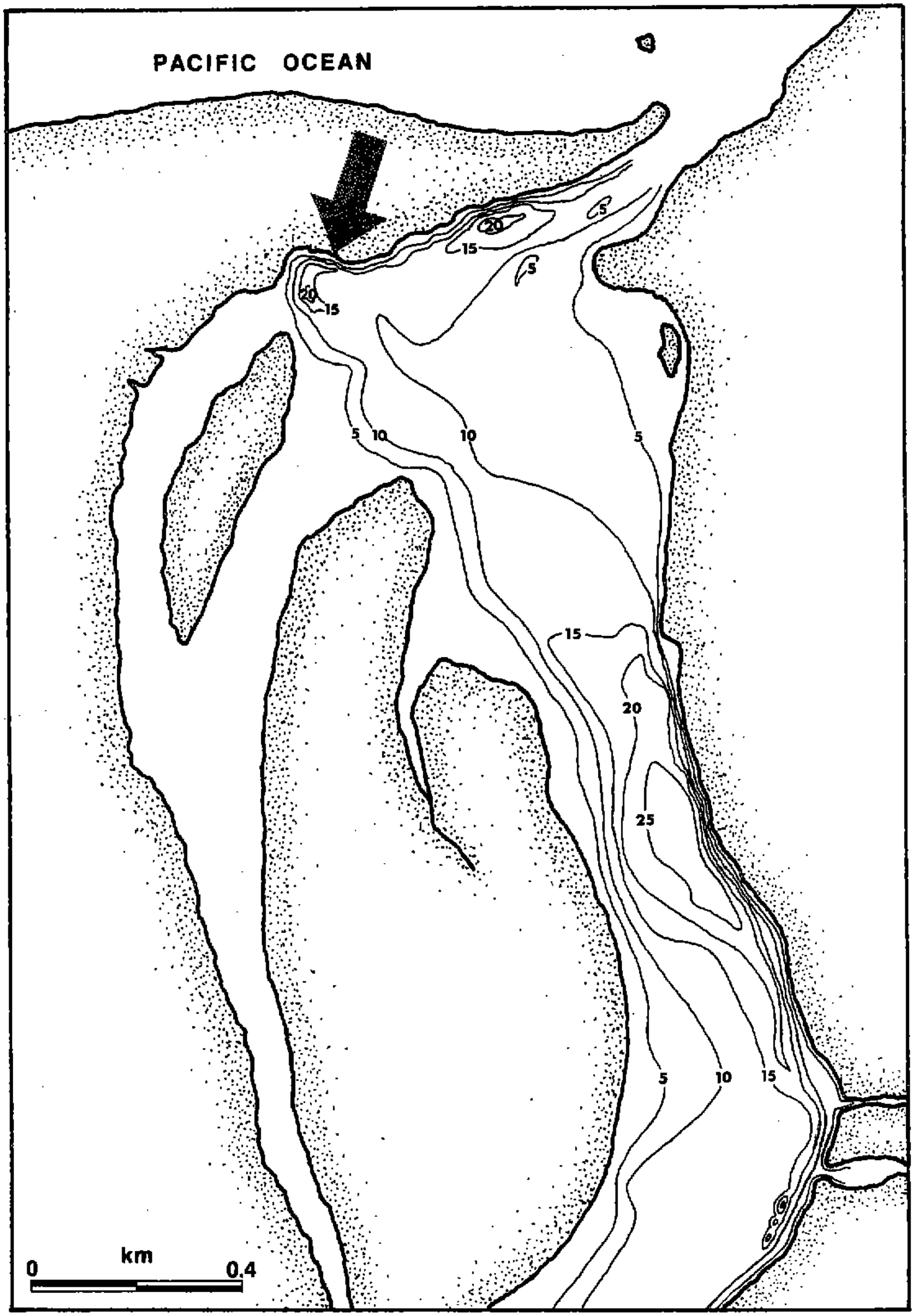


FIGURE 2. Depth contours (expressed in feet below mean high tide) of the Klamath River estuary in 1981. Arrow depicts 1981 beach seining site.

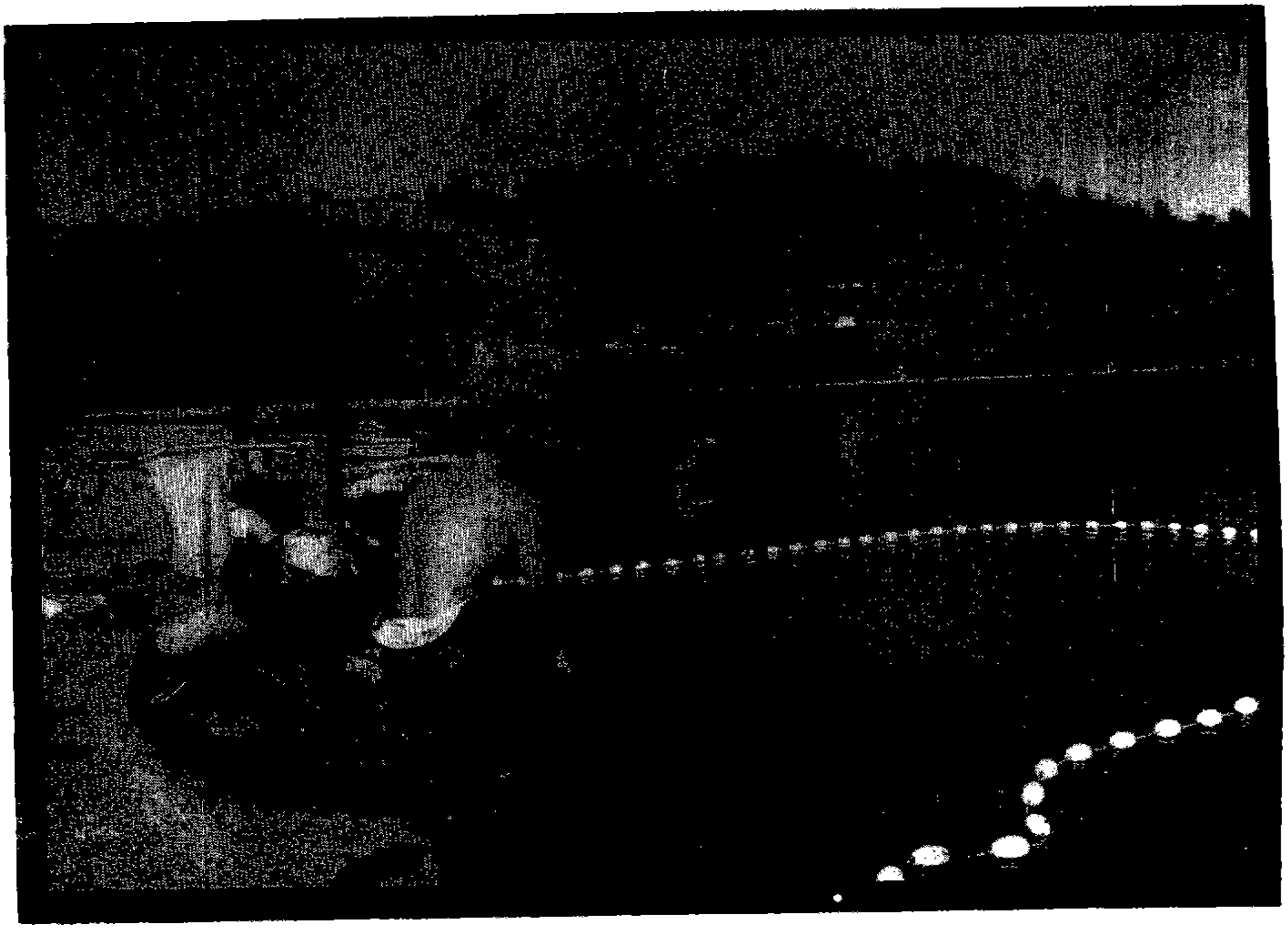


PLATE 2. The crowding of fish captured through 1981 beach seining operations.

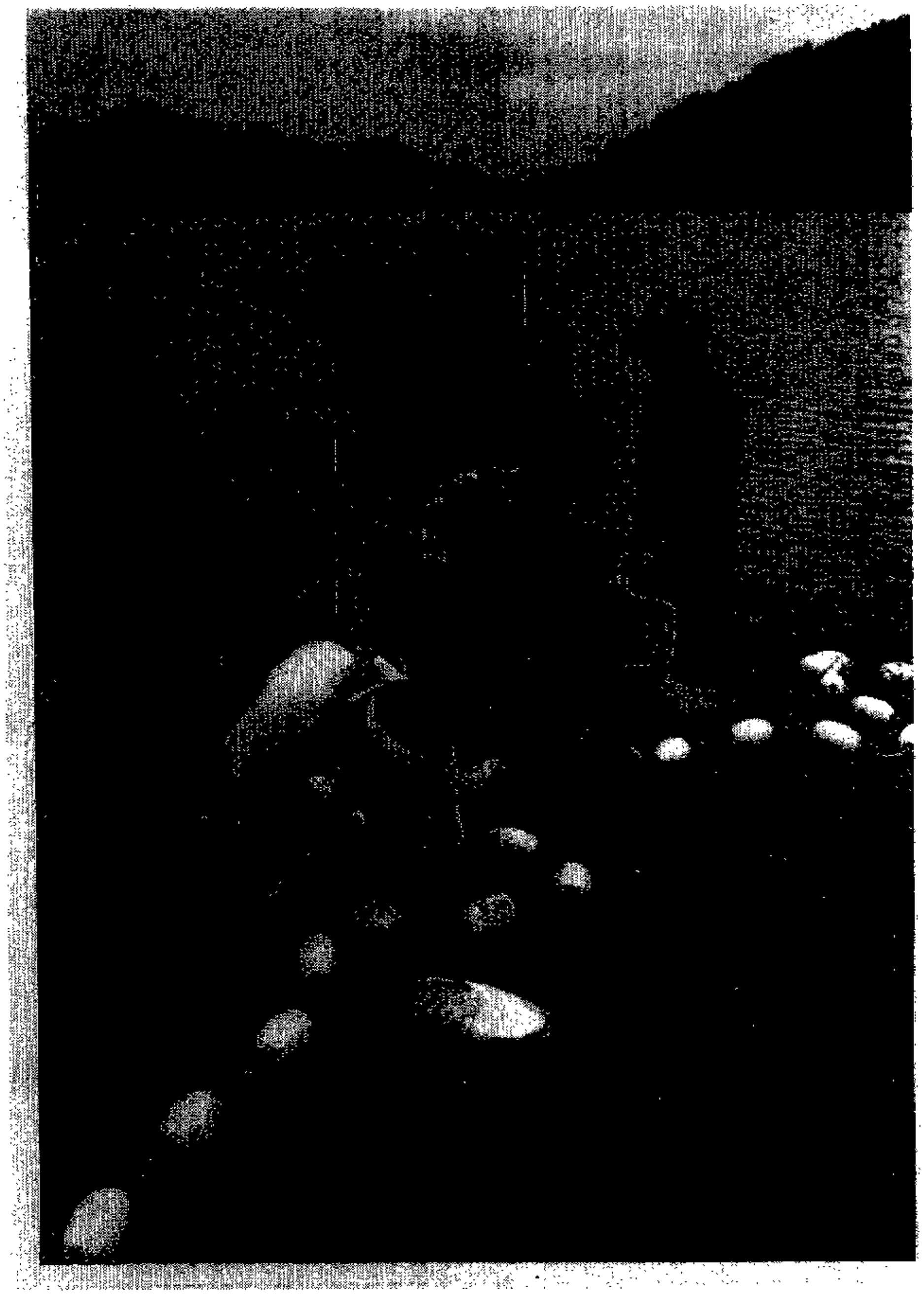


PLATE 3. The handling of fish captured through 1981 beach seining operations.

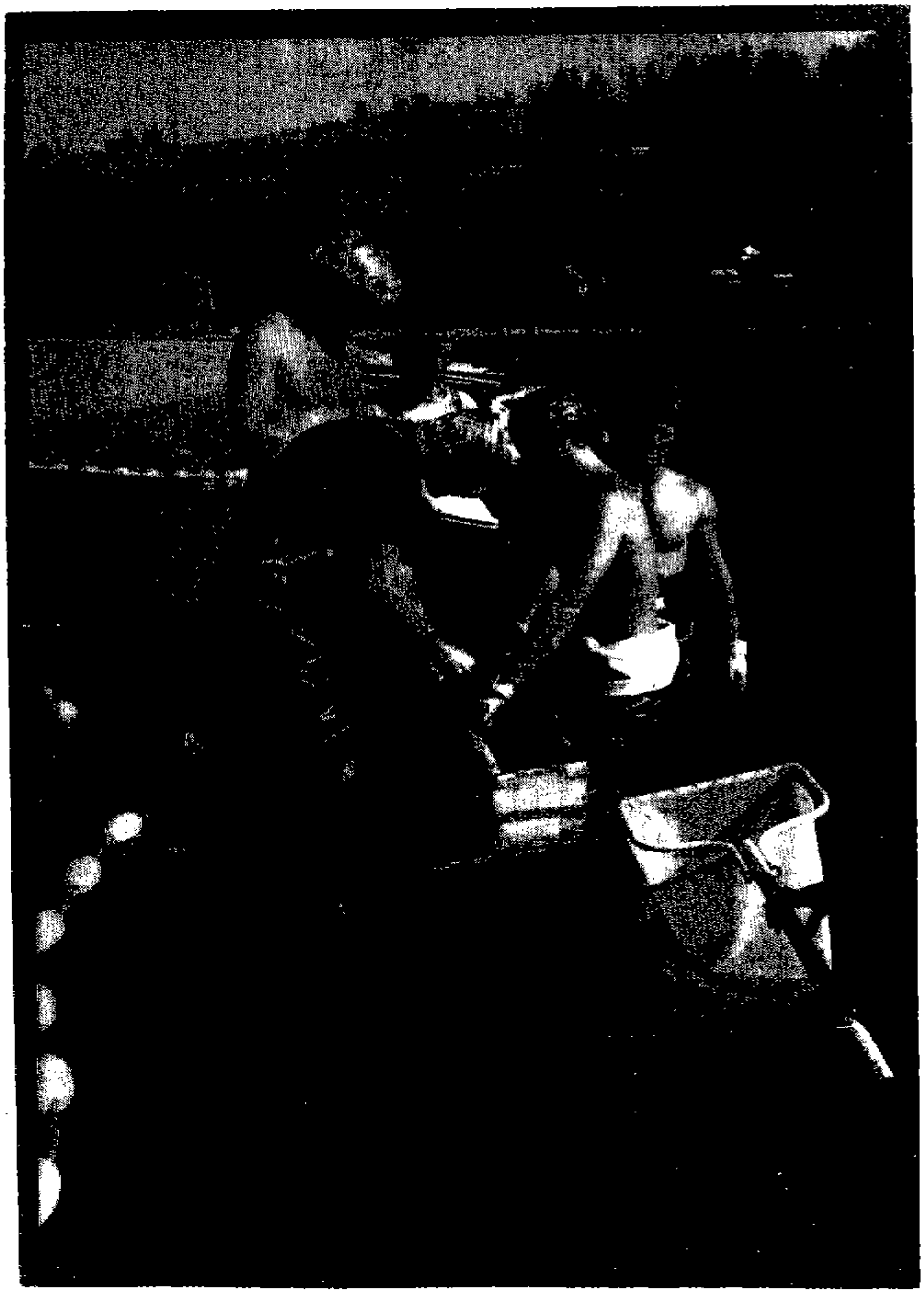


PLATE 4. The examination of fish captured through 1981 beach seining operations.

cause of decreases in dissolved oxygen levels resulting from the decomposition process, the recovery time for handled fish increased dramatically, necessitating the release of many unexamined fish to minimize mortality. Statistical tests were conducted to insure that inclusion of data from partially sampled sets would not bias data presented in this report.

RESULTS AND DISCUSSION

A total of 1,774 chinook salmon, including 579 grilse (< 58 cm), were sampled during 1981 beach seining operations from July 13 to September 25. In contrast to a predominance of 2-year-old chinook seined in 1980, 3-year-olds appeared to dominate our 1981 catch (Figure 3). Three-year-olds also appeared to contribute proportionately more than 4-year-olds to the 1981 run, as reflected by a significant (t-test; $P < 0.05$) decrease in mean length of sampled adult chinook (71.8 cm in 1981 versus 75.2 cm in 1980). Grilse comprised 29.2 and 38.0% of respective samples obtained prior to and after September 5 (a significant difference derived through chi-square analysis; $P < 0.05$), an increase apparently related to a higher percentage of fin-clipped hatchery returns after this date.

Of 1,272 chinook examined for adipose fin-clips in 1981, 41 of 412 grilse (10.0%) and 70 of 860 adults (8.1%) exhibited such clips. Mean lengths of adipose fin-clipped grilse (46.2 cm) and adults (69.2 cm) differed significantly (t-tests; $P < 0.05$) from those of non-clipped grilse (50.0 cm) and adults (72.0 cm), respectively (differing tagging rates between classes may somewhat distort mean length comparisons). The relatively large compliment of fin-clipped grilse less than 40 cm in length (Figure 4) may be due, in part, to large numbers of spring chinook in the sample (large numbers of relatively small fin-clipped grilse were seined during the period of July 26 to August 2). Adipose fin-clipped chinook increased from 6.4 to 9.1% of respective samples collected during the periods of August 17 to 28 and August 29 to September 11, 1981 (significant through chi-square analysis; $P < 0.05$), an increase observed in both adults and grilse (Figure 5). Another significant ($P < 0.05$) increase in the percentage of sampled fin-clipped grilse occurred during the period of August 10 to 14.

One of 412 grilse (0.2%) and 53 of 860 adult chinook (6.2%) examined in 1981 beach seining operations exhibited gill net markings. Lengths of examined net-marked adults (Figure 6) averaged 2 cm more than the mean length of all measured adults (73.8 versus 71.8 cm), and 2.1 cm less than the mean length of fall chinook adults examined in the Estuary Area during net harvest monitoring activities (73.8 versus 75.9 cm). Both differences were significant (t-test; $P < 0.05$), and probably reflect size-selectivity effects of the tidewater gill net fishery. Further information regarding net marking observations in the upper drainage, as well as hook-scarring observations in beach seining operations, is provided in subsequent sections of this report.

Five chinook salmon bearing spaghetti tags applied by CDFG biologists at their Waukel Creek beach seining site (River Kilometer 4.5) were recaptured in our 1981 beach seining operations. Periods between tagging and recovery ranged from 0 to 2 days, and averaged 1.2 days.

Run Timing and Catch-Effort Analyses

Respective numbers of grilse and adult fall chinook captured per beach seining haul in 1981 were 1.90 and 3.92. The ratio between 1981 and 1980 adult catch per seine haul values is 2.38:1. For reasons discussed herein, this ratio appears to exaggerate the difference in magnitude between the two runs.

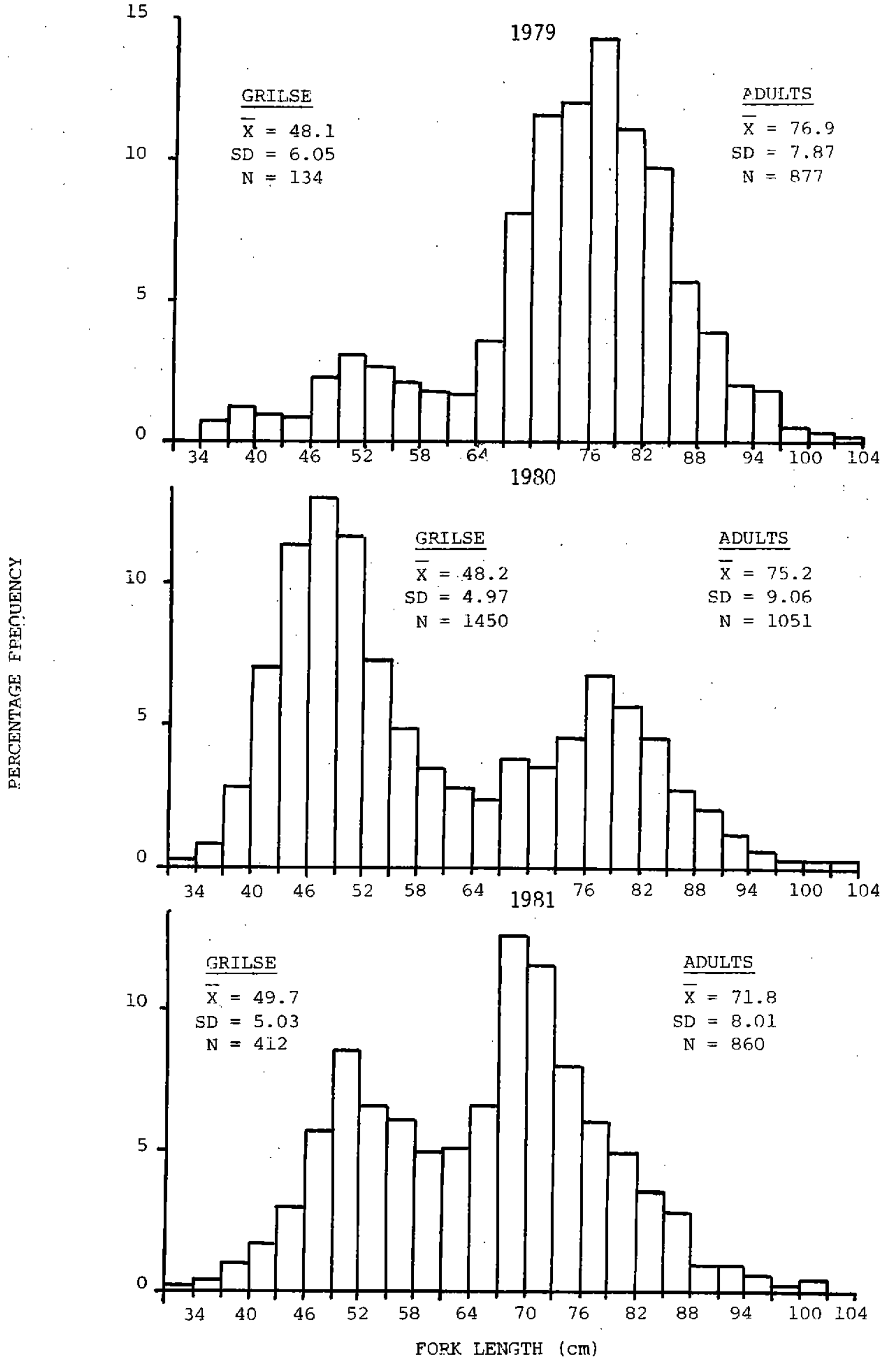


FIGURE 3. Length-frequency distributions of chinook salmon captured during beach seining in the Klamath River estuary in 1979, 1980, and 1981.

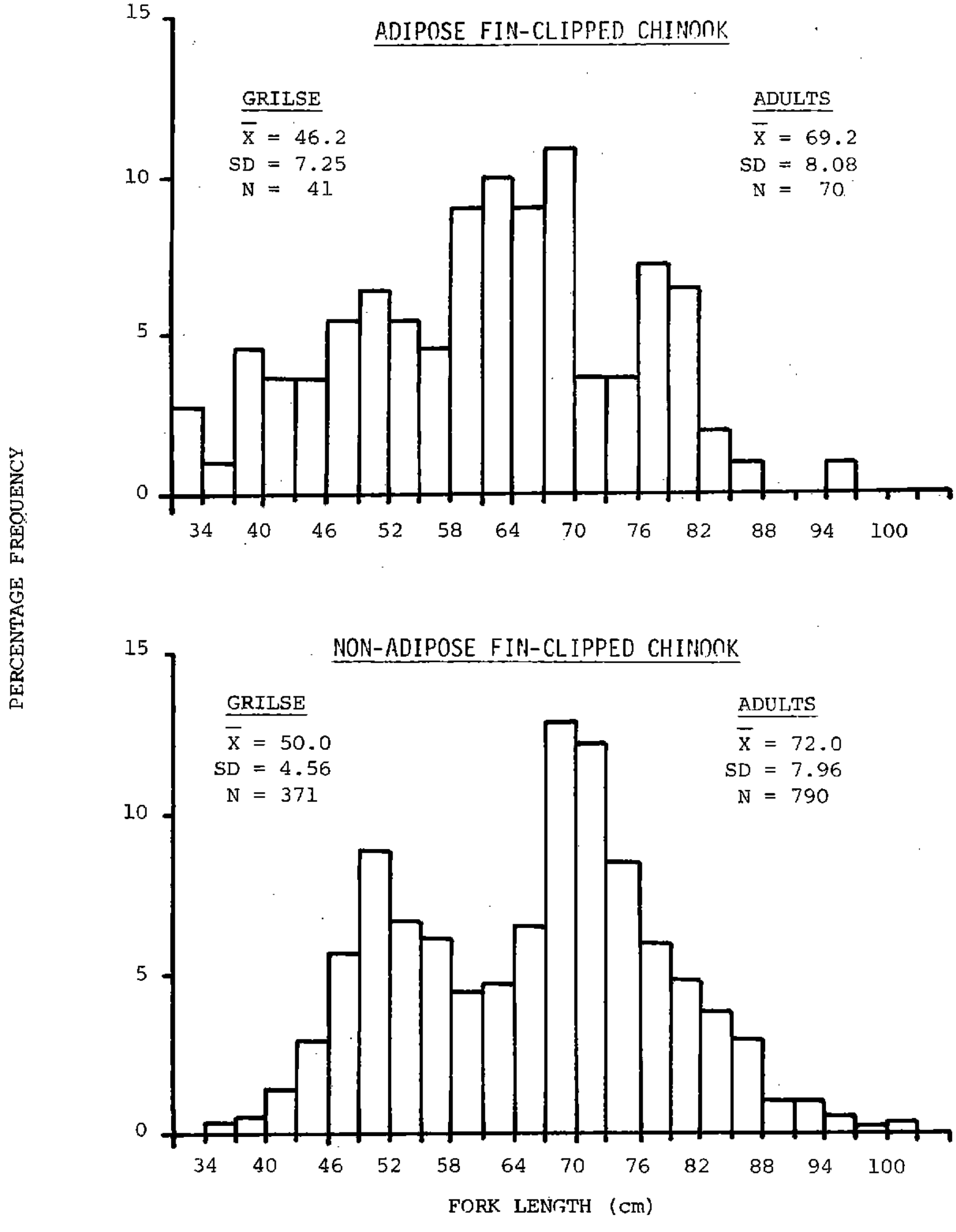


FIGURE 4. Length-frequency distributions of adipose fin-clipped and non-adipose fin-clipped chinook salmon captured in 1981 beach seining operations.

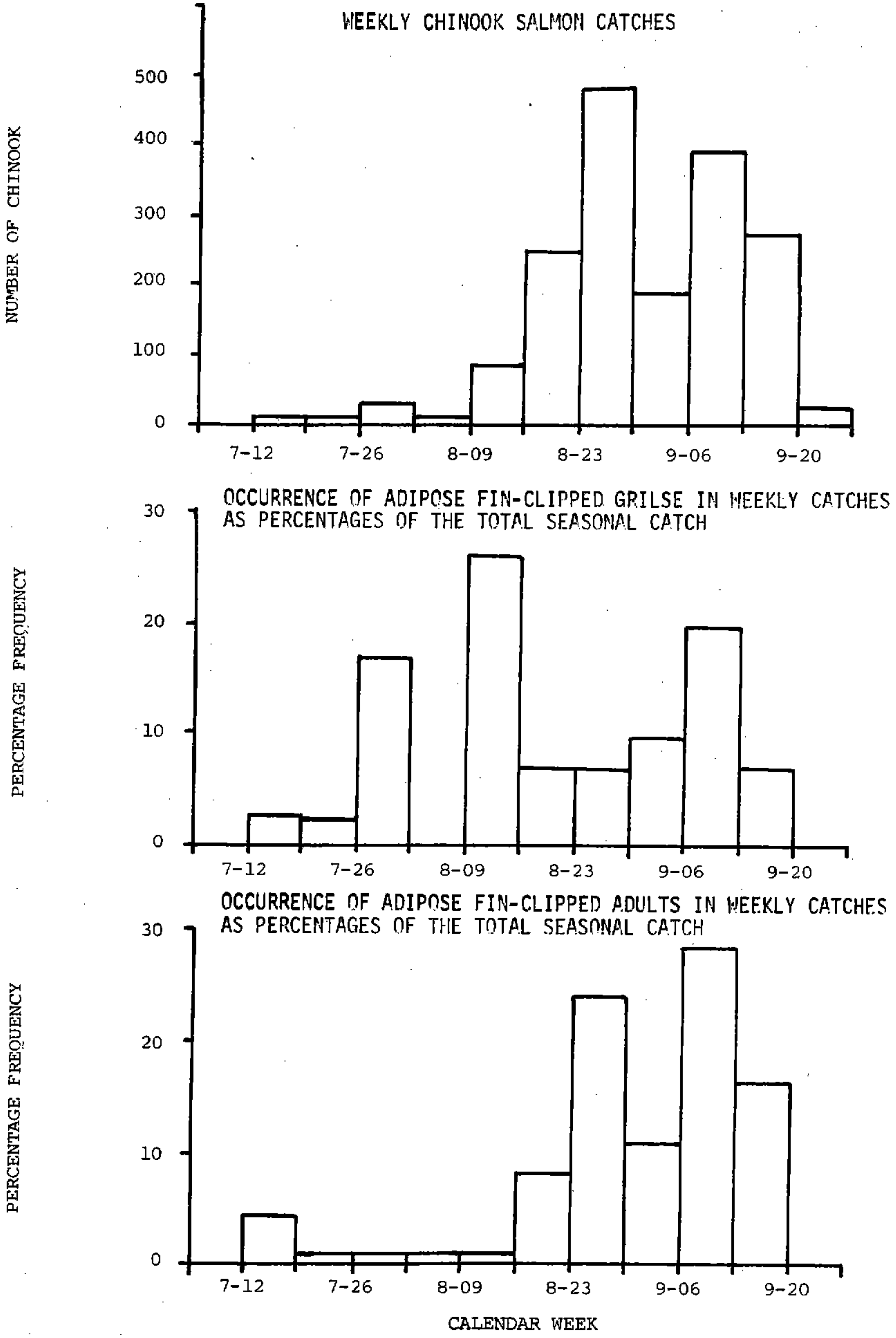


FIGURE 5. Numbers of chinook salmon captured weekly in 1981 beach seining operations (top) and temporal distributions of adipose fin-clipped grilse (middle) and adults (bottom) observed (respective weekly totals divided by seasonal totals).

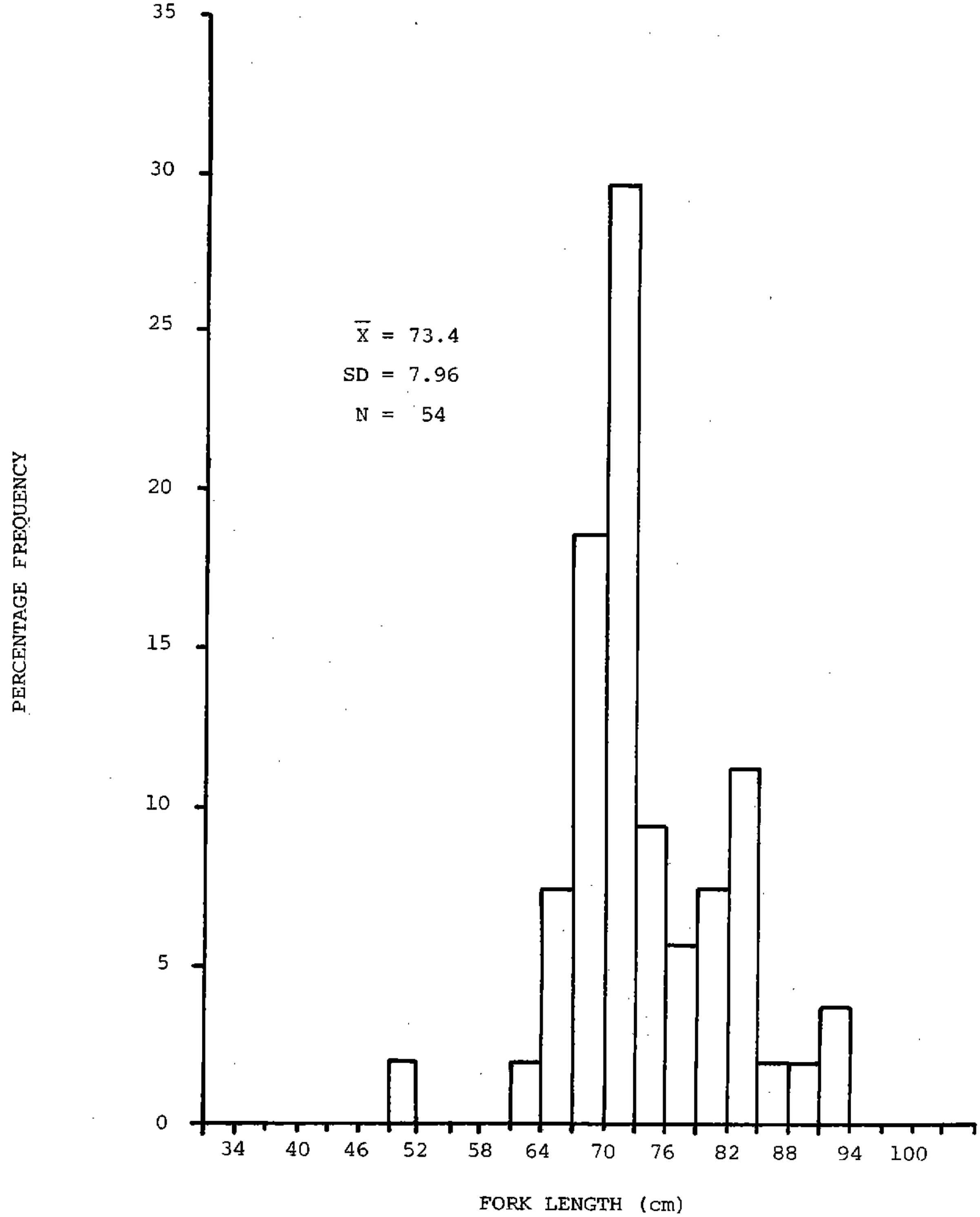


FIGURE 6. Length-frequency distribution of gill net marked chinook salmon captured in 1981 beach seining operations.

In comparing data from 1979, 1980, and 1981 beach seining operations, several distinct behavior patterns of fall chinook entering the Klamath River estuary have emerged. These patterns, in conjunction with inconsistent sampling effort, can influence catch-effort values calculated from the raw data. Attempts to apply seining effort in a consistent manner have helped eliminate a portion of these inherent biases, but certain manipulations of the data were deemed necessary to yield catch-effort statistics better reflecting actual run size differences among years.

Annual variations in physical characteristics of, and environmental conditions in the Klamath River estuary, and seining site relocations between years, may affect the availability of chinook to sampling gear. There appears to be no way of reliably evaluating this potential bias, the effects of which appear to have been minimal.

An apparent difference in 1981 run timing between grilse and adults was reflected by a marked increase in percentage occurrence of grilse sampled during the latter half of the run. This bias was treated by separating grilse and adults in data workups, a separation we would have made anyway, considering that spawner escapement goals for the Klamath River basin are expressed in terms of adults only. Similar differences in run timing may occur between 3-, 4-, and 5-year-old chinook; however, such differences have not been apparent.

Bias could have been introduced into catch-effort data had size-selectivity of the capture gear occurred in conjunction with variations in age class frequency (reflected in length-frequency distributions) between run years, but no evidence of such selectivity was apparent in the seining data from 1979, 1980, or 1981, and treatment appeared unnecessary. Another possible source of bias relates to the tendency of fall chinook to hold in the lower estuary and be recaptured in seining operations. Recapture rates in 1979, 1980, and 1981, however, were only 2.5, 3.1, and 1.3%, respectively, and counts of recaptured chinook were easily eliminated from catch-effort calculations.

Beach seining operations conducted during the peak of the fall run reveal that daily chinook movement into the Klamath River estuary from the ocean has tended to be concentrated during a short period (or periods) of time. These daily peak movement periods have usually extended from 1.5 to 2 hours, and have occurred at various times of day regardless of tidal stage. Data collected in 1980 and 1981, however, indicate that such movement typically occurred later in the afternoon or during the early portion of incoming tides (Table 1). Considering that 1980 and 1981 seining efforts focused on anticipated daylight peak movements, and that seasonal effort during both years appears proportional with regard to times of day and tides seined, no special bias-related treatment of the data appears necessary.

Although the average duration of daily periods of peak chinook movement into the estuary appears consistent between years, the average number of hours seined per day decreased from 6 in 1980 to 4 in 1981. Consequently, we would expect 1980/1981 catch-effort comparisons to exaggerate the relative strength of the 1981 run. To compensate for this bias, we compared seasonal catch-effort data from the three highest consecutive daily seine hauls (peak three sets) only. The length of time required to complete three seine hauls approximated the average duration of daily peak movement periods.

Although we recognize that the rate of movement into the estuary may vary greatly between daylight and nighttime hours, it appears reasonable to assume that differences between such diurnal variations remain relatively uniform throughout the course of a run and between years. Other than establishing a nighttime seining effort, there appears to be no way of quantifying this potential bias.

TABLE 1. Adult chinook salmon catch-effort statistics by time of day and tidal stage during 1980 and 1981 beach seining operations in the Klamath River estuary (all sets included).

YEAR	TIDAL STAGE	HOURS OF DAY 0800-1100	1100-1400	1400-1700	ALL HOURS
	Outgoing	1.00	4.54	5.38	4.29
	Low Slack	0.50	1.90	11.00	3.91
1981	Incoming	0.55	5.26	3.41	3.85
	High Slack	0.00	2.94	7.40	3.35
	ALL TIDES	0.58	4.25	5.29	3.92
	Outgoing	0.67	0.75	1.27	0.90
	Low Slack	0.22	1.24	2.79	1.15
1980	Incoming	1.19	1.42	4.32	2.27
	High Slack	0.00	1.09	1.00	0.92
	ALL TIDES	0.81	1.21	3.01	1.65

Disproportionate seining effort between periods occurring within and outside of defined seasonal run peak periods, regardless of annual variations in the intensity and duration of the run peaks, can bias catch-effort comparisons between years; e.g., a greater proportion of 1980 than 1981 seining effort occurred external to the run peak periods (34 versus 15%, respectively), further exaggerating the relative strength of the 1981 run. This bias may be treated by comparing seasonal catch-effort data collected only during the peak of each annual run. Seasonal differences in the duration of run peak periods (not accounted for in such comparisons) can be treated by accrediting the relative number of days in each run year during which catch-effort values remain consistently above a defined level.

In identifying run peak periods for use in comparing run intensity and duration between years, we plotted daily and cumulative daily adult chinook catch-effort values involving all seine hauls (Figures 7 and 8, respectively) and the daily peak three sets (Figures 9 and 10, respectively). Run peaks in 1980 and 1981 were defined as those periods during which adult catch-effort values in the peak three sets consistently exceeded 4.0. Applying this criterion, the 1980 fall chinook run peaked over a 24-day period (August 18 to September 10), during which time adult catch-effort values averaged 8.57; the 1981 run peak extended for 29 days (August 18 to September 15), with adult catch-effort averaging 14.38. The 1981 run, therefore, as interpreted from beach seining data, was 1.68 times greater than the 1980 run in terms of intensity, and 1.21 times greater in terms of duration. Taking into account both run intensity and duration, the 1981 run appears to exceed in magnitude the 1980 run by a factor of 2.03. Table 2 summarizes various data treatments and their effects on the 1981:1980 catch-effort ratio.

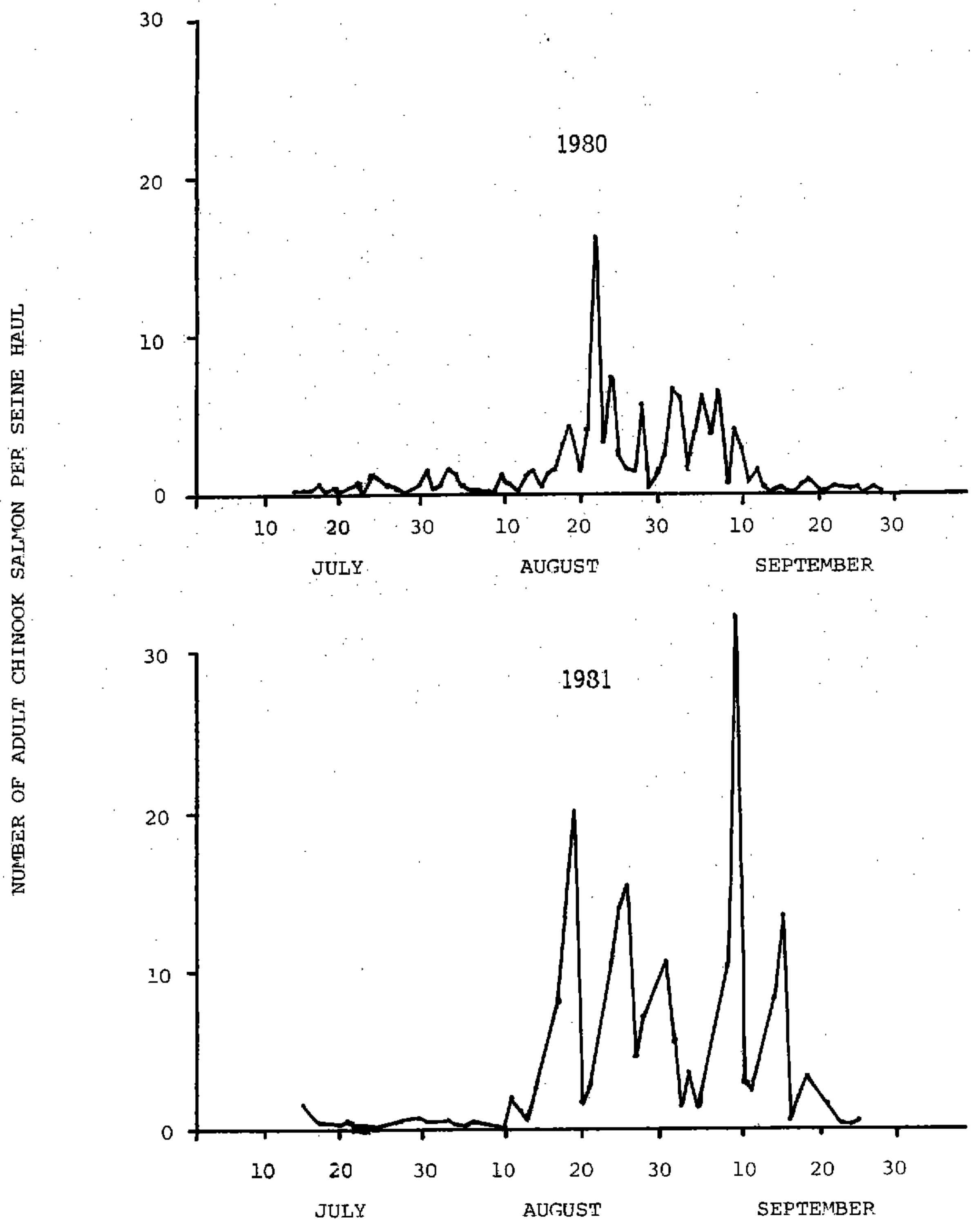


FIGURE 7. Daily numbers of adult chinook salmon captured per beach seining haul in the Klamath River estuary in 1980 and 1981 (all sets included).

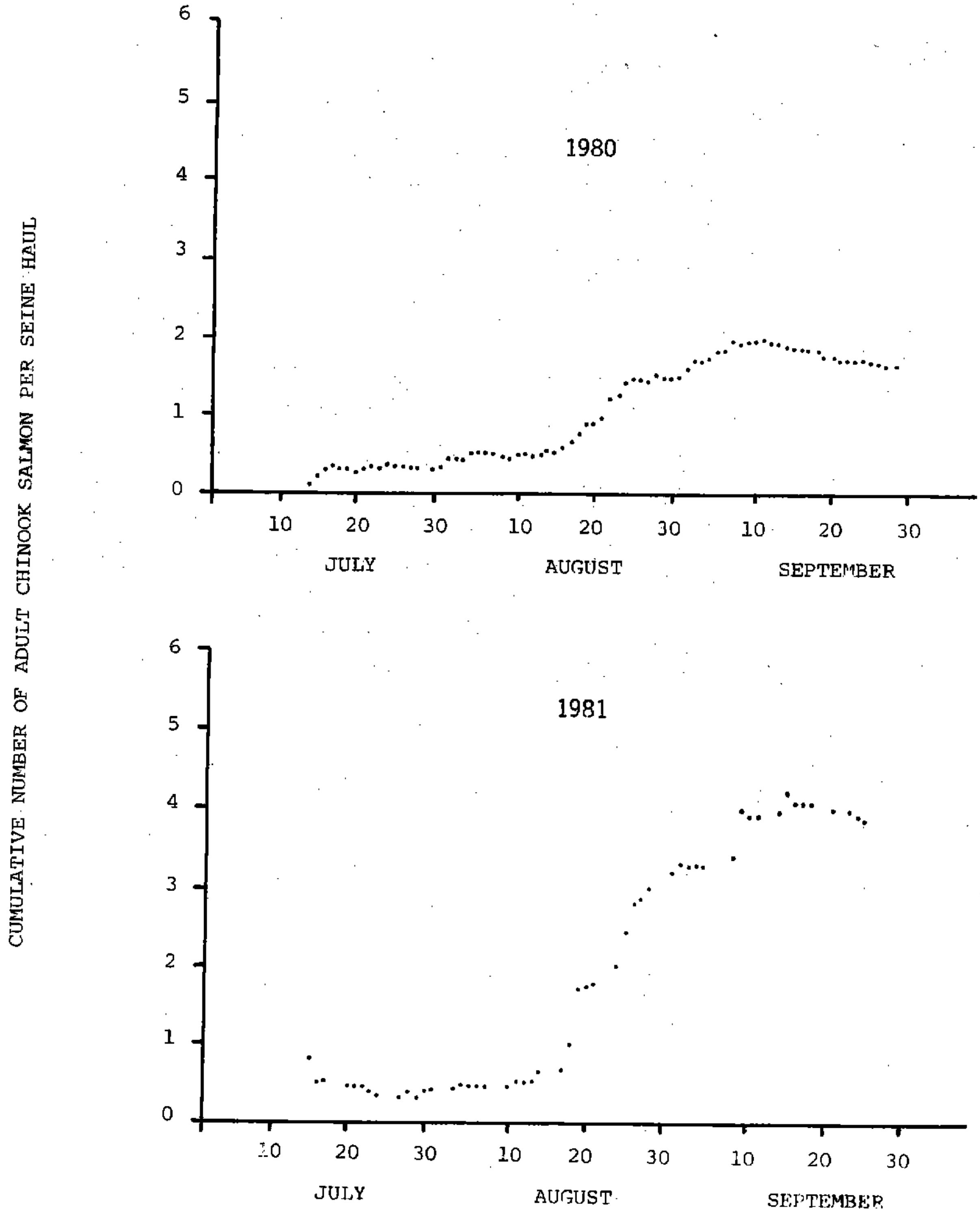


FIGURE 8. Cumulative daily adult chinook salmon catch-effort values in 1980 and 1981 beach seining operations in the Klamath River estuary (all sets included).

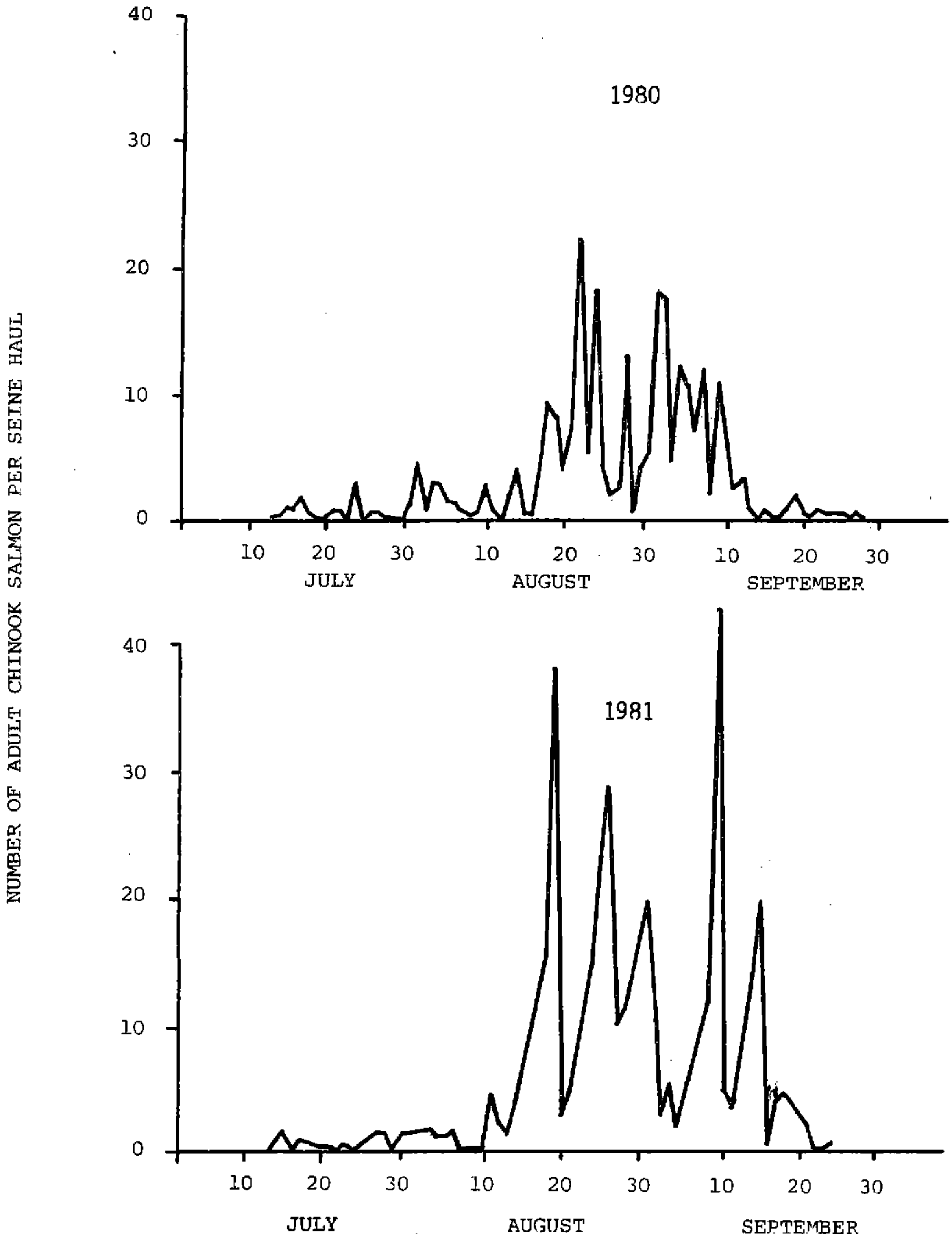


FIGURE 9. Daily numbers of adult chinook salmon captured per beach seining haul (peak 3 sets only) in the Klamath River estuary in 1980 and 1981.

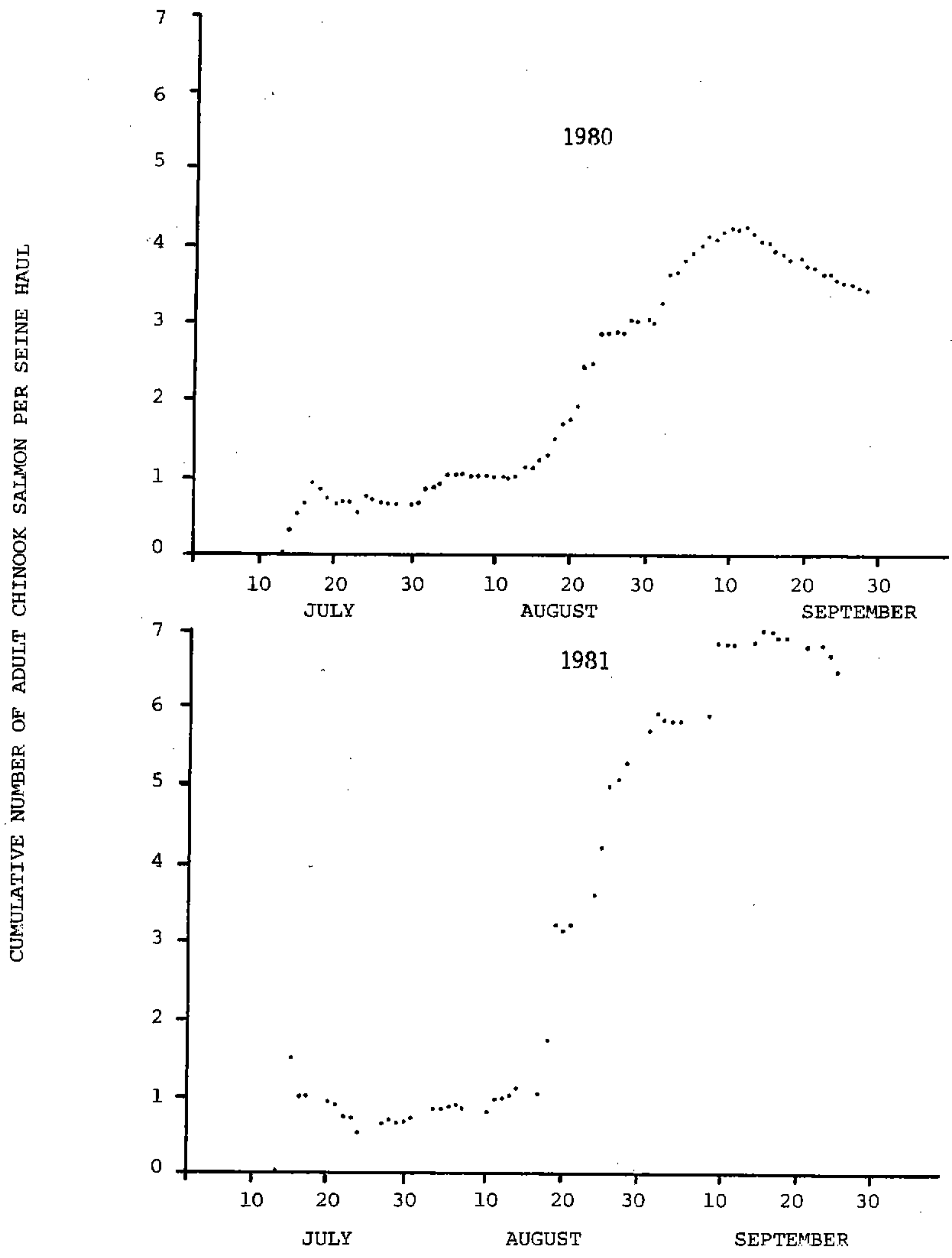


FIGURE 10. Cumulative daily adult chinook salmon catch-effort values (peak 3 sets only) in 1980 and 1981 beach seining operations in the Klamath River estuary.

TABLE 2. Treatments of catch-effort data involving chinook salmon captured in 1980 and 1981 beach seining operations in the Klamath River estuary.

TIMING	CHINOOK RUN COMPONENT	YEAR 1980	YEAR 1981	1981/1980 RATIO
All Sets Total Season	Grilse	2.40	1.90	0.79
	Adults	1.65	3.92	2.38
	All Chinook	4.06	5.82	1.43
Peak 3 Sets Total Season	Grilse	4.73	2.97	0.63
	Adults	3.41	6.55	1.92
	All Chinook	8.14	9.51	1.17
Peak 3 Sets 8-15 to 9-20	Grilse	7.29	5.65	0.78
	Adults	6.04	12.90	2.14
	All Chinook	13.32	18.55	1.39
Peak 3 Sets Run Peak	Grilse	9.90	6.28	0.63
	Adults	8.57	14.38	1.68
	All Chinook	18.47	20.67	1.12

We attempted to calculate comparative catch-effort statistics representing periods of time wide enough to account for differences in annual run duration, yet narrow enough to minimize effort bias. Unfortunately, seining effort in 1980 and 1981 differed to such an extent that inherent biases could not be eliminated in this manner.

Other Species Captured

As in previous years, individuals of other species were captured in 1981 beach seining operations, notably, coho salmon, steelhead trout, and coastal cutthroat trout (*Salmo clarki clarki*). Because of the relatively small sample sizes involved, beach seining data pertaining to these species are not included herein. Net harvest data involving coho salmon and steelhead trout is presented in a subsequent section of this report.

Considerable numbers of Pacific hake (*Merluccius productus*), which apparently followed the dense schools of northern anchovy into the estuary, were seined in 1981. To our knowledge, this is the first reported occurrence of hake in the estuary.

NET HARVEST MONITORING PROGRAM

INTRODUCTION

Hupa, Yurok, and Karok Indians living along the Klamath and Trinity rivers have traditionally fished for salmon, steelhead, sturgeon, and other species utilizing a variety of techniques including spears, dip nets, weirs, and, most recently, gill nets. Historically, salmon consumption by these people exceeded 907,000 kg (two million pounds) annually (Hoptowit 1980). Historical accounts of the Indian fisheries are included in Hoptowit (1980), Bearss (1981), and USFWS (1981*a*).

Regulations governing Indian fishing on the Hoopa Valley Reservation were first promulgated by the Department of the Interior in 1977, and FAO-Arcata biologists began monitoring gill net harvest levels on the reservation in 1978 (USFWS 1981*a*), focusing efforts on fall chinook salmon. Through the continued operation of the lower Klamath River net harvest monitoring station (established in 1980) and the establishment of a new upper Klamath River monitoring station in 1981, considerable progress was made in ascertaining net harvest levels. The newly-established upriver station was utilized to monitor gill net fisheries operating on the upper Klamath and Trinity river portions of the reservation in 1981, and, in 1982, we plan to establish a third station in Hoopa to improve monitoring of net harvest levels on the Hoopa Square, and to coordinate this effort closely with biologists recently hired by the Hoopa Valley Tribe. In 1981, for the first time, a log sheet program was tested as an alternative net harvest censusing technique.

METHODS

As described by Harper (1981), net harvest monitoring data were collected and compiled from four contiguous areas (Estuary, Resighinni, Upper Klamath, and Trinity) of the Hoopa Valley Reservation in 1981 (Figure 11). The tidewater (tidal-influenced) portion of the lower Klamath River was divided into two census areas: the Estuary Area, representing the lower 6 km of the river from the mouth to the Highway 101 Bridge, and the Resighinni Area, encompassing the uppermost portion of tidewater from the Highway 101 Bridge to the mouth of Terwer Creek, 8.5 km above the river mouth. The Upper Klamath Area includes the 61-km stretch of the Klamath River between Terwer Creek and Weitchpec, a relatively remote and inaccessible portion of the reservation. The Trinity Area represents the lower 26 km of the Trinity River contained within the Hoopa Square portion of the reservation. Following is a brief description of monitoring procedures employed for each area.

Estuary Area

Operating from a base camp at Welk Wau Village (formerly "Chub's Camp"), located at the southern edge of the estuary, FAO-Arcata biologists and Indian technicians monitored netting activity using a Valco river boat as the principal means of transportation (Plate 5). Monitoring efforts were conducted on a periodic basis during the spring chinook run, and daily from July 14 to September 29 to assess fall chinook harvest levels. Indian fishers were contacted

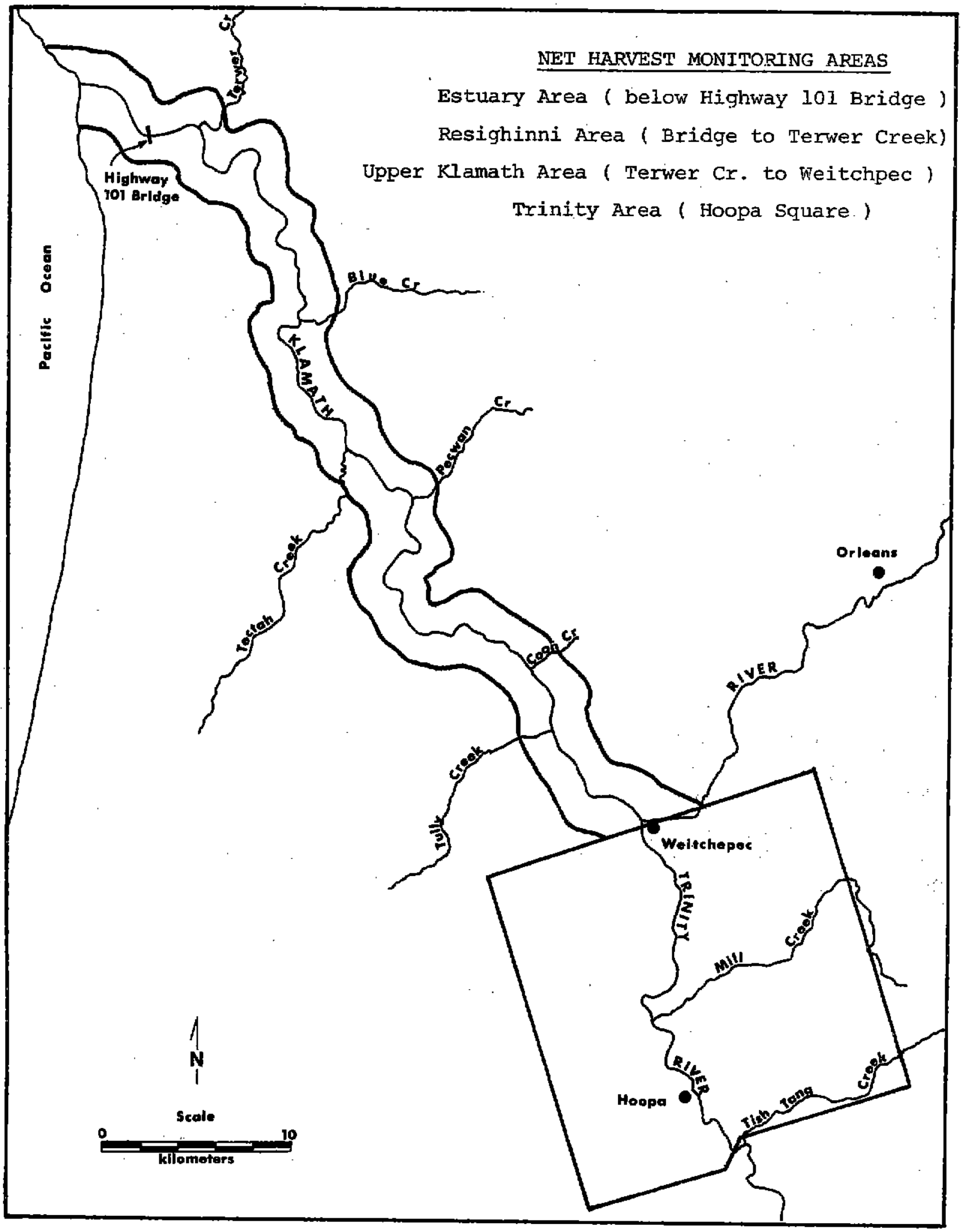


FIGURE 11. Net harvest monitoring areas - Hoopa Valley Indian Reservation.

PLATE 5. FAO-Arcata biologists contact Indian fishers on the lower Klamath River utilizing a jet boat as the primary means of transportation.

while fishing in their boats, at their riverside camps, or at several boat landings in the area (Plates 6 and 7). Monitoring activities were generally confined to the lower 2 km of the estuary, as Indian fishers typically set their nets in the deep channel off the south spit or just off the north bank of the river below Requa (Figure 12). Daily surveys, scheduled to coincide with hours of anticipated peak harvest, typically occurred during the hours of 1900 to 0300 and 0700 to 0900, with spot surveys normally occurring between 1200 and 1700 hours. Daily net counts made just prior to dark were adjusted to include additional nets that subsequently entered the fishery.

Resighinni Area

FAO-Arcata personnel stationed at Welk Wau Village periodically monitored the Resighinni Area fishery during the spring chinook run; during the fall run, the fishery was monitored daily from August 1 to October 11. Daily surveys and net counts were made during the morning hours when fishers typically checked their nets and cleaned their fish. Spot surveys were conducted occasionally in the evening.

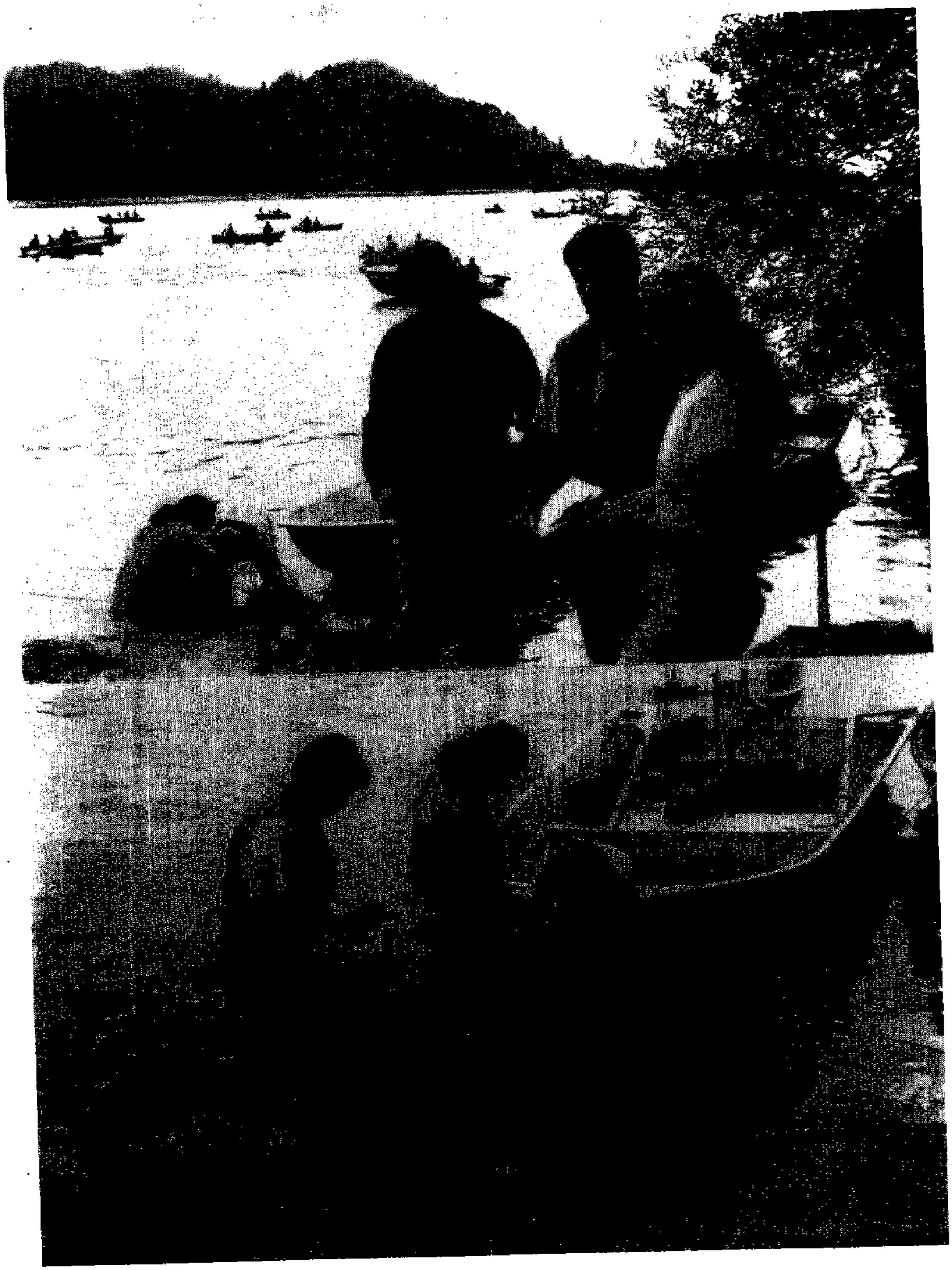
Upper Klamath River Area

Net harvest monitoring in the Upper Klamath Area was conducted from a base camp located near Pecwan Creek, 46 km upstream from the river mouth. Indian fishers operating from Klamath Glen to Coon Creek were contacted at netting sites scattered along the river (Figure 13), or at their residences. Difficulty in negotiating a boat over the falls near Coon Creek necessitated the monitoring of netting activity between this point and Weitchpec by motor vehicle via the Johnson Road, which parallels this stretch of the river. We operated the upriver station periodically during the spring fishery, and at least 5 days per week during the fall fishery (August 5 to October 27), alternating work days between the Upper Klamath and Trinity areas after September 1. Work days were staggered to sample the net fishery on different days of the week, and work shifts were scheduled to coincide with the time the majority of Indians checked their nets — usually during the evening and early morning daylight hours.

Trinity Area

The spring fishery operating in the Trinity Area was monitored through periodic contacts with Indian fishers and by observing netting activity during periods of peak fishing. The fall chinook fishery was monitored on a regular basis from September 2 to October 27 by personnel from the upriver monitoring station near Pecwan Creek. During this time, the monitoring crew alternated work days between the Upper Klamath and Trinity areas. Surveys in the Trinity Area were conducted at fishing sites during the early morning hours when Indian fishers normally checked their nets; later in the day, Indian fishers were also interviewed at their residences.

Estimated daily, weekly, and monthly net harvest levels were derived by (1) summing numbers of chinook measured, seen but not measured, and reported caught by reliable sources, and (2) dividing these respective sums by estimated percentages of net harvest these sums were judged to represent, based on



PLATES 6 & 7. Net harvest data are recorded at various fishing and boat landing sites on the Hoopa Valley Indian Reservation.

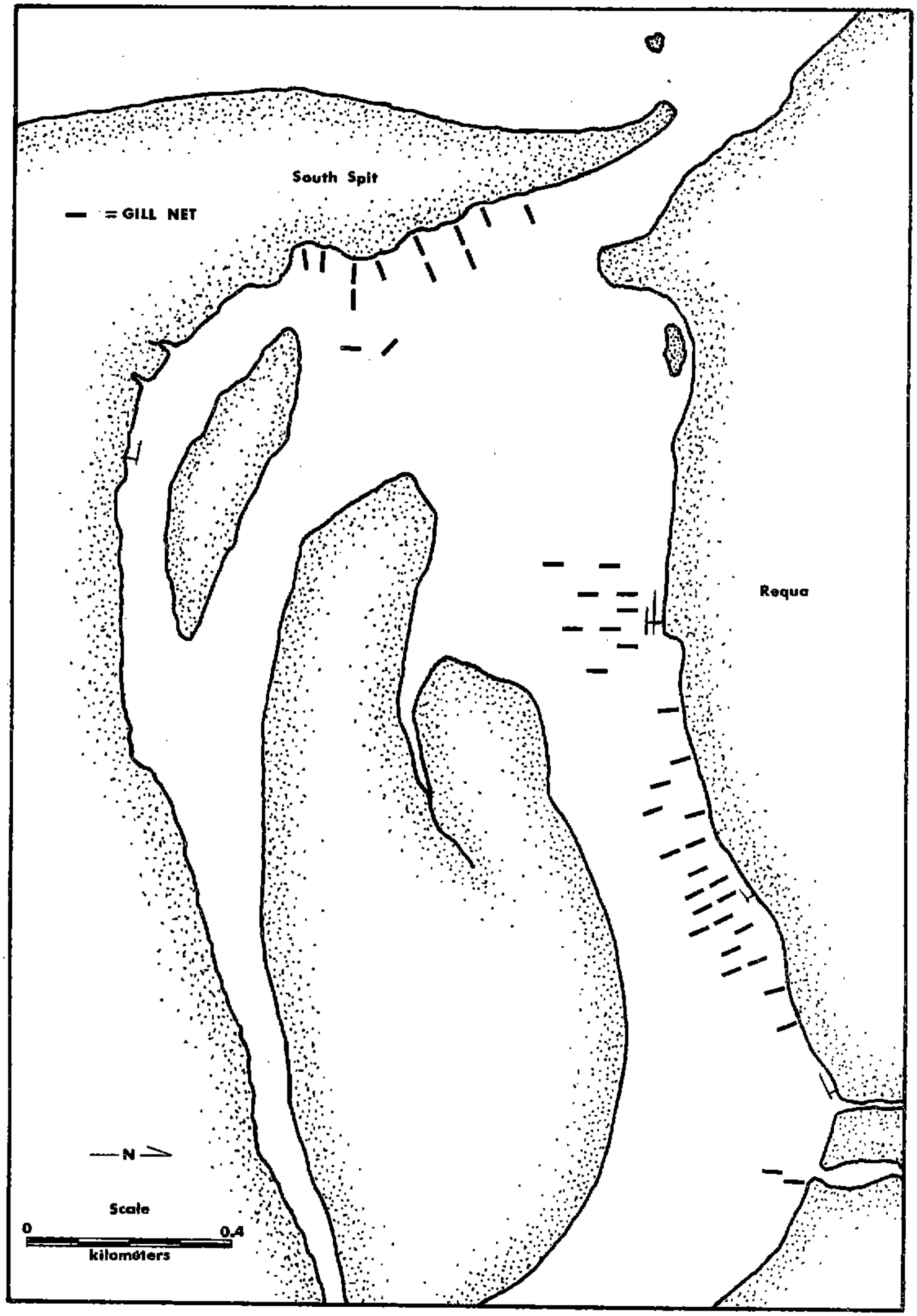


FIGURE 12. Typical net placement pattern in the Klamath River estuary on a heavy netting night during the peak of the 1981 fall chinook salmon run.

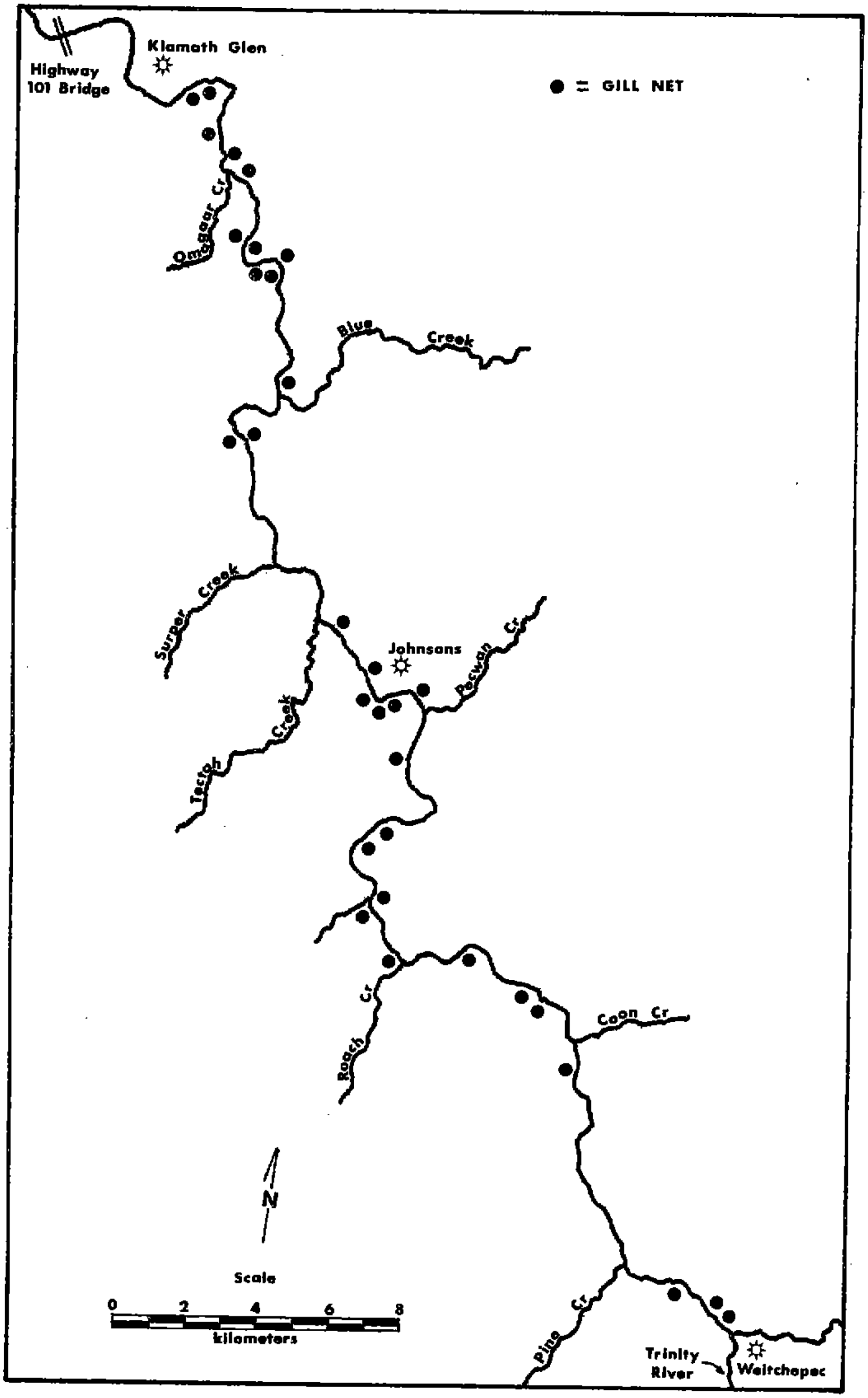


FIGURE 13. Typical net placement pattern in the Upper Klamath Area during the peak of the 1981 fall chinook salmon run.

our intimate knowledge of the net fisheries and our network of contacts on the reservation. Fall chinook harvest estimates were derived daily for the Estuary and Resighinni areas, and weekly for the Upper Klamath and Trinity areas. Spring chinook harvest estimates were determined on a monthly basis for each of the four areas. The close association between FAO-Arcata biologists and the Indian fishing communities afforded opportunities to formulate reasonably dependable, albeit subjective, judgements regarding the reliability of unseen harvest data supplied. Questionable harvest data obtained was routinely evaluated by field biologists and subjected to possible adjustment taking into account a variety of factors including (1) fishing location, (2) average catch/effort values of nets in close proximity to the fishing location, (3) netting proficiency of individual fishers as gleaned over a period of time, and (4) the reliability of past reporting by individual fishers.

We define a contact as an interview with an Indian fisher sometime during or after the time the fisher had set a net in the river. Indian fishers using two nets were counted as two contacts per interview. In the Resighinni, Upper Klamath, and Trinity areas, interviews with Indian fishers occurred once a day, each interview being recorded as one contact per number of nets fished. In the Estuary Area, where large numbers of salmon were often caught over a relatively short time period, we commonly interviewed Indian fishers two or three times daily, counting each interview as a separate contact. For example, an Indian fisher who used two nets and was interviewed twice in one evening was regarded as four contacts.

Catch per net-night values for the Estuary and Resighinni areas were derived from estimated daily net harvests divided by daily net counts. In the Upper Klamath and Trinity areas, where total net counts were not made, catch per net-night values were derived by dividing weekly summaries of the combined harvest categories (measured, seen but not measured, and reliable unseen) by the weekly tabulations of contacts. In the upper two areas, we considered contacts interchangeable with net nights, because only one interview per Indian fisher was made daily, and the number of nets used was reflected in the number of contacts made.

Chinook examined in the net fishery were measured in fork length to the nearest centimeter, checked for fin clips, and inspected for seal-bite damage. A subsample of chinook harvested from the lower Klamath River were weighed to the nearest pound; these measurements were then converted to kilograms. Whenever possible, snouts were removed from adipose fin-clipped fish for subsequent CWT identification. Snouts were also obtained through voluntary returns by Indian fishers.

Although data obtained in recent years have indicated that spring and fall chinook salmon runs enter the Klamath River during relatively distinct time periods, 1981 CWT recoveries (see subsequent section) reveal that a relatively large spring run entered the river over a more protracted time period, resulting in substantial mixed-race fisheries on the lower river between July 1 and August 9. Contributions of spring and fall chinook to the fisheries operating on them during this time period were estimated by comparing observed percentages of adipose fin-clipped chinook caught in the mixed-race fisheries with observed percentages of clipped chinook recovered before and after this period, when harvest was considered to consist of only one race. Coded-wire tag recoveries in upriver areas revealed relatively distinct timing of entry patterns of the two races into these fisheries; consequently, cutoff dates of August 22 for the Upper Klamath Area and September 1 for the Trinity Area were established to separate the harvest of spring from fall chinook.

RESULTS AND DISCUSSION

Fall Chinook Salmon

FAO-Arcata biologists observed over 18,000 fall chinook salmon harvested by Indian fishers on the Hoopa Valley Reservation in 1981. Of this total, 12,761 chinook were mark-sampled for adipose fin-clips, and length measurements were obtained from 4,565 chinook. Based on nearly 4,500 contacts with Indian fishers during the year, we estimate that total reservation-wide net harvest approximated 35,500 fall chinook, including about 33,000 adults (93% of net harvest) and 2,500 grilse (<58 cm).

The large majority (80.7%) of fall chinook harvest occurred in the lower 8.5 km of the Klamath River, with the fisheries in the Estuary and Resighinni areas accounting for 67.6 and 13.1%, respectively, of reservation-wide harvest (Table 3). An estimated 23,100 and 2,000 adult fall chinook were captured in the Estuary and Resighinni area fisheries, respectively. Grilse comprised 4 and 7% of the respective Estuary and Resighinni area catches, representing approximately 1,200 salmon.

TABLE 3. Semi-monthly net harvest estimates of fall chinook salmon captured in the four monitoring areas of the Hoopa Valley Reservation in 1981.

Time Period		Net Harvest Monitoring Area				Semi-Monthly Total (All Areas)	Cumulative Seasonal Total
		Estuary	Resighinni	Upper Klamath	Trinity		
Jul	1-15	410	0	0	0	410	410
	16-31	1,077	0	0	0	1,077	1,487
Aug	1-15	1,883	192	0	0	2,075	3,562
	16-31	10,643	1,255	1,185	0	13,083	16,645
Sep	1-15	7,864	1,973	2,169	377	12,383	29,028
	16-30	2,132	1,074	1,200	1,038	5,444	34,472
Oct	1-15	0	137	264	540	941	35,413
	16-27	0	0	60	25	85	35,498
TOTAL		24,009	4,631	4,878	1,980	35,498	
PERCENTAGE		67.6	13.1	13.7	5.6	100.0	

During the peak harvest period (August 16 to September 10), daily net harvest in the Estuary Area ranged from an estimated 191 to 1,624, and averaged 672 fall chinook (Figure 14). During this period, 23 to 57 gill nets fished daily in the Estuary Area, resulting in catch per net-night values ranging from 5.5 to 50.8, and averaging 18.2 chinook (Figure 15). The 1981 net harvest of fall chinook in the Estuary Area was 3.5 times greater than the 1980 harvest (Figure 16).

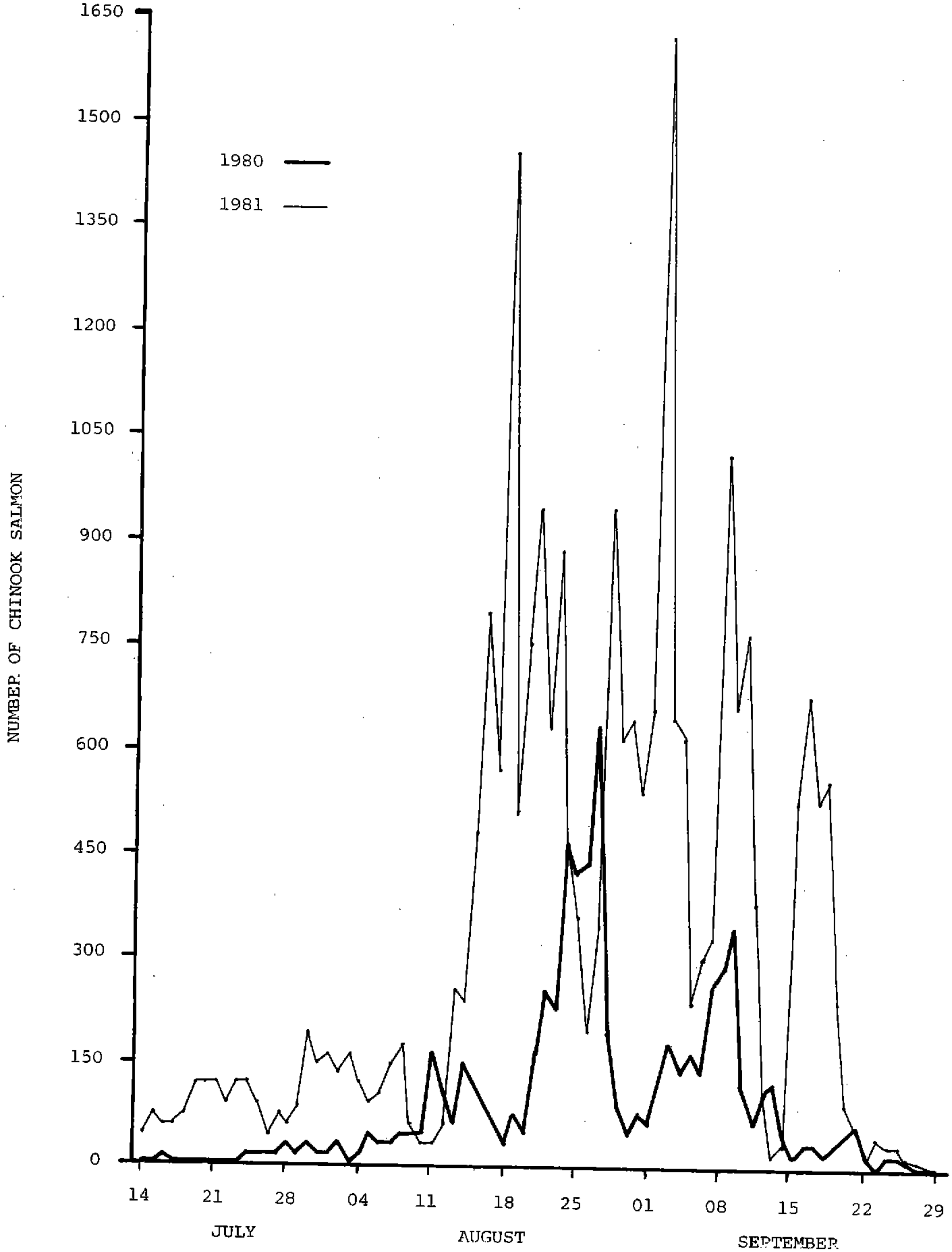


FIGURE 14. Estimated daily Indian gill net harvests of chinook salmon from the Klamath River estuary in 1980 and 1981.

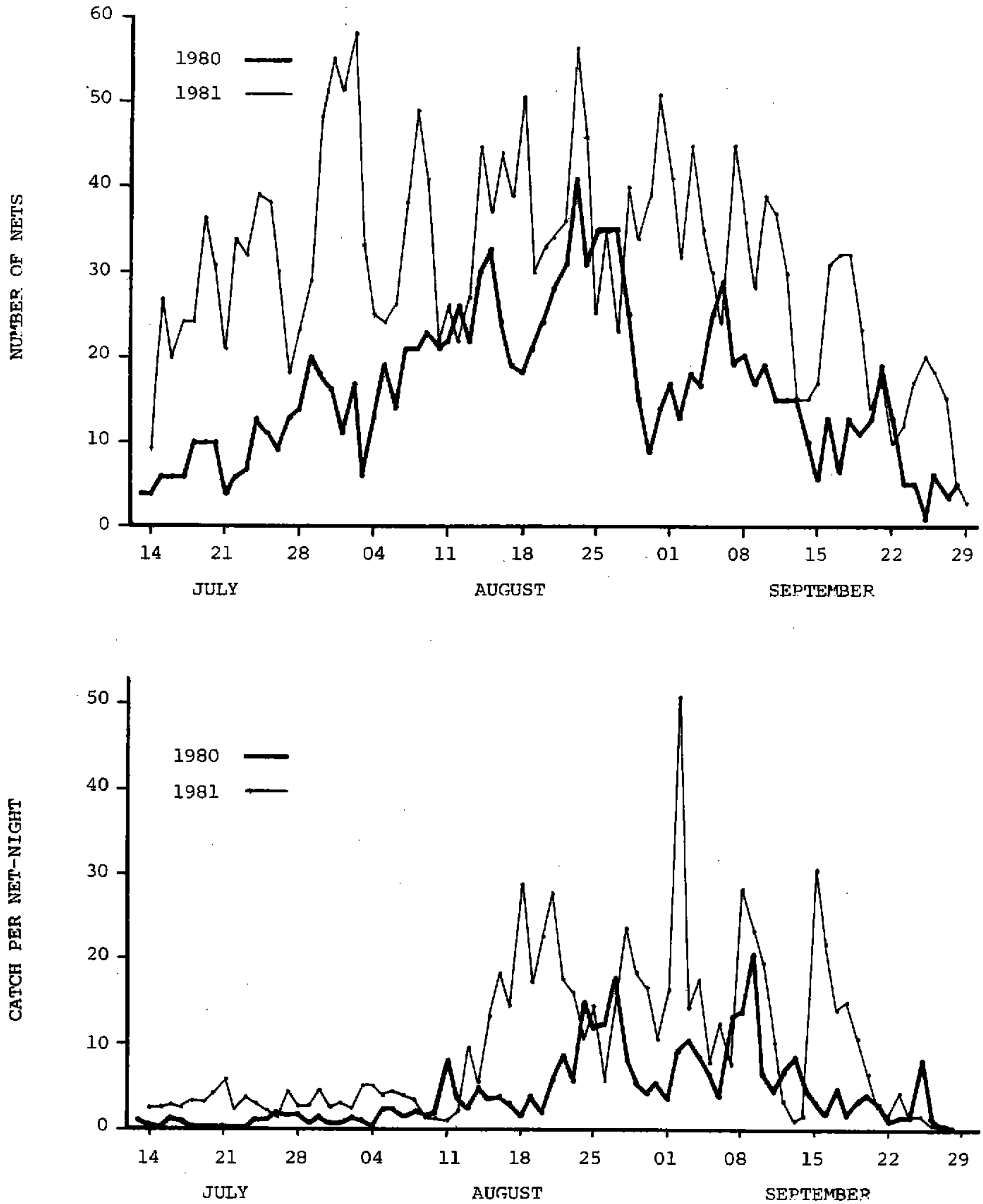


FIGURE 15. Gill net counts (above) and estimated catches of chinook salmon per net-night of effort (below) in the Klamath River estuary in 1980 and 1981.

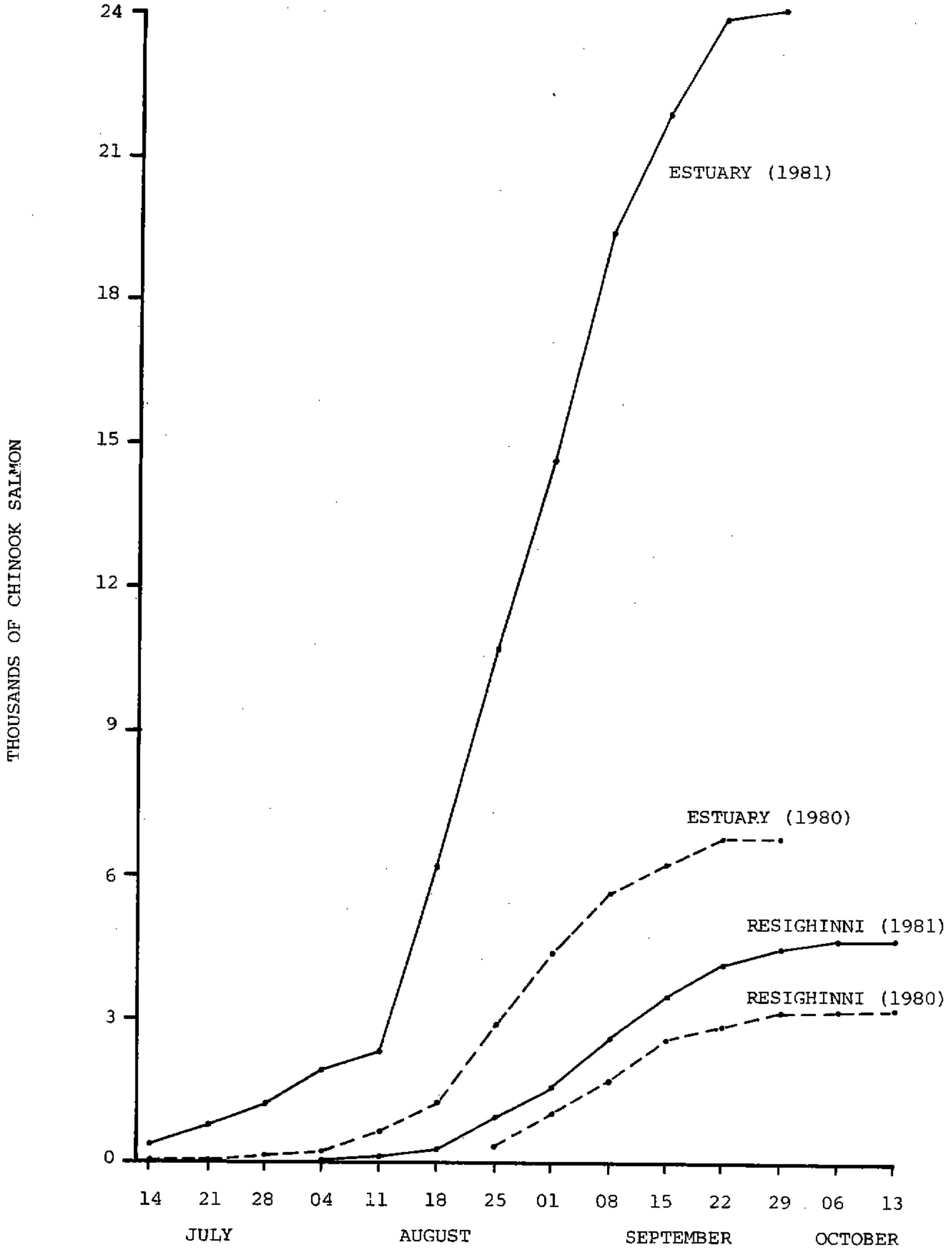


FIGURE 16. Cumulative Indian gill net harvests of fall chinook salmon from the Estuary and Resighinni areas of the Hoopa Valley Reservation in 1980 and 1981.

Catch-effort values calculated for the Estuary Area during the period of August 15 to September 15 were utilized for run size estimation purposes (see subsequent section). Approximately 77 and 82% of respective 1981 and 1980 fall chinook catches occurred during this period. Spring chinook harvest in the Estuary Area after August 15 was considered insignificant.

Seventy-six percent of the fall chinook harvest from the Resighinni Area was taken during a 30-day period extending from August 24 to September 22, with the highest daily catch occurring on September 8 (Figure 17). An average of seven gill nets fished the Resighinni Area daily, resulting in an estimated mean catch per net-night value of 9.4 chinook (Figure 18). The 1981 fall chinook harvest estimate for the Resighinni Area was 1.4 times greater than in 1980 (Figure 16). Daily catch estimates in the 2 years indicated similar run timing patterns, with only 2 days separating peak harvest days (Figure 17).

The majority of fall chinook harvest in the Upper Klamath Area occurred during a 7-week period extending from August 19 to October 6, with peak harvest occurring during the week ending September 8 (Figure 19). An estimated 4,900 fall chinook were captured in the area, with grilse comprising 15.7% of the harvest. Catch per net-night values ranged from 0.5 to 6.6, and averaged 4.5 chinook (Figure 19).

Peak harvesting in the Trinity Area occurred during the week ending September 29, 3 weeks later than in the Upper Klamath Area. The majority of chinook harvest occurred during a 5-week period from September 8 to October 13, with weekly catch per net-night values ranging from 1.1 to 5.5 chinook (Figure 19). Grilse comprised 22.7% (450) of the estimated fall chinook harvest of 2,000 fish.

A length-weight relationship $[\text{Log } W = -4.379 + 2.77 (\text{Log } L)]$ was derived from a sample of 358 chinook, captured in the lower river net fishery, that ranged in fork length from 48 to 107 cm and in weight from 1.6 to 20.4 kg (Figure 20). Grilse averaged 50.6 cm in length and 2.3 kg in weight, whereas the average harvested adult measured 75.0 cm and weighed 6.7 kg.

Chinook exhibiting adipose fin-clips represented 6.2% of the fall chinook harvest, including 5.3, 6.0, 7.3, and 19.9% of net harvest in the Estuary, Resighinni, Upper Klamath, and Trinity areas, respectively. Adult fall chinook of known hatchery origin averaged 72.5 cm in length and were significantly smaller (t-test; $P < 0.05$) than adults not exhibiting adipose fin-clips (Figure 21). Fin-clipped grilse averaged 49.5 cm in length, and did not differ significantly ($P > 0.05$) from the mean length of non-clipped grilse.

Length-frequency comparisons of fall chinook harvested from the four areas reveal that a higher proportion of smaller salmon were captured in the upriver fisheries (Figures 22 and 23). Mean lengths of adults captured in each of the areas differed significantly ($P < 0.05$), with the largest differences occurring between the tidewater (Estuary and Resighinni areas) and eddy fisheries (Upper Klamath and Trinity areas), and between the Upper Klamath and Trinity areas. Grilse exhibited no significant difference ($P > 0.05$) in mean length between each of the four areas.

Possible explanations for the harvest of proportionately larger numbers of relatively small chinook in the upriver fisheries include changes in size composition of the run resulting from size-selective effects of high harvest rates experienced in the tidewater area, and size-selectivity differences between the tidewater and eddy fisheries. Considering the large net harvest in the Estuary Area (23,100 adults in 1981), size selective effects on the run might be reflected by a relatively large difference in the mean size of chinook harvested

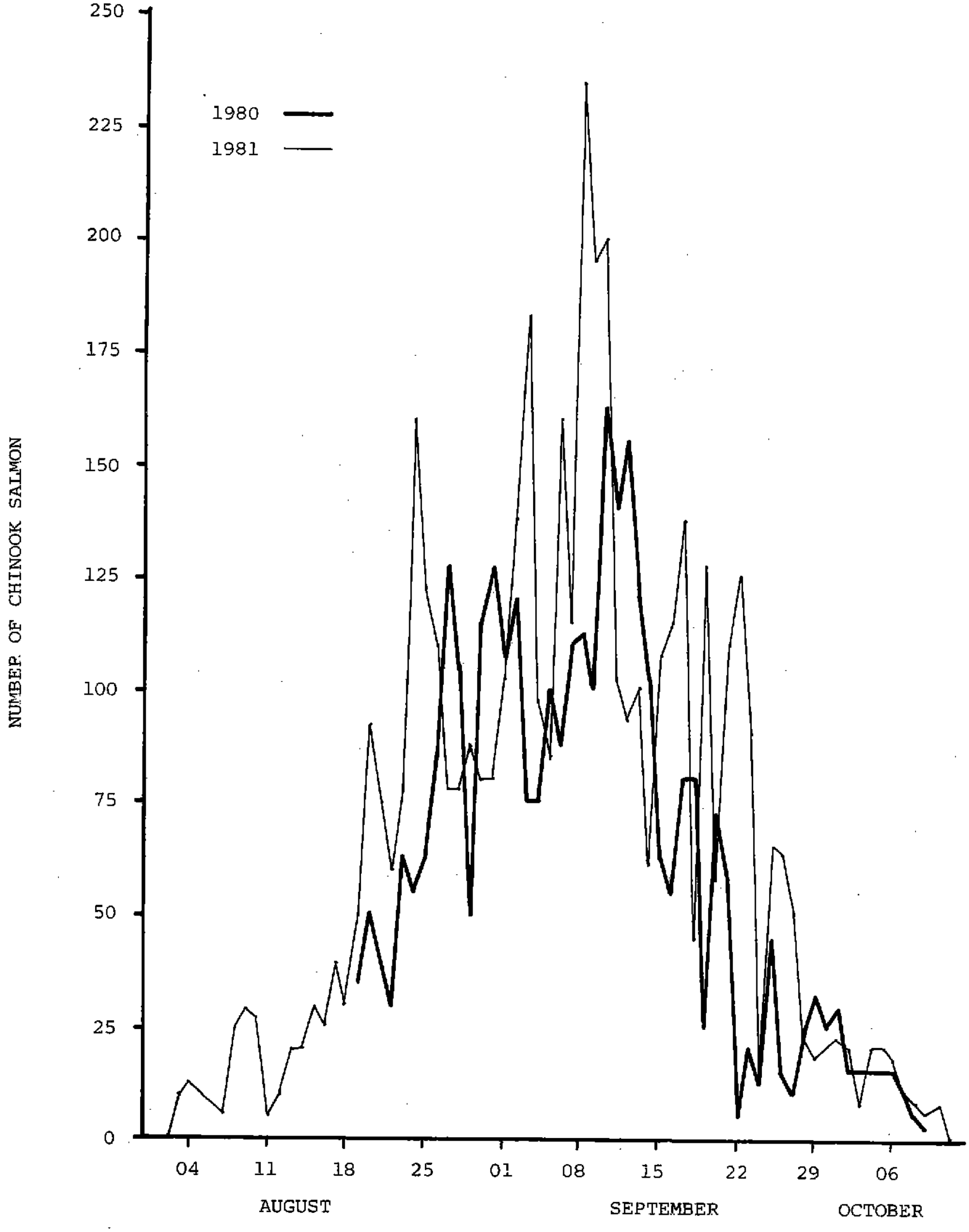


FIGURE 17. Estimated daily Indian gill net harvests of chinook salmon from the Resighinni Area of the Hoopa Valley Reservation in 1980 and 1981.

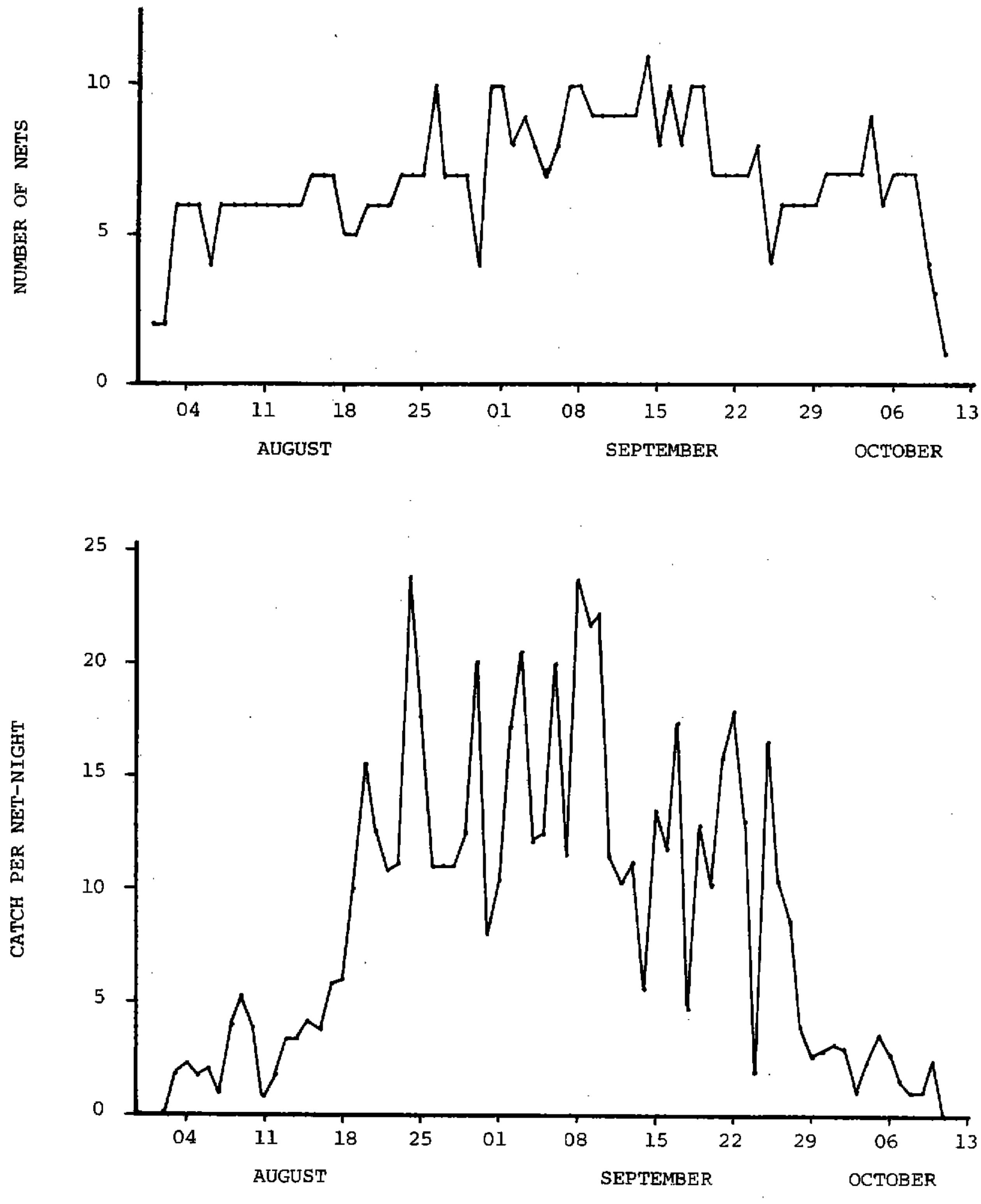


FIGURE 18. Gill net counts (above) and estimated catches of chinook salmon per net-night of effort (below) in the Resighinni Area of the Hoopa Valley Reservation in 1981.

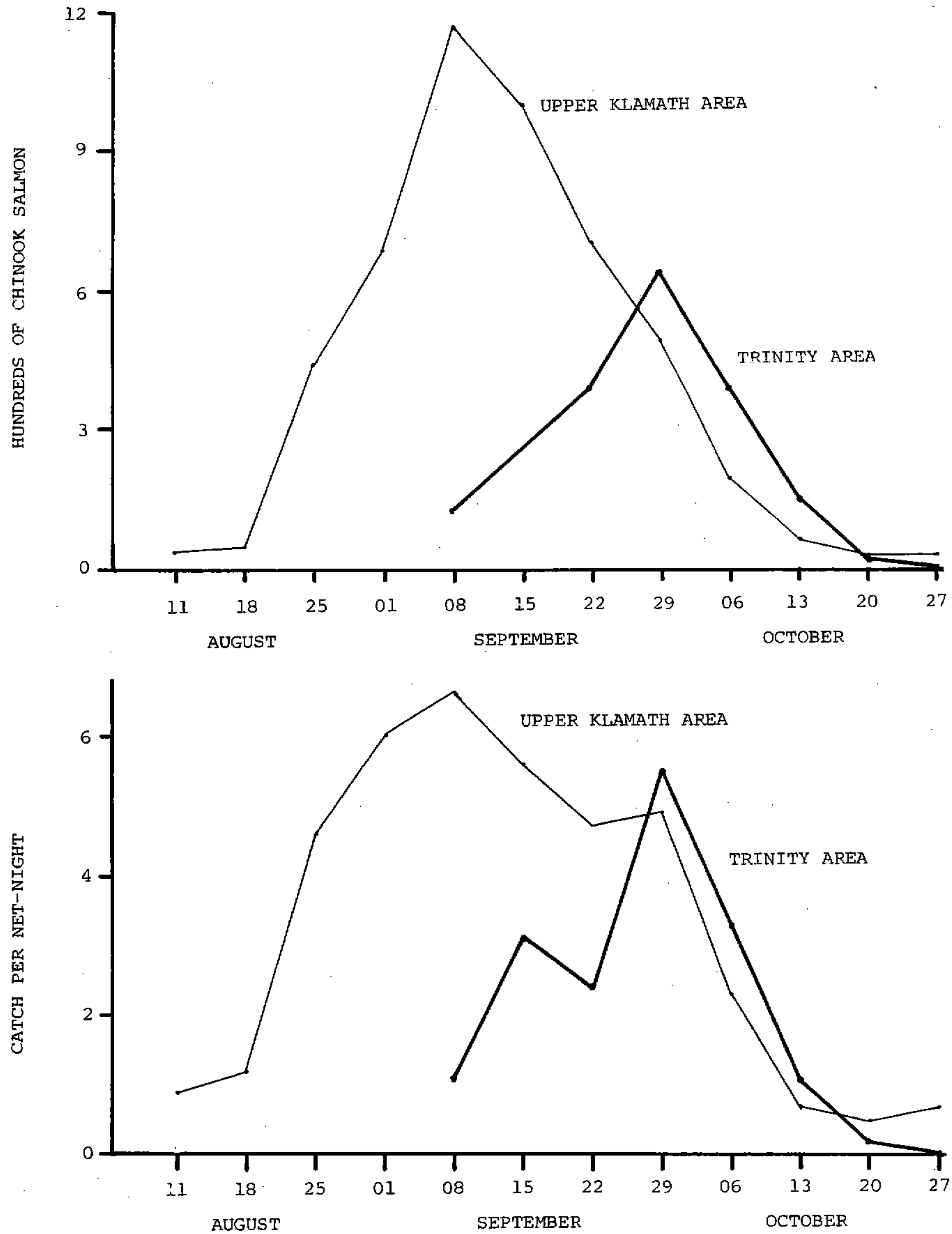
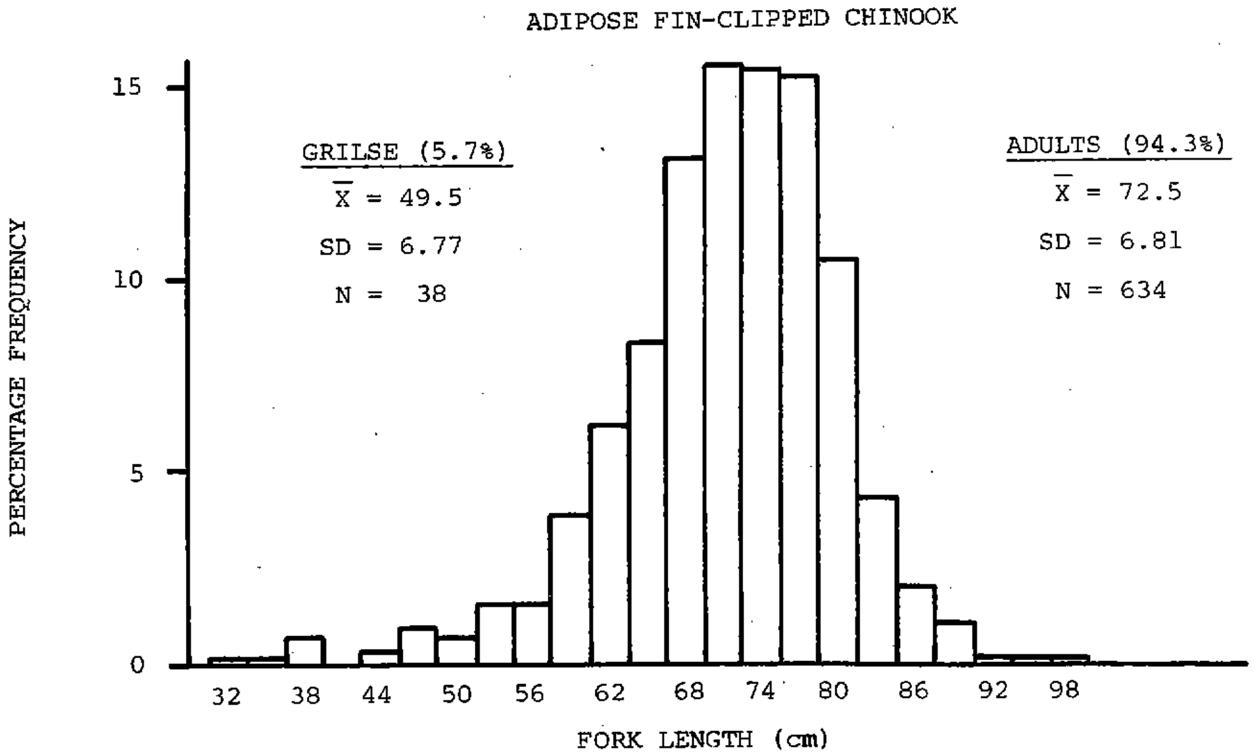


FIGURE 19. Estimated weekly Indian gill net harvests (above) and catches per net-night of effort (below) of chinook salmon in the Upper Klamath and Trinity areas of the Hoopa Valley Reservation in 1981.



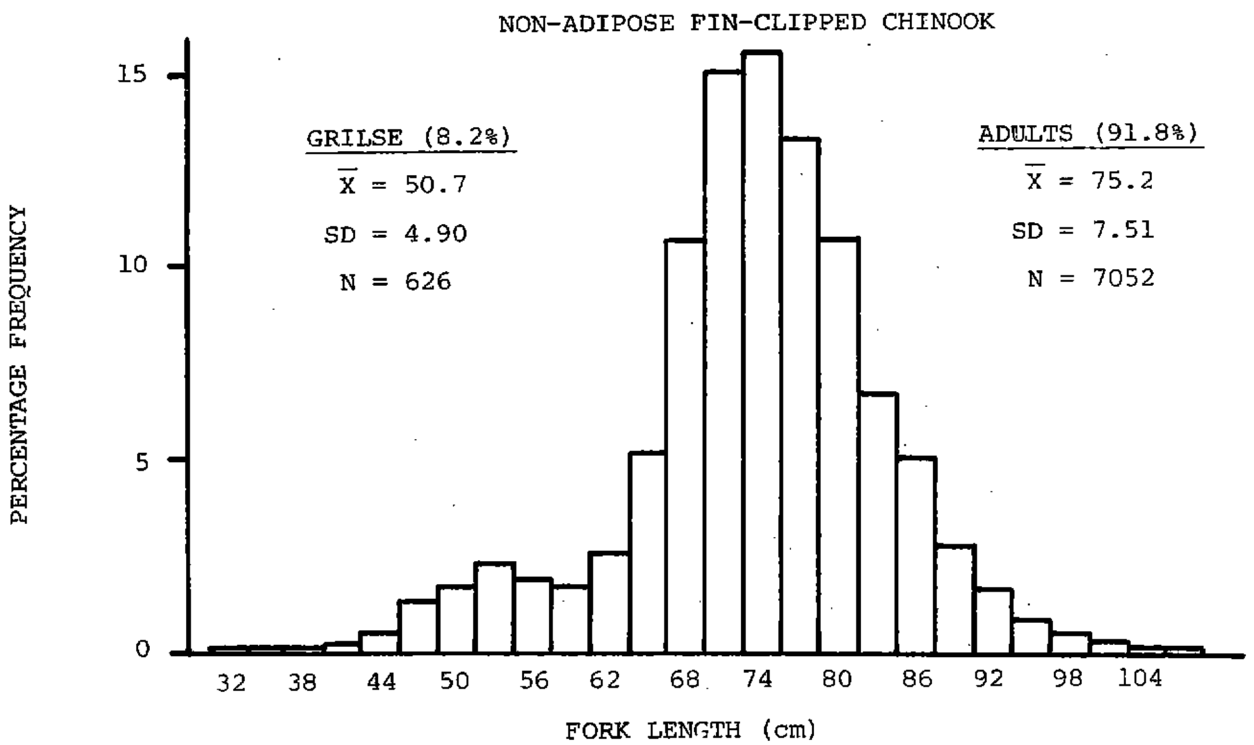
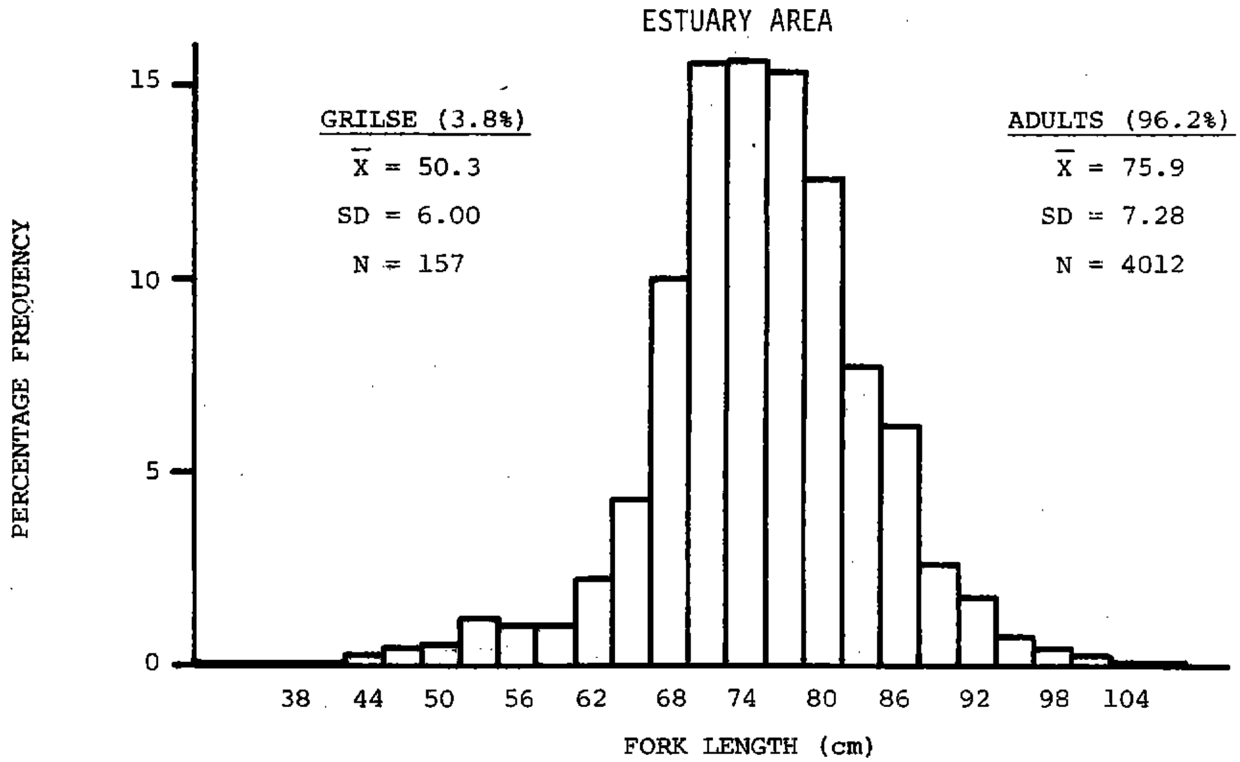


FIGURE 21. Length-frequency distributions of adipose fin-clipped and non-adipose fin-clipped fall chinook salmon caught by Indian gill netters on the Hoopa Valley Reservation in 1981.



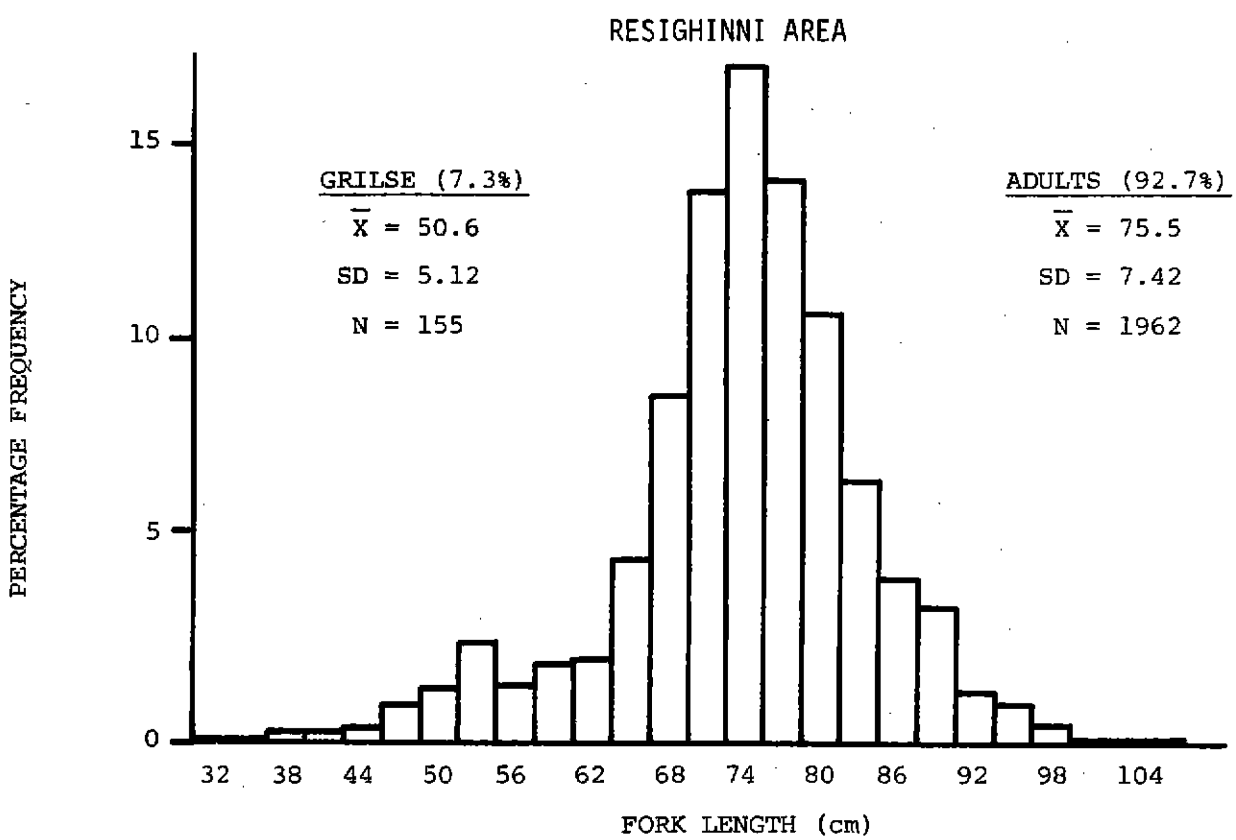


FIGURE 22. Length-frequency distributions of fall chinook salmon caught by Indian gill netters in the Estuary and Resighinni areas of the Hoopa Valley Reservation in 1981.

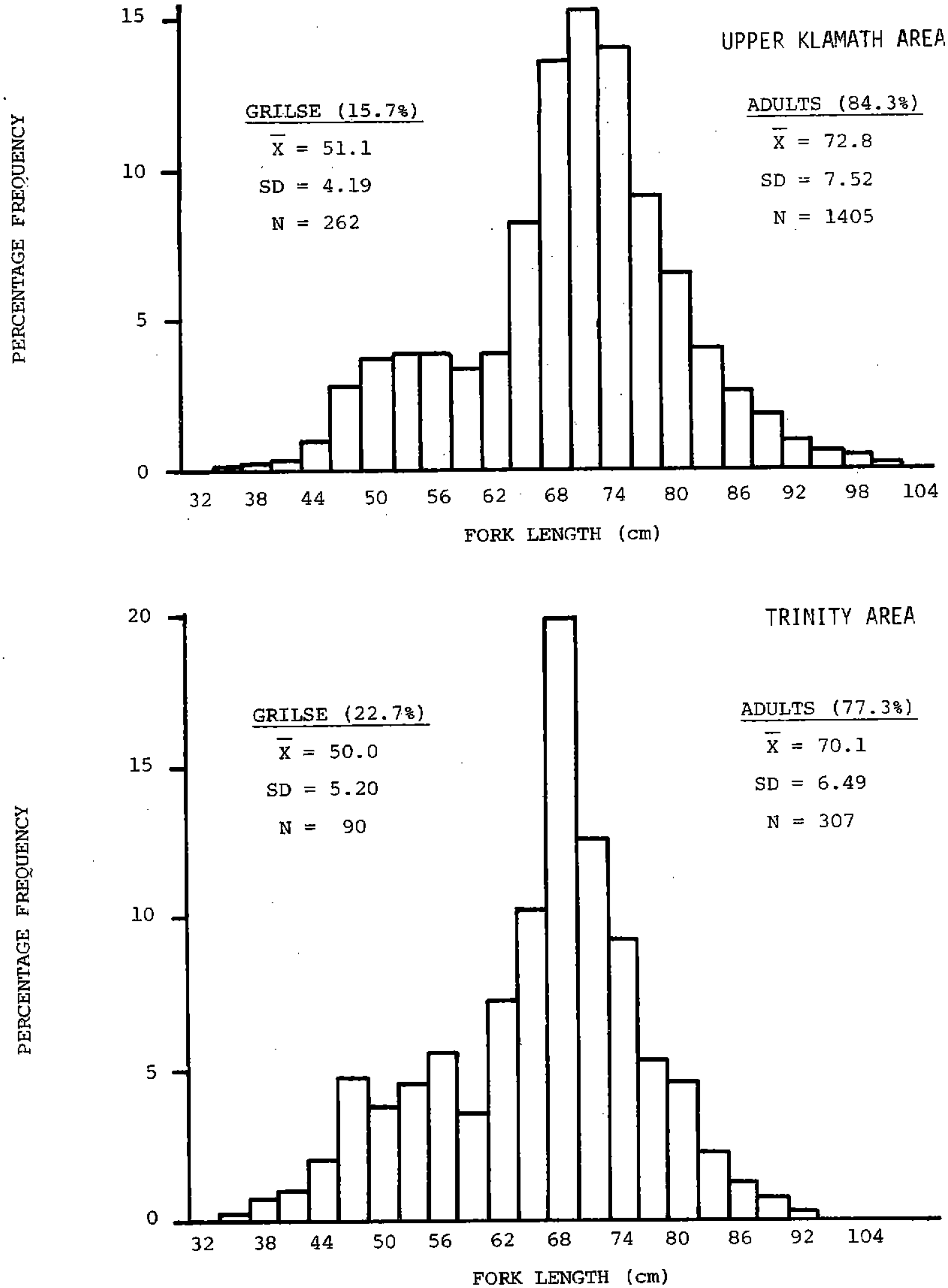


FIGURE 23. Length-frequency distributions of fall chinook salmon caught by Indian gill netters in the Upper Klamath and Trinity areas of the Hoopa Valley Reservation in 1981.

in the Estuary versus Resighinni areas. Adult chinook captured in the Resighinni Area, however, were only 4 mm shorter than the mean length of adults harvested in the Estuary Area — a significant difference ($P < 0.05$), but the smallest size difference in adult mean length observed between each of the four areas. Size-selectivity differences between tidewater and upriver eddy gill net fisheries might by reflected by the fact that upriver eddy nets captured grilse at a much higher rate (1.0 and 2.4 grilse per net-night in the Upper Klamath and Trinity areas, respectively) than tidewater nets in the Estuary and Resighinni areas (0.4 and 0.7 grilse per net-night, respectively). Nets employed in both types of fisheries were typically of the same 18.4 cm (7 1/4-inch) to 19.1 cm(7 1/2-inch) stretched mesh.

Grilse harvested in the net fishery were significantly larger ($P < 0.05$) in 1981 than in 1980, and age specific CWT information collected in the 2 years indicates that fall chinook of each age class were larger in 1981. The overall mean length of adult chinook captured in the net fishery, however, was significantly smaller ($P < 0.05$) in 1981 than in 1980 (Figure 24), suggesting a larger contribution of 3-year-olds versus 4-year-olds to the 1981 fishery. As noted previously, 1980 and 1981 beach seining samples reflected a similar pattern.

Seal-bite damage, primarily attributable to harbor seals (*Phoca vitulina*), was most evident in the Estuary Area where 5.3% of the measured chinook were observed with bite marks; only 1% of the chinook examined in the Resighinni Area displayed seal-bites (Table 4). None of the netted salmon observed in the upriver fisheries exhibited seal bites, but a number of netted fish displayed evidence of predation by river otter (*Lutra canadensis*) and black bear (*Ursus americanus*). Seal predation percentages presented represent minimum values, as they do not take into account fish completely removed from nets or severely damaged fish discarded by Indian fishers.

TABLE 4. Incidences of seal depredation on netted chinook salmon in the 1981 gill net fisheries of the lower Klamath River.

Time Period	ESTUARY AREA			RESIGHINNI AREA		
	Number Bitten	Sample Size	Percent Bitten	Number Bitten	Sample Size	Percent Bitten
Jul 14-31	25	752	3.3	--	----	---
Aug 1-15	63	750	8.4	0	76	0.0
Aug 16-31	69	1421	4.9	5	330	1.5
Sep 1-15	53	1143	4.6	10	969	1.0
Sep 16-30	34	499	6.8	5	656	0.8
Oct 1-10	--	----	---	1	78	1.3
SEASON TOTALS	244	4565	5.3	21	2109	1.0

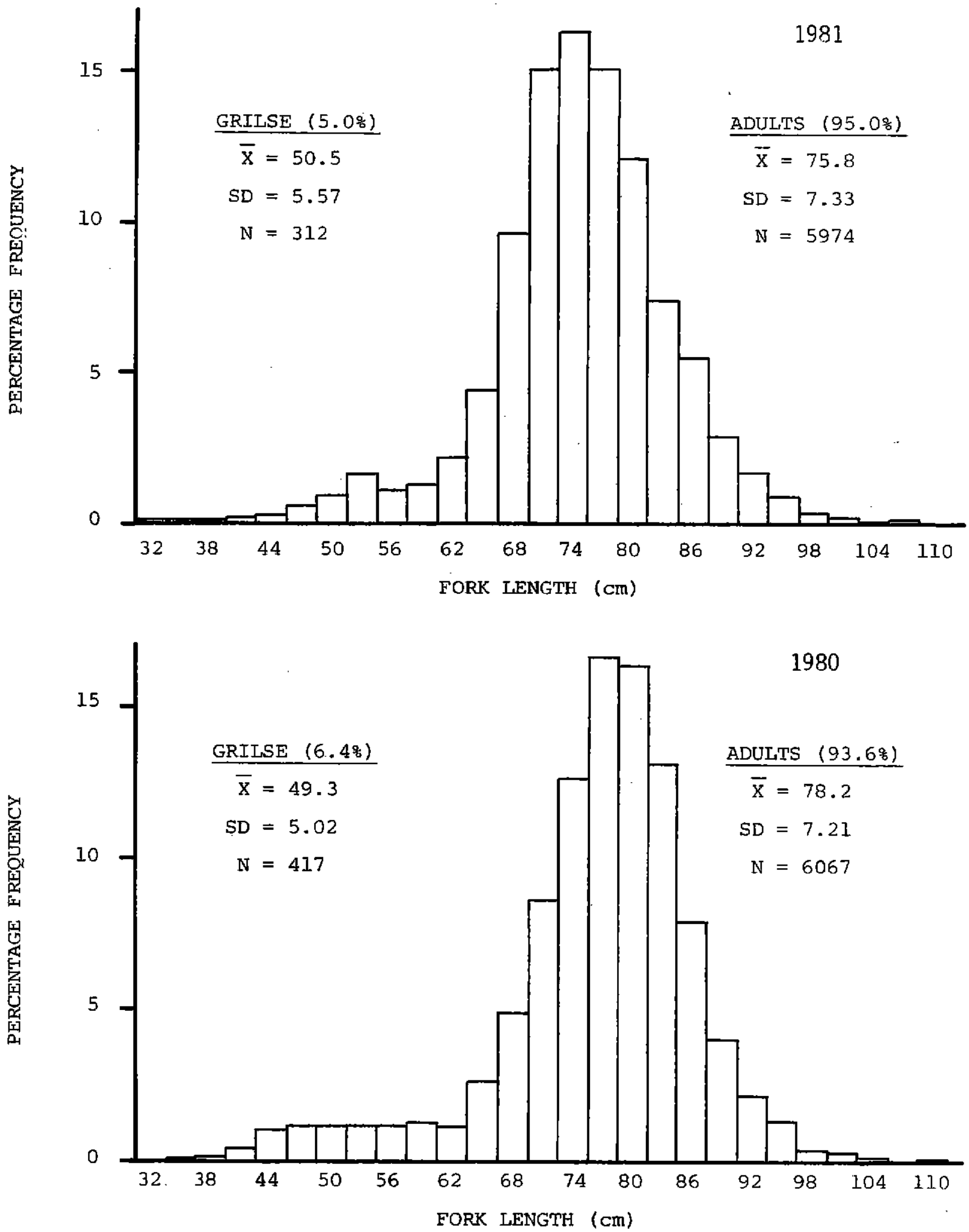


FIGURE 24. Length-frequency distributions of fall chinook salmon caught by Indian gill netters in the lower Klamath River in 1980 and 1981.

Spring Chinook Salmon

FAO-Arcata biologists examined and mark-sampled for adipose fin-clips 346 spring chinook salmon harvested on the reservation in 1981. Based on over 700 contacts with Indian fishers, we estimate reservation-wide net harvest for the year approximated 2,900 spring chinook, with grilse (< 52 cm) comprising only 2% of the catch.

The net harvest of spring chinook began in April, and continued through August, with the highest monthly catch occurring in July (Table 5). Most of the early harvest (April-June) was taken upriver, Upper Klamath and Trinity area fisheries accounting for 75% of the catch prior to July (Figure 25). The majority of later-arriving fish were captured in the Estuary Area, where, with the arrival of fall chinook, an intense net fishery developed in July. The lower river fisheries accounted for 47% of the overall catch, with fisheries in the Upper Klamath and Trinity areas accounting for 14 and 39%, respectively (Table 5).

TABLE 5. Monthly net harvest estimates of spring chinook salmon captured in the four monitoring areas of the Hoopa Valley Reservation in 1981.

Month	NET HARVEST MONITORING AREA				Monthly Total (All Areas)	Cumulative Seasonal Total
	Estuary	Resighinni	Upper Klamath	Trinity		
April	10	*	10	25	45	45
May	40	--	120	100	260	305
June	150	--	180	475	805	1,110
July	743	--	50	200	993	2,103
August	398	16	40	307	761	2,864
TOTAL	1,341	16	400	1,107	2,864	
PERCENTAGE	46.8	0.6	14.0	38.6	100.0	

* April-July harvest from Resighinni Area is included in Estuary Area harvest.

The mean length of adult spring chinook captured in the net fishery measured 71.2 cm, significantly smaller (t-test; $P < 0.05$) than adult fall chinook, which averaged 75.0 cm. As was the case for adult fall chinook, mean length of adult spring chinook harvested in each area decreased significantly ($P < 0.05$) from downriver to upriver areas. Only 8% of the spring chinook harvest in the tidewater areas was comprised of fish less than 67 cm, whereas fish in the same size range represented 26% of the catches in the Upper Klamath and Trinity areas (Figure 26).

The difference in mean length of adults caught in the Upper Klamath and Trinity areas appears largely due to a reduced harvest of relatively large fish in the Trinity fishery. Spring chinook greater than 78 cm in length constituted 21% of the catch in the Upper Klamath Area, but only 8% of the Trinity harvest. Mean length differences between each of the four areas may result, in part, from the wide array of mesh-sizes employed in the spring fishery. Because

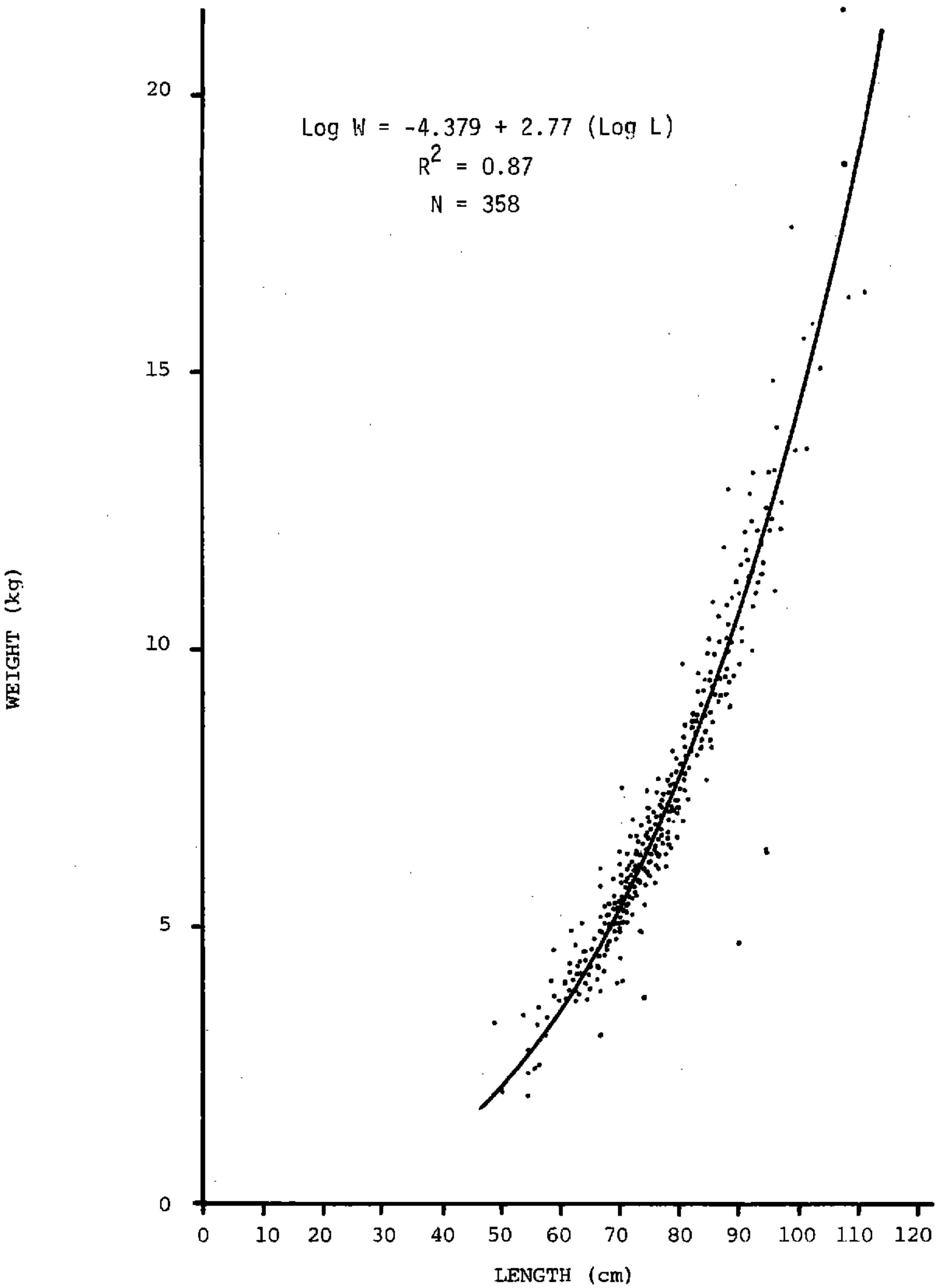


FIGURE 20. Length-weight relationship of chinook salmon caught by Indian gill netters on the lower Klamath River in 1981.

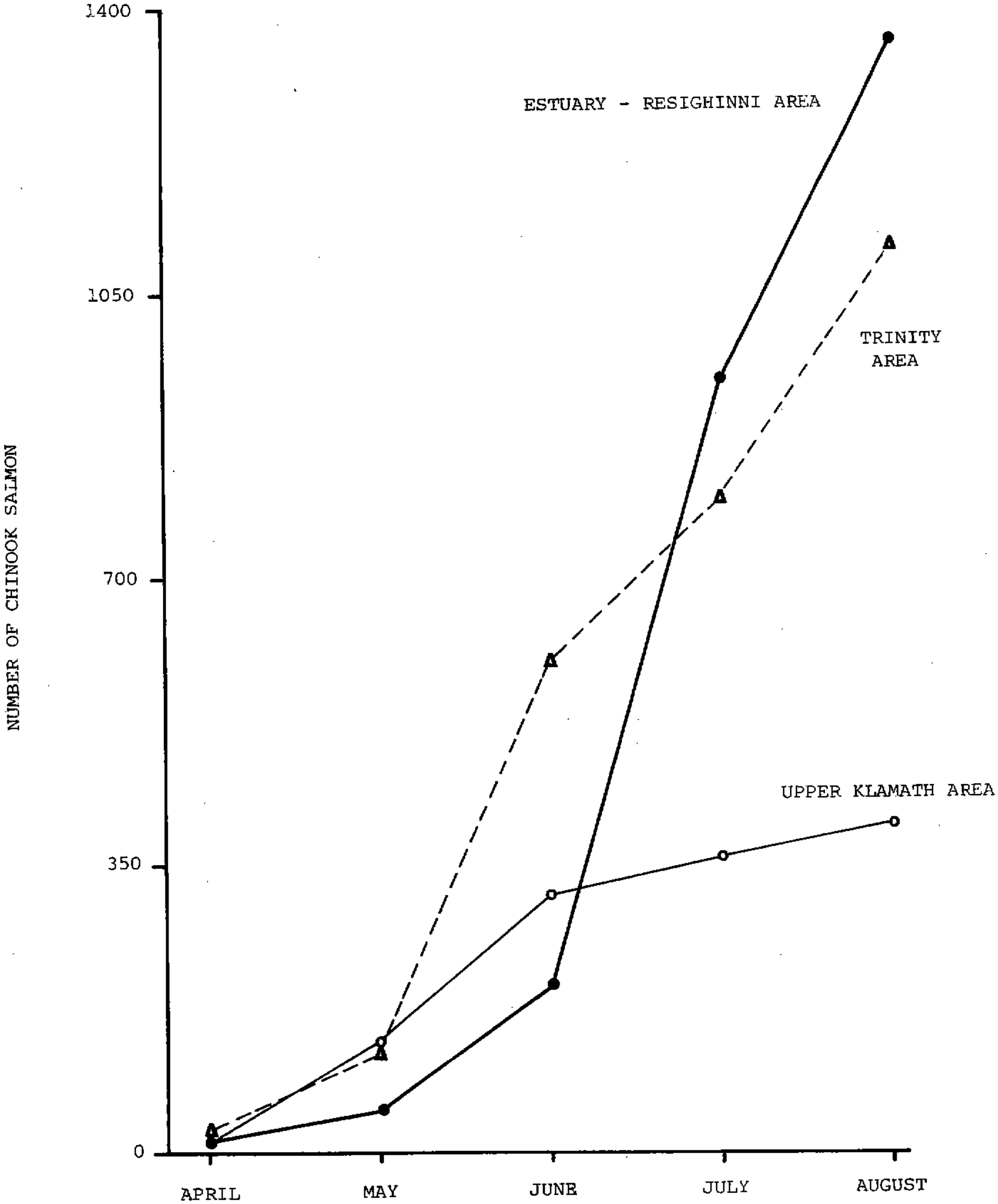


FIGURE 25. Cumulative Indian gill net harvests of spring chinook salmon from the Estuary-Resighinni, Upper Klamath, and Trinity areas of the Hoopa Valley Reservation in 1981.

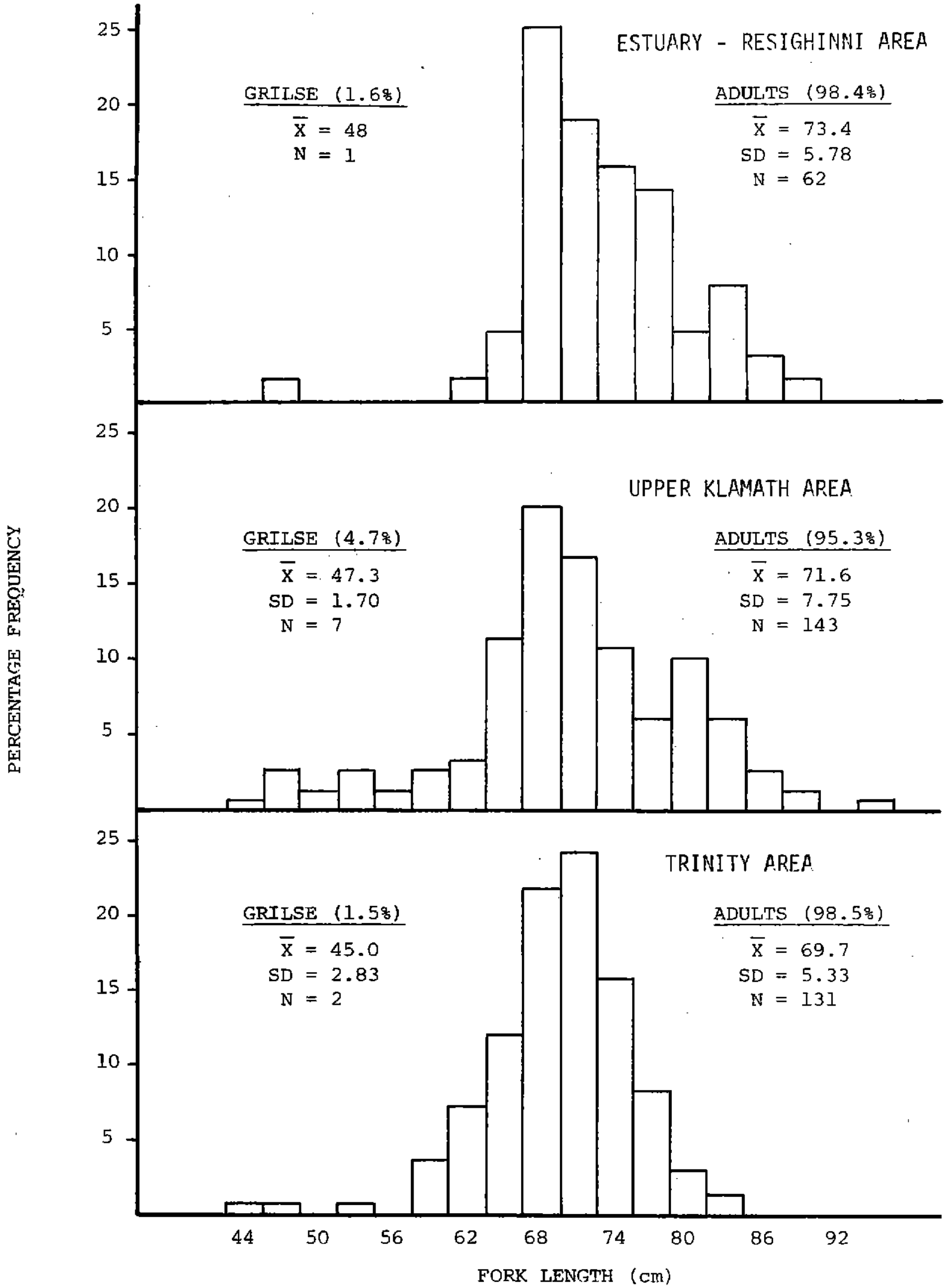


FIGURE 26. Length-frequency distributions of spring chinook salmon caught by Indian gill netters on the Hoopa Valley Reservation in 1981.

of the concurrent run of sturgeon, Indian fishers typically used nets ranging in mesh size from 18.4 cm (7 1/4-inch) to 24.1 cm (9 1/2-inch), stretched. However, we observed no apparent differences between areas in the proportionate use of nets with smaller or larger mesh sizes.

Adipose fin-clipped fish comprised 34% of the observed spring chinook harvest. Based on marked/unmarked ratios of CWT releases from the Trinity River Hatchery (TRH) in recent years, it appears that the spring chinook salmon run in the Klamath River basin consists largely of hatchery fish. Fin-clipped adult spring chinook were significantly smaller ($P < 0.05$) than non-clipped adults (Figure 27), perhaps due to the relatively small percentage of returning unmarked 3-year-old hatchery fish. None of 10 grilse sampled during the spring months, when we considered the run to be comprised of only spring chinook, exhibited adipose fin clips.

The mean length of adult spring chinook salmon captured in the 1981 net fishery was significantly smaller ($P < 0.05$) than in 1980. A comparison of length-frequency distributions (Figure 28) suggests a much larger contribution of 3-year-old versus 4-year-old fish in 1981 than in 1980, when spring salmon in their fourth year represented 83% and salmon in their third year constituted only 6% of the observed net harvest.

Net Harvest Log Sheet Program

To test the feasibility of a new net harvest monitoring technique, the 1981 regulations governing Indian fishing on the Hoopa Valley Reservation required each eligible Indian fisher holding a valid 1981 fisher identification card to file monthly log sheets reporting fish catch data. To date, only seven log sheets have been received, all indicating no fish caught. In proposing 1982 regulation changes, a recently-established Indian Fishery Screening Committee recommended that the log sheet program be retained with procedural modifications agreed to by the Bureau of Indian Affairs (BIA), USFWS, and Indian community. The Committee raised the question of whether monthly log sheets should be required from card holders who fish only a few months a year. Officials of the Interior Department are currently considering modifying the log sheet program, taking into account the Committee's recommendations.

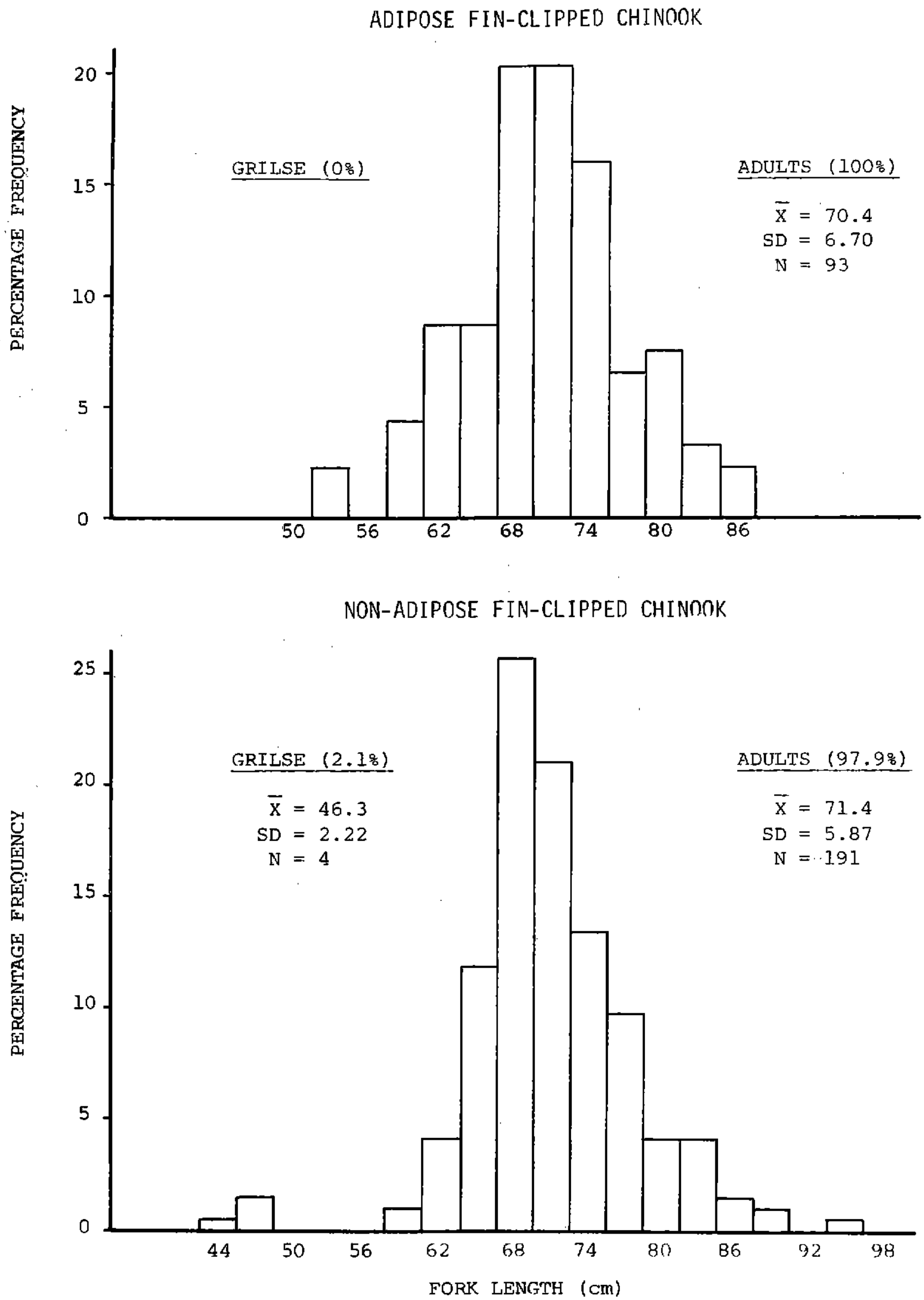


FIGURE 27. Length-frequency distributions of adipose fin-clipped and non-adipose fin-clipped spring chinook salmon caught by Indian gill netters on the Hoopa Valley Reservation in 1981.

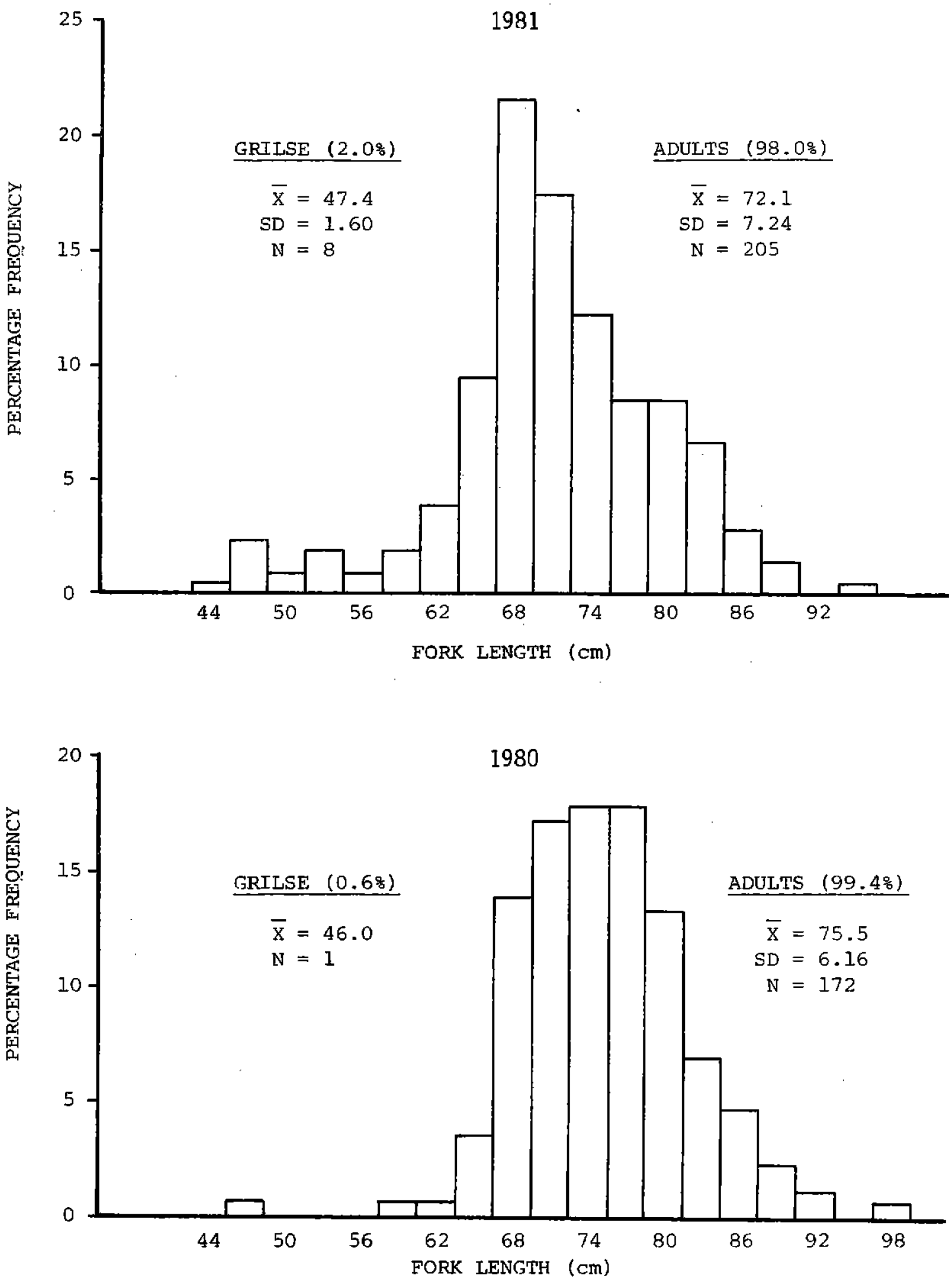


FIGURE 28. Length-frequency distributions of spring chinook salmon caught by Indian gill netters in the Estuary, Resighinni, and Upper Klamath areas of the Hoopa Valley Reservation in 1980 and 1981.

RUN SIZE ESTIMATION PROGRAM

INTRODUCTION

For the second year, we explored the possibility of estimating fall chinook salmon run size in the Klamath River basin on an in-season basis, using as indicators catch-effort data collected through beach seining and net harvest monitoring programs. Utilizing these indicators in 1980, we suggested in three progress reports, beginning with one on August 20, 1980, that the 1980 run would fall far short of satisfying the spawner escapement goal, and might not even surpass the low run of 1979. The CDFG post-season estimate of 1980 run size was 45,500 adults, 10,600 adults less than the 1979 level of 56,100.

Assuming that net harvest, as a proportion of run size, would not deviate significantly from patterns observed in 1979 and 1980, we speculated in 1981 progress reports that spawning levels might satisfy established spawner escapement goals, and that run size would exceed the 1980 level by a factor of 2 to 3. After thoroughly evaluating catch-effort statistics collected in 1980 and 1981, and accounting for potential sources of bias (as explained herein), the data suggest that 1981 run size exceeds the 1980 level by an approximate factor of 2. Because of the unanticipated greater percentage of the run harvested in the 1981 net fishery, it is clear that catch-effort data compilations cannot be correlated to spawner escapement levels.

We are still in the process of developing the in-season run size estimation program, and will require at least 2 more years of data to evaluate the reliability of associated estimates and of four underlying assumptions:

- the great majority of chinook caught in the Klamath River estuary are part of that year's spawning run in the basin;
- there is a discernible relationship between numbers of fish in the run and numbers of fish captured per unit of effort in beach seining and net harvest monitoring programs;
- catch per seine-haul values observed in our beach seining operation and catch per net-night values observed in the net fishery operating in the Estuary Area are comparable between years; and
- post-season run size estimates utilized in defining relationships between run size and catch-effort statistics are accurate.

If these assumptions are valid, considering the large percentage of the run that we can observe on the lower Klamath River through our beach seining and net harvest monitoring programs, we anticipate generating reasonably accurate in-season projections of total run size in a timely manner for use in promulgating needed in-season adjustments to fishing regulations. Based on preliminary post-season chinook run size estimates provided by the CDFG (45,500 adults in 1980 and 76,100 adults in 1981), we observed approximately 17 and 21% of the respective 1980 and 1981 adult runs through these lower river operations. Taking into account the expanded upriver net harvest coverage (coverage we anticipate expanding further in future years), we managed to observe approximately 18,900 adult fall chinook in 1981, 24.8% of the CDFG post-season run size estimate.

METHODS

Methodologies involved in deriving annual catch-effort values through beach seining and net·harvest monitoring programs are explained in the two preceding sections of this report. As upriver harvest data become more available, additional catch-effort comparisons will be possible. We are currently exploring the potential use of such statistics in developing an in-season run size estimation model.

RESULTS AND DISCUSSION

In applying data collected in 1980 and 1981 beach seining operations to predict relative strength of adult fall chinook salmon runs, annual catch-effort values in the peak three sets during run peak periods were multiplied by the number of consecutive days in which catch-effort values remained consistently above 4.0:

1980 Run Strength Index = 8.57 x 24 = 205.68
1981 Run Strength Index = 14.38 x 29 = 417.02

The resulting 1981:1980 ratio (417.02 ÷ 205.68 = 2.03:1) suggests a 1981 adult run size twice that of 1980:

1981 Adult Run Size = 2.03 x 1980 Adult Run Size
= 2.03 x 45,500
= 92,365

This estimate is approximately 16,300 higher than the preliminary CDFG estimate of 76,100 adults. The 1981:1980 grilse ratio of 0.94:1 translates into a 1981 grilse run size estimate of nearly 22,000, approximately 12,170 fewer than the preliminary CDFG estimate of 34,170.

Utilizing mean seasonal catch per net-night values in the gill net fishery operating in the Estuary Area during the August 15 to September 15 period, (7.15 and 16.01 adult chinook in 1980 and 1981, respectively), we calculated a 1981:1980 run size ratio of 2.24:1, suggesting a 1980 adult run of nearly 102,000:

1981 Adult Run Size = 2.24 x 1980 Adult Run Size
= 2.24 x 45,500
= 101,920

This estimate is approximately 25,800 higher than the preliminary CDFG estimate of 76,100, but only about 9,600 greater than the independently-derived run size estimate obtained through our beach seining program.

The 1981:1980 run size ratios derived through our beach seining program correspond closely to 1980 and 1981 run levels in the Shasta River, where actual counts of fish obtained through the Shasta Racks facility provide the most reliable estimate of natural chinook salmon spawning in the drainage. The 1981:1980 adult run size ratio of 2.10:1 in this system (7,890 and 3,762 adults in 1981 and 1980, respectively) compares to our derived ratio of 2.03:1; the corresponding grilse ratio of 1:1 in the Shasta River system (4,330 and 4,334 grilse in 1981 and 1980, respectively) compares to our derived ratio of 0.94:1. The Shasta River drainage supported nearly 25% of adult natural spawning in the Klamath River basin in 1981.

Although durations of fall chinook run peak periods in given years cannot be known until completed, run peak catch-effort statistics become established considerably earlier. For example, 1980 and 1981 beach seining catch-effort values (based on cumulative daily adult catch-effort values in the peak three sets during run peak periods) varied less than 5% after September 1, 1980, and September 2, 1981, from respective final season statistics (Figure 29), suggesting a critical date after which reasonably accurate in-season estimates of run size could be made. Application of an average run duration statistic calculated from previous years to future derived in-season catch-effort values would probably not greatly increase error levels. A linear regression model, relating final season catch-effort run strength indices to post-season estimates of run size over a period of several years, would be utilized to derive statistical expressions of run size on an in-season basis from calculated in-season indices. Because large portions of the annual fall chinook run and harvest occur after the apparent critical date (September 1), run size predictions forthcoming at that time should facilitate decisions concerning in-season management of the fisheries.

Considering the problems that FAO-Arcata and CDFG biologists have experienced in developing reliable in-season and post-season run size estimation programs in the Klamath River basin, and the large combined annual cost of these programs, we again (see USFWS 1981a) propose that a feasibility study be undertaken to explore alternative run size estimation techniques, including a fish counting weir across the lower Klamath River. Because dependable fall chinook salmon run size estimates will probably be required for years to come, it would seem imprudent from economic and biological standpoints to continue funding costly annual run size estimation programs if more accurate data could be collected at a lower cost over the long term through a properly designed fish counting weir. Such a structure, in addition to providing for better run size estimates involving fall chinook salmon, might also permit better estimates of fall steelhead, coho salmon, and green sturgeon run sizes. A feasibility study addressing the possibilities, designs, and costs of a fish counting weir across the lower river could be accomplished at relatively low cost.

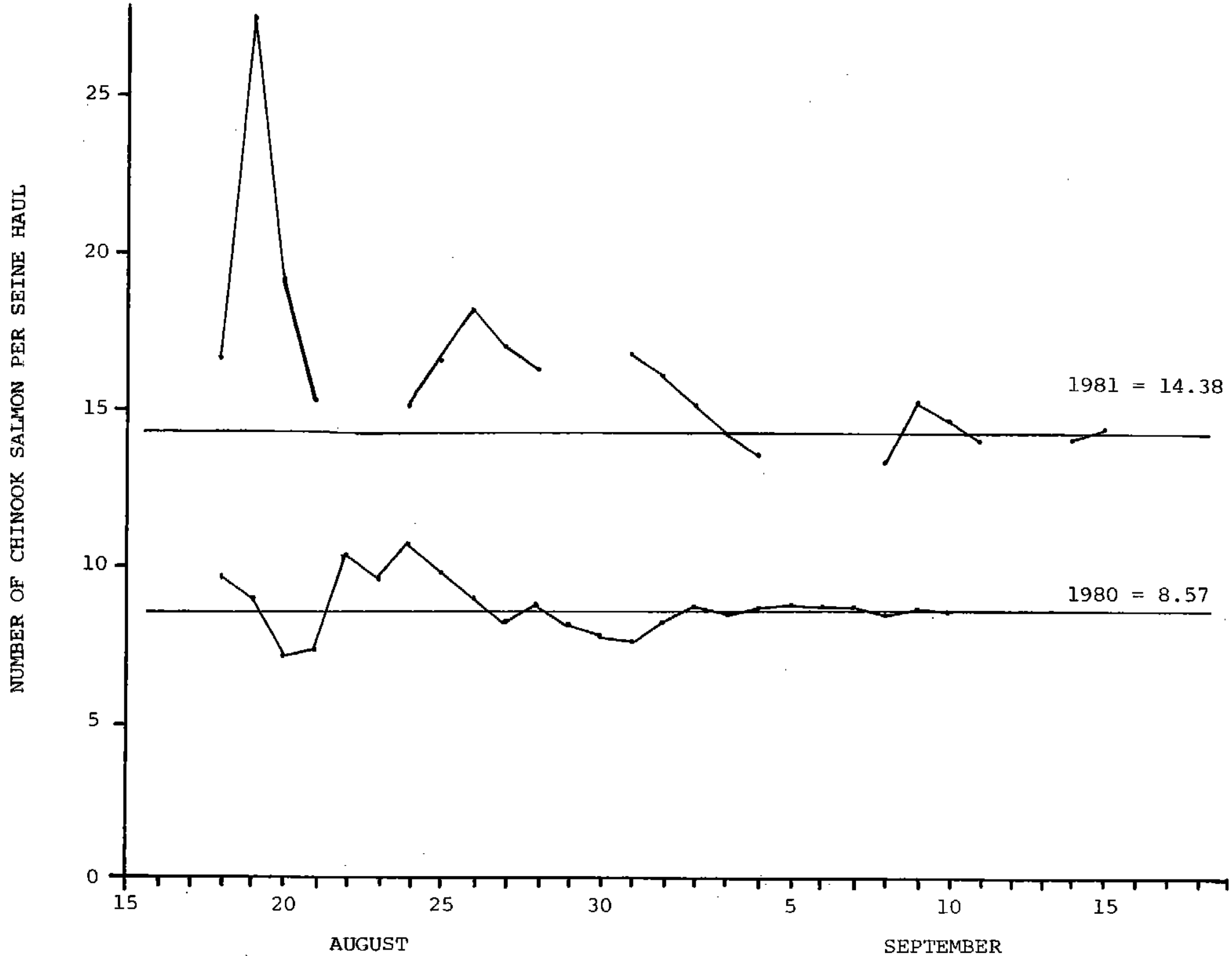


FIGURE 29. Cumulative daily adult chinook salmon catch-effort values (during peak 3 sets of run peak periods) in 1980 and 1981 beach seining operations, relative to full-season statistics.

SCALE INTERPRETATION AND ANALYSIS

INTRODUCTION

As part of a continuing effort to evaluate age composition of chinook salmon runs in the Klamath River basin, we collected scales from spring and fall races through our 1981 net harvest monitoring and beach seining programs. Preliminary results of scale analyses conducted to date are contained herein.

METHODS

To evaluate the age structure of the adult spring chinook run, scales were collected in the gill net fishery from May 1 to July 1. Age composition of the fall chinook run was assessed by analyzing a 50% subsample of 1,090 scale samples collected through beach seining (scales collected on a weekly basis were arranged into 5 cm fish-length groupings, from which 50% subsamples were randomly selected). Only scales collected after August 9 were used to evaluate the age structure of the fall run.

Cellulose acetate impressions of the scales are made utilizing a Carver Model C laboratory press, and viewed on a Bell and Howell ABR-1020 dual lens projector. Scale impressions are analyzed independently by two interpreters, with a third reading by both if the initial two interpretations differ. Scales not aged with confidence after the third reading are excluded from the age analysis. Scales from known age fish (CWT recoveries) are used to assist in age evaluation.

RESULTS AND DISCUSSION

Preliminary analysis of 285 spring chinook scale samples collected through the Indian fishery indicates that the 1981 net harvest included four age groups dominated by fish in their third year; 2-, 3-, 4-, and 5-year-old spring chinook comprised 1, 76, 17, and 6% of the sample, respectively. Preliminary evaluation of 542 fall chinook scale samples obtained through beach seining suggests that the run consisted of 32, 52, 14, and 2% of respective 2-, 3-, 4-, and 5-year-old fish.

As was the case with scales examined from chinook spawners of the 1980 run, scales collected from many 1981 spawners reflect unusually rapid growth in 1979 (Plate 8). These areas of widely-spaced circuli serve as excellent markers to aid in age analysis.

As observed on scales collected from 1980 spawners, many scales obtained from chinook of the 1981 run exhibit a check reflecting an interruption in ocean growth during the spring-summer rapid growth period. On the hypothesis that the growth check characteristic is related to ocean hooking, chinook sampled in 1981 beach seining operations were examined closely for hook scars, and scales were collected from known scarred and non-scarred fish for further evaluation of the relationship. We anticipate preparing a special report on this subject after scales collected through 1981 have been fully analyzed.

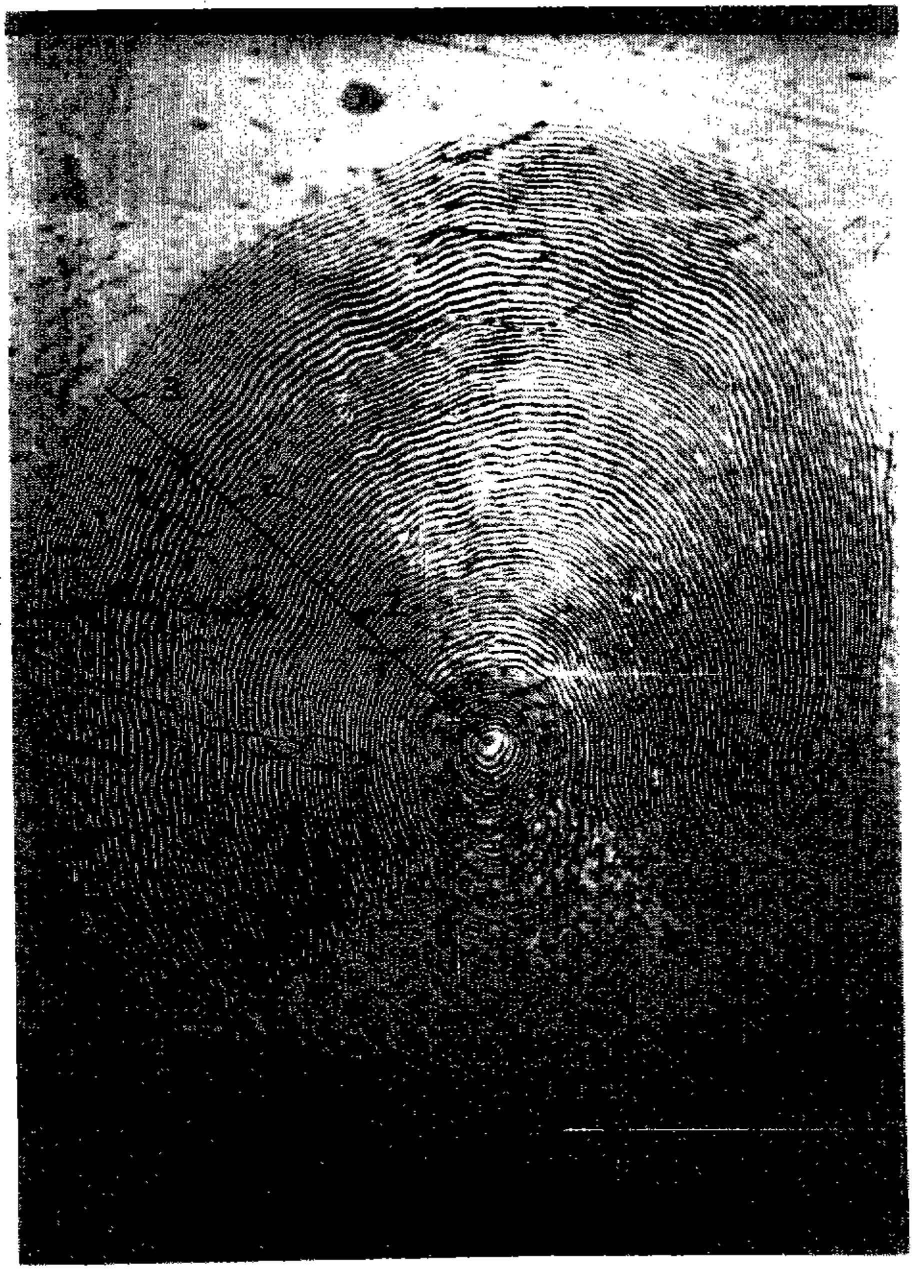


PLATE 8. Scale impression from a 76 cm chinook salmon depicting the end of apparent hatchery growth (H), three annuli, and unusually rapid growth during the spring of 1979.

GILL NET MARKING INVESTIGATIONS

INTRODUCTION

Although it is generally acknowledged that gill netting is a highly effective method of capture for chinook salmon, numbers of fish escape nets after initial entanglement. Depending on the nature and duration of the net encounter, these "fallouts" (used herein to denote chinook surviving gill net entanglements) are generally recognizeable by distinctive markings resulting from the experience (Plate 9). In recent years, CDFG biologists have reported on incidences of gill net markings observed on salmon sampled at upstream locations in the Klamath River basin (notably, at the Willow Creek and Junction City weirs, and the Trinity River and Iron Gate hatcheries).

During the course of spawner migration, chinook salmon may acquire a variety of markings through netting, hooking, or encounters with rocks, debris, weirs, etc. This, coupled with the fact that fish sampled at upstream locations are often in a physically degenerated condition, can render proper identification of markings difficult. Our experience reveals, however, that markings resulting from gill nets are normally distinctive enough to be recognizeable to the trained observer.

Because of questions concerning the meaning and utility of gill net marking data reported in recent years, FAO-Arcata biologists experienced in identifying gill net markings on Pacific salmon examined chinook for net marks at upstream locations in the Klamath River basin in 1981. Data collected is presented herein, and a more detailed paper addressing the significance of net marking data and fall-out rates is in preparation.

METHODS

Iron Gate Hatchery (IGH) and Trinity River Hatchery (TRH) were selected as the upriver sites to sample chinook salmon for gill net marks. Chinook were examined closely after removal from the hatchery traps during normal spawning operations. Badly deteriorated fish were excluded from the samples. Occurrence frequencies of gill net marks were recorded separately for grilse and adults observed at each hatchery.

RESULTS AND DISCUSSION

Of 282 grilse ($<$ 58 cm) and 797 adult chinook salmon examined at TRH and IGH in October, 1981, no gill net markings were observed on grilse. The absence of such markings in this sample may be viewed as an anomaly of the data, as grilse are harvested in the net fishery to a limited extent, and, certainly, some marking must occur. Marking incidences on adults ranged from a low of 3.9% on spring chinook sampled at TRH on October 1, to a high of 12% on fall chinook sampled at IGH on October 16 (Table 6). Overall occurrence frequencies of gill net markings on adult fall chinook salmon sampled at TRH and IGH during the month were 10.6 and 12.0%, respectively (Table 6). No significant

PLATE 9. Markings on fish resulting from gill net capture are generally recognizeable.

difference (P>0.05) between these rates was found through chi-square analysis.

TABLE 6. Occurrences of gill net markings (GNM) observed on 282 grilse and 797 adult chinook salmon sampled at TRH and IGH in October, 1981.

Date	Race	Hatchery	Grilse			Adults			Total Chinook		
			Sample Size	No. GNM	% GNM	Sample Size	No. GNM	% GNM	Sample Size	No. GNM	% GNM
1	Spring	TRH	25	0	0	128	5	3.9	153	5	3.3
26	Fall	TRH	92	0	0	192	18	9.4	284	18	6.3
29	Fall	TRH	128	0	0	269	31	11.5	397	31	7.8
TOTAL TRH FALL			220	0	0	461	49	10.6	681	49	7.2
16	Fall	IGH	37	0	0	208	25	12.0	245	25	10.2
TOTAL - FALL RACE			257	0	0	669	74	11.1	926	74	8.0

In contrast to the data presented in Table 6, CDFG biologists have reported much higher occurrence frequencies of net-marked chinook salmon sampled in 1980 and 1981 through fish trapping operations conducted on the Trinity River. Preliminary data collected by the CDFG in 1981 reveal that 28.7% of 1,336 fall chinook salmon sampled at the Willow Creek trapping site exhibited net markings, including 44.5% of the adults and 5.4% of the grilse (Heubach pers. comm.). It is unlikely that the populations sampled by CDFG and FAO-Arcata biologists varied enough to account for differences in gill net marking frequencies observed; consequently, such differences are, most likely, attributable to contrasting criteria utilized by respective agency personnel in identifying gill net markings.

It has been suggested that, because of the gill net fishery operating on the Hoopa Square portion of the reservation, Trinity River chinook salmon are harvested at a relatively higher rate, and consequently, should exhibit higher gill net marking incidences. Similar marking frequencies observed at TRH and IGH (10.6 and 12.0%, respectively, in 1981), however, support the hypothesis that the great majority of gill net marking occurs below the confluence of the Trinity and Klamath rivers. Considering that approximately 94% of the estimated net harvest on the reservation occurred in this area, this hypothesis appears reasonable.

As noted previously, the significance of data regarding incidences of gill net markings on chinook salmon is unclear. Net marking occurrence frequencies are influenced by harvest rates, fallout rates, and fallout mortality rates which, in turn, are affected by conditions such as water temperature, flow, gill net mesh size, fishing location, run size, and size frequencies of the spawning runs. Some of these conditions vary between years and appear to vary considerably between the three basic types of gill net fisheries occurring on the Hoopa Valley Reservation: the tidewater fishery operating in the lower 8.5 km of the Klamath River (accounting for most of the gill net harvest), the upriver eddy fishery, and the upriver drift net fishery. Because of the large differences between reported occurrence frequencies of gill net markings on fish, and the paucity of available information relating gill net marking incidences to fallout and fallout mortality rates in the various gill net fisheries, the management value of existing gill net marking data appears very questionable. If additional data concerning gill net marking rates are to be collected and reported in the future, studies should be initiated to assess fallout and fallout mortality rates in the various gill net fisheries, gill net marking identification techniques should be standardized, and data should be collected by trained observers at a variety of upstream sample locations. So that size selectivity of the fisheries can be accounted for, data should be recorded in conjunction with length-frequency information.

HOOK SCARRING INVESTIGATIONS

INTRODUCTION

In recent years, considerable attention has focused on assessing the impacts of the ocean troll fisheries on Klamath River chinook salmon stocks. FAO-Arcata biologists have participated in this effort by relating CWT recoveries in the ocean to recoveries obtained through net harvest monitoring activities, and by observing overall percentage occurrences of hook-scarred fish captured through beach seining operations. In 1981, we expanded beach seining efforts to include observations on the location, severity, and healing stage of hook scars.

In 1980, we began exploring the relationship between ocean hooking and growth interruptions as observed on scales collected from hook-scarred fish. Preliminary scale analyses indicate that such a relationship exists. Scales were collected in 1981 for further analysis, and results of that work will be forthcoming.

The lower estuary beach seining site affords an excellent opportunity to evaluate ocean hook-scarring data, because fish are in prime condition and scars are easily recognizeable, especially the many relatively recent, unhealed scars. In addition, ocean hook scars are rarely confused with those received through the in-river sport fishery, as little sport harvest occurs between the site and the ocean. The beach seining operation also allows for a representative in-river population sample, because the size-selective gill net and sport fisheries have not had an opportunity to influence population structure.

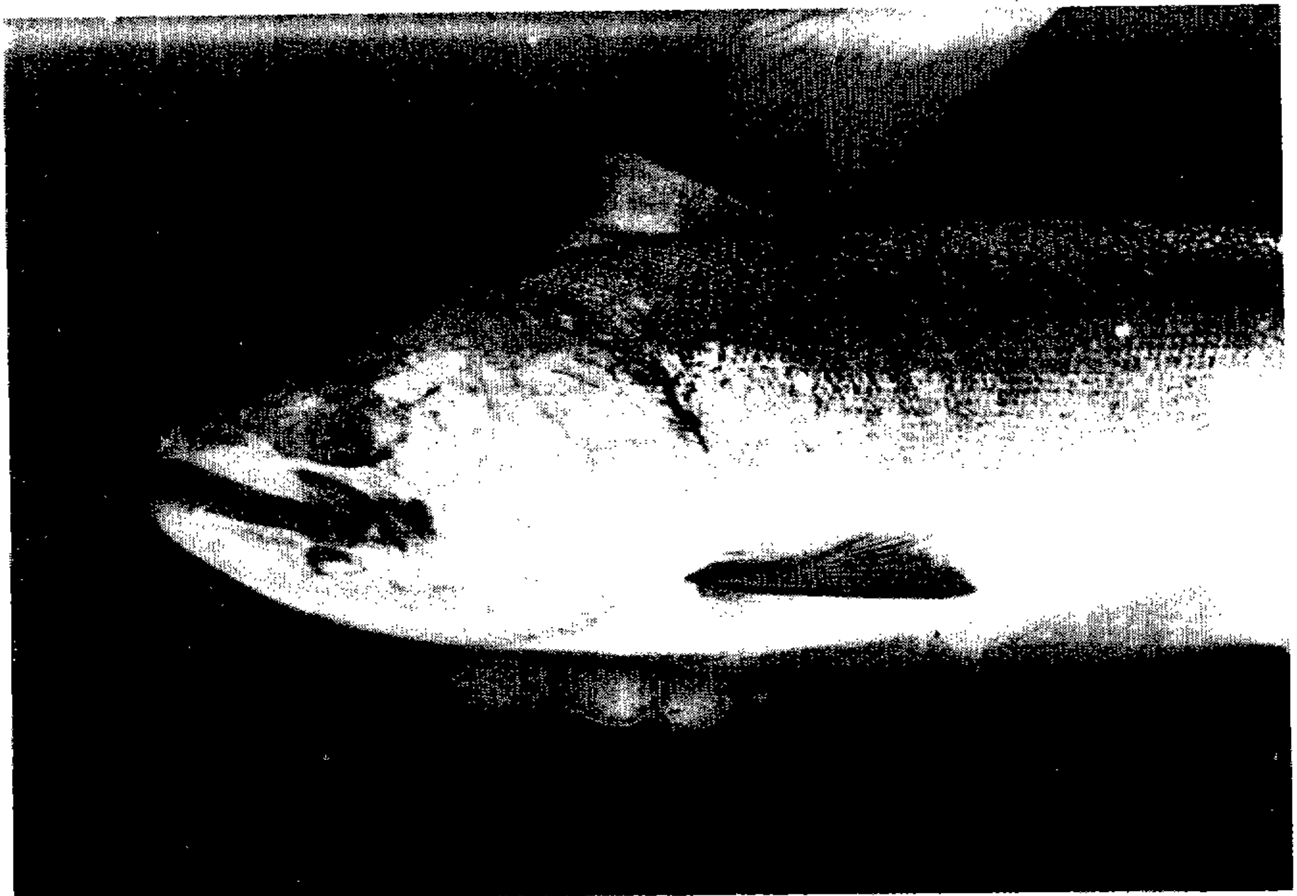
METHODS

Chinook salmon captured in the 1981 beach seining operation were examined closely for scars and wounds on the head area. When uncertainty existed as to whether given scars and wounds resulted from hooking incidents, they were recorded as "questionable hook scars," and excluded from frequency-of-occurrence presentations. Wounds and scars identified as resulting from hooking incidents were categorized as to freshness, severity, and location on the head (Plates 10-13; Table 7). Individuals exhibiting two or more wounds or scars, identified as having resulted from separate hooking incidents, were recorded as such.

RESULTS AND DISCUSSION

A total of 528 of 1,293 (40.8%) chinook salmon examined during 1981 beach seining operations near the mouth of the Klamath River exhibited one or more ocean hook scars, with a higher rate of occurrence observed for adults (44.3%) than grilse (33.5%). Fresh hook scars were more common than healed scars (22.9 versus 19.9% of the sample), and 4.2% of the sample exhibited two or more scars apparently caused by separate hooking incidents (Table 8). Five hooks were found imbedded in fish.

PLATES 10 & 11. Fresh (above) and healed (below) hook scars classified as major.



PLATES 12 & 13. Fresh (above) and healed (below) hook scars classified as moderate.

TABLE 7. Categorization of hook scars observed during 1981 beach seining operations in the Klamath River estuary.

Characteristic	Classification	Criteria for Classification
Freshness	Fresh	Open wound, whether bleeding or not. No substantial healing exhibited.
	Healed	Completely healed scar or open wound, exhibiting a state of near total healing
Severity	Minor	Obvious wound or scar, but not extensive or deep.
	Moderate	Extensive or deep wound or scar. Major vital structures intact.
	Major	Extensive or deep wound or scar. Vital structures missing or shredded. Debilitating damage (e.g., blindness).
Location	Upper Jaw	
	Lower Jaw	
	Eye & Orbit	
	Opercle	
	Isthmus	
	All other head areas	

TABLE 8. Percentage occurrences of hook scars observed on 1,293 Klamath River chinook salmon sampled through 1981 beach seining operations.

Type of Scar	Run Component		
	Grilse	Adults	All Chinook
Fresh Hook Scar	21.1	23.8	22.9
Healed Hook Scar	13.1	23.2	19.9
Single Hook Scar 1/	33.5	44.3	40.8
Two Hook Scars 2/	3.3	4.6	4.2
Three Hook Scars	0.0	0.1	0.1
Questionable Hook Scars	2.1	3.9	3.3
Hook Imbedded	0.0	0.6	0.4

1/ All fish exhibiting one or more hook scars included in this category.

2/ All fish exhibiting two or more hook scars caused by separate hooking incidences included in this category.

Hook scars designated as minor, moderate, and major comprised 43.2, 29.0, and 27.8% of the sample, respectively (Table 9), and of all scars observed, 49.6% were found on the upper jaw area. These values represent occurrence frequencies for the respective hook-scarring categories within the total sample of 583 scars; they do not relate directly to occurrence frequencies involving the total chinook sample of 1,293, as 55 multiple-scarred chinook were represented by 111 individual scars. The incidence of hook-scarred fish sampled through the 1981 season increased at a rate of 2.18% per week (Figure 30), the regression being significant by *F*-test ($P < 0.05$).

TABLE 9. Location, healing stage, and severity frequencies involving 583 hook scars observed on chinook salmon sampled through 1981 beach seining operations.

LOCATION	HEALING STAGE	SEVERITY			
		MINOR	MODERATE	MAJOR	TOTAL
Upper Jaw	Fresh	14.1	6.0	6.2	26.2
	Healed	8.1	6.5	8.8	23.3
	Total	22.2	12.5	15.0	49.6
Lower Jaw	Fresh	8.6	4.0	1.4	13.9
	Healed	5.5	2.1	2.7	10.3
	Total	14.1	6.1	4.1	24.2
Eye & Proximity	Fresh	0.3	0.7	1.0	2.1
	Healed	0.5	1.7	1.2	3.4
	Total	0.8	2.4	2.2	5.5
Opercle	Fresh	1.9	2.6	1.0	5.5
	Healed	1.5	1.4	1.2	4.1
	Total	3.4	4.0	2.2	9.6
Isthmus & Proximity	Fresh	1.9	1.5	1.2	4.6
	Healed	0.5	1.5	1.0	3.1
	Total	2.4	3.0	2.2	7.7
Other Head Areas	Fresh	0.2	0.2	1.2	1.5
	Healed	0.2	0.9	0.9	1.9
	Total	0.4	1.1	2.1	3.4
All Head Areas Combined	Fresh	26.9	14.9	12.0	53.9
	Healed	16.3	14.1	15.8	46.1
	Total	43.2	29.0	27.8	100.0

Length-frequency distributions of hook-scarred and non-scarred chinook sampled through beach seining in 1981 are presented in Figure 31. Although the difference between mean fork lengths of scarred and non-scarred adults (71.2 and 72.2 cm, respectively) was not significant (t-test; $P > 0.05$), significant length differences between these groups were calculated for 1979 and 1980 samples. A significant difference (t-test; $P < 0.05$) was found between the mean lengths of non-scarred adult chinook (72.2 cm), and adults exhibiting healed hook scars of

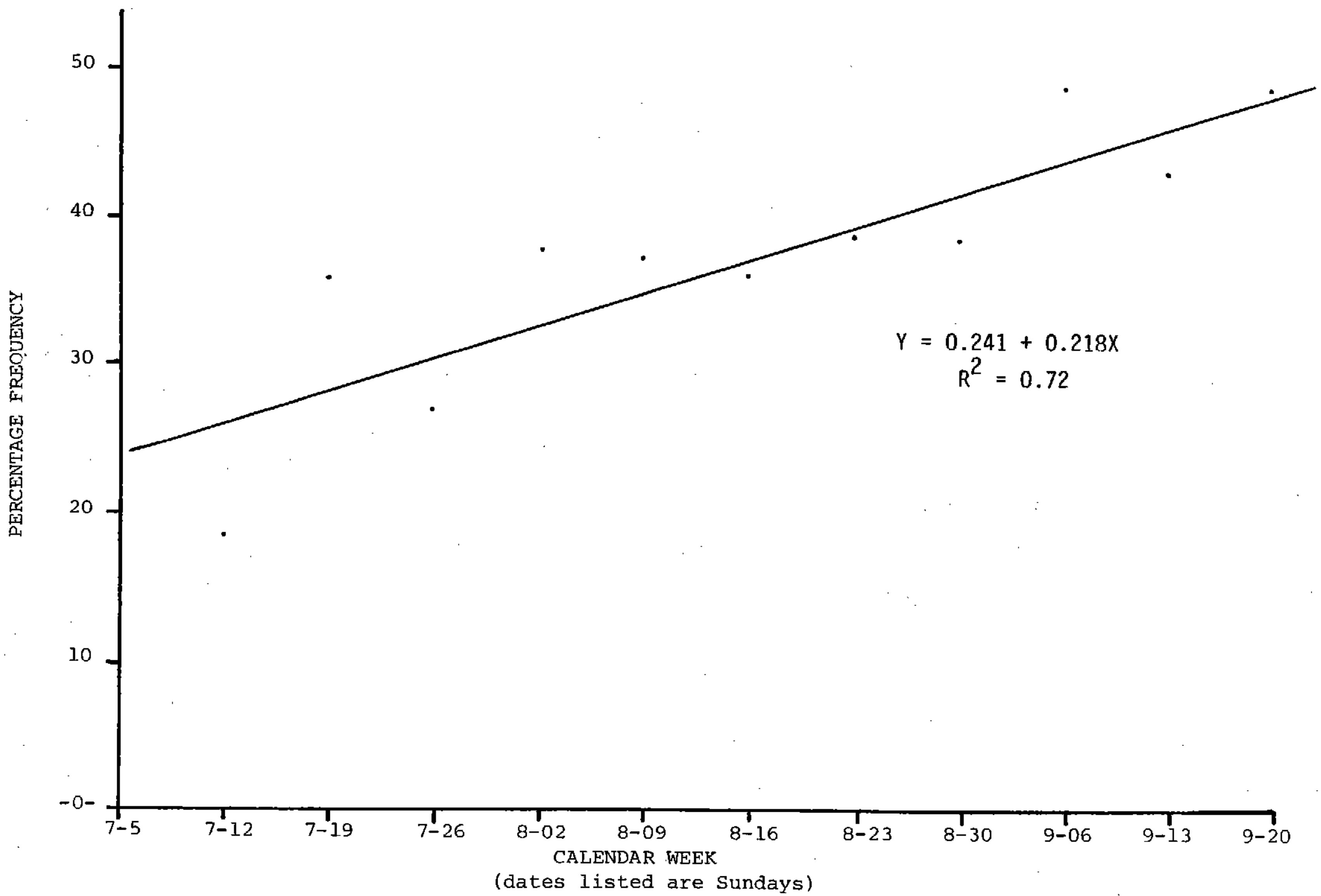


FIGURE 30. Least squares linear regression of hook scar frequency by calendar week in the 1981 beach seine sample.

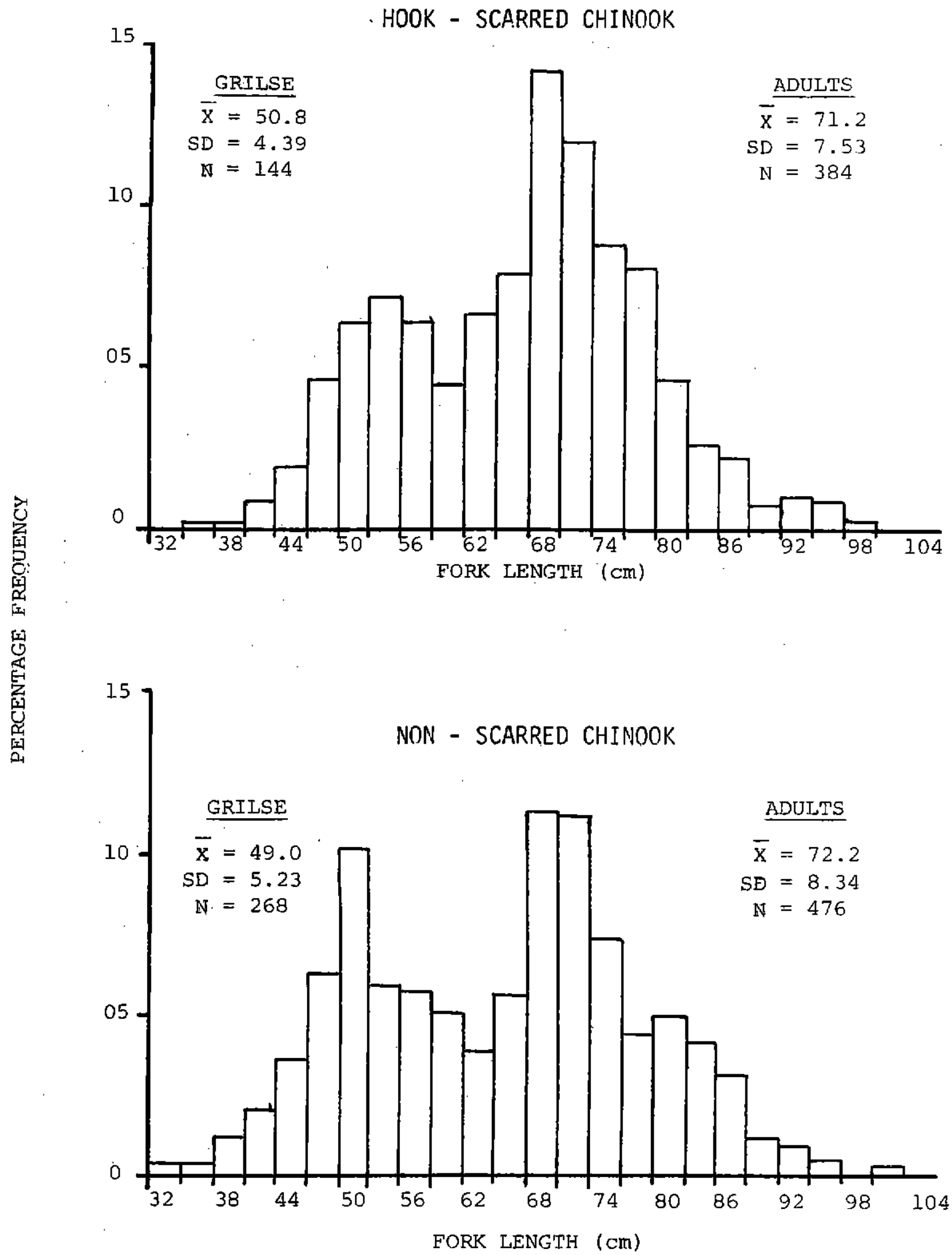


FIGURE 31. Length-frequency distributions of hook-scarred and non-hook-scarred chinook in the 1981 beach seine sample.

moderate or major severity (70.5 cm). Size differences observed in each of the last 3 years may reflect growth interruptions caused by hooking incidents, and, as noted previously, we plan to explore this possibility further through scale analysis. Mean lengths of hook-scarred grilse were significantly greater (t-test; $P < 0.05$) than those of non-scarred grilse in each of the 3 seasons sampled, perhaps reflecting a lesser ability of smaller fish to survive the hooking experience.

Overall hook-scarring incidences involving adults and grilse have risen steadily since 1979 (Figure 32), having averaged 18.0, 25.7, and 40.8% in 1979, 1980, and 1981, respectively. This trend may reflect a pattern in the ocean fisheries and/or closer examination of chinook for hook scars each year.

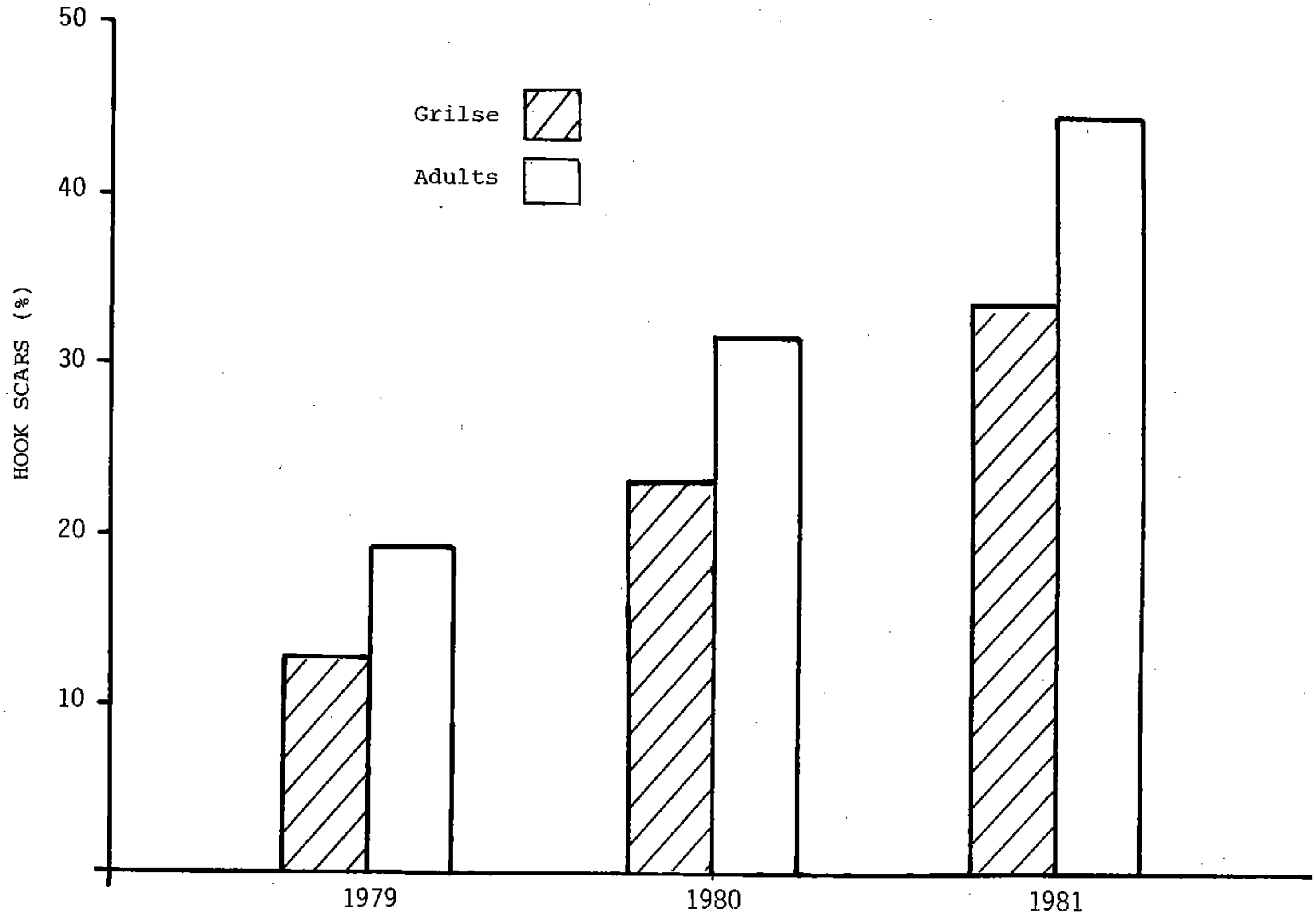


FIGURE 32. Grilse and adult chinook salmon hook scarring rates observed during 1979, 1980 and 1981 beach seining operations in the Klamath River.

CODED-WIRE TAG RECOVERY INVESTIGATIONS

INTRODUCTION

In recent years, increased numbers of CWT returns have been utilized to assess contributions of Klamath River stocks to the ocean and gill net fisheries, and to evaluate release programs of hatcheries in the basin (TRH and IGH). In conjunction with 1981 net harvest monitoring activities, FAO-Arcata biologists expanded their CWT recovery effort involving the Indian fishery on the Hoopa Valley Reservation. Results of that effort are presented herein along with preliminary 1981 ocean recovery data.

METHODS

Coded-wire tags were dissected from chinook salmon utilizing a magnetic field detector, and read with the aid of a Nikon 104 dissecting scope. Recovery data for each CWT group was expanded to estimate total net harvest by area and time employing a procedure similar to that used by personnel of the Oregon Department of Fish and Wildlife (ODFW) in estimating contributions of CWT groups to the Oregon troll fishery. The first part of the expansion adjusts for the non-recovery of tags from adipose fin-clipped fish in the mark sample, and the second part adjusts for the portion of net harvest not mark-sampled:

$$(1)\quad \text{Tag Recovery Rate} = \frac{\text{Number of tags recovered}}{\text{Number of adipose fin-clipped chinook observed}}$$

$$(2)\quad \text{Harvest Sampling Rate} = \frac{\text{Number of chinook examined for marks}}{\text{Total estimated net harvest}}$$

For each CWT group recovered, the two derived rates were multiplied to yield an Expanded Tag Factor, which was then divided into the respective number of returns to produce the total harvest estimate.

Harvest estimates of CWT groups were generally derived biweekly, except when low sampling rates or abbreviated sampling schedules called for deviations from this time period. Annual estimates of net harvest involving each tag group were derived by summing time period estimates for each area, and then summing the four area estimates.

RESULTS AND DISCUSSION

Fall Chinook Salmon - Indian Net Fishery

Of 504 CWT's recovered from fall chinook in the 1981 Indian net fishery, 453 were obtained through our mark-sampling program (Table 10) and 51 were acquired through voluntary returns by Indian fishers. The tags represent 16 release groups: 14 from the Klamath River, 1 from the Rogue River, and 1 from the Feather River (a single recovery obtained through a voluntary return).

TABLE 10. Actual and expanded (underlined) CWT group recoveries of fall chinook salmon in the 1981 gill net fishery on the Hoopa Valley Reservation.

Tag Code	Brood Year	Hatchery[1/] Of Origin	Release[2/] Type	Reservation Monitoring Area: Estuary		Resighinni		Upper Klamath		Trinity		All Areas	
06-61-01	1976	TRH	Y	4	23	4	14	3	11	2	19	13	67
06-61-07	1977	TRH	Y+	60	359	27	84	22	76	8	38	117	557
06-61-05	1977	TRH	Y	35	209	12	39	17	47	13	67	77	362
06-61-02	1977	TRH	F	6	34	0	0	3	12	0	0	9	46
06-61-03	1977	TRH	F[3/]	2	15	1	3	0	0	3	14	6	32
06-61-15	1978	TRH	Y+	15	85	7	25	21	75	19	150	62	335
06-59-01	1978	IGH	Y	34	207	15	47	16	48	0	0	65	302
06-61-14	1978	TRH	Y	16	90	5	16	16	57	7	57	44	220
06-61-10	1978	TRH	F[4/]	19	135	5	16	5	13	0	0	29	164
06-61-08	1978	TRH	F	5	44	2	5	3	8	2	24	12	81
07-18-53	1978	CRH	Y	1	9	0	0	0	0	0	0	1	9
06-61-17	1979	TRH	F[5/]	1	6	2	7	6	21	3	20	12	54
06-59-03	1979	IGH	F	1	6	0	0	1	3	0	0	2	9
06-61-16	1979	TRH	F	1	6	0	0	0	0	0	0	1	6
06-61-20	1979	TRH	Y+	1	6	0	0	1	3	1	5	3	14
TOTALS				201	1234	80	256	114	374	58	394	453	2258

1/ CRH - Cole Rivers Hatchery (Rogue River System)
IGH - Iron Gate Hatchery
TRH - Trinity River Hatchery

2/ F (Fingerling) - May or June release
Y (Yearling) - Late September to early December release
Y+ (Yearling-plus) - March release

3/ Off-site release at Trinity River Kilometer 24.6 (Tish Tang)

4/ Off-site release at Trinity River Kilometer 20.0

5/ Off-site release at Trinity River Kilometer 40.0 (Willow Creek)

Coded-wire tag groups of TRH origin returned to the net fishery at higher rates the longer the groups were held (i.e., the larger the size at release). Groups released as yearlings-plus (06-61-07,15), yearlings (06-61-05,14), and fingerlings (06-61-02,03,08,10) comprised a respective 50, 32, and 18% of the tagged adult harvest originating from the hatchery. Considering the greater number of tagged fingerlings (724,653) versus yearlings (395,294) and yearling-plus fish (349,930) released, the relative contribution of the fingerling releases was substantially less.

The release site of TRH-reared fingerling groups also seemed to influence the rate of return to the fishery. Of an estimated net harvest of 383 tagged fall chinook released as yearlings, 35% were from groups released at the hatchery (on-site), whereas 65% were from groups released off-site in the Trinity River (137 to 156 river kilometers below the hatchery). Although a higher survival of the off-site fingerling releases is indicated, straying of fish released off-site may have occurred to a greater degree; e.g., the estimated net harvest of a 3-year-old off-site release group (06-61-10) was 135 in the Estuary Area and zero in the Trinity Area. Net harvest of a comparable fingerling group (06-61-08) released at TRH was 44 in the Estuary Area and 24 in the Trinity Area.

Only one CWT group (06-59-01) released from IGH returned at a reasonably high rate; this return was approximately twice that of a comparable Brood Year 1978 yearling release (06-61-14) from TRH to the net fisheries operating in the three combined Klamath River areas. The higher return may be attributable, in part, to the larger size at release of the IGH versus TRH groups (20.0 fish/kg and 30.8 fish/kg, respectively).

The age composition of tagged fall chinook salmon of TRH origin harvested in the 1981 Indian net fisheries included 53.6% 4-year-olds, 41.5% 3-year-olds, and 4.9% 2-year-olds (percentages corrected for unequal CWT releases); 5-year-olds were not included because only one CWT group (06-61-01) from an atypical egg source (IGH) was represented. Age class composition changed from mostly 4-year-olds in the tidewater fisheries to primarily 3-year-olds in the upper river fisheries, with the 2-year-old class comprising a relatively low percentage of the overall harvest, but an increasingly prominent portion of the upriver catch (Figure 33).

Three-year-old CWT groups released as fingerlings generally entered the lower river net fishery before yearling and yearling-plus release groups (Table 11). In 1981, initial recoveries of fingerling release groups (06-61-08 on-site release group and 06-61-10 off-site release group) began 2 to 8 weeks sooner than yearling and yearling-plus groups, and the time by which 50% of the cumulative seasonal harvest of the fingerling release groups had been reached occurred 2 to 6 weeks earlier. In 1980, initial recovery of an on-site fingerling release group (06-61-02) occurred 2 to 4 weeks before returns from any of the other 3-year-old release groups, and during the same period as returns from a 4-year-old yearling release group (06-61-01); the 50% cumulative harvest levels for the 3-year-old on-site fingerling and 4-year-old yearling release groups were also reached during the same period. Initial 1980 recoveries of the off-site fingerling release group (06-61-03) occurred during similar time periods as returns from the 3-year-old non-fingerling release groups (06-61-05 and 06-61-07), and the 50% cumulative harvest levels for the three groups occurred during the same time span. With regard to yearling and yearling-plus release groups, initial recoveries of 4-year-olds (CWT groups 06-61-01, 05,07) began 2 to 4 weeks sooner than returns of 3-year-old release groups (06-61-05,07,14,15), and the time period in which 50% of the cumulative seasonal harvest of 4-year-old release groups was reached occurred 2 weeks earlier (Table 11).

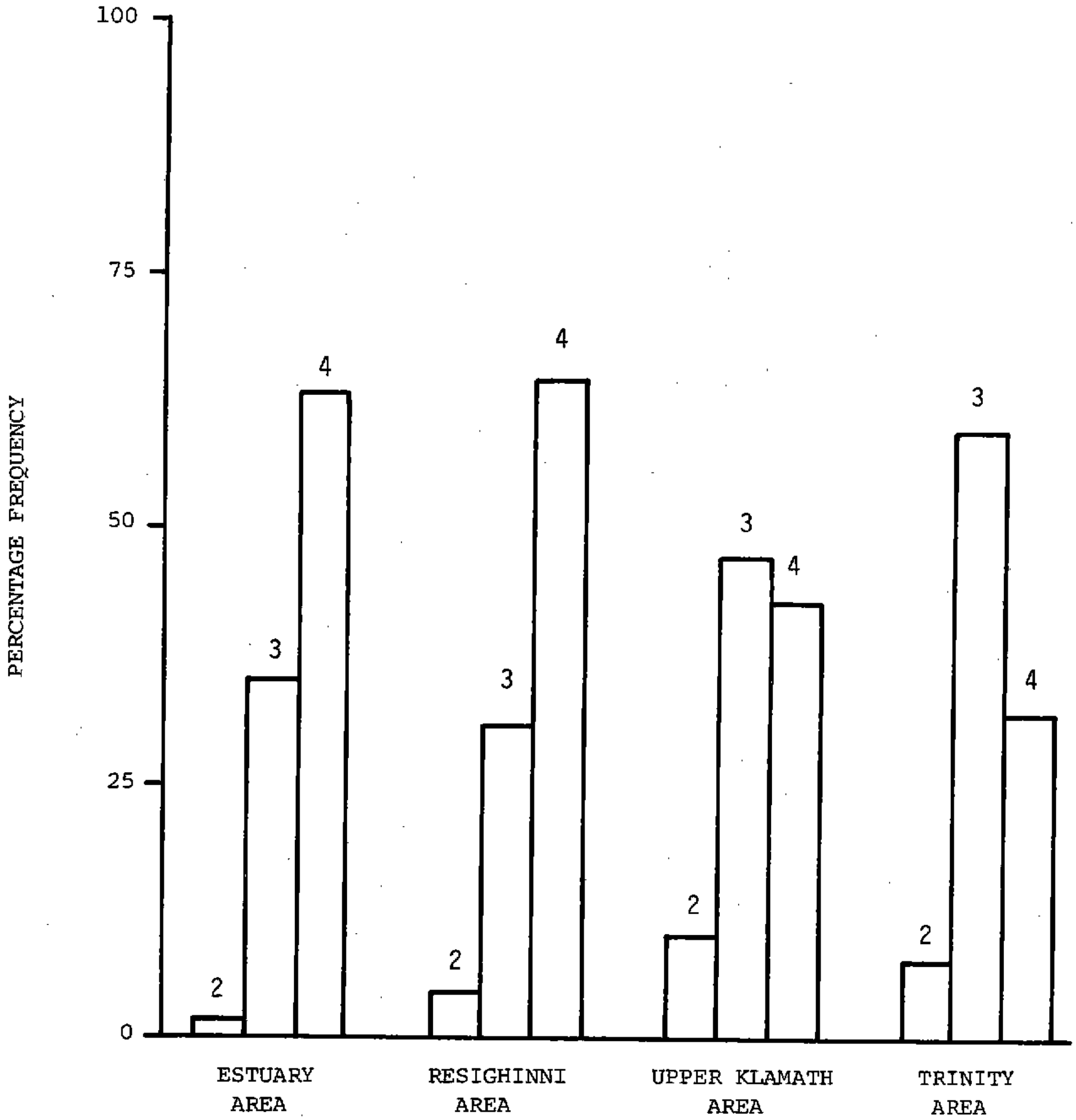


FIGURE 33. Age composition of Trinity River Hatchery CWT groups harvested in the four monitoring areas of the Hoopa Valley Reservation in 1981 (percentages are corrected for unequal sizes of CWT release groups in respective brood years).

TABLE 11. Cumulative percentage estimates of major fall chinook CWT groups harvested in the combined Estuary and Resighinni net fisheries in 1980 and 1981.

Release Type 1/	Tag Code	Brood Year	Return Year	Age at Return	Harvest Periods 7/01-7/11	7/12-7/25	7/26-8/08	8/09-8/22	8/23-9/05	9/06-9/19	9/20-10/03	10/04-10/17
F	06-61-02	1977	1980	3	00.0	00.0	05.3	21.1	57.9	100.0	100.0	100.0
F 2/	06-61-03	1977	1980	3	00.0	00.0	00.0	00.0	15.0	100.0	100.0	100.0
F	06-61-08	1978	1981	3	34.9	45.8	63.3	89.6	100.0	100.0	100.0	100.0
F 2/	06-61-10	1978	1981	3	11.4	22.1	44.9	68.9	82.5	100.0	100.0	100.0
Y	06-61-01	1976	1980	4	00.0	00.0	01.6	13.8	53.0	90.1	100.0	100.0
Y	06-61-05	1977	1981	4	00.0	04.3	07.8	26.0	59.6	94.3	99.1	100.0
Y+	06-61-07	1977	1981	4	00.0	02.4	06.3	16.5	53.8	93.7	99.4	100.0
Y	06-61-05	1977	1980	3	00.0	00.0	00.0	04.9	31.7	96.3	100.0	100.0
Y	06-61-14	1978	1981	3	00.0	00.0	00.0	06.0	19.6	96.2	100.0	100.0
Y+	06-61-07	1977	1980	3	00.0	00.0	00.0	00.0	21.7	94.2	100.0	100.0
Y+	06-61-15	1978	1981	3	00.0	00.0	00.0	00.0	07.8	79.2	100.0	100.0

1/ Y (Yearling) - September, October, or November release
Y+ (Yearling-plus) - March release
F (Fingerling) - May or June release

2/ Off-site release

An inverse relationship generally existed between the size of fish released from the hatcheries and the mean length of respective CWT recoveries in the net fishery. Although no significant difference (t-test; $P > 0.05$) in mean length existed between returns of the 5-year-old yearling release group (06-61-01) and returns of the combined 4-year-old fingerling release groups (06-61-02,03), significant decreases ($P < 0.05$) in mean length occurred between returns of groups released as fingerlings, yearlings, and yearlings-plus, respectively, within the 3- and 4-year-old age classes (Table 12). No significant difference ($P > 0.05$) in mean length existed between returns of off-site versus on-site fingerling release groups.

Mean length comparisons between each of the four net harvest monitoring areas of six CWT groups (06-61-05,07,10,14,15 and 06-59-01) that contributed relatively high returns to the fisheries, revealed little variation (Table 12). Only two of 30 tests between single areas revealed significant differences ($P < 0.05$) in mean lengths: a 3.9 cm decrease between the Resighinni and Upper Klamath areas for CWT group 06-61-14, and a 2.9 cm decrease between the Estuary and Upper Klamath areas involving CWT group 06-59-01. Two of the six groups exhibited significant ($P < 0.05$) decreases in mean length between downriver (Estuary and Resighinni areas combined) and upriver (Upper Klamath and Trinity areas combined) fisheries: 3.4 and 3.6 cm decreases involving CWT groups 06-61-05 and 06-61-14, respectively.

Coded-wire tag groups of given age classes recovered in the lower river net fisheries were larger in 1981 than in 1980. Significant ($P < 0.05$) mean length increases in 1981 returns were evident for each comparable group: a 1.9 cm increase involving returns of 4-year-old yearling groups (06-61-05 versus 06-61-01), a 5.0 cm increase for returns of 3-year-old on-site fingerling release groups (06-61-08 versus 06-61-02), a 5.2 cm increase involving returns of 3-year-old off-site fingerling release groups (06-61-10 versus 06-61-03), a 5.2 cm increase for returns of 3-year-old yearling groups (06-61-14 versus 06-61-05), and a 2.8 cm increase involving returns of 3-year-old yearling-plus groups (06-61-15 versus 06-61-07).

Spring Chinook Salmon - Indian Net Fishery

Of 151 CWT's obtained from spring chinook in the 1981 Indian net fishery, 120 were acquired through our mark-sampling program (Table 13), and 31 were recovered through voluntary returns by Indian fishers. These tags represent eight release groups from the Klamath River and five groups of Rogue River origin.

Expanded spring chinook CWT returns to the net fishery varied considerably, depending on the type and site of the juvenile releases. A 3-year-old spring chinook fingerling group (06-61-11), raised at TRH and released approximately 158 river kilometers downstream, comprised 43% of the total spring chinook CWT harvest, and returned to the fishery at a rate more than 4 times that of a comparable fingerling group released at the hatchery (06-61-31). The second most abundant expanded spring chinook CWT returns occurred from a 3-year-old group released from TRH as yearlings (06-61-30). These fish contributed at a rate greater than 7 times that of a 3-year-old yearling-plus group (06-61-31) released from the hatchery 4 months later. Although a 4-year-old spring chinook tag group released from TRH as yearlings (06-61-04) made up only 11% of the expanded CWT harvest, the number released (approximately 95,000) was only about half of the average number of 3-year-olds released per group (175,000). The 5-year-old CWT group released as yearlings from TRH (06-61-06), which dominated 4-year-old spring chinook returns in the 1980 net harvest, comprised

TABLE 12. Mean fork lengths of 11 fall chinook CWT groups netted in the four fishery areas of the Hoopa Valley Reservation in 1981.[1]

Tag Code	Brood Year	Hatchery[2] Of Origin	Release[3] Type	Harvest Monitoring Area				
				Estuary	Resighinni	Upper Klamath	Trinity	All Areas[8]
06-61-01	1976	TRH	Y	78.3[5]	79.0	84.5	80.8	80.1
				5.32[6]	2.00	0.71	6.70	4.73
				4[7]	4	2	4	14
06-61-02	1977	TRH	F	86.7	-----	74.0	-----	79.0
				3.56	-----	0.00	-----	4.31
				6	0	2	0	8
06-61-03	1977	TRH	F[4]	77.0	79.0	-----	81.7	79.7
				1.41	-----	-----	0.58	2.42
				2	1	0	3	6
06-61-05	1977	TRH	Y	78.0	77.3	74.2	75.0	76.6
				5.64	5.53	8.38	3.74	6.34
				35	12	18	9	74
06-61-07	1977	TRH	Y+	75.6	76.2	75.9	75.0	75.8
				4.64	5.47	5.59	5.00	5.00
				60	27	19	9	115
06-61-08	1978	TRH	F	70.4	77.0	75.0	68.5	72.3
				2.07	2.83	2.65	2.12	3.77
				5	2	3	2	12
06-61-10	1978	TRH	F[4]	73.2	69.0	71.0	-----	72.1
				5.11	5.00	2.65	-----	4.91
				19	5	5	0	29
06-61-14	1978	TRH	Y	69.0	69.8	65.9	64.9	67.3
				4.26	1.10	5.13	6.99	5.08
				16	5	15	7	43
06-59-01	1978	IGH	Y	71.7	68.7	68.8	-----	70.3
				4.66	6.72	3.76	-----	5.17
				35	15	15	0	65
06-61-15	1978	TRH	Y+	65.1	62.1	62.2	63.1	63.2
				4.98	2.79	4.21	6.19	4.97
				15	7	19	17	58
06-61-17	1979	TRH	F[4]	39.0	54.0	48.7	54.8	50.6
				-----	2.83	3.67	9.14	6.92
				1	2	6	4	13

1/ Includes recoveries from mark sampling and voluntary returns

2/ TRH - Trinity River Hatchery
IGH - Iron Gate Hatchery

3/ F (Fingerling) - May or June release
Y (Yearling) - Late Sept. to early Nov. release
Y+ (Yearling-plus) - March release

4/ Off-site release

5/ Mean fork length

6/ Standard deviation

7/ Number in sample

8/ Includes recovered tags not site-identified

TABLE 13. Actual and expanded (underlined) CWT group recoveries of spring chinook salmon in the 1981 gill net fishery on the Hoopa Valley Reservation.

Tag Code	Brood Year	Hatchery[1/] Of Origin	Release[2/] Type	Reservation Monitoring Area									
				Estuary		Resighinni		Upper Klamath		Trinity		All Areas	
06-61-06	1976	TRH	Y	0	0	0	0	1	3	1	8	2	11
09-16-19	1976	CRH	Y	0	0	0	0	3	10	0	0	3	10
09-16-17	1976	CRH	Y	0	0	0	0	2	6	0	0	2	6
09-16-33	1976	CRH	Y	0	0	0	0	1	3	0	0	1	3
06-61-04	1977	TRH	Y	1	6	0	0	5	15	3	61	9	82
07-16-34	1977	CRH	Y	1	5	0	0	1	3	0	0	2	8
06-61-11	1978	TRH	F[3/]	14	119	0	0	9	44	24	154	47	317
06-61-30	1978	TRH	Y	18	112	1	3	4	11	11	66	34	192
06-61-12	1978	TRH	F	7	58	1	4	2	7	1	5	11	74
06-61-31	1978	TRH	Y+	3	16	0	0	2	9	0	0	5	25
07-19-36	1978	CRH	Y	0	0	0	0	1	3	0	0	1	3
06-61-33	1979	TRH	F[4/]	1	5	0	0	1	2	0	0	2	7
06-61-34	1979	TRH	Y	1	5	0	0	0	0	0	0	1	5
TOTALS				46	326	2	7	32	116	40	294	120	743

1/ CRH - Cole Rivers Hatchery (Rogue River System)
TRH - Trinity River Hatchery

2/ F (Fingerling) - May or June release
Y (Yearling) - Late September to early December release
Y+ (Yearling-plus) - March release

3/ Off-site release at Trinity River Kilometer 20.0

4/ Off-site release at Trinity River Kilometer 40.0 (Willow Creek) less than 2% of the 1981 expanded CWT net harvest.

The contribution of Rogue River spring chinook to total 1981 CWT net harvest approximated 11%, whereas in 1980, approximately 48% of the CWT spring chinook catch in the Indian net fishery consisted of Rogue River fish reared at Cole Rivers Hatchery. Two Rogue River groups (09-16-17,19) of five sampled in 1981 were represented in the 1980 net harvest. A number of Rogue River spring chinook were recovered in the Upper Klamath Area, suggesting that these fish would have spawned in the Klamath River basin. Although no Rogue River salmon were observed in the Trinity Area, concentrated sampling of this fishery did not begin until early June, nearly 3 weeks after most Rogue River chinook had been sampled in the Upper Klamath Area.

With regard to CWT spring chinook groups of TRH origin, two returned relatively heavily to the upriver net fishery (62% of the 06-61-11 and 92% of the 06-61-04 groups), and two contributed comparatively more to the downriver net fishery (60% of the 06-61-30 and 83% of the 06-61-12 groups). Because of the earlier start of the upriver spring chinook fishery, the 06-61-04 and 06-61-11 CWT groups may represent earlier-arriving fish.

As was the case for fall chinook salmon, an inverse relationship existed between the size of juvenile spring chinook released and the mean length of respective CWT recoveries in the Indian net fisheries (Table 14). Significant decreases (t-test; $P<0.05$) in mean length occurred between returns of groups released as fingerlings (the 06-61-11 and 06-61-12 CWT groups, combined), yearlings, and yearlings-plus, respectively, within the 3-year-old age class (1978 Brood Year). No significant difference ($P>0.05$) in mean length was noted between 4-year-old (CWT group 06-61-04) and 3-year-old (06-61-30) yearling release groups.

Mean length comparisons between each of the four net harvest monitoring areas of five CWT groups that contributed relatively high returns to the fisheries revealed significant differences ($P<0.05$) in only one group (06-61-30) between single areas: a 5.3 cm decrease between the Estuary and Upper Klamath areas, and a 4.0 cm decrease between the Estuary and Trinity areas (Table 14). Returns of the same group were also the only fish to exhibit a significant ($P<0.05$) decrease in mean length (4.1 cm) between combined downriver and combined upriver fisheries.

Indian Net Versus Ocean Fisheries

Based on data collected by FAO-Arcata biologists in 1980 and 1981, and preliminary ocean CWT return data provided by the CDFG and ODFW, it appears that the overall ratio of ocean to Indian gill net landings of tagged Klamath River fall chinook salmon decreased from approximately 8:1 in 1980 to 3:1 in 1981 (Table 15). In 1980, harvest ratios involving individual adult CWT groups ranged from 14.2:1 for a TRH, 3-year-old, fingerling release group (06-61-02) to 6.4:1 for a TRH, 3-year-old, yearling release group (06-61-07). Ratios involving adult CWT groups harvested in 1981 ranged from 8.0:1 for a 3-year-old, yearling release group from IGH (06-59-01) to 1.3:1 for a 5-year-old, yearling release group from TRH (06-61-01). Coded-wire tag group 06-59-01 comprised 35% of the 1981 ocean harvest of tagged adult Klamath River fall chinook, but only 14% of the 1981 gill net harvest, possibly indicating a delayed maturity schedule for this release group. Grilse CWT groups contributed little to the ocean landings and net fisheries.

TABLE 14. Mean fork lengths of five spring chinook CWT groups netted in the four fishery areas of the Hoopa Valley Reservation in 1981. 1/

Tag Code	Brood Year	Hatchery 2/ Of Origin	Release 3/ Type	Harvest Monitoring Area: Estuary	Resighinni	Upper Klamath	Trinity	All Areas 8/
06-61-04	1977	TRH	Y	----- ----- 0	----- ----- 0	68.0 4.64 5	74.7 5.69 3	70.9 5.53 9
06-61-11	1978	TRH	F 4/	69.6 5/ 4.78 6/ 14 7/	----- ----- 0	69.9 7.13 9	70.9 4.19 24	70.3 4.95 47
06-61-12	1978	TRH	F	72.2 1.94 6	75.0 11.31 2	68.0 4.24 2	78.0 ----- 1	72.5 4.99 11
06-61-30	1978	TRH	Y	68.9 5.53 18	66.0 ----- 1	63.6 2.52 3	64.9 3.96 11	67.0 5.11 33
06-61-31	1978	TRH	Y+	60.0 2.65 3	----- ----- 0	59.5 6.36 2	----- ----- 0	59.8 3.70 5

1/ Includes recoveries from mark sampling and voluntary returns

2/ TRH - Trinity River Hatchery

3/ F (Fingerling) - May or June release
Y (Yearling) - Late September to early November release
Y+ (Yearling-plus) - March release

4/ Off-site release

5/ Mean fork length

6/ Standard deviation

7/ Number in sample

8/ Includes recovered tags not site-identified

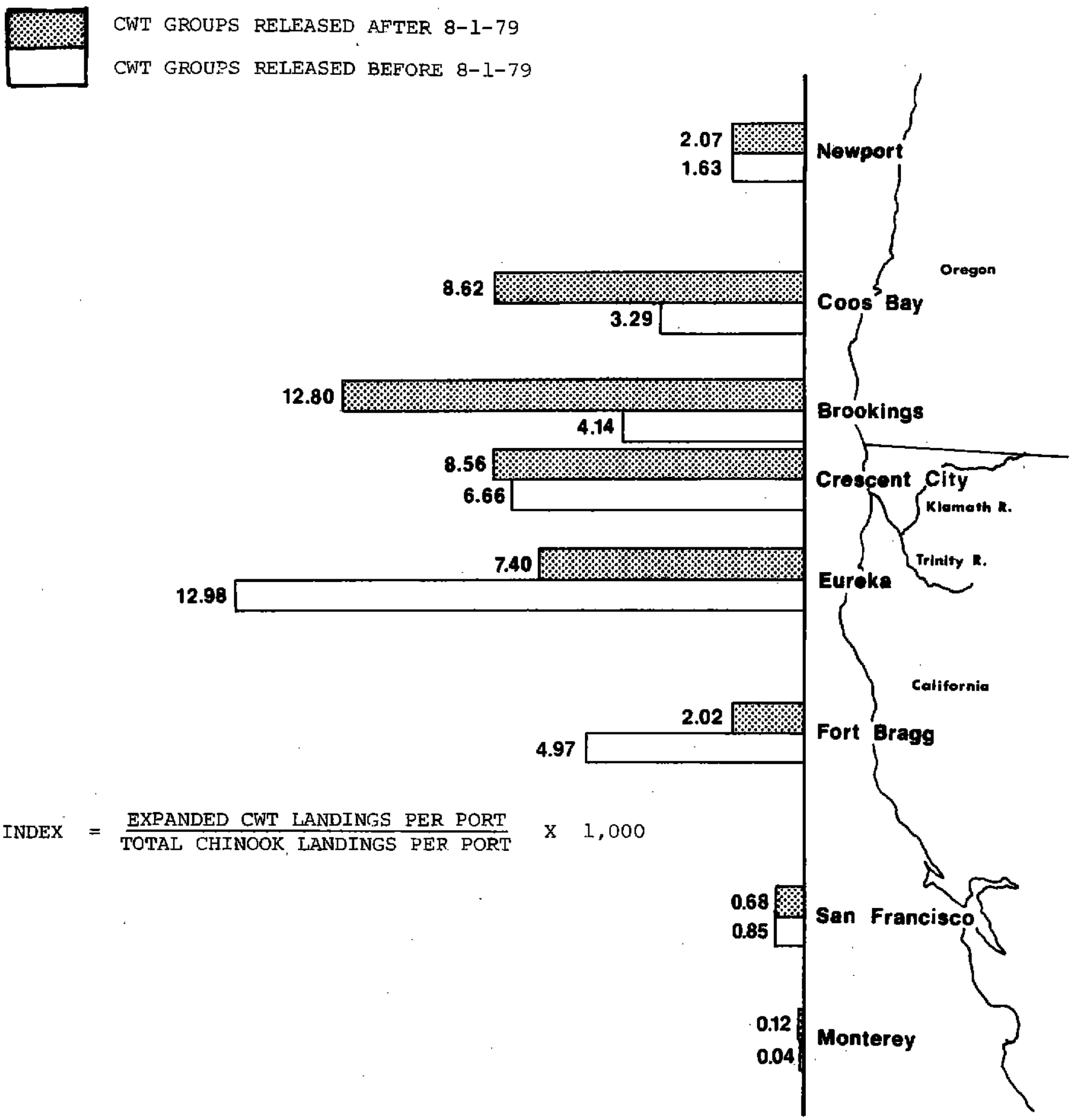
TABLE 15. Estimated contributions of Klamath River fall chinook CWT groups to the 1980 and 1981 ocean and Indian gill net fisheries.

Tag Code	Brood Year	Return Year	Ocean[1/] Harvest	Gill Net Harvest	Harvest Ratio Ocean/Gill Net
06-61-01	1976	1980	2,547	329	7.7:1
		1981	84	67	1.3:1
06-61-02	1977	1980	356	25	14.2:1
		1981	88	46	1.9:1
06-61-03	1977	1980	326	27	12.1:1
		1981	144	32	4.5:1
06-61-05	1977	1980	811	109	7.4:1
		1981	828	363	2.3:1
06-61-07	1977	1980	1,028	160	6.4:1
		1981	1,539	557	2.8:1
06-59-01	1978	1981	2,405	302	8.0:1
06-61-08	1978	1981	144	81	1.8:1
06-61-10	1978	1981	498	164	3.0:1
06-61-14	1978	1981	530	220	2.4:1
06-61-15	1978	1981	532	335	1.6:1
06-59-03	1978	1981	5	9	0.6:1
06-61-16	1979	1981	8	6	1.3:1
06-61-17	1979	1981	4	54	0.1:1
06-61-20	1979	1981	0	14	0.0:1
06-61-09	1979	1981	14	0	-----
TOTALS AND OVERALL RATIOS		1980	5,068	650	7.8:1
		1981	6,823	2,250	3.0:1

1/ Combined troll and sport returns in Oregon and California compiled from preliminary data provided by the CDFG and ODFW.

As in previous years, preliminary 1981 ocean return data compiled by the Pacific Fishery Management Council (PFMC), CDFG, and ODFW reveal that Klamath River CWT fall chinook groups contributed primarily to fisheries operating between Fort Bragg, California, and Coos Bay, Oregon, with the port of Eureka, California, accounting for proportionately more tagged Klamath River chinook than other ports. Relative contribution indices of tagged Klamath River fall chinook to each California and Oregon port (derived by dividing expanded Klamath River CWT return estimates by total chinook landings at each port and multiplying the respective results by 1,000) were calculated independently for combined CWT groups released prior and subsequent to August 1, 1979 (Figure 34). Tagged Klamath River fall chinook released before August 1, 1979, contributed, on a proportionate basis, at least twice as many fish to the port of Eureka than any other port; however, CWT groups released after August 1, 1979 (06-61-14,15, and 06-59-01), contributed proportionately more to landings in Crescent City, California, Brookings, Oregon, and Coos Bay, than to Eureka. These data may support existing evidence that Klamath River stocks tend to migrate north after entering the ocean.

The overall ratio of ocean to gill net landings of tagged Klamath River spring chinook groups approximated 3:1 in both 1980 and 1981 (Table 16). In 1980, harvest ratios involving individual adult CWT groups ranged from 6.3:1 for a 3-year-old, TRH yearling release group (06-61-04) to 2.3:1 for a 4-year-old, TRH yearling release group (06-61-06). Ratios involving adult CWT spring chinook groups harvested in 1981 ranged from 7.1:1 for a 3-year-old, TRH yearling release group (06-61-31) to 1.5:1 for a 4-year-old, TRH yearling release group (06-61-04). As was the case with fall chinook salmon, spring chinook grilse CWT groups contributed little to the ocean and net fisheries.



$$\text{INDEX} = \frac{\text{EXPANDED CWT LANDINGS PER PORT}}{\text{TOTAL CHINOOK LANDINGS PER PORT}} \times 1{,}000$$

FIGURE 34. Relative contribution indices of tagged Klamath River fall chinook (Brood Years 1976-1978) to 1981 ocean landings at each California and Oregon port (calculated from preliminary data provided by the CDFG, ODFW, and PFMC).

TABLE 16. Estimated contributions of Klamath River spring chinook CWT groups to the 1980 and 1981 ocean and Indian gill net fisheries.

Tag Code	Brood Year	Return Year	Ocean[1/] Harvest	Gill Net Harvest	Harvest Ratio Ocean/Gill Net
06-61-06	1976	1980	469	206	2.3:1
		1981	70	12	5.8:1
06-61-04	1977	1980	119	19	6.3:1
		1981	126	82	1.5:1
06-61-11	1978	1981	626	317	2.0:1
06-61-12	1978	1981	275	74	3.7:1
06-61-30	1978	1981	983	192	5.1:1
06-61-31	1978	1981	178	25	7.1:1
06-61-32	1979	1981	13	0	-----
06-61-33	1979	1981	2	7	0.3:1
06-61-34	1979	1981	0	5	0.0:1
TOTAL AND OVERALL RATIOS		1980	588	225	2.6:1
		1981	2,273	714	3.2:1

1/ Combined troll and sport returns in Oregon and California compiled from preliminary data provided by the CDFG and ODFW.

CHINOOK SALMON HARVEST OVERVIEW

The 1981 California ocean troll fishery was regulated through an in-season closure during the month of June and, for the first time, by the adoption of chinook salmon harvest quotas (300,000 above and 265,000 below Point Arena) established at levels approximating mean annual landings during the 1970's. Statewide landings for the year totaled 549,300 chinook of which 292,600 were landed above Point Arena (PFMC 1982). North Coast landings approximated 98% of both the established quota and 1980 landings (299,000 chinook). California ocean recreational landings totaled 83,700 chinook in 1981; approximately 13.5% were landed on the North Coast.

The 1981 Oregon ocean troll fishery was regulated through in-season closures in the absence of chinook salmon harvest quotas. Landings for the year totaled 160,500 chinook in the troll fishery, and 28,800 chinook in the ocean recreational fishery. Of these respective totals, 110,400 (69%) and 13,000 (45%) were landed south of Coos Bay (PFMC 1982).

Klamath River chinook comprise an estimated 40% of annual chinook landings in the northern California and southern Oregon ocean fisheries operating in the area between Point Arena and Coos Bay (approximately 206,000 of 514,000 chinook landed annually in this area since 1979). Preliminary CWT return data indicate that about 90% of the total annual ocean harvest of Klamath River chinook occurs in this area. Taking into account these assumptions, and applying a 40% ocean hooking mortality rate, the 1979, 1980, and 1981 ocean fisheries accounted for approximately 320,000 Klamath River chinook annually (Table 17).

Annual Klamath River sport and Indian gill net harvests averaged approximately 7,700 and 22,800 chinook, respectively, since 1979, and chinook run size and spawner escapement in the basin during these 3 years averaged a respective 83,600 and 53,000 annually. These data result in mean annual ratios of 3.8:1 ocean fishing losses to river returns, and 6.6:1 total fishing losses to spawner escapement (Table 18; Figure 35).

Had the chinook quotas for the Fishery Conservation Zone off northern California and southern Oregon, recommended by the Under Secretary of the Interior for the 1981 season (200,000 from Point Arena to the California-Oregon border and 50,000 from the California-Oregon border to Cape Blanco), been in effect, approximately 210,000 additional chinook would have survived the 1981 ocean fisheries (150,000 in landings and 60,000 in hooking mortality). Approximately 40% of these survivors (84,000 chinook, including 60,000 in landings) would have been Klamath River fish, many of which would have returned to the river as spawners in 1981. Adult chinook salmon spawner escapement in the basin in 1981 was only 36,700 — a respective 32 and 43% of the long-term (115,000) and short-term (86,000) spawner escapement goals.

With regard to the 1982 season, the Under Secretary of the Interior has recommended harvest quotas of 200,000 chinook for the northern California ocean fishery, 50,000 chinook for the southern Oregon ocean fishery, and 30,000 adult fall chinook for the Indian subsistence fishery on the Hoopa Valley Reservation. A troll fishery closure off northern California during May and June was also recommended. If adopted, such measures should result in achieving spawner escapement goals in the Klamath River basin for the first time in at least 4 years.

TABLE 17. Estimated numbers of Klamath River chinook salmon lost through the ocean fisheries in 1979, 1980 and 1981.

Year	Total Chinook Landings 1/ N.CA Troll	Total Chinook Landings 1/ S.OR Troll	Total Chinook Landings 1/ N.CA Sport	Total Chinook Landings 1/ S.OR Sport	Sub Total	Number of 2/ Klamath R Chinook Landed in N.CA and S.OR	Total 3/ Ocean Landings of Klamath R Chinook	Hooking 4/ Mortality	Total Number of Klamath R Chinook Lost Through the Ocean Fisheries
1979	438,200	192,500	14,000	10,900	655,600	262,240	291,380	116,550	407,930
1980	299,000	143,200	8,000	10,100	460,300	184,120	204,580	81,830	286,410
1981	292,600	110,400	11,300	13,000	427,300	170,920	189,910	75,960	265,870
X̄ 1979-81	343,270	148,700	11,100	11,330	514,400	205,760	228,620	91,450	320,070

1/ Landings in N.CA (northern California) north of Point Arena and in S.OR (southern Oregon) south of Coos Bay (PFMC 1982).
2/ Numbers of Klamath River chinook assumed to be 40 percent of landings.
3/ Ninety percent of ocean landings of Klamath River chinook assumed to occur between Point Arena and Cape Blanco.
4/ Hooking mortality in the ocean fisheries assumed to be 40 percent.

TABLE 18. Contributions of Klamath River chinook salmon (adults and grilse) to the ocean, inland sport and Indian gill net fisheries in 1979, 1980 and 1981.

Year	Losses to 1/ Ocean Fisheries	Run Size 2/ in Klamath R	Klamath R 2/ Sport Catch	Indian Gill Net Catch	Spawner 2/ Escapement	Ratio Between Ocean Fishing Losses and River Returns	Ratio Between Total Fishing Losses and Spawner Escapement
1979	407,930	66,580	2,400	15,000	44,180	6.1:1	9.6:1
1980	286,410	73,820	7,880	14,000	52,940	3.9:1	5.8:1
1981	265,870	110,260	12,780	38,400	61,980	2.4:1	5.1:1
X̄ 1979-81	320,070	83,550	7,690	22,500	53,030	3.8:1	6.6:1

1/ From Table 17
2/ 1979 and 1980 preliminary data from PFMC 1981. 1981 preliminary data from PFMC 1982.

NOTE: Contributions to ocean and Indian fisheries include spring and fall chinook. Run size, spawner escapement, and sport catch values apply to fall chinook only.

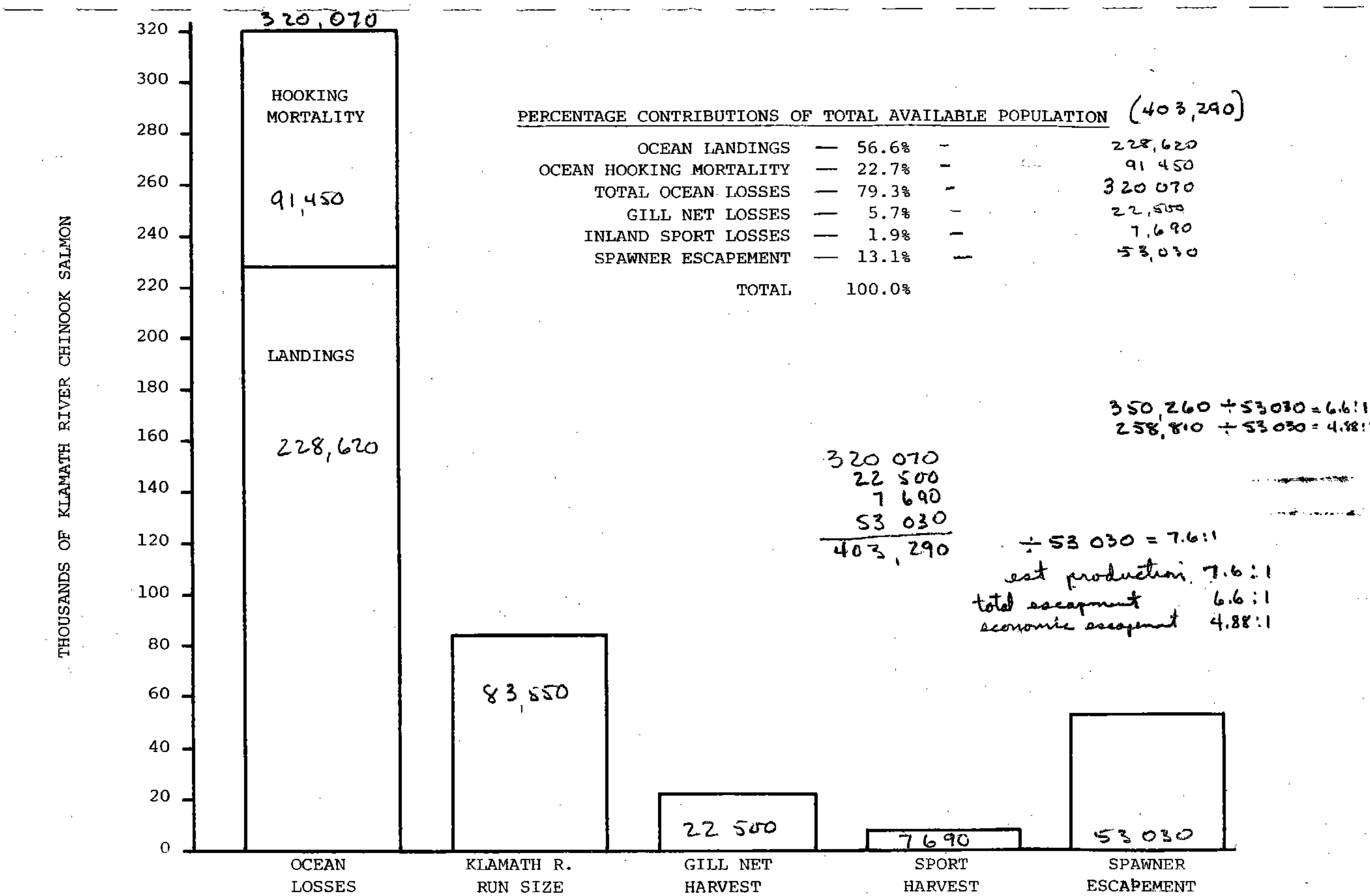


FIGURE 35. Estimated mean annual contributions of Klamath River chinook salmon (adults and grilse combined during the 1979, 1980, and 1981 seasons) to the ocean, inland sport, and Indian gill net fisheries (contributions to the ocean and Indian fisheries include spring and fall chinook, but run size, spawner escapement, and sport catch levels apply to fall chinook only).

Fisheries and habitat-related impacts on wild stocks of Klamath River chinook salmon are discussed at length in previous papers (USFWS 1981a; Rankel 1980), and Adair (1981a) presents an overview of spawner escapement goal formulation in the basin. Despite an apparent continuing overharvest problem, the majority of fall chinook spawner escapement in the basin in 1981 was comprised of naturally-reproducing fish (approximately 90 and 86% of spawner escapement in the Klamath and Trinity river portions of the drainage, respectively). It appears reasonable to assume that the Klamath River basin, in conjunction with other North Coast California river systems, result in the production of more wild chinook than drainages along any other section of the Continental United States, with the possible exception of the Columbia River system. Clearly, the option to preserve and enhance native populations still exists.

COHO SALMON AND STEELHEAD TROUT INVESTIGATIONS

ABSTRACT

Coho salmon and fall steelhead trout remain relatively unimportant to the Indian gill net fishery on the Hoopa Valley Reservation. Although targeted on by some Indian fishers, coho salmon enter the Klamath River during the latter part of and after the fall chinook run, when many fishers have curtailed fishing activity for the season. Fall steelhead are seldom targeted on, and we consider the small net harvest that does occur incidental to the chinook salmon fishery.

Based on 1,400 contacts with Indian fishers during the months of September and October, we estimate a reservation-wide net harvest of 1,650 coho in 1981, with grilse comprising 10% of the catch. Adipose fin-clipped coho comprised 33% of the observed harvest, and 76 CWT's representing nine release groups were recovered. Coho returning in their third year (1978 Brood) represented 93% of the estimated harvest of tagged groups.

Reservation-wide net harvest of fall steelhead in 1981 approximated 700 fish, with "half-pounders" comprising 25% of the harvest. The highest monthly catch occurred in August from the Estuary Area.

COHO SALMON AND STEELHEAD TROUT INVESTIGATIONS

INTRODUCTION

The 1981 coho salmon and fall steelhead trout runs in the Klamath River were monitored through the previously described net harvest monitoring program. Relatively few coho and steelhead were sampled through beach seining, and such data is excluded from this report. Although a targeted species for some Indian fishers, coho salmon remain relatively unimportant to the net fishery, because they begin entering the river during the latter part of the fall chinook run — a time when many Indian fishers have curtailed fishing activity for the season. Primarily because of the concurrent run of relatively large fall chinook, fall steelhead are seldom targeted on, and we consider the small net harvest that does occur incidental to the chinook salmon fishery.

METHODS

Methods utilized in collecting and treating net harvest and CWT return data involving coho salmon and steelhead trout are the same as described for chinook salmon in previous sections of this report.

RESULTS AND DISCUSSION

Coho Salmon

Coho salmon began entering the net fishery in September, and were caught through October, with peak harvesting occurring during the first half of October. Based on 1,400 contacts during this 2-month period, we estimate a reservation-wide net harvest of 1,650 coho, with grilse ($<$ 54 cm) comprising 10.0% of the catch.

In the tidewater fisheries, coho were taken over a 5-week period in September and early October, with catch per net-night values ranging from 0.1 to 4.5. An estimated 700 coho, including approximately 40 grilse, were harvested in the Estuary and Resighinni areas, these fisheries accounting for a respective 25 and 18% of the reservation-wide harvest (Table 19).

Coho salmon harvest was highest in the Upper Klamath Area, comprising approximately 500 fish, including 50 grilse, and representing 31.0% of the reservation-wide harvest (Table 19). Harvest in this area occurred during a 6-week period extending from September 16 to October 27, and peaked during the week ending October 13. During this period, catch per net-night values ranged from 0.2 to 2.0, and averaged 1.2 coho.

Coho salmon harvest in the Trinity Area (approximately 400) occurred during a 5-week period extending from September 23 to October 27, with weekly catch per net-night values ranging from 0.1 to 1.3. Grilse comprised 16.2% of the estimated catch.

TABLE 19. Semi-monthly harvest estimates of coho salmon captured in the 1981 Indian gill net fishery on the Hoopa Valley Reservation.

Time Period		Reservation Monitoring Area: Estuary	Resighinni	Upper Klamath	Trinity	Semi-Monthly Total	Cumulative Total
Sep.	1-15	86	3	0	0	89	89
	16-30	322	97	51	8	478	567
Oct.	1-15	---	201	257	285	743	1,310
	16-27	---	0	198	125	323	1,633
TOTAL		408	301	506	418	1,633	
PERCENTAGE		25.0	18.4	31.0	25.6	100.0	

Comparisons of length-frequency distributions of coho salmon netted in the four areas reveal that smaller adults were caught in the Estuary Area fishery (Figure 36). The mean length of adults captured in the Estuary Area (68.7 cm) was significantly smaller (t-test; $P<0.05$) than adults harvested in either the Resighinni or Trinity areas (71.5 cm). Percentages of grilse comprising net harvest in the four areas increased from 5.3 and 6.1% in the tidewater fisheries to 10.6 and 16.2% in the Upper Klamath and Trinity areas, respectively.

Adult coho harvested in the 1981 net fishery, both in the lower Klamath River and reservation-wide, did not differ significantly ($P>0.05$) in size from adults harvested in the lower river in 1980 (Figure 37).

Adipose fin-clipped coho comprised 33% of the observed harvest — 34% of the combined Klamath River harvest, and 32% of the Trinity Area catch. Fin-clipped adults and grilse (with mean lengths of 71.2 and 46.2 cm, respectively) did not differ significantly ($P>0.05$) in size from non-clipped fish.

Of 76 CWT's recovered from coho salmon in the 1981 Indian net fishery, all but one were obtained through our mark-sampling program. These tags represent nine release groups: five from TRH, one from IGH, and three from the Cole Rivers Hatchery in the Rogue River system (Table 20). Coho returning in their third year (1978 Brood) comprised 93% of the estimated harvest of tagged groups, with the remaining 7% representing grilse (1979 Brood). Correcting for unequal numbers of tagged fish at time of release, relative contributions of the three adult Klamath-Trinity river groups to the net fishery were comparable: 31% for CWT group 06-59-41, 29% for CWT group 06-61-53, and 26% for CWT group 06-61-54. Rogue River adult groups contributed to a lesser extent: 12% for CWT group 07-20-02, and 3% for CWT group 07-20-01. Although returns of the IGH CWT group (06-59-41) had a larger mean length than returns from both CWT groups released from TRH (06-61-53,54), returns from only one Trinity group (06-61-53) were significantly ($P<0.05$) smaller (Table 21). Returns from one CWT group (07-20-02) released from Cole Rivers Hatchery were larger than all other groups, but significantly larger ($P<0.05$) than only one TRH CWT group (06-61-53).

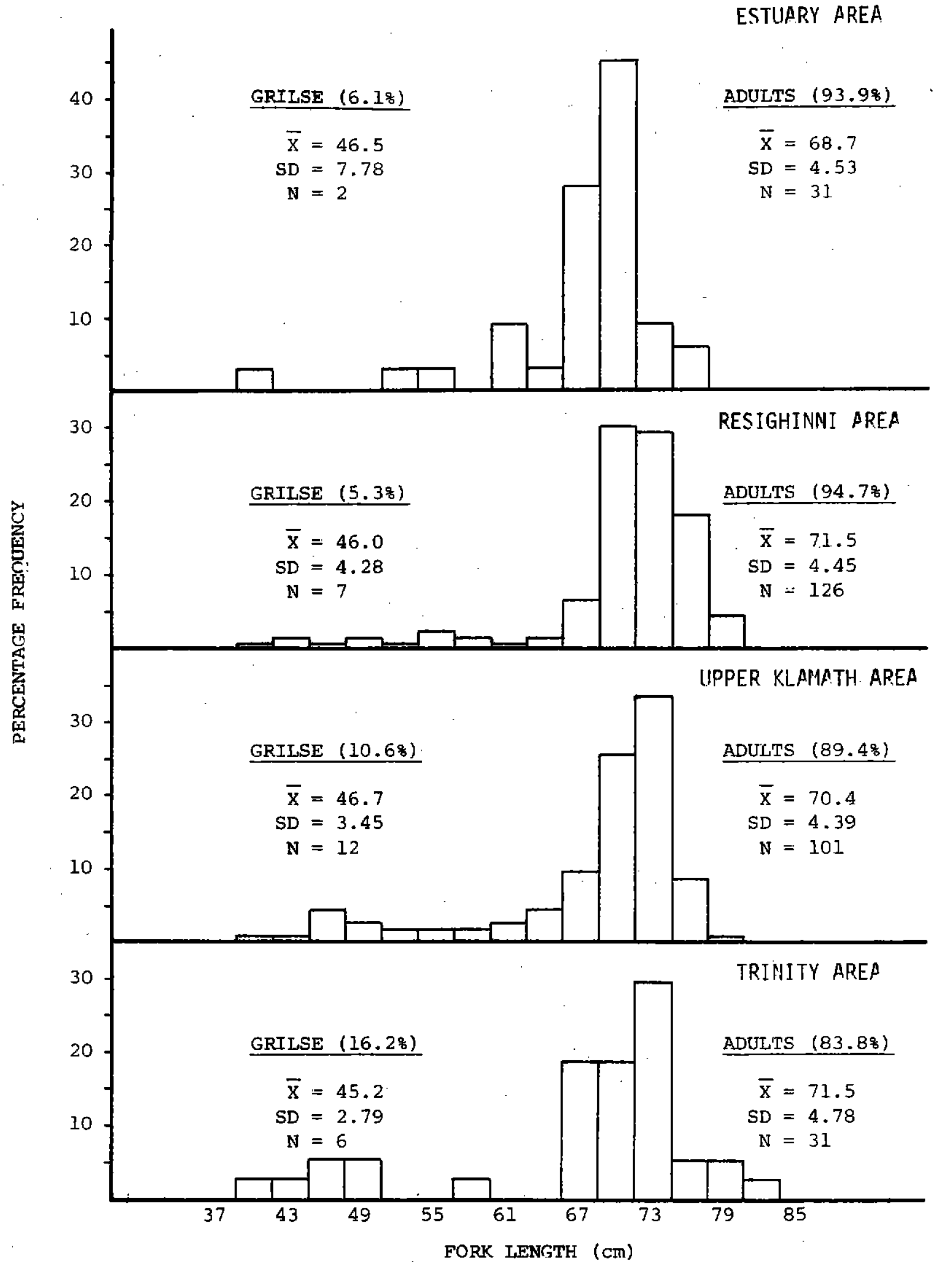


FIGURE 36. Length-frequency distributions of coho salmon caught by Indian gill netters in the four monitoring areas of the Hoopa Valley Reservation in 1981.

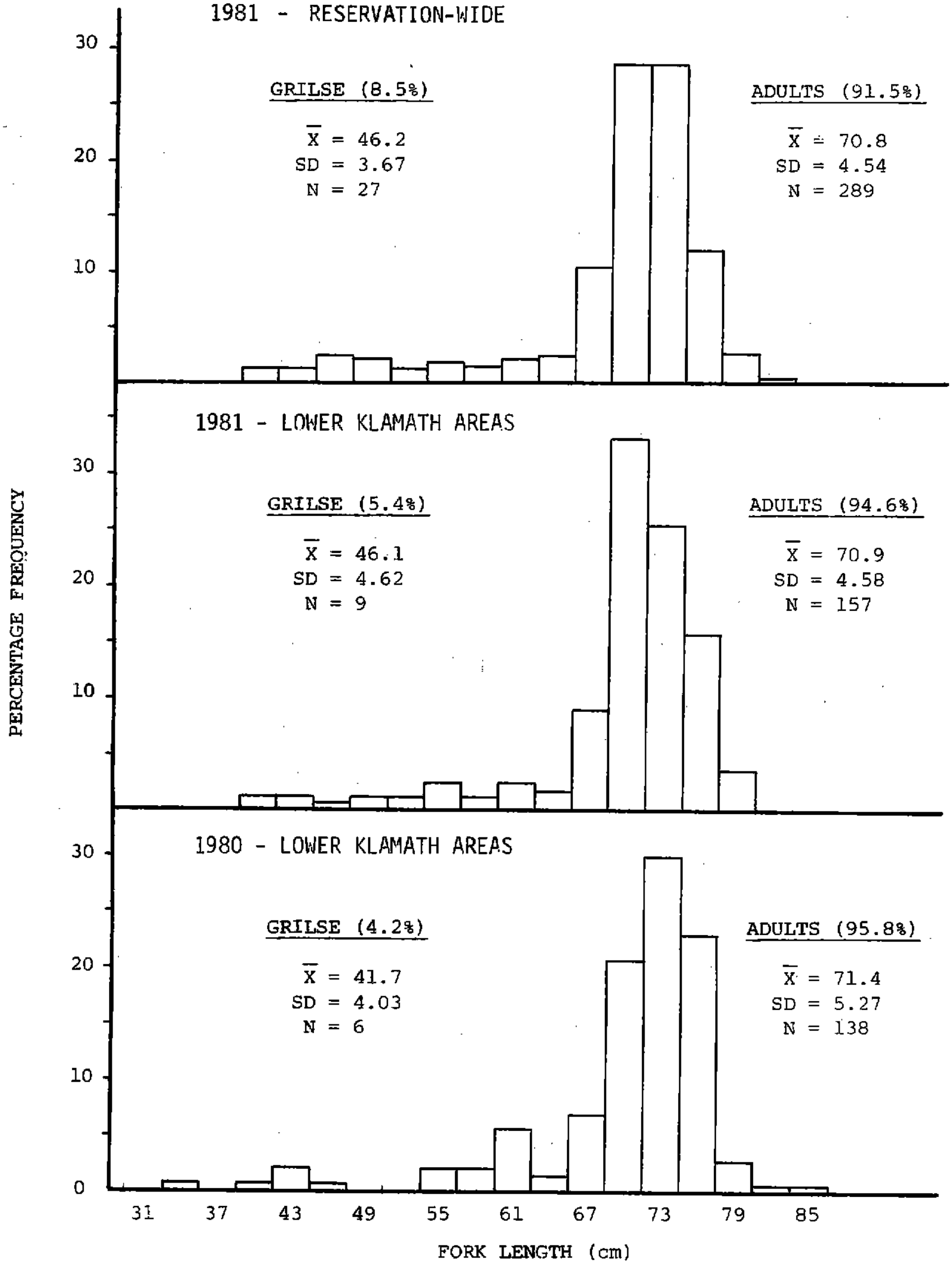


FIGURE 37. Length-frequency distributions of coho salmon caught by Indian gill netters from Lower Klamath areas of the Hoopa Valley Reservation in 1980 and 1981, and reservation-wide in 1981.

TABLE 20. Actual and expanded (in parentheses) CWT group recoveries of coho salmon in the 1981 gill net fishery on the Hoopa Valley Reservation.

Tag Code	Brood Year	Hatchery[1/] Of Origin	Reservation Monitoring Area Estuary	Resighinni	Upper Klamath	Trinity	All Areas
06-61-53	1978	TRH	70 (6)	33 (10)	61 (12)	43 (4)	207 (32)
06-59-41	1978	IGH	18 (2)	41 (8)	52 (12)	0 (0)	111 (22)
06-61-54	1978	TRH	18 (2)	2 (1)	21 (3)	11 (1)	52 (7)
07-20-02	1978	CRH	0 (0)	6 (1)	18 (5)	0 (0)	24 (6)
07-20-01	1978	CRH	0 (0)	6 (1)	0 (0)	0 (0)	6 (1)
06-61-59	1979	TRH	9 (1)	4 (1)	0 (0)	0 (0)	13 (2)
06-61-55	1979	TRH	0 (0)	6 (1)	3 (1)	0 (0)	9 (2)
06-61-57	1979	TRH	0 (0)	4 (1)	3 (1)	0 (0)	7 (2)
07-23-27	1979	CRH	0 (0)	0 (0)	3 (1)	0 (0)	3 (1)
TOTALS			115 (11)	102 (24)	161 (35)	54 (5)	432 (75)

1/ All fish released as yearlings during March, April, and May from:

CRH - Cole Rivers Hatchery
TRH - Trinity River Hatchery
IGH - Iron Gate Hatchery

TABLE 21. Mean fork lengths of nine coho salmon CWT groups netted on the Hoopa Valley Reservation in 1981.

Tag Code	Brood Year	Hatchery of Origin 1/	Mean FL (SD)	Sample Size
06-59-41	1978	IGH	71.8 (3.05)	22
06-61-53	1978	TRH	70.0 (3.26)	34
06-61-54	1978	TRH	71.2 (2.40)	6
07-20-02	1978	CRH	74.3 (2.94)	6
07-20-01	1978	CRH	72.0	1
06-61-59	1979	TRH	46.0 (8.49)	2
06-61-55	1979	TRH	44.3 (2.52)	3
06-61-57	1979	TRH	47.5 (2.12)	2
07-23-27	1979	TRH	50.0	1

1/ IGH - Iron Gate Hatchery; TRH - Trinity River Hatchery; CRH - Cole Rivers Hatchery

Fall Steelhead Trout

Fall steelhead were captured in the net fishery from July to October, with the highest monthly catch occurring in August. Reservation-wide net harvest of fall steelhead for the year approximated 700 fish, with "half-pounders" (< 40 cm) comprising 25.0% of the catch. The Estuary Area fishery accounted for 36.4% of the steelhead harvest, followed by fisheries of the Upper Klamath (30.3%), Resighinni (22.5%), and Trinity (10.8%) areas (Table 22). The proportion of "half-pounders" in the harvest was highest in the Upper Klamath Area, where 48.8% of the catch consisted of the early-returning immature fish. "Half-pounders" represented 12.4, 16.7, and 22.2% of the respective steelhead harvests in the Estuary, Resighinni, and Trinity areas.

TABLE 22. Semi-monthly harvest estimates of fall steelhead captured in the 1981 Indian gill net fishery on the Hoopa Valley Reservation.

Time Period		Reservation Monitoring Area				Semi-Monthly Total	Cumulative Total
		Estuary	Resighinni	Upper Klamath	Trinity		
Jul	1-15	6	---	---	--	6	6
	16-31	22	---	---	--	22	28
Aug	1-15	70	35	16	--	121	149
	16-31	106	44	82	--	232	381
Sep	1-15	44	27	50	7	128	509
	16-30	13	33	52	20	118	627
Oct	1-15	---	22	7	40	69	696
	16-31	---	---	10	10	20	716
TOTAL		261	161	217	77	716	
PERCENTAGE		36.4	22.5	30.3	10.8	100.0	

Based on relatively small sample sizes, the mean length of adult steelhead harvested in the three Klamath River fisheries decreased from downriver to upriver areas (Figure 38). Adults harvested in the Estuary Area were significantly larger ($P < 0.05$) than adults caught in either the Resighinni or Upper Klamath areas. Although not significant ($P > 0.05$), adult steelhead sampled in the Resighinni Area were larger than adults netted in the Upper Klamath Area. Mean length comparisons involving adult and "half-pounder" steelhead captured in 1980 and 1981 reveal no significant size differences ($P > 0.05$) between the respective groups (Figure 39).

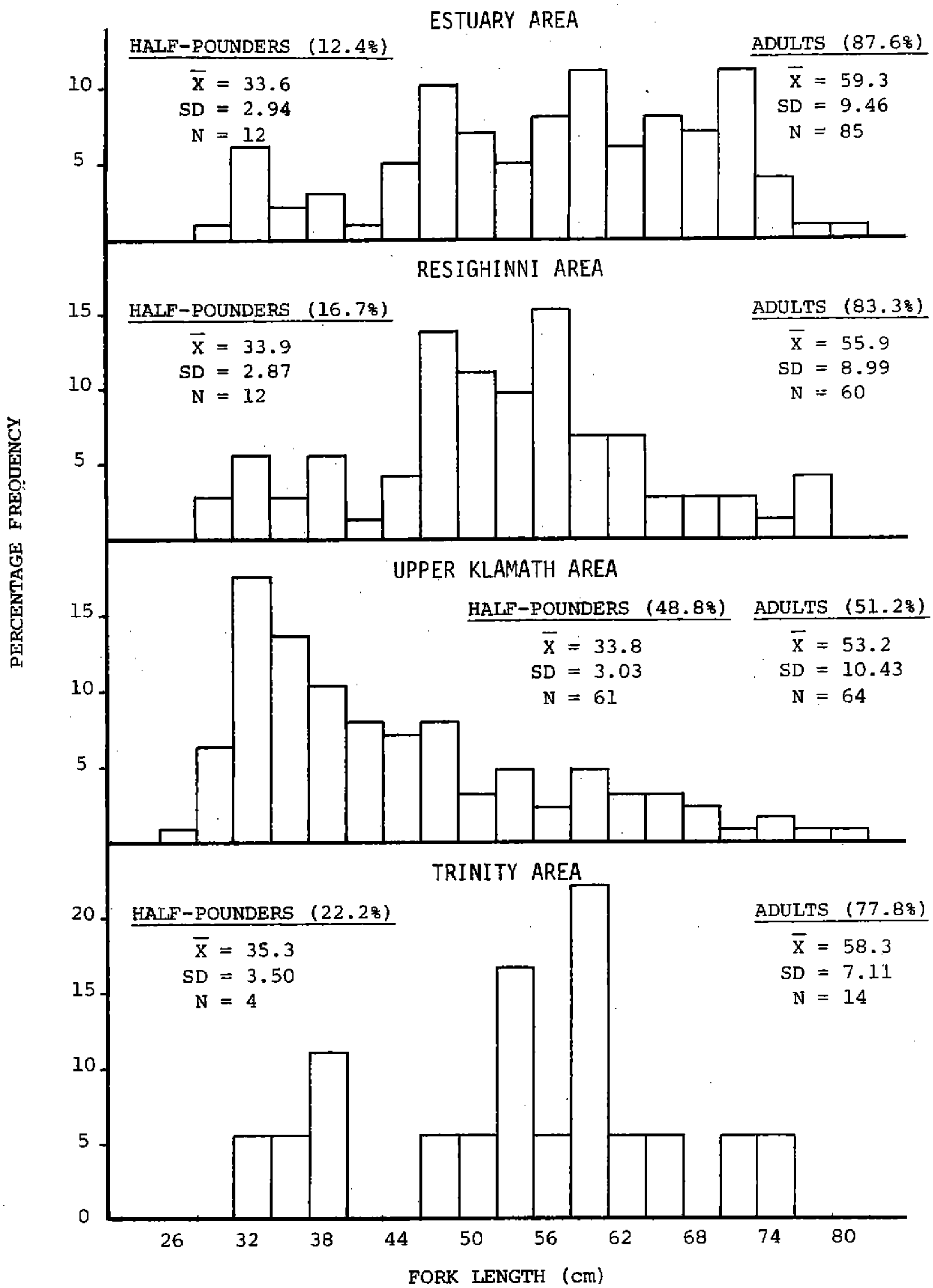


FIGURE 38. Length-frequency distributions of fall steelhead caught by Indian gill netters in the four monitoring areas of the Hoopa Valley Reservation in 1981.

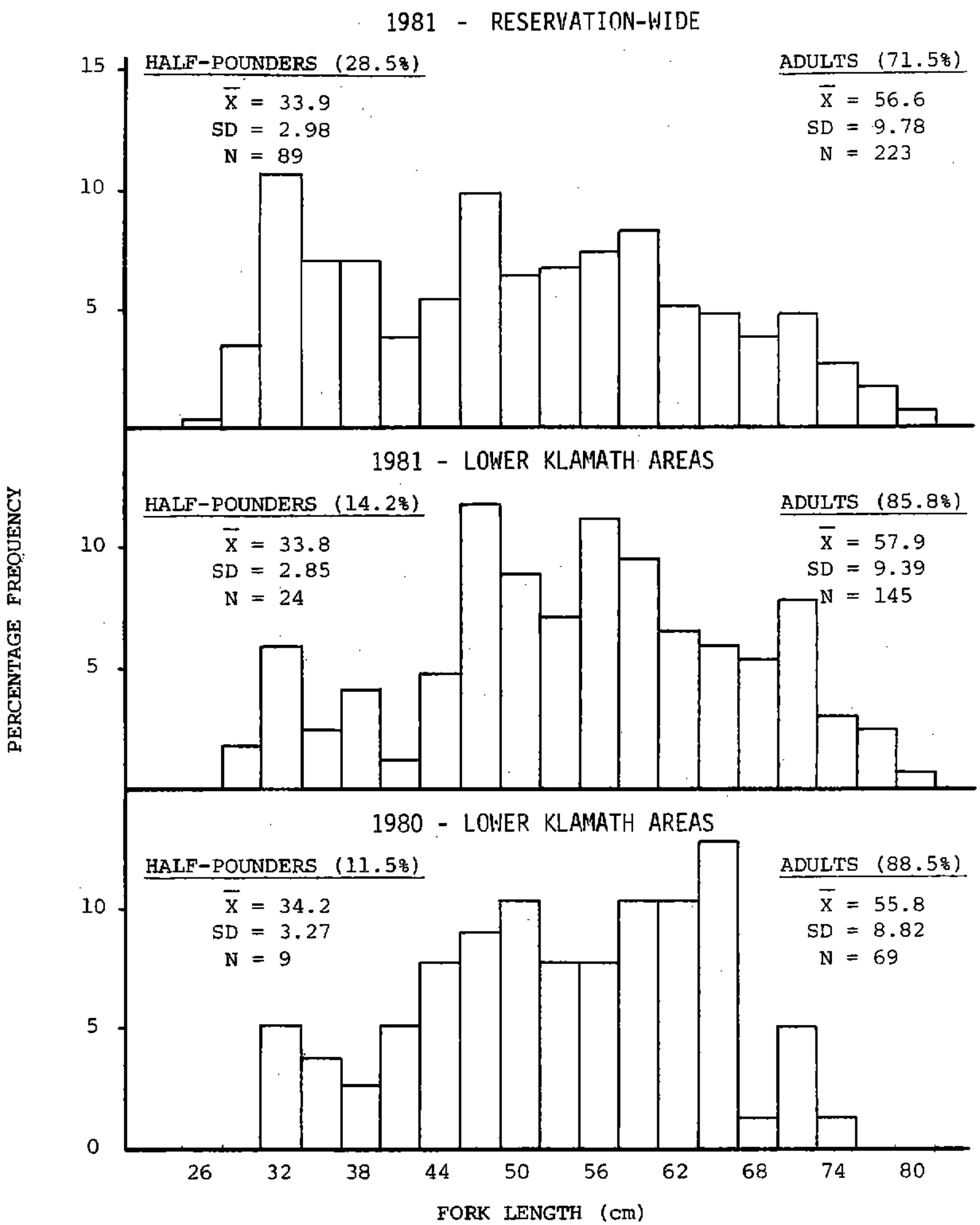


FIGURE 39. Length-frequency distributions of fall steelhead caught by Indian gill netters from Lower Klamath areas of the Hoopa Valley Reservation in 1980 and 1981, and reservation-wide in 1981.

STURGEON INVESTIGATIONS

ABSTRACT

An estimated 15 white and 905 green sturgeon were harvested on the Hoopa Valley Reservation in 1981, all but 70 (caught through illegal snagging activity) of which were taken by gill net. Peak green sturgeon spawning movement occurred in April, and, as in 1980, females were larger in size and less numerous than males in the run. Preliminary analyses of 85 pectoral fin ray sections collected in 1980 indicate that most green sturgeon migrate seaward by their second summer, and first enter the spawning population at 16 years of age or older. Few appear to exceed 35 years of age.

PLATE 14. Adult green sturgeon harvested on the Hoopa Valley Reservation.

STURGEON INVESTIGATIONS

INTRODUCTION

Little information has been available regarding the abundance, harvest, and life history of green and white sturgeon of the Klamath River basin. A sturgeon investigation program initiated in 1979 to gather baseline data was continued in 1981, and a plan outlining a more comprehensive effort was prepared during the year (Adair 1981*b*). During the course of our investigation, it has become clear that few white sturgeon utilize the basin, only ten having been encountered during the last 3 years. However, the green sturgeon population appears to be one of the largest occurring in Pacific North American drainages. Historical information indicates that green sturgeon have long outnumbered white sturgeon in the drainage (Gilbert 1897; Snyder 1908, 1924; Everman and Clark 1931).

METHODS

The majority of green sturgeon sampled in 1981 occurred through the net harvest monitoring program, conducted from April through October. Although many of the sturgeon observed were captured incidentally to net fisheries focusing on spring and fall chinook, several Indian fishers targeted on sturgeon during the spring spawning migration. Sampling efforts during this period were directed toward maximizing the number of sturgeon observed. Green sturgeon were also sampled in 1981 through beach seining in the lower 5 km of the Klamath River.

Green sturgeon net harvest estimates were derived through expansions of sampled catch-effort data (numbers of nets and fishers, and catches per net) obtained through net harvest monitoring efforts. As was the case in 1980, illegal snagging activity for sturgeon appeared concentrated in a stretch of the Klamath River located directly below the mouth of Coon Creek (River Kilometer 58). We observed fishing activity in this area on 20 dates between April 11 and June 9, 1981, and derived harvest approximations through expansions of our catch and effort data observations.

Sturgeon were identified to species by lateral scute count, measured, weighed, and examined for distinguishing marks or tags. Whenever possible, sex and sexual maturity condition were noted, stomach contents were examined, and gonadal weights were recorded. Egg subsamples were taken to provide fecundity information, and sections from the proximal ends of lead rays of pectoral fins were excised for use in age analysis. Disc-dangler tags were applied immediately anterior to the dorsal fins of all adult, and each juvenile measuring over 35 cm in total length, captured and released through beach seining.

RESULTS AND DISCUSSION

Harvest

An estimated 15 white and 905 green sturgeon were harvested on the Hoopa Valley Reservation in 1981, all but 70 green sturgeon being accounted for through the Indian gill net fishery (Table 23). Of the estimated five adult and ten juvenile white sturgeon harvested, all were taken by gill net in the lower 6 km of the Klamath River, leading us to speculate that some of these individuals were coastal migrants originating from other river systems. Such behavior has been documented for green and white sturgeon through mark-recapture studies (Fry 1973; Miller 1972; Moyle 1976).

TABLE 23. Harvest estimates involving green and white sturgeon caught on the Hoopa Valley Reservation in 1981.

FISHERY AND MONITORING AREA		HARVEST PERIOD, SPECIES, AND RUN COMPONENT											
		April-July				August-October				Season			
		White		Green		White		Green		White		Green	
		Juv	Adult	Juv	Adult	Juv	Adult	Juv	Adult	Juv	Adult	Juv	Adult
Gill Net	Estuary	5	0	10	150	5	3	15	20	10	3	25	170
	Resighinni	0	0	0	200	0	2	0	70	0	2	0	270
	Upper Klamath	0	0	0	200	0	0	0	70	0	0	0	270
	Trinity	0	0	0	100	0	0	0	0	0	0	0	100
Snag	All Areas	0	0	0	50	0	0	0	20	0	0	0	70
TOTAL		5	0	10	700	5	5	15	180	10	5	25	880

An estimated 810 adult green sturgeon were netted on the reservation, with the harvest of upstream migrants apparently outnumbering that of downstream migrant post-spawners. This exceeds, considerably, the 1980 net harvest estimate of 300 adults. Many post-spawners were taken in the lower 6 km of the Klamath River incidentally to the fall chinook and coho salmon fisheries in August, September, and October. An estimated 25 juvenile green sturgeon were netted on the Klamath River in 1981 — all taken from the estuary. Perhaps, as was speculated for white sturgeon, some of these individuals were coastal migrants originating from other river systems.

The illegal snag fishery accounted for approximately 70 adult green sturgeon in 1981, down considerably from the estimated 400 of 1980. As has been the case since 1978, most of the snag harvest occurred from a pool located directly below the mouth of Coon Creek at River Kilometer 58. Intensified law enforcement efforts by the BIA, coupled with a more protracted and dispersed spawning run, appear to have substantially reduced the effectiveness of the 1981 snag fishery.

The illegal snag harvest of sturgeon below Coon Creek Falls has been a problem since a debris slide created the fish migration obstacle in 1977. Since the spring of 1980, when the magnitude of the snagging problem became apparent, we have recommended that the obstacle be removed. On May 7, 1981, FAO-Arcata biologists accompanied BIA and CDFG personnel to the site to determine the feasibility of removing the obstacle, at which time all agreed it should be eliminated through blasting. Upon receiving the required clearances for the work, blasting of the in-river obstacle occurred during the last week in August through a cooperative effort involving the three agencies (Plate 15). We will re-examine the area after winter flows recede to determine if further blasting or other treatment of the problem area is required.

FAO-Arcata biologists observed no legal hook and line harvest of sturgeon on the reservation in 1981, but did observe anglers legally catching sturgeon at Bluff Creek (River Kilometer 78) in October. The extent of the legal hook and line fishery for sturgeon in the basin is unknown.

Population Characteristics

Catch-effort data involving gill nets fished between River Kilometers 45 and 50 on the Klamath River in 1980 and 1981 indicate that the 1981 green sturgeon spawning run began and peaked earlier than the 1980 run (Figure 40). We observed spawned-out individuals as early as April 9, and near-ripe females as late as August 9, 1981. As in 1980, the majority of the downstream post-spawning migration appeared complete by early October. Significant (*F*-tests; $P < 0.05$) percentage occurrence linear regressions of spawned-out individuals sampled in the net fishery through time indicate that green sturgeon spawning activity in the basin commenced about May 8, and continued for a period of 158 days in 1980, whereas spawning in 1981 began about April 5, and extended over a 151-day period (Figure 41). Because of delays between spawning and occurrence of spawned-out fish in our sample, spawning may have occurred somewhat earlier than indicated.

In 1981, as in 1980, female green sturgeon were less numerous and larger than males in the known sex sample. In both years, mean length differences between the sexes were significant ($P < 0.05$) by t-test for sample means and by chi-square analysis for frequency classes (Figure 42). With regard to all adults sampled (males, females, and sex unknown), no significant difference ($P > 0.05$) in mean length was found between years, but a significant difference ($P < 0.05$) in frequency classes existed, apparently due to a predominance of males in 1980 (Figure 43). Linear interpolation of mean length data from known sex and total samples yield male/female ratio estimates of 1.7:1 and 1.1:1 in 1980 and 1981, respectively. Female green sturgeon sampled in 1980 and 1981 ranged between 33.6 and 61.2 kg in weight, and averaged 45.0 kg; males ranged between 15.0 and 58.1 kg, and averaged 28.4 kg (Table 24). Fecundity estimates ranged from 51,000 to 224,000, and averaged 127,500 (Table 24). All of 24 adult green sturgeon stomachs examined in 1980 and 1981 were empty.

Fork lengths and total lengths of 217 green sturgeon were recorded in 1980 and 1981, with the geometric mean functional relationship (Ricker 1973) calculated as:

$$\text{Total Length} = 0.858 + 1.079 \text{ Fork Length } (R^2 = 0.99)$$

Separate geometric mean functional length-weight regressions (Ricker 1973) were computed for 70 juvenile, 40 adult male, and 28 adult female green sturgeon in spawning condition, sampled in 1980 and 1981 (Figure 44).

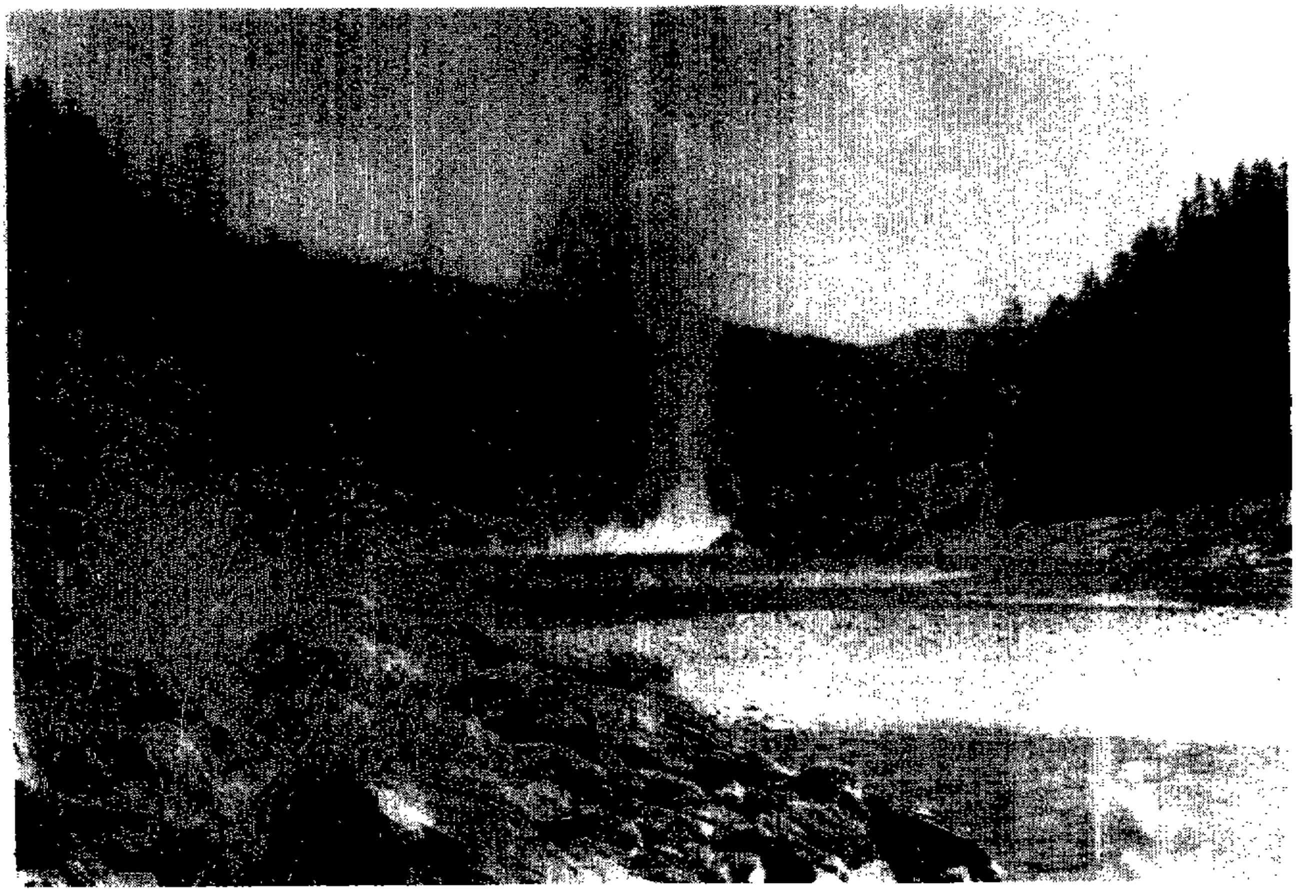


PLATE 15. Blasting operations at Coon Creek Falls on the Klamath River in August, 1981.

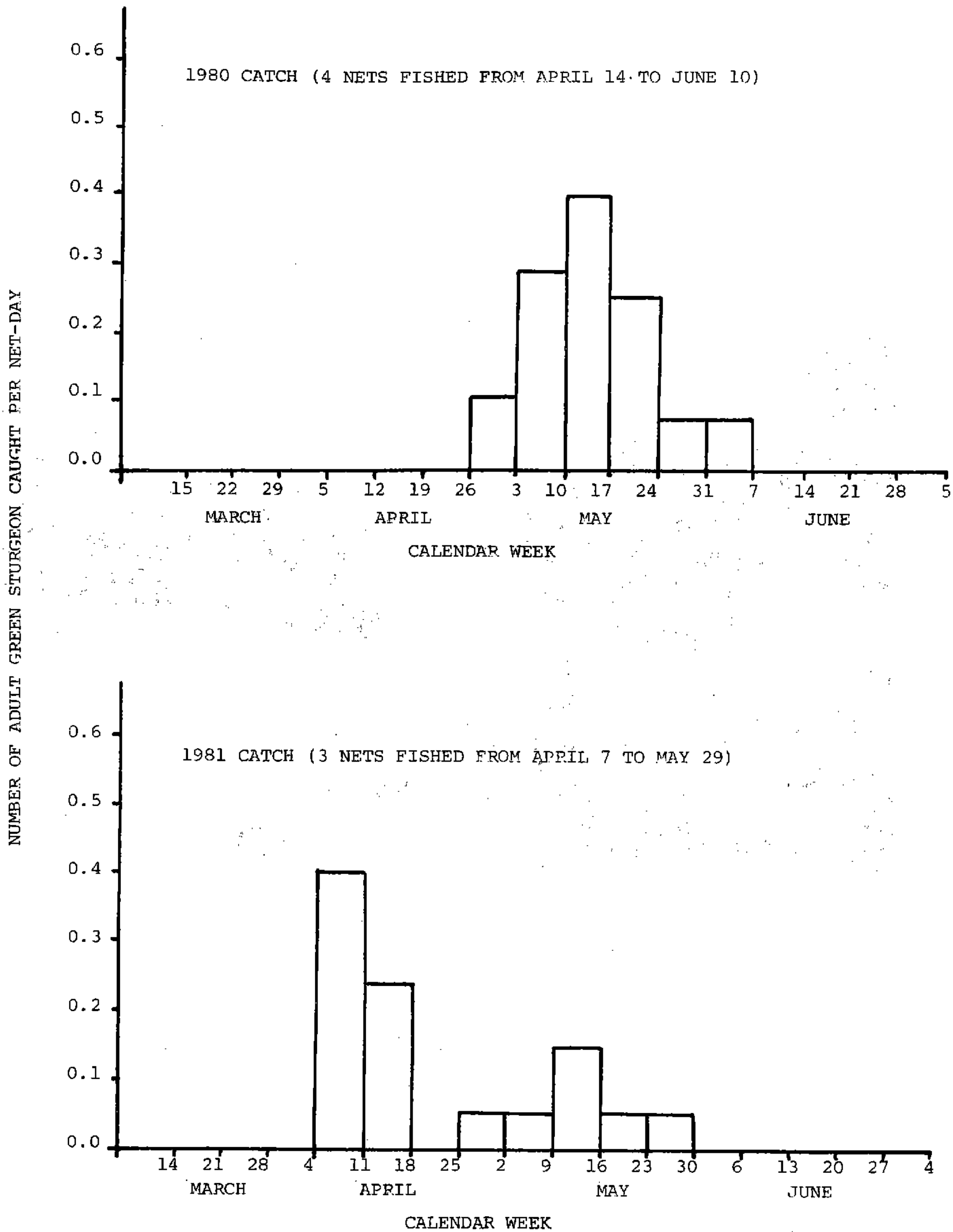


FIGURE 40. Catch per net-day of adult green sturgeon, by gill nets fished between Klamath River Kilometers 45 and 50 during the 1980 and 1981 spawning migration.

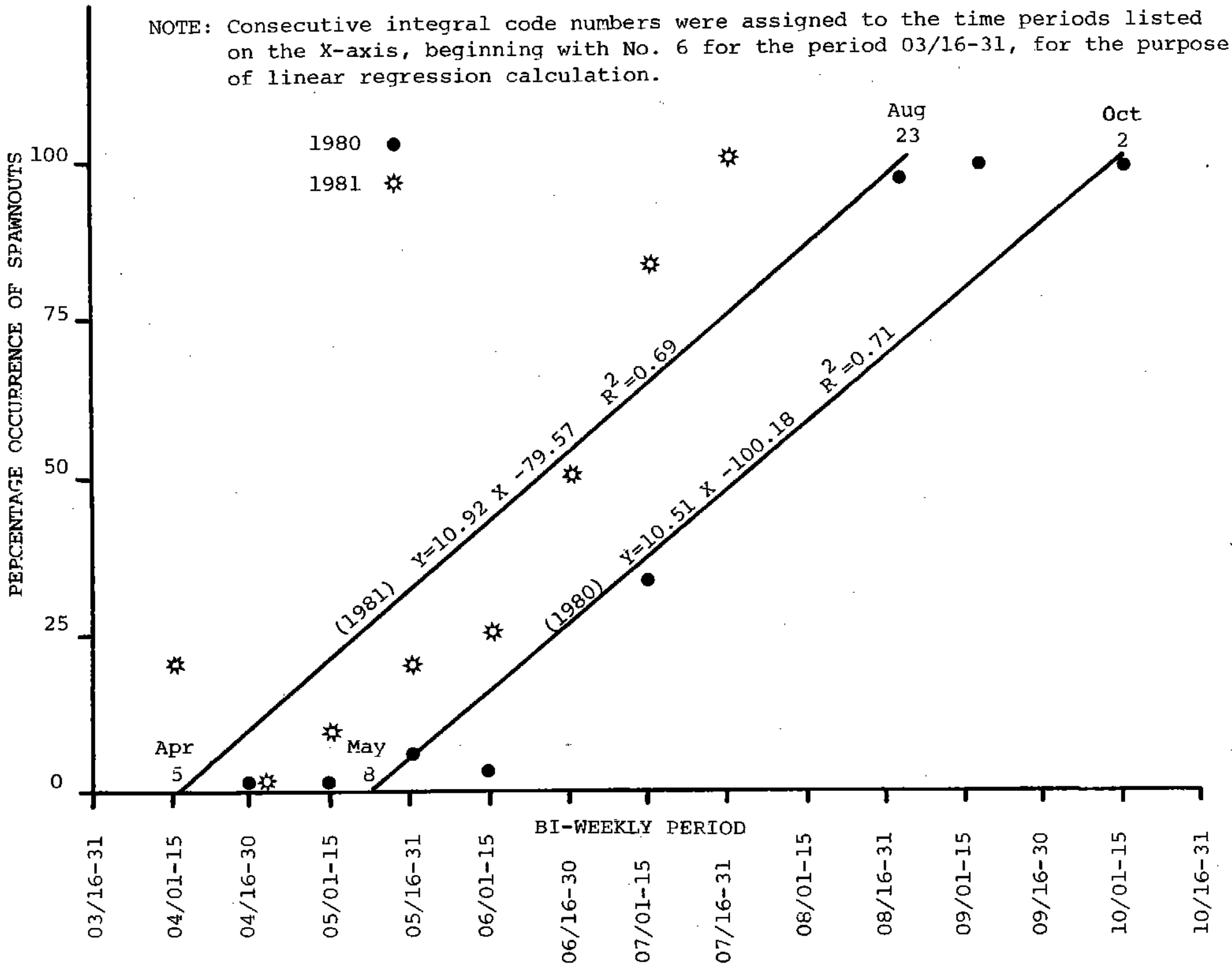


FIGURE 41. Linear regressions of percentage occurrence of spawned out green sturgeon through time in the 1980 and 1981 gill net and hook and line fisheries on the Hoopa Valley Reservation.

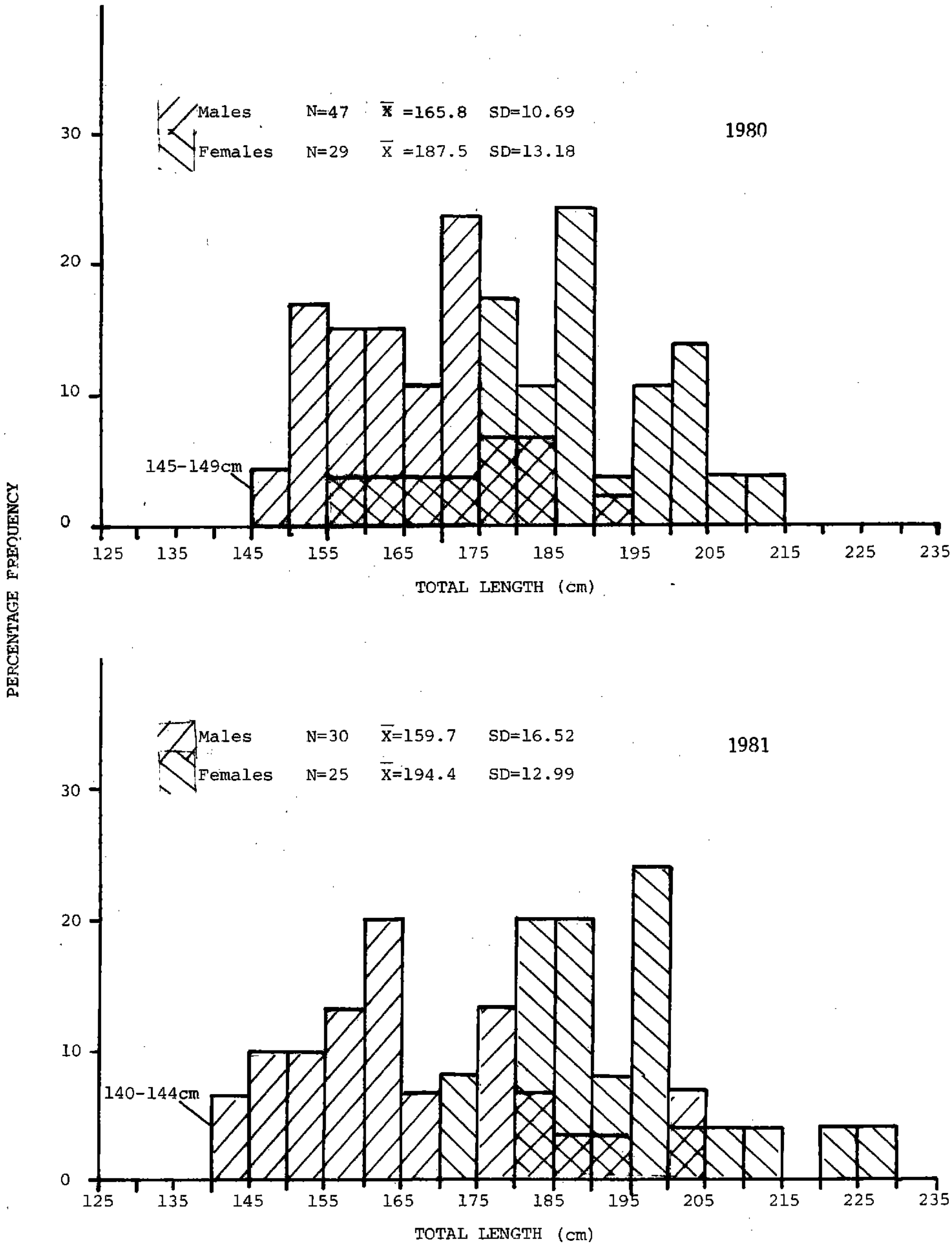


FIGURE 42. Length-frequency distributions of Klamath River male and female green sturgeon captured by gill net and hook and line in 1980 and 1981.

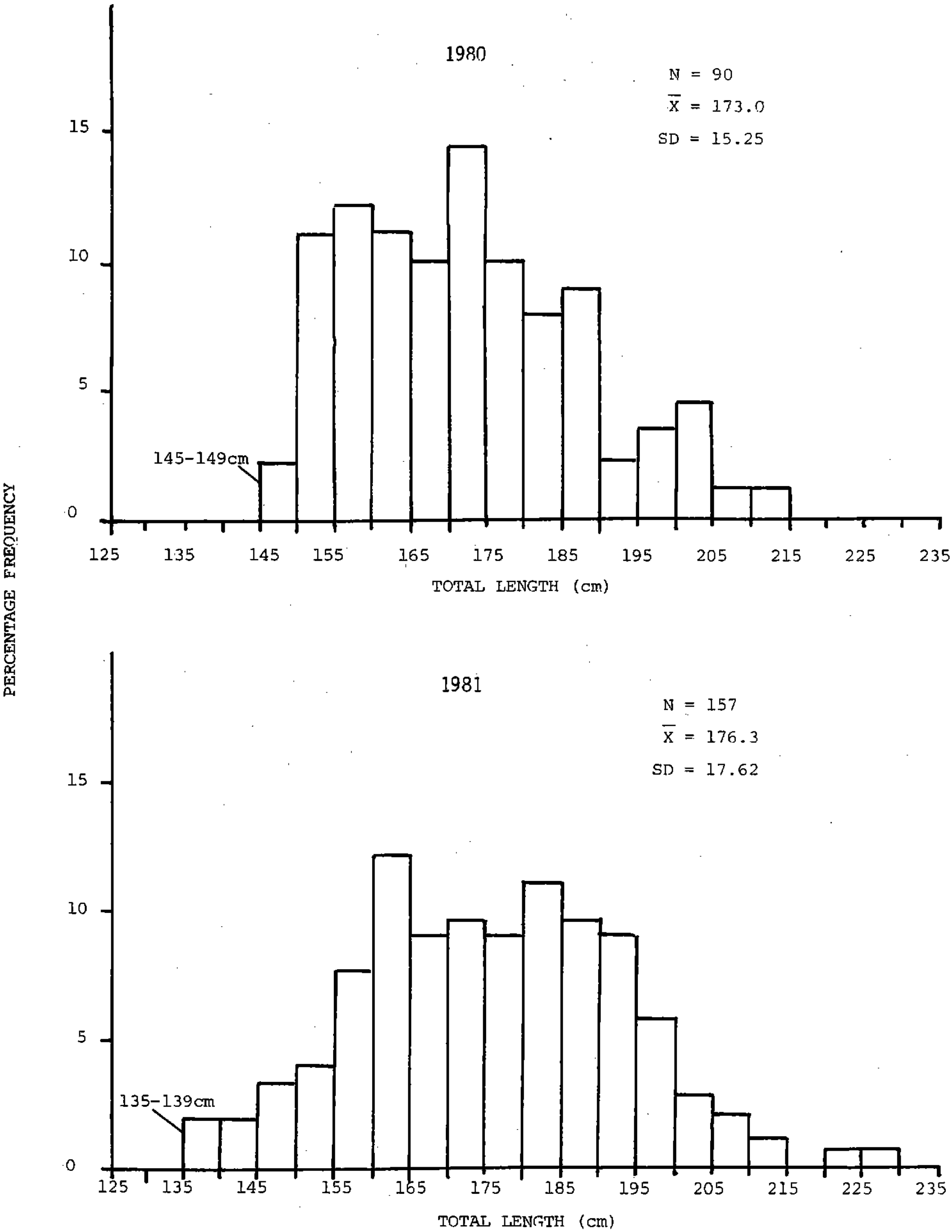


FIGURE 43. Length-frequency distributions of Klamath River adult green sturgeon captured by gill net, beach seine and hook and line in 1980 and 1981.

TABLE 24. Length, weight, sex ratio, and fecundity characteristics of Klamath River green sturgeon sampled in 1980 and 1981.

CHARACTERISTIC	YEAR AND SEX					
	1980			1981		
	Males	Females	Total	Males	Females	Total
Total Length						
Range, cm	148-195	160-211	148-211	143-201	172-228	138-288[1]
Mean, cm	165.3	187.0	173.3	159.7	194.4	176.3
Round Weight						
Range, kg	17.7-40.8	34.0-61.2	17.6-61.2	15.0-58.1	33.6-59.9	15.0-59.9
Mean, kg	28.3	45.0		28.5	45.0	
Gonadal Material						
Weight Range, kg	0.9-1.6	3.2-5.0		0.5-2.6	3.9-8.2	
Mean Weight, kg	1.248	4.083		1.304	6.218	
% Total Body Weight	4.4	10.4		4.6	13.3	
Fecundity[2]						
Range, Eggs/gram gonadal weight					17.8-23.0	
Mean, Eggs/gram gonadal weight					21.3	
Range, Eggs/Female					50,850-223,810	
Mean, Eggs/Female					127,500	
Sex Ratio[3]			1.71:1			1.10:1

1/ Total differs from data by sex, as sex was not discerned for all fish.

2/ Total counts estimated from subsamples as described in text. Ranges theoretical.

3/ Sex ratio interpolated from length data as described in text.

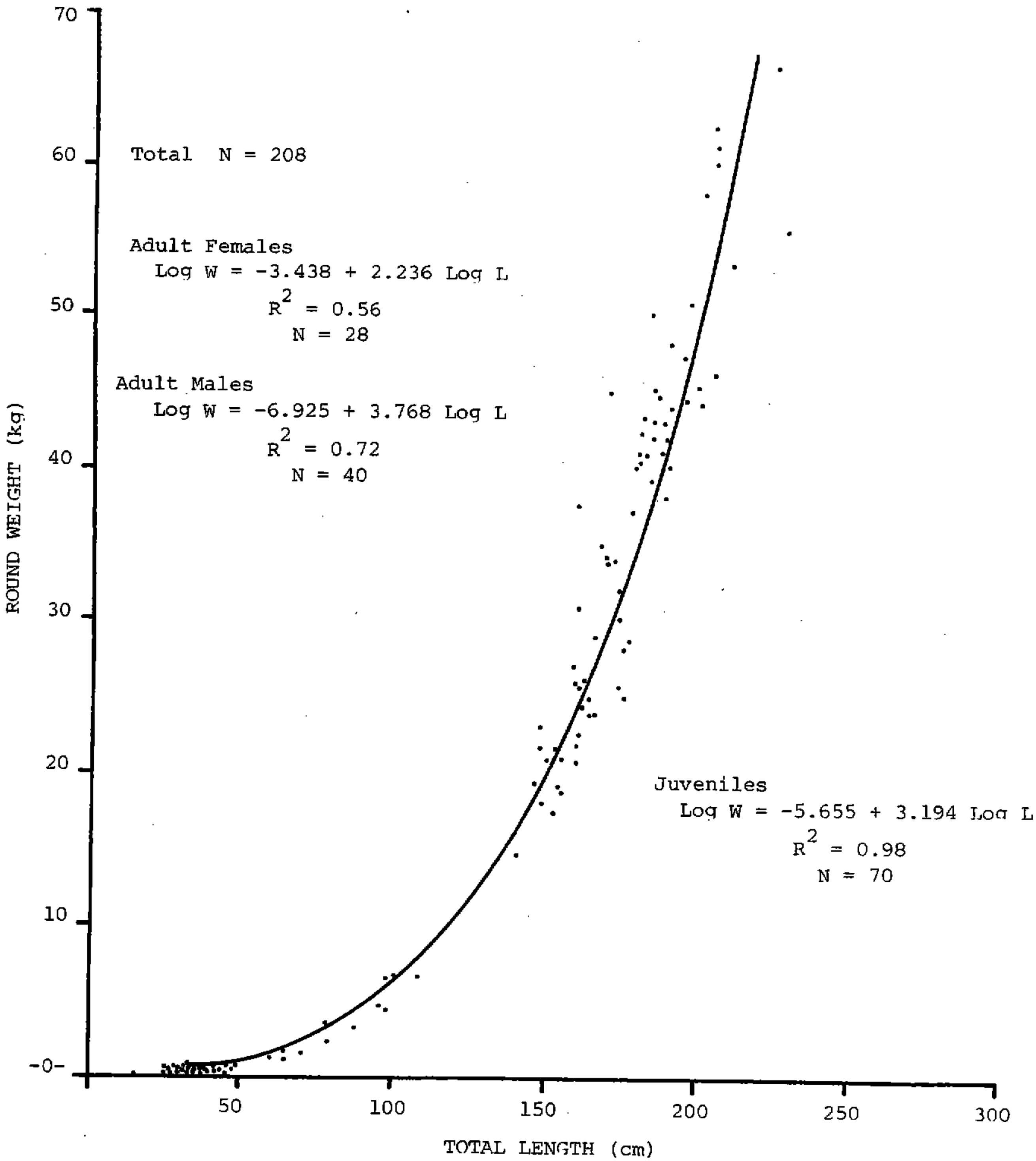


FIGURE 44. General length-weight relationship for Klamath River green sturgeon captured during 1980 and 1981.

Information is lacking on green sturgeon spawning behavior, egg incubation, and hatching in the Klamath River basin. As in previous years, individuals measuring approximately 10 to 20 cm in length were observed in upriver areas during the summer. Downstream migration of yearling and young-of-the-year green sturgeon apparently occurs between June and September (Healy 1970; USFWS 1981a). Juvenile green sturgeon out-migrants (Plate 16) captured by CDFG biologists in a beach seining operation on the lower Klamath River in September, 1981, measured between 15 and 42 cm in total length (Figure 45). Although these individuals were primarily yearlings, the 5.7 cm stretched-mesh seine utilized may not have effectively sampled young-of-the-year fish, and the ratio of yearlings to young-of-the-year in annual out-migrations remains unknown. Fyke net sampling at key locations could provide additional information on annual juvenile green sturgeon out-migrations in the basin.

Length-frequency data compiled on 457 green sturgeon sampled in the Klamath River basin since 1979 reveal that spawners measuring between 140 and 230 cm, and juveniles less than 40 cm in total length have predominated (Figure 46). Individuals measuring between 40 and 140 cm have been observed infrequently, and then, only in the lower 3 km of the river. To our knowledge, biologists have not observed green sturgeon in the 112 to 138 cm size range in the basin. It is not clear if the absence of individuals in this size range indicates a scarcity of certain year class abundance or whether juveniles of this size, in the final process of gonadal maturation before spawning, do not enter the freshwater environment. Tagging data collected in recent decades suggest that the coastal migratory range of juvenile green sturgeon may be extensive, and that these fish may migrate in composite groups of similar-sized individuals (Roedel 1941; Norris 1957; Miller 1972; USFWS 1981a). Juvenile green sturgeon ranging from 31 to 111 cm in total length have been collected in the Klamath River estuary through beach seining since 1979 (Figure 47). During this period, the mean size of fish sampled increased significantly ($P < 0.05$) from 52.8 to 90.5 cm. If this increase represents growth of a particularly strong year class (or year classes), we may see juvenile green sturgeon in the 112 to 138 cm size range in the Klamath River in 1982.

To date, pectoral fin ray sections have been collected from 160 green sturgeon for age analysis. Of 75 sections obtained in 1981, 66 have not yet been analyzed, and results from 85 sections collected in 1980 are preliminary. Positive determination of age has been difficult, especially for older individuals, and measurements for back calculations of growth appear unlikely. The 94 fin ray sections (Plate 17) examined to date appear to represent individuals ranging from 0+ to 37 years of age. Juveniles appear to average 31 cm total length by their second summer, at which time most appear to have migrated to sea. Individuals appear to first enter the spawning population at approximately 16 years of age and 140 cm, although some, especially females, may mature much later. Few individuals over 35 years of age apparently occur in the spawning population, and few relatively old males have been observed. No significant difference ($P > 0.05$) has been noted in lengths at given ages between male and female green sturgeon.

Green sturgeon gill net harvest and run timing patterns in 1980 and 1981 suggest that 1981 spawner abundance was roughly comparable to, or somewhat larger than, the 1980 run. Data collected by CDFG biologists through their lower Klamath River beach seining operation indicate that juvenile out-migrant levels in 1981 may have exceeded those of the preceding 5 years.

As noted previously, population characteristics of this species remain largely undefined. Only since 1980 have harvest data been collected. Ricker (1963) states that an annual harvest rate of 5% or more on a population con-

PLATE 16. Juvenile green sturgeon out-migrant captured in the lower Klamath River in 1981.

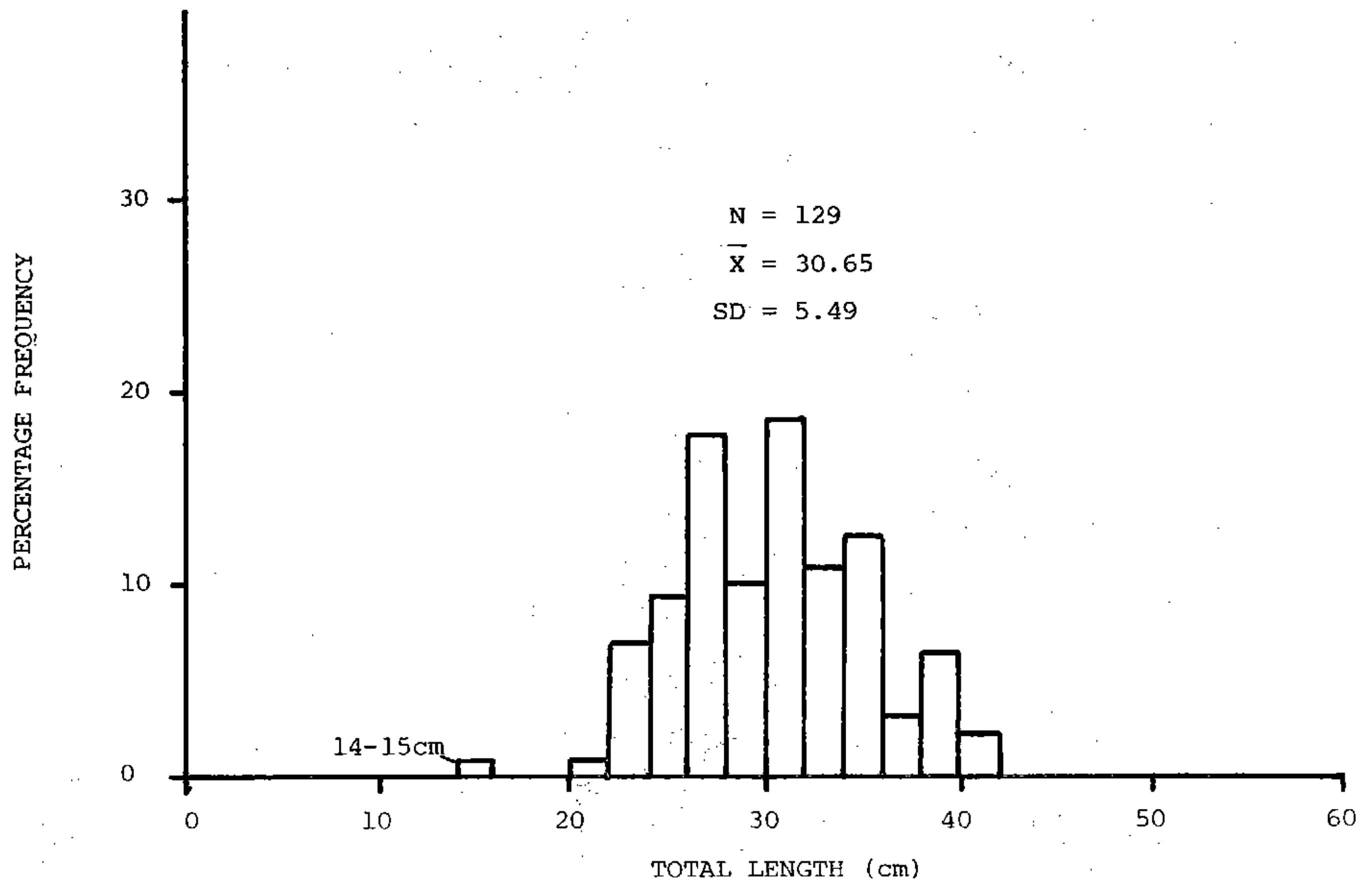


FIGURE 45. Length-frequency distribution of green sturgeon outmigrants captured during beach seining operations conducted by CDFG biologists at Klamath River Kilometer 4.5 in September, 1981.

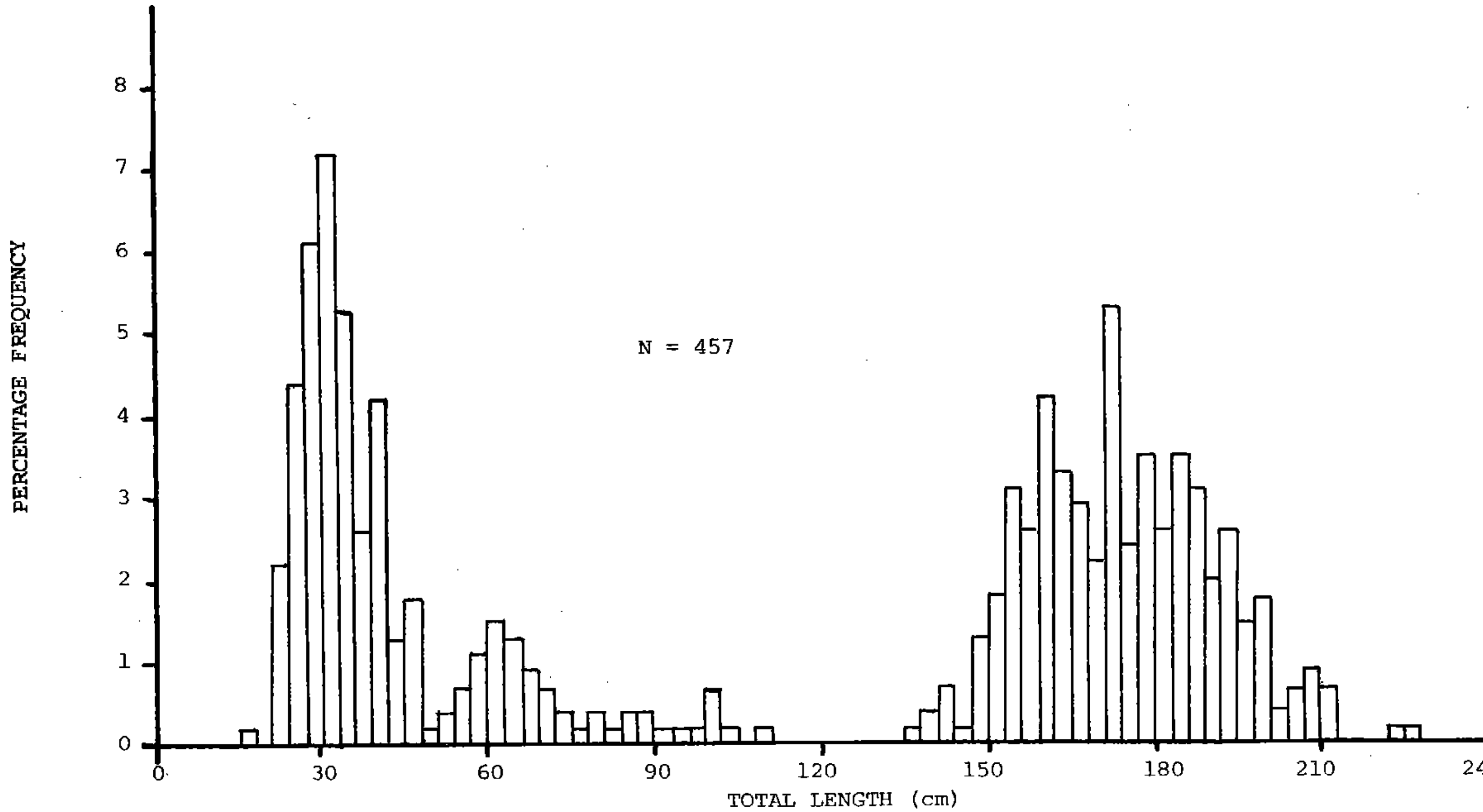


FIGURE 46. Combined length-frequency distrubution of Klamath River green sturgeon captured during 1979, 1980, and 1981 by beach seine, gill net and hook and line.

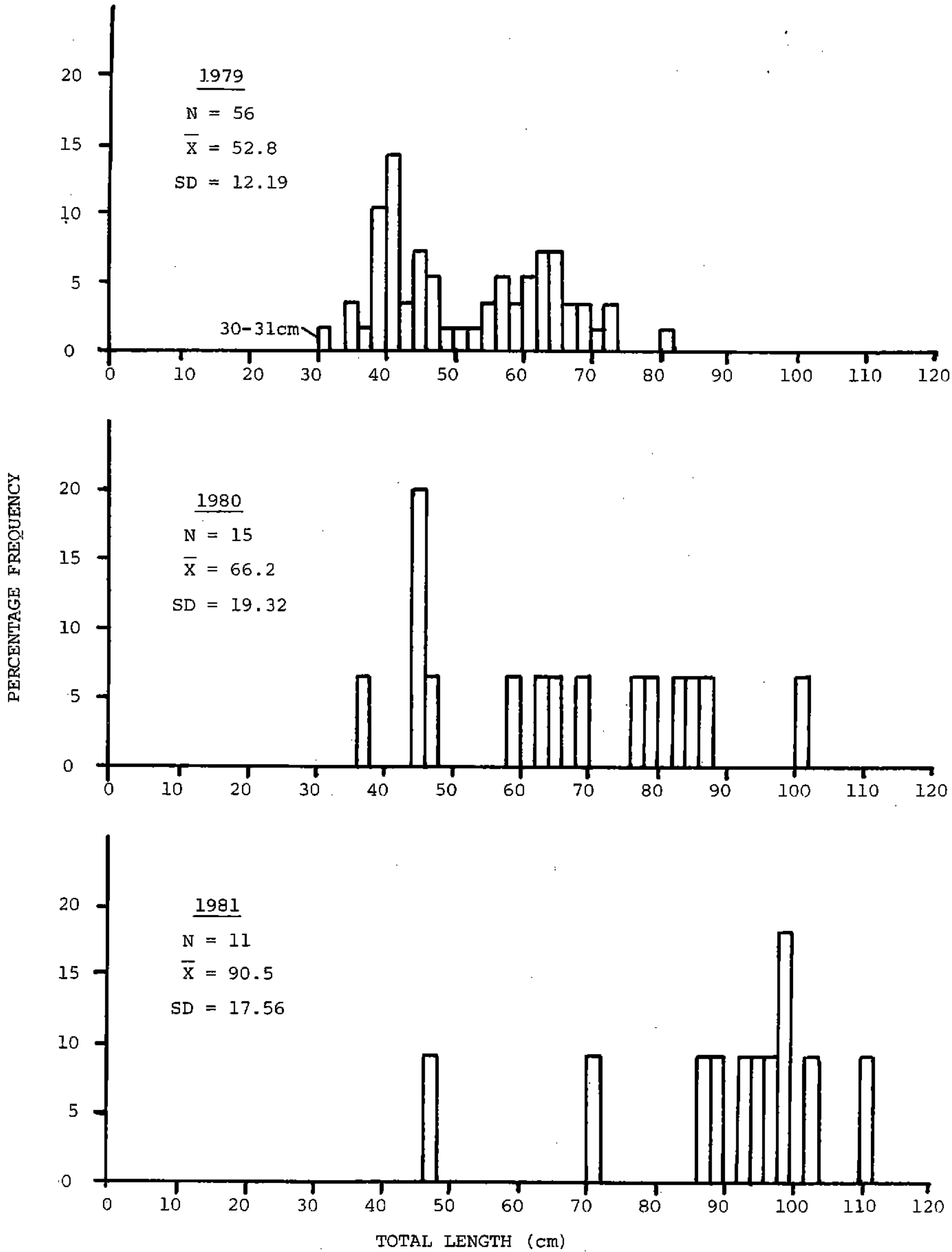


FIGURE 47. Length-frequency distributions of coastal migrant green sturgeon juveniles captured during beach seining operations in the Klamath River estuary in 1979, 1980, and 1981.

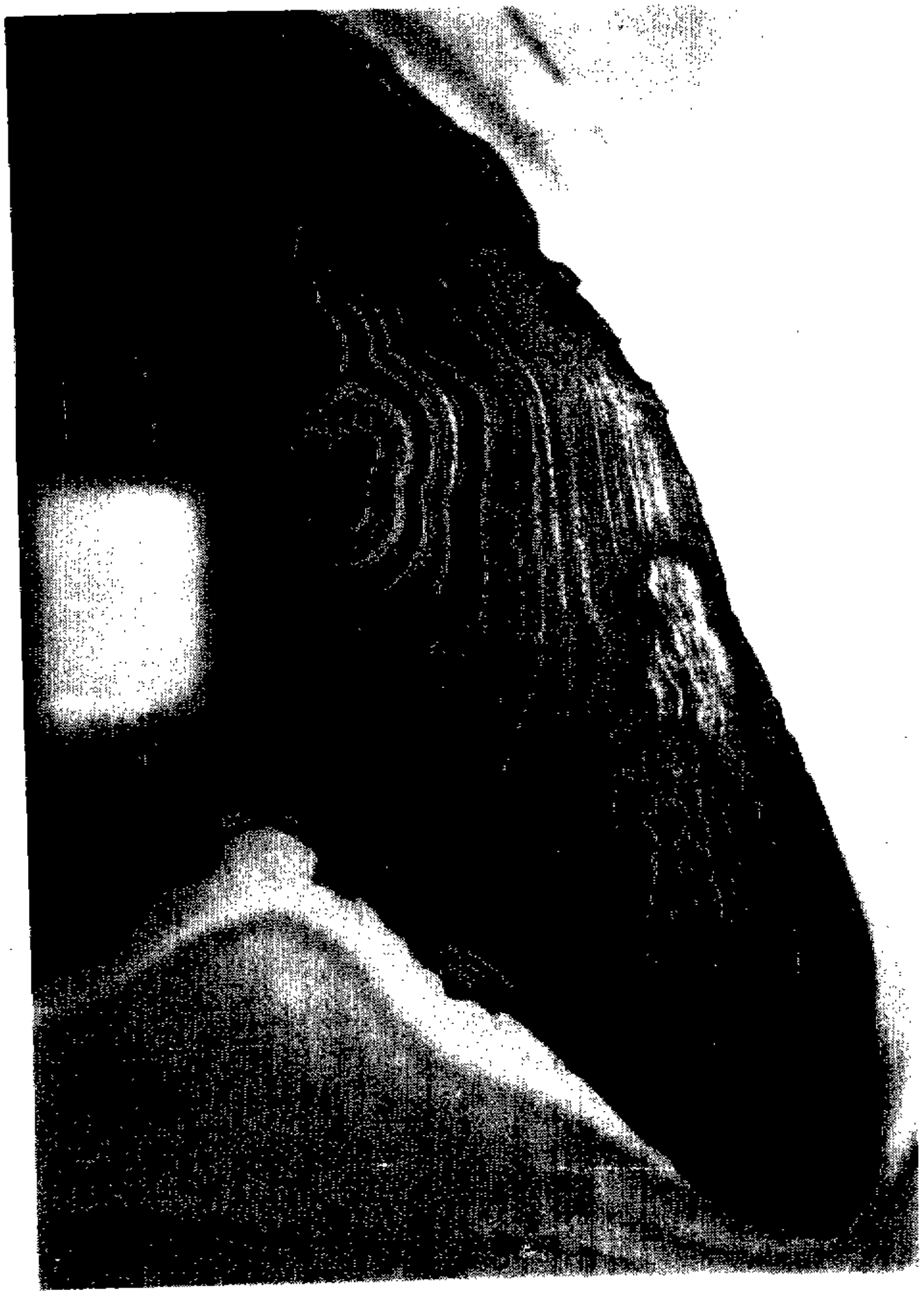


PLATE 17. Cross-section of a pectoral fin ray taken from a Klamath River green sturgeon.

sisting of 12 to 15 age groups or more may eventually cause a major reduction in total biomass and in relative biomass of older individuals. Effects become more pronounced as the number of age classes in a population increases. With regard to Klamath River green sturgeon, the older and highly fecund females are impacted most by the annual harvests. Given the estimated harvest of approximately 700 and 900 adult green sturgeon in 1980 and 1981, respectively, the total population would have to number somewhat greater than 18,000 individuals in order to escape over-harvest as defined by Ricker (1963). Data on spawning periodicity (as discussed by Roussow 1957, and others) and spawner abundance would be required to estimate the size of the total adult green sturgeon population of Klamath River origin. Sub-adult population size would be even more difficult to estimate.

JUVENILE INVESTIGATIONS

ABSTRACT

Juvenile sampling efforts in 1981 resulted in the capture of 1,808 chinook salmon, 66 steelhead trout, 33 coastal cutthroat trout, 3 coho salmon, and over 20,000 individuals representing at least 10 non-salmonid species. Individual chinook representing at least five CWT groups were sampled along with other individuals exhibiting left ventral and right ventral fin clips. A new pushnet sampling assembly (Plate 18) was constructed and tested during the year.

PLATE 18. Pushnet assembly used to sample juveniles in the lower Klamath River in 1981.

JUVENILE INVESTIGATIONS

INTRODUCTION

Through the establishment of a juvenile sampling effort in 1980, we initiated investigations to assess the migration patterns, distribution, growth, and racial composition of chinook salmon smolts in the Klamath River drainage, and to explore the potential for developing annual smolt abundance indices to utilize in predicting future run sizes. Because of the substantial manpower requirement associated with the sampling of juveniles through trawling and beach seining techniques in 1980 (USFWS 1981*a*), a more labor efficient experimental pushnet operation was developed for use in the estuary, and previously established upriver sites were not sampled in 1981.

METHODS

Four lower river sites (Figure 48) were sampled with a 30.5 m long by 1.8 m deep beach seine having a mesh size of 0.6 cm, Utilizing a river boat in setting the seine, the sites were generally sampled on a weekly basis from May 21 to August 12. We discontinued sampling at the site located above the Highway 101 Bridge after July 10 because of damage to the seine caused by underwater obstructions.

An experimental pushnet assembly (Figure 49; Plate 18), patterned after one described by Kriete and Loesch (1980), was constructed to sample pelagic portions of the estuary (Figure 48). The sites were usually sampled on a weekly basis from April 21 to September 17. Sampling was ordinarily conducted during the night at various tidal stages, with the duration of sampling runs (pushes) extending from 5 to 20 minutes and averaging approximately 7 minutes.

We identified all fish collected to species, examined most captured salmonids for fin clips, and measured fork lengths of salmonids sampled to the nearest millimeter. Some adipose fin-clipped salmonids were sacrificed for CWT identification, and scale samples were taken from various marked and unmarked individuals to evaluate life history patterns, thereby assisting in the aging of adult salmon.

RESULTS AND DISCUSSION

Of 1,808 juvenile chinook salmon captured in 1981, 1,761 resulted from 35 beach seining sets. Highest catch rates occurred in July (Figure 50), corresponding to increased abundance of hatchery-marked fish; however, because 81% of all seined chinook were caught on a single day (1,303 in a single set), the applicability of this data is very limited. Only 47 juvenile chinook were captured in 52 pushnet runs. Because the pushnet operation was effective on a number of non-salmonid species, the gear might be tested further to fully evaluate its effectiveness on salmonids.

Marked juvenile chinook salmon from hatchery release groups (Table 25) comprised approximately 13% of the mark-sampled catch. Of 47 juvenile chinook captured through the pushnet operation, two each exhibited adipose and left ventral

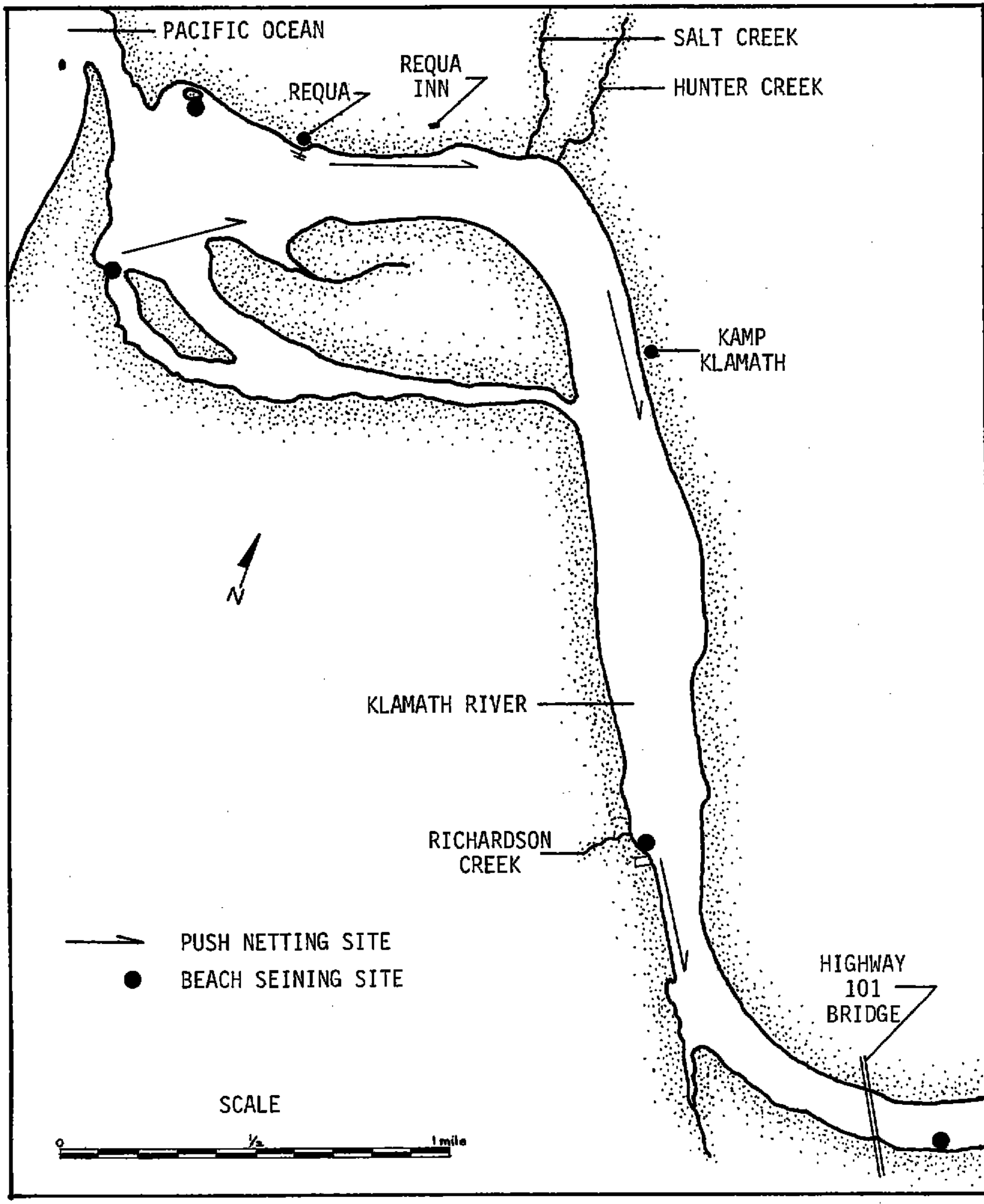


FIGURE 48. Locations of lower Klamath River beach seining and push netting sites used in 1981.

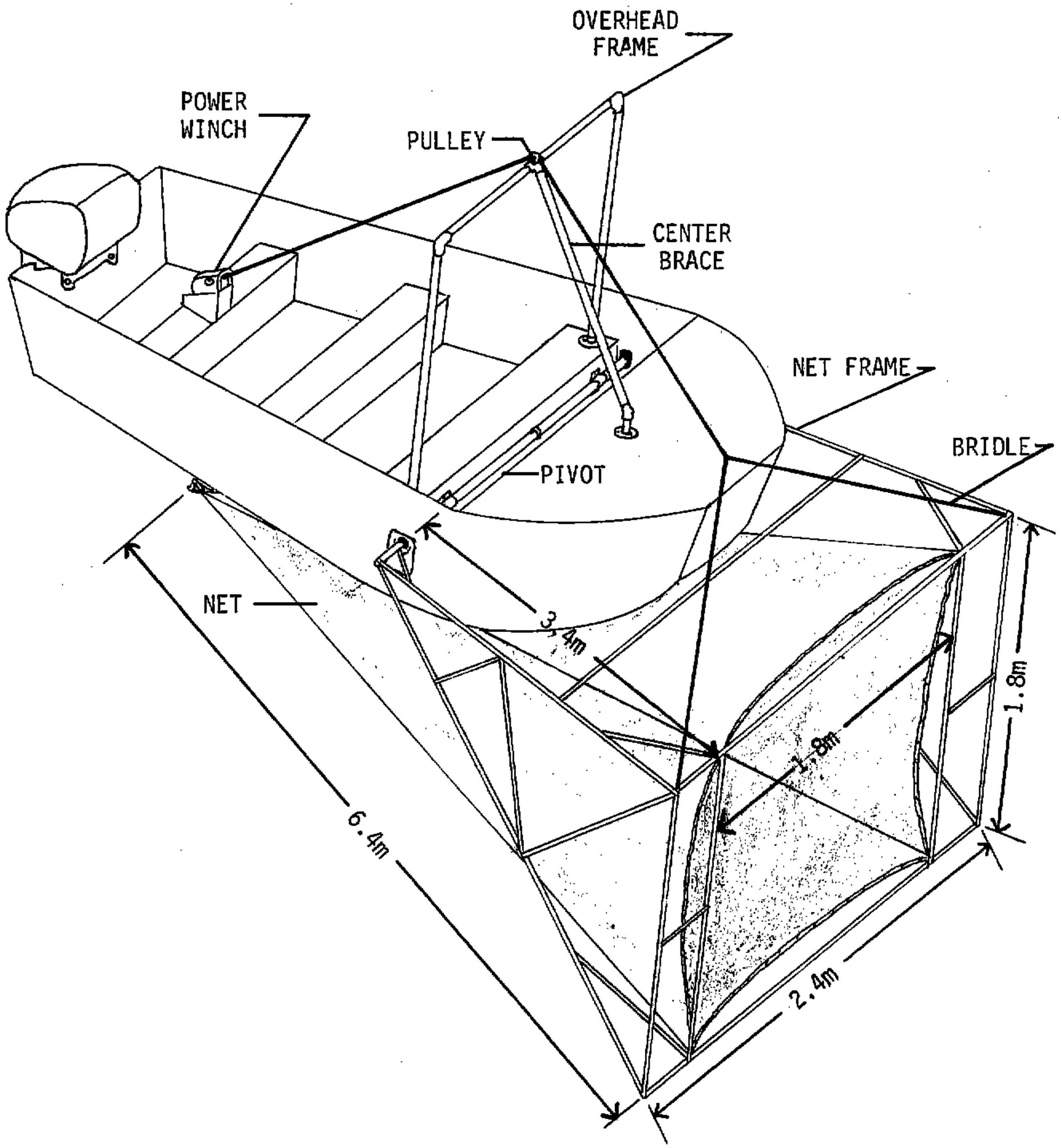


FIGURE 49. Schematic diagram of pushnet assembly used to sample juvenile salmonids in the lower Klamath River in 1981.

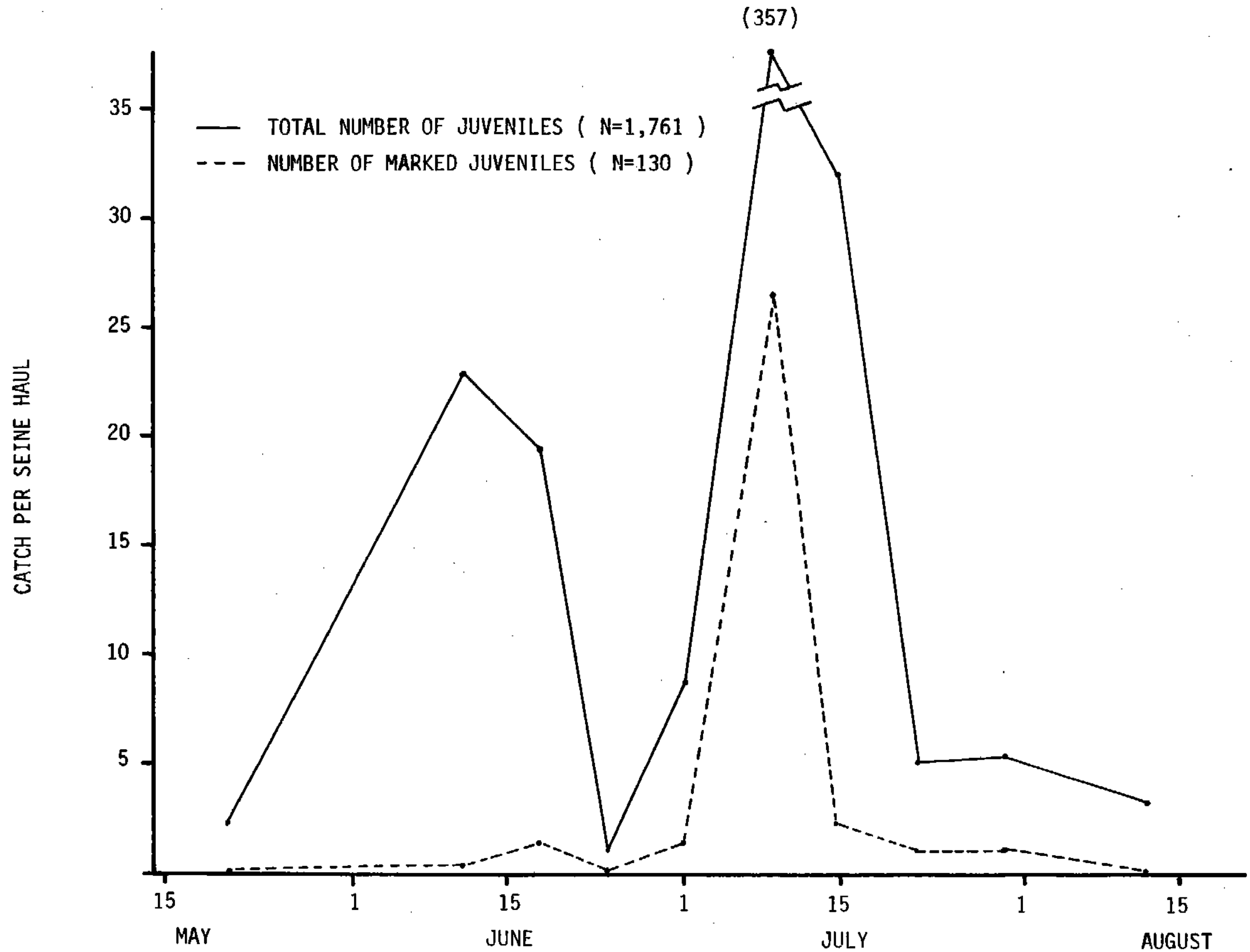


FIGURE 50. Mean catch rates of juvenile chinook salmon sampled at four beach seining sites located on the lower Klamath River in 1981.

fin clips; of 1,047 juvenile chinook mark-sampled in the beach seining catches, 6.1, 6.2, and 0.5% exhibited adipose, left ventral, and right ventral fin clips, respectively (Table 26). Of five CWT groups observed, four originated from IGH (06-59-05,12,13,16), and one (06-61-18) was of TRH origin (Table 26). All recoveries represented fingerling releases from the 1980 Brood Year. Lengths of juvenile chinook averaged approximately 73 mm in May, 94 mm in June, and 98 mm in August. No individuals larger than 112 mm were captured during the year.

Juveniles of Other Species Captured

Other salmonid species captured through the juvenile sampling program included 66 steelhead trout, 33 coastal cutthroat trout, and 3 coho salmon. One CWT was recovered from a coho (06-59-46), and no marked steelhead or cutthroat were observed.

Non-salmonid species captured through beach seining included approximately 6,500 threespine stickleback (*Gasterosteus aculeatus*), 2,300 shiner perch (*Cymatogaster aggregata*), 600 northern anchovy, 270 sculpins (*Cottus sp.*), 80 smelt (*Osmeridae*), 25 speckled dace (*Rhinichthys osculus*), 20 starry flounder (*Platichthys stellatus*), 5 American shad (*Alosa sapidissima*), and 3 suckers (*Catostomus sp.*). Through the pushnet operation, we also captured approximately 5,200 northern anchovy, 2,200 threespine stickleback, 393 shiner perch, 124 American shad, 37 sculpins, 36 smelt, 2 speckled dace, 2 suckers, and 1 Pacific lamprey (*Entosphenus tridentatus*).

TABLE 25. Juvenile fin-clipped and CWT salmon releases from IGH and TRH during the 1980-81 season (compiled from preliminary data provided by Bill Heubach, CDFG).

Brood Year	Month of Release	Species[1/] and Race	Fin[2/] Clip	CWT Code	Origin[3/]	Number Released Marked	Number Released Unmarked	Size at Release (No/kg)
1979	10-80	FCS	AD	06-61-09	TRH	90,995	353,190	33.9
1979	10-80	SCS	AD	06-61-34	TRH	86,594	174	29.9
1979	10-80	FCS	RV	--	TRH	168,344	N/A[10/]	30.8
1979	11-80	FCS	AD	06-59-02	IGH	91,000	N/A	24.2
1979	11-80	FCS	LV	--	IGH	259,274	N/A	24.2
1979	02-81	COS	AD	06-61-55	TRH	48,213	1,697	30.8
1979	02-81	COS	AD	06-59-44	IGH	24,347	N/A	59.4
1979	03-81	FCS	AD	06-61-20	TRH	82,982	13,583	16.3
1979	03-81	SCS	AD/RV	06-61-36	TRH	35,666	1,294	16.9
1979	03-81	COS	AD	06-61-56	TRH	42,299	2,557	27.7
1979	04-81	COS	AD	06-61-57	TRH	51,671	2,153	25.5
1979	04-81	COS	AD	06-59-45	IGH	23,481	N/A	37.4
1979	04-81	COS	AD	06-61-58	TRH	43,634	170,619	25.7
1979	04-81	COS	AD	06-59-46	IGH	22,705	N/A	37.4
1979	05-81	COS	AD	06-61-59	TRH	42,427	1,313	23.8
1979	05-81	COS	AD	06-59-47	IGH	23,654	N/A	35.2

CONTINUED

TABLE 25. CONTINUED

Brood Year	Month of Release	Species and Race 1/	Fin Clip 2/	CWT Code	Origin 3/	Number Released	
						Marked	Unmarked	Size at Release (No/kg)
1980	05-81	FCS	AD	06-59-15	IGH 4/	N/A	N/A	220.0
1980	06-81	FCS	AD	06-59-12	IGH 5/	N/A	N/A	220.0
1980	06-81	FCS	AD	06-61-18	TRH	201,090	3,000	189.2
1980	06-81	FCS	RV	--	TRH	409,277	845,473	223.1
1980	06-81	FCS	AD	06-59-05	IGH	185,857	N/A	162.8
1980	06-81	FCS	LV	--	IGH	264,824	N/A	198.0
1980	09-81	SCS	AD	06-61-39	TRH	34,601	527	22.2
1980	09-81	FCS	AD	06-61-21	TRH	104,160	840	37.2
1980	09-81	FCS	RV	--	TRH	287,997	578,876	29.7
1980	10-81	FCS	AD	06-59-14	IGH 6/	N/A	N/A	20.5
1980	10-81	FCS	AD	06-59-17	IGH 7/	N/A	N/A	12.5
1980	10-81	FCS	AD	06-59-06	IGH	87,450	N/A	N/A
1980	10-81	FCS	LV	--	IGH	222,296	N/A	19.8
1980	10-81	FCS	LP	--	IGH 8/	13,270	N/A	14.3
1980	10-81	FCS	LP	--	IGH 4/	13,000	N/A	14.3
1980	N/A	FCS	AD	06-59-13	IGH 8/	N/A	N/A	N/A
1980	N/A	FCS	AD	06-59-16	IGH 9/	N/A	N/A	N/A

1/ FCS - Fall chinook salmon; SCS - Spring chinook salmon; COS - Coho salmon

2/ AD - Adipose; RV - Right ventral; LV - Left ventral; LP - Left pectoral

3/ TRH - Trinity River Hatchery; IGH - Iron Gate Hatchery

4/ Camp Creek offsite release

5/ Beaver Creek offsite release

6/ Red Cap Creek offsite release

7/ Pearch Creek offsite release

8/ Thompson Creek offsite release

9/ Indian Creek offsite release

10/ Not available

TABLE 26. Recoveries of fin-clipped juvenile chinook salmon and CWT codes on the lower Klamath River in 1981.

Sampling Technique	Fin Clip[1/] or CWT Code	Number Recovered	Date of Capture[2/] First	Middle	Last	Mean Fork Length and Standard Deviation	No. in Length Sample
Beach Seine	LV	61	7-01	7-09	7-30	94.0 (5.04)	20
	RV	6	7-09	7-09	7-15	100.0 (7.78)	2
	AD	68	6-11	7-09	7-30	97.0 (6.12)	17
	06-59-05	20	6-18	7-09	7-30	97.1 (6.81)	8
	06-59-12	1	7-09	7-09	7-09	112.0 ---	1
	06-59-13	1	6-11	6-11	6-11	85.0 ---	1
	06-59-16	5	6-18	6-18	7-09	97.3 (2.63)	4
	06-61-18	2	7-09	7-09	8-21	111.0 ---	1
Push Net	LV	2	6-24	6-24	7-01	89.0 (5.65)	2
	RV	0	--	--	--	-- ---	--
	AD	2	6-18	6-18	7-15	88.0 (0.71)	2
	06-59-05	1	6-18	6-18	6-18	88.0 ---	1

1/ LV - Left ventral; RV - Right ventral; AD - Adipose (includes all adipose fin-clipped fish recovered including those not sacrificed for CWT identification).

2/ Capture dates include the first and last dates sampled and the dates on which the cumulative catches equaled 50 percent of total seasonal catches.

PROGRAM PLANNING, DIRECTION, AND COORDINATION

ABSTRACT

The course of the Klamath River Fisheries Investigation Program, and the role of FAO-Arcata in addressing resource-related issues involving the Klamath River basin, have evolved in response to Departmental direction through pertinent Memoranda of Understanding and the Critical Issues Management System, the USFWS Management By Objectives program, and a variety of external factors. A Strategy Plan addressing anadromous fishery resources of the Klamath River and North Coast was developed in 1981 and the step-down operational planning process continues. The Bureau of Indian Affairs has prepared a concept paper addressing a proposed Klamath River basin fishery resource plan, and has initiated an Environmental Impact Statement process concerning a proposal to modify Indian fishing regulations authorizing the commercial harvesting of anadromous fish on the Hoopa Valley Reservation.

PROGRAM PLANNING, DIRECTION, AND COORDINATION

INTRODUCTION

The course of the Klamath River Fisheries Investigation Program, and the role of FAO-Arcata in addressing resource-related issues involving the Klamath River basin, have evolved in response to Departmental direction through pertinent Memoranda of Understanding (MOU's) and the Critical Issues Management System (CIMS), the USFWS Management By Objectives (MBO) program, and a variety of external factors (Figure 51). Further direction has recently been received through BIA planning processes involving fisheries resources of the Hoopa Valley Indian Reservation.

DEPARTMENTAL DIRECTION

In order to carry out the Interior Secretary's resource and Indian trust responsibilities with regard to the Klamath River basin and Hoopa Valley Reservation, MOU's between the Assistant Secretaries of Indian Affairs and Fish, Wildlife, and Parks have been reached providing for: (1) promulgation of Indian fishing regulations and necessary emergency and in-season adjustments thereto, based on the best run size and catch information available, and designed with the objective of ensuring adequate spawning escapement in a manner consistent with Indian rights; (2) a cooperative enforcement program, with regard to the Indian fishing regulations, involving the USFWS and BIA; and (3) a fisheries investigation program, the subject of this report. Through the submittal of annual study and budget proposals, the FAO-Arcata program has been funded by the BIA in accord with the MOU's.

SERVICE DIRECTION - THE MBO PROCESS

Through the MBO process, Service direction from the Central Office (CO) in the form of fisheries resource priorities, missions, goals, and objectives has been provided through the *Important Resource Problems Source Document* (USFWS 1980*a*), the *Service Management Plan* (USFWS 1980*b*), and the *Fishery Resource Program Management Document* (USFWS 1980*c*). National goals and objectives with particular relevance to the Klamath River basin include: (1) the development, collection, interpretation, and dissemination of information and analysis related to all aspects of fishery resource condition, management, use, and protection; (2) the development of studies to acquire, develop, and disseminate information in order to determine the effects of harvest management strategies on the stability of fishery resources; (3) the promotion of land and water use and fishery management practices, to insure that fishery resources are protected and restored in all situations where the Service provides technical assistance or has legislative responsibility; and (4) the provision of technical fishery management assistance for fishery resources found on trust lands, in cooperation with the BIA and tribal governments, and as defined in MOU's.

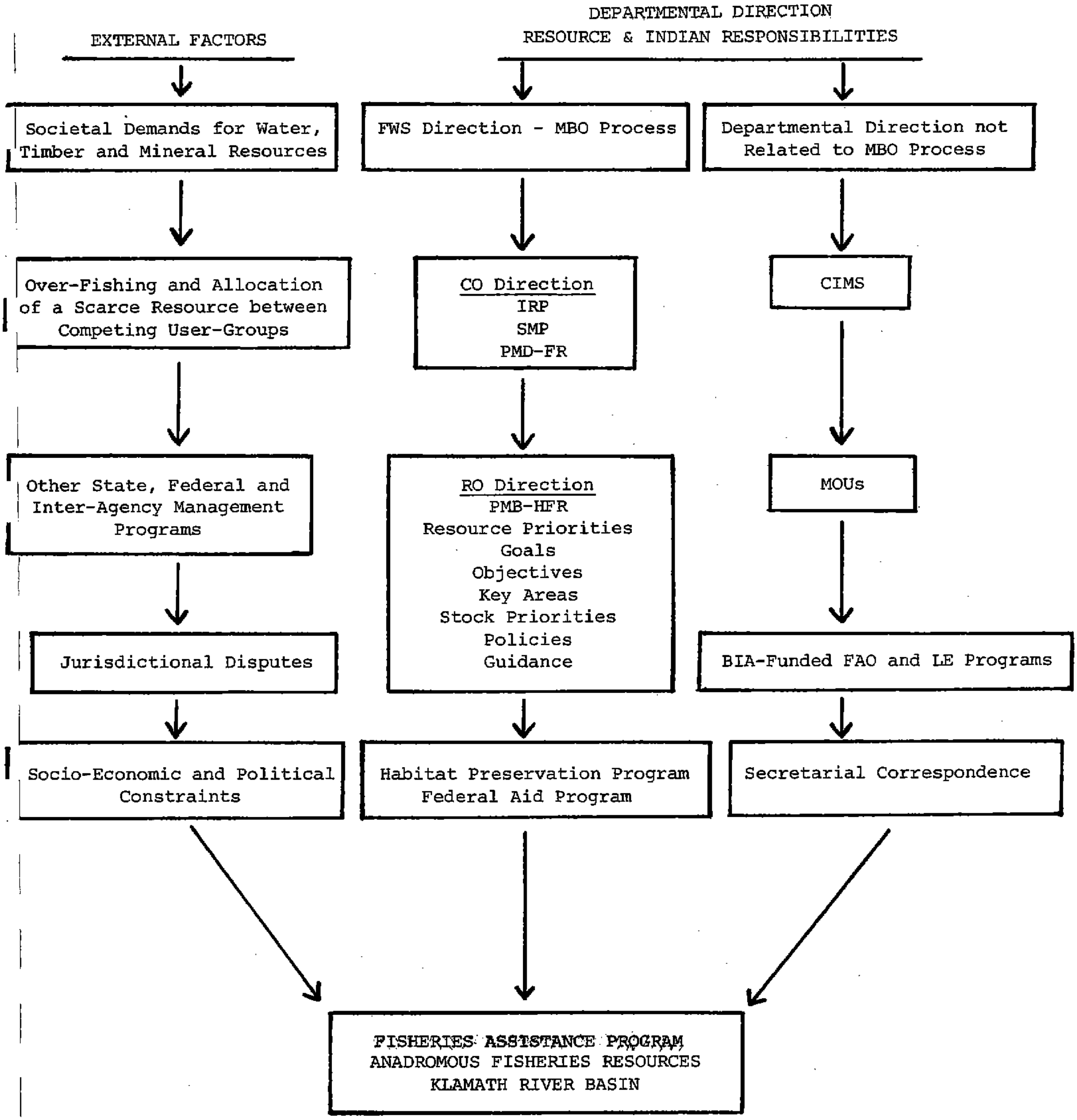


FIGURE 51. Factors which have influenced the development and direction of the Klamath River Fisheries Investigation Program conducted through FAO-Arcata.

Program direction from the Regional Office (RO) in the form of resource priorities, goals, objectives, policies, and guidance, has been provided through the *Region 1 Program Management Brief for Hatcheries and Fisheries Resources* (USFWS 1980*d*) and the *Region 1 Policy Book* (USFWS 1979*b*). Regional policies with particular relevance to the Klamath River basin include: (1) the conservation of fisheries resources for the public good rather than to benefit any particular user group or political constituency; (2) the preservation of all significant wild (naturally spawning) stocks of anadromous fish; and (3) a preference for selective stock fisheries over mixed stock fisheries, because the former allow for greater protection of depressed stocks. With regard to issues dealt with by the PFMC, Regional policy supports or encourages: (1) the harvest of mature fish over juveniles; (2) limited entry of commercial and charter boats as a control on fishing pressure; (3) sufficient escapement to provide for historical Native American fisheries, traditional sport fisheries, and recruitment needs; (4) the preservation and maintenance of all existing races, runs, or stocks of ocean fishes; and (5) special methods and means for reducing the mortality of juvenile fish in the sport, commercial, and Indian fisheries.

As part of the Regional planning process, a *Preliminary Draft - Anadromous Fisheries Resources Strategy Plan - Klamath River Basin* (USFWS 1981*b*) was incorporated into a *Draft - North Coast Strategy Plan* (USFWS 1981*c*) during the year. Step-down operational planning is continuing in 1982.

EXTERNAL FACTORS INFLUENCING PROGRAM DIRECTION

A variety of external factors generally beyond the control of the Service and Department, including over-fishing, resource allocation, habitat degradation, jurisdictional questions, and socio-economic and political constraints, continue to influence how resource problems of the Klamath River basin are addressed. Further elaboration of these factors, and how they have influenced the direction of the Klamath River Fisheries Investigation Program, is contained in the 1979 and 1980 FAO-Arcata annual reports (USFWS 1979*a*, 1981*a*), in a review of the history and status of anadromous fishery resources of the Klamath River basin and Hoopa Valley Reservation (USFWS 1979*c*), and in a paper presented by the Project Leader, FAO-Arcata to the American Fisheries Society in 1980 (Rankel 1980).

The Klamath River Fisheries Investigation Program has been conducted taking into account the involvement in resource problems of the basin by a variety of governmental agencies, multi-agency management groups, user groups, interest groups, and elected representatives of federal, state, and local government. In addition to the BIA and USFWS, other agencies with jurisdictional authority over harvest management policy formulation affecting Klamath River stocks include the U.S. Department of Commerce, through the PFMC and National Marine Fisheries Service (NMFS), the CDFG, and ODFW. Principal agencies and entities with resouce and land management responsibilities in the Klamath River basin include the USFS, CDFG, BIA, U.S. Bureau of Reclamation (USBR), U.S. Bureau of Land Management (BLM), California Department of Forestry (CDF), California Department of Water Resources (CDWR), and the Trinity River Basin Fish and Wildlife Task Force (TRBF&WTF). Primary user groups associated with anadromous fisheries resources of the Klamath River basin, and their principal representative organizations, include: (1) ocean commercial fishermen, represented by the Pacific Coast Federation of Fishermen's Associations, Inc. (PCFFA), Salmon Unlimited, and various fishermen's marketing associations; (2) ocean sport fishermen, represented by a number of charter boat organizations; (3) interior sport fishermen, represented by the Klamath/Trinity River Coalition, Northwest Steelheaders Association, Trout

Unlimited, California Trout, and other groups; and (4) interior Indian fishermen, represented by the BIA, Hoopa Valley Business Council, the Karok Tribe, and the Rek-Woi Indian Community Association.

Elected representatives of government have conducted public hearings on the Klamath River and introduced legislation into the U.S. House of Representatives and California Senate and Assembly which would, among other things, create a California Council separate from the PFMC, ban gill nets on the Klamath River, create various allocation systems involving Klamath River stocks, and transfer jurisdiction over Indian fishing on the Hoopa Valley Reservation to the State of California. One piece of legislation which recently became law (California Senate Bill No. 872 approved by the Governor of California on September 23, 1981) requires the CDFG Director to appoint a Klamath/Trinity Salmon Restoration Advisory Committee (representing Indians of the Klamath River, the ocean commercial salmon fishery, the recreational salmon fishery, and major land owners in the Klamath River basin) to advise the CDFG on restoration programs, and assist in the establishment and coordination of these programs. Through the passage of three resolutions, the American Fisheries Society has expressed its concerns about Klamath River salmon, and the Sierra Club and Friends of the River have publicly expressed views regarding anadromous fisheries problems of the Klamath River. Coordination of the Klamath River Fisheries Investigation Program with the various agencies, entities, and individuals involved with the resource has been complicated by: (1) the unsettled nature of the Indian fishing rights question in northern California; (2) the socio-economic implications of reduced salmon stock abundance on the North Coast economy; (3) continued differences over the appropriate implementation of "optimum fishery management policy" as it relates to wild stock protection on the one hand and providing for maximum ocean harvests on the other; and (4) differences of opinion, with regard to identifying and addressing problem areas.

BIA PLANNING PROCESSES INFLUENCING PROGRAM DIRECTION

In an attempt to develop a unified cooperative working relationship between concerned agencies and interest groups in addressing fisheries resource problems of the Klamath River basin, personnel of the BIA and Office of the Assistant Secretary for Indian Affairs drafted a *Concept Paper for a Klamath-Trinity Rivers Basin Fishery Resource Plan* (BIA 1981). The paper is in the final draft stage, and USFWS comments on the first draft were submitted through channels.

In August, 1981, an agreement was reached between the BIA and the National Park Service (NPS) to engage a NPS study team to prepare an Environmental Impact Statement (EIS) concerning a proposal to modify Indian fishing regulations authorizing the commercial harvesting of anadromous fish on the Hoopa Valley Reservation. The Project Leader, FAO-Arcata, was designated to represent the USFWS on the study team, and has participated in the scoping process. A series of 12 public scoping sessions was held in northern California in December, 1981, to gather public input on the EIS. As anticipated, representative Indian and non-Indian opinion concerning the proposal was divided. Of 245 people attending the sessions, 101 made statements. From a prepared transcript, the NPS team has identified approximately 130 issues raised during the sessions. The team plans to complete a scoping report by May, 1982.

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