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KLAMATH RIVER FISHERIES INVESTIGATION PROGRAM

Annual Report - 1985

ANNUAL REPORT

KLAMATH RIVER FISHERIES INVESTIGATION PROGRAM

1985

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

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ANNUAL REPORT

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FORWARD

The Klamath River watershed 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 (Figure 1). The Hoopa Valley Indian Reservation (HVR), 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 tributaries 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 (km 306) and Lewiston Dam on the Trinity River (km 249) 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) were constructed in mitigation for natural fish production losses 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 30% 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 USFS lands in the Klamath River basin in excess of $20 million, and mean annual net economic values per kilometer of chinook salmon, coho salmon (*Oncorhynchus kisutch*), and steelhead trout habitat in the basin of $15,600, $1,400 and $2,800, respectively (USFS 1977, USFS 1978). In 1980, the Department of the Interior included the Klamath and Trinity Rivers in the National Wild and Scenic Rivers System. Portions of the Klamath and Trinity Rivers are also under California state classification as Wild and Scenic Rivers.

Concern about the depletion of anadromous salmonid resources and associated habitat in the basin emerged around the turn of the century, and has accelerated in recent decades coincident with expanded logging and fishing operations, dam building activity, road construction, and other development. 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 over-exploitation, as reflected by declining runs in recent decades.

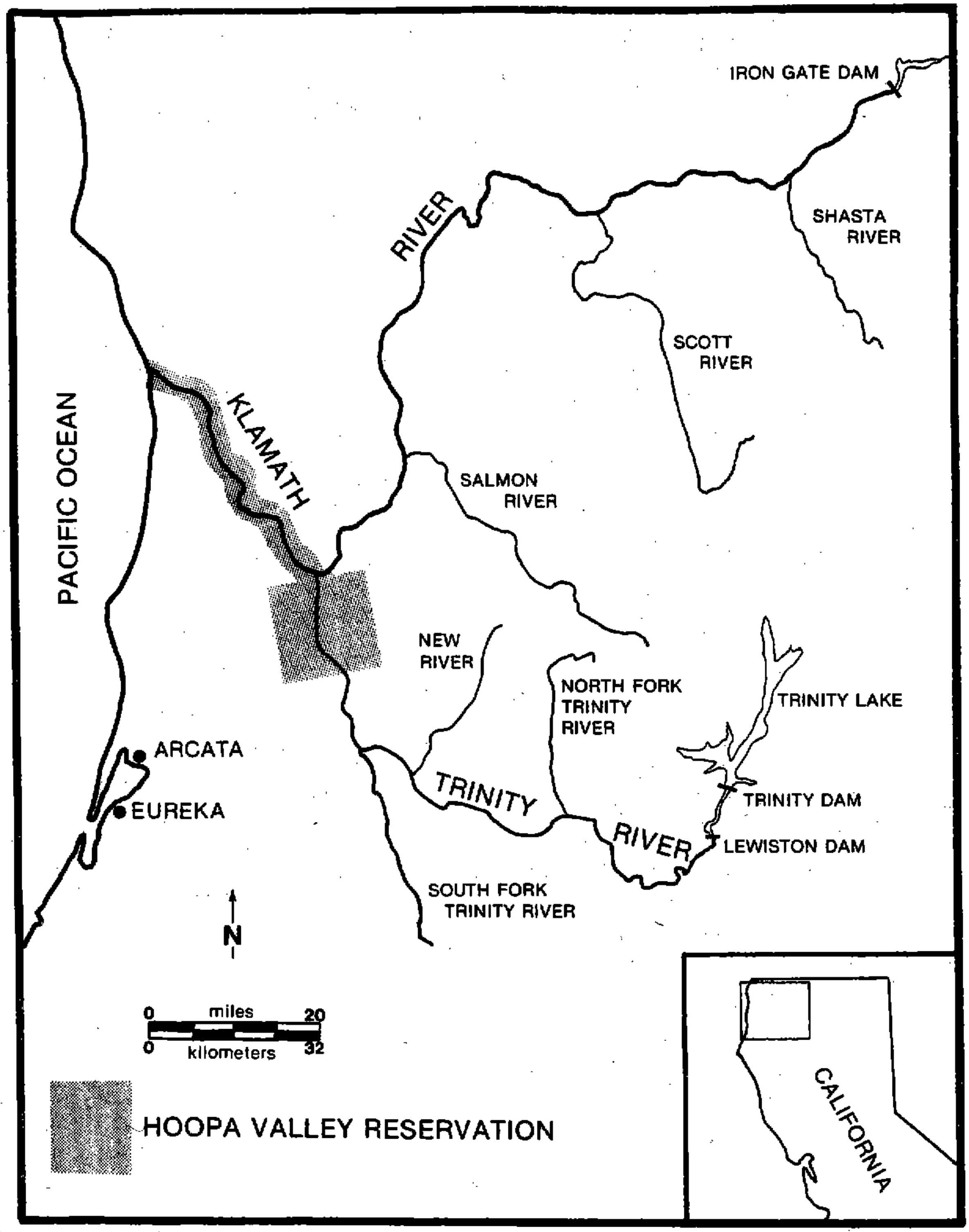

FIGURE 1. The Klamath River basin and Hoopa Valley Indian Reservation.

PLATE 1. The mouth of the Klamath River during summer, 1985.

In response to habitat problems resulting from the Trinity River Division project, the Congress enacted P.L. 98-541, the Trinity River Basin Fish and Wildlife Management Program (TRBFWMP) on October 24, 1984. This action directs the Secretary of the Interior to restore fish and wildlife populations in the Trinity basin to levels approximating those which existed immediately before the start of construction on that project. An office administered jointly by the U.S. Bureau of Reclamation and U.S. Fish and Wildlife Service (USFWS) was recently opened to oversee work under P.L. 98-541.

CH_2M Hill, a consulting firm, recently completed a document entitled "Klamath River Basin Fisheries Resource Plan" (KRBFRP), through contract with the Department of the Interior, Bureau of Indian Affairs (USDI 1985). This plan details restoration actions for the remainder of the Klamath basin which are similar to those included in the TRBFWMP described above. Information from the KRBFRP has recently been used in the preparation of HR 4712, a new version of a bill (HR2487) originally introduced in May of 1985 "to provide for the restoration of the fish and wildlife in the Klamath and Trinity River Basin Areas, and for other purposes."

Since passage of the Fishery Conservation Management Act of 1976 and the promulgation of the first set of Federal fishing regulations governing Indian fishing on the HVR in 1977, considerable attention has also focused on the fisheries operating on the depressed chinook salmon runs, notably the ocean troll fisheries and the Indian gill net fishery on the Klamath and Trinity Rivers. During 1985 a new organization of particular relevance to the management of the combined fisheries operating on Klamath River chinook stocks was formed. As described in the organization's charter, the Klamath River Salmon Management Group (KRSMG):

> "is an interagency mechanism to coordinate a comprehensive review of the salmon resource of the Klamath-Trinity River system and to recommend to the Pacific Fishery Management Council, U.S. Department of the Interior, State of California, and the Klamath-Trinity Tribes the following management issues:
>
> 1. spawning escapement goals;
> 2. rebuilding schedule to meet the adopted escapement goals including production goals;
> 3. methods for harvest sharing between recreational, Indian, and commercial users; and
> 4. short and long-range data needs to meet the above goals."

Beginning in 1986, the KRSMG will provide recommendations concerning allowable levels of harvest for all Klamath stock fisheries.

The USFWS has ranked anadromous salmonid problems of the Klamath River basin number 18 of 78 "Important Resource Problems" in the United States (USFWS 1980). The Assistant Secretaries of Indian Affairs and Fish, Wildlife and Parks, in addressing Departmental resource and Indian Trust responsibilities concerning the Klamath River basin resource and Hoopa Valley Reservation, have entered into annual fiscal Interagency Agreements (IA) providing for fisheries investigation programs focusing on the monitoring and evaluation of chinook salmon runs in the Klamath River, and the monitoring of Indian net harvest levels on the HVR. This is the seventh in a series of annual reports covering the Klamath River Fisheries Investigation Program, conducted through the Fisheries Assistance Office, Arcata, California (FAO-Arcata) under the Fiscal Year 1985 IA.

The program consists of four major groupings of related activities:

(1) Beach Seining Operations focus on:

(a) development of a model for annual estimation of fall chinook run size on an in-season basis;

(b) the provision of age composition data required to forecast annual Klamath River chinook ocean population abundance; and

(c) the annual monitoring of fall chinook runs to evaluate natural/hatchery composition, to assess hook scarring and gill net marking incidences, to collect age-growth, length-frequency and length-weight data, and to provide data on run timing and migration patterns by external tag application.

(2) Harvest Monitoring and Evaluation Efforts focus on:

(a) the annual estimation of the Indian net harvest levels on the Hoopa Valley Reservation involving chinook salmon (spring and fall runs), steelhead trout (fall run), coho salmon, green sturgeon (*Acipenser transmontanus*);

(b) the collection and reading of coded-wire tags recovered from the net fishery during harvest monitoring activities and use of this data in statistical evaluation of the various tagged release groups through their occurrence in the ocean and in-river net fisheries; and

(c) the annual monitoring of chinook and coho salmon, steelhead trout, and green sturgeon runs to evaluate natural/hatchery composition, to assess length-frequency, age-growth, and length-weight relationships within the harvest and to collect run-timing and migration pattern data by recovery of tags placed during beach seining operations.

(3) Technical Assistance involves:

(a) participation in various technical committees including the Department of Interior technical team and the Technical Advisory Team to the Klamath River Salmon Management Group;

(b) the provision of general technical assistance as requested to the California Department of Fish and Game, Bureau of Indian

Affairs, Hoopa Valley Business Council Fisheries Department, other branches of the USFWS, various other groups and agencies;

and

(c) the conduct of various other field studies in the Klamath River basin as is deemed appropriate.

(4) Program-Planning, Direction, and Coordination involves keeping abreast of program planning and direction in conjunction with guidance received from the USFWS and Interior Department, annual budgeting and other administrative functions, coordinating the program with and disseminating data to a variety of concerned agencies, interest groups, and the general public.

Methods utilized and results obtained during 1985 through these program activities are detailed in sections summarizing data collected on chinook salmon, coho salmon, steelhead trout, and sturgeon. Abstracts covering the primary points precede each of the major sections of this report. While previous annual reports through 1981 have included sections detailing information on juvenile salmonid investigations within the basin, no such data is available for 1985 since budget constraints precluded field activities involving juvenile salmon and steelhead. During 1983 the Hoopa Valley Business Council Fisheries Department assumed responsibility for harvest monitoring programs covering the Trinity River portion of the HVR, formerly a part of FAO-Arcata responsibilities. This responsibility remained with the Hoopa Tribe during 1985. It should, therefore, be realized that harvest data presented in this report, unless otherwise noted, are not strictly comparable with harvest data presented in certain previous reports since the area of coverage has changed as described.

CHINOOK SALMON INVESTIGATIONS

ABSTRACT

A total of 12,796 chinook salmon were captured in 294 sets during 1985 seining operations in the Klamath River estuary. Of the 12,070 individual fall chinook captured during 7/29-9/25, 3,632 (2,681 adults and 951 jacks) were sampled. Tags were applied to 1,746 chinook for mark recapture analysis. Scales were collected from 2,344 chinook for age analysis. Adipose fin-clipped chinook comprised 13.7% of the sample, and 0.4% and 12.7% of the chinook examined exhibited gill net marks and hook scars, respectively.

Age analysis from scale samples and coded wire tag (CWT) recoveries indicates the dominance of 3-year-olds in 1985.

Gill net harvest on the Klamath River portion of the Hoopa Valley Reservation during 1985 is estimated at 10,233 fall and 1,119 spring chinook. These harvests represent a 43% decrease in the fall chinook fishery and a 332% increase in the spring chinook fishery from respective 1984 levels.

A total of 164 CWT, representing 26 fall and 5 spring chinook release groups, were recovered during mark sampling of the 1985 net fisheries on the Klamath River portion of the Hoopa Valley Reservation. These recoveries expand to a total estimated harvest of 983 CWT fall and 188 CWT spring chinook in the 1985 net fisheries. In-river net and preliminary ocean troll CWT return data suggest an overall ratio of ocean landings to Klamath River net harvest for CWT Klamath River basin fall chinook of 4.5:1 in 1985.

An estimated 4.0 Klamath River fall chinook were harvested through the combined ocean and river fisheries for each one spawning in the basin since 1978.

A discussion of "El Niño", its impacts on the Klamath River fall chinook population and pertinent 1985 data concerning the observed recovery of growth rate and size at age are presented.

BEACH SEINING PROGRAM

INTRODUCTION

A beach seining program was initiated by FAO-Arcata biologists in 1979 with the intent of evaluating potential for developing in-season and post-season run size estimates utilizing catch/effort and mark-recapture techniques, and to collect biological data on Klamath River fall race chinook salmon. Problems encountered during the 1980 season in satisfying the requirements of mark-recapture methodology resulted in the discontinuation of the mark-recapture post-season population estimation program. Consequently, emphasis was shifted towards collection of basic biological data, such as age composition and development of in-season run size indices derived from beach seine catch-effort data.

At present, this program provides the only available estimates of age composition in the total Klamath River fall chinook spawning run. These data have proven valuable in estimating ocean stock size of 3 and 4 year-old Klamath River fall chinook, and therefore in management of the ocean fisheries. The 1985 season marks the seventh consecutive year of beach seine sampling of fall chinook salmon near the mouth of the Klamath River.

METHODS

Beach seining operations were conducted on the north spit of the Klamath River estuary from July 15 to September 25, 1985 (Figure 2). This estuarine site was chosen to sample the fall chinook run prior to sustaining impacts of the various size-selective, in-river fisheries and to provide data comparability with prior 1979-1984 sampling seasons. Site selection within the estuary was based on previous observations which indicated that fall chinook tend to migrate through the deep channel of cool, highly saline water. A hydro-acoustic survey was conducted during July 1985 to obtain depth profile transects to locate this channel (Figure 2).

Methods utilized in 1985 were similar to those of previous years. Seining was conducted five days per week during daylight hours by a nine-person crew of biologists and technicians. A 150 m long by 6 m deep seine net (8.9 cm stretched mesh) was set from a Valco river boat and retreived using gas powered winches.

Captured fish were transferred into holding cages, and then individually examined for fin-clips, hook scars, tags, gill-net marks and other distinguishing characteristics. Examination of fish for hook scars and gill-net markings is part of a continuing effort to collect information on fisheries impacts on the Klamath River chinook salmon populations. Identified wounds and scars attributable to hooking incidences were classified as described in Table 1. All salmonids were measured to the nearest centimeter fork length and each chinook salmon received a 9.5 mm or 6.4 mm hole punch placed in the upper caudal lobe for recapture identification. In addition, a numbered aluminum or monel-metal band was applied to the left mandible of every other chinook sampled throughout the

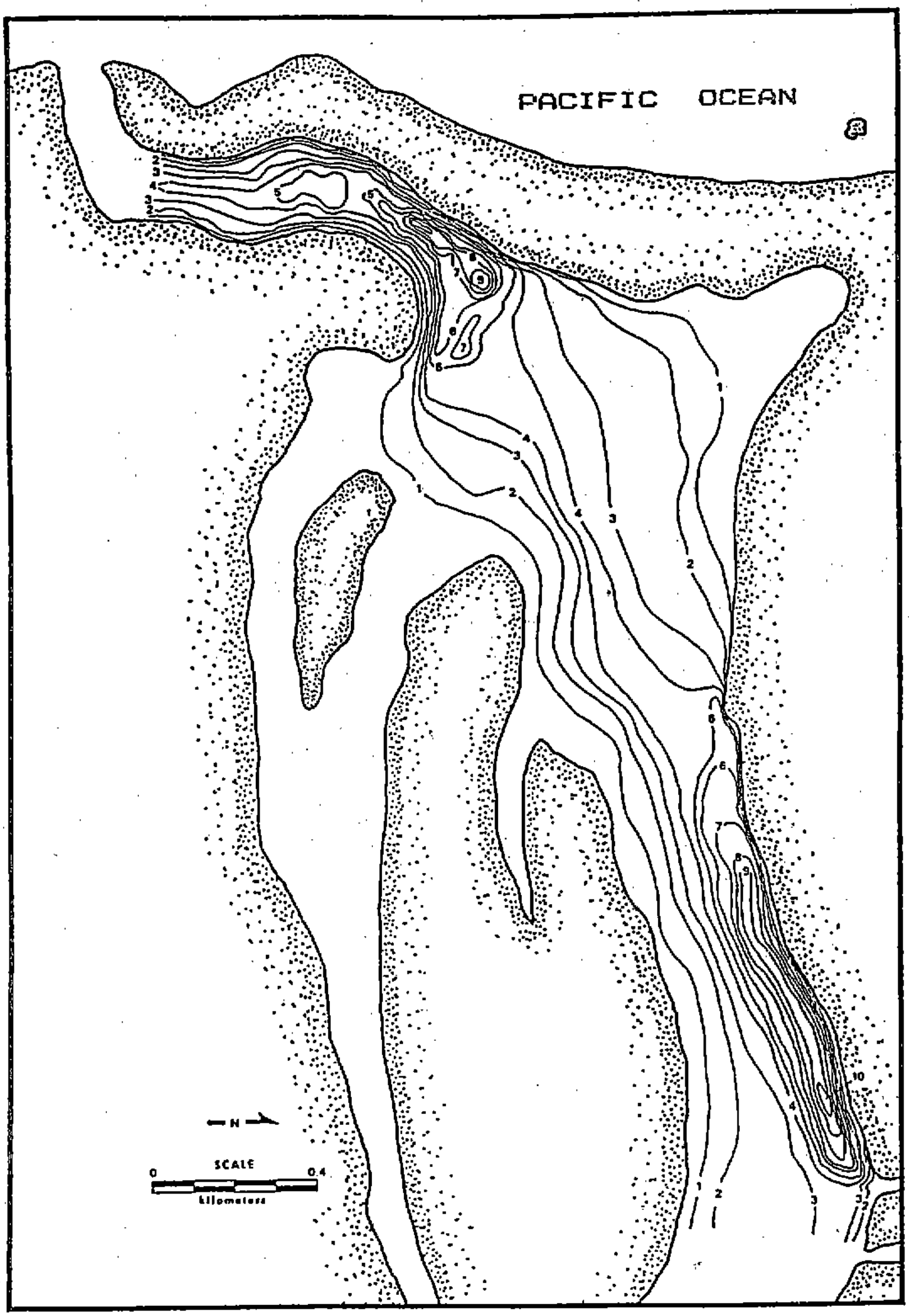

FIGURE 2. Depth contours (expressed in meters below mean high tide) of the Klamath River estuary during 1985. Arrow depicts approximate beach seining site.

TABLE 1. Categorization of hook scars observed during 1985 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 and Orbit	
	Opercle	
	Isthmus	
	All Other Head Areas (Includes nose, inside mouth and top head)	

photos not needed

PLATES 2 and 3. The crowding (above) and examination (below) of chinook salmon captured through 1985 beach seining operations in the Klamath River estuary.

season, for evaluation of migration timing and patterns. Scale samples were taken as in previous years for age analysis.

Sets with large numbers of fish captured (> 40) were subsampled to minimize handling time and reduce stress to fish. Fish not subsampled were identified as to species and size class (i.e. jack or adult) prior to release, for inclusion in catch/effort data. Statistical tests (chi-square, $p < 0.05$) were conducted on the proportion of jack/adult represented from the subsampled sets to insure that their inclusion would not bias data presented herein. Recaptures were eliminated from analyses to minimize bias from any tendency of chinook to linger in the estuary after capture.

Beach seine catch/effort (C/E) data were treated to derive indices for use in predicting in-season, in-river population abundance. Methods utilized in 1985 are similar to those reported in previous reports (USFWS 1983, 1984, 1985). To aid in comparison of C/E between years of varying effort, seasonal C/E data were compared from the three highest consecutive daily seine hauls (peak three sets). This treatment has been effective considering that a range of 73% to 81% of the total catches during the 1980-1985 years has been captured in the peak three daily sets. The C/E data are derived from chinook sampled and those released unsampled.

All 1985 analyses (age composition, length-frequency, catch per effort, fin-clips, etc.) were based upon data collected from July 29 to September 25, 1985. The former date was chosen as the representative start of the fall race chinook run, based upon analysis of Coded-Wire-Tag (CWT) samples obtained from the Estuary Area gill-net fishery (refer to Coded Wire Tag section).

RESULTS AND DISCUSSION TTK / JCP

During the entire (7/15-9/25) 1985 field season, 12,796 chinook salmon (including 69 recaptures) were captured in 294 seine sets. Of this total, 12,112 (including 42 recaptures) were caught in 236 seine hauls during the defined fall race chinook (7/29-9/25) sampling period. Of 12,070 individual fall race chinook captured, 3,632 (2,681 adults and 951 jacks) were sampled and 8,438 (6611 adults and 1827 jacks) released unsampled. Jaw tags were applied to 1,746 chinook, and 2,344 scale samples were taken. Data from all 236 fall race period sets were included in bio-analyses, as no bias was detected in subsampling. Data from 2 of 236 fall race period sets were removed from C/E analyses due to possible sampling bias.

The length-frequency distribution of jacks and adults differ markedly from previous years (Figure 3). The mean length of jacks (< 61 cm) significantly (t-test, $p < 0.05$) exceeds those of the prior three years, while the overall mean length for adults significantly exceeds those of 1983-1984 and is close to that observed in 1982. More detailed information on fall chinook age, growth and size at maturity is presented in the El Niño and Age Composition sections of this report.

Fin-clips were observed on 852 (23.5%) of the 3,632 chinook salmon sampled during the 1985 fall chinook beach seining operation. Adipose (AD) fin-clips representing various hatchery coded-wire-tag (CWT) release groups

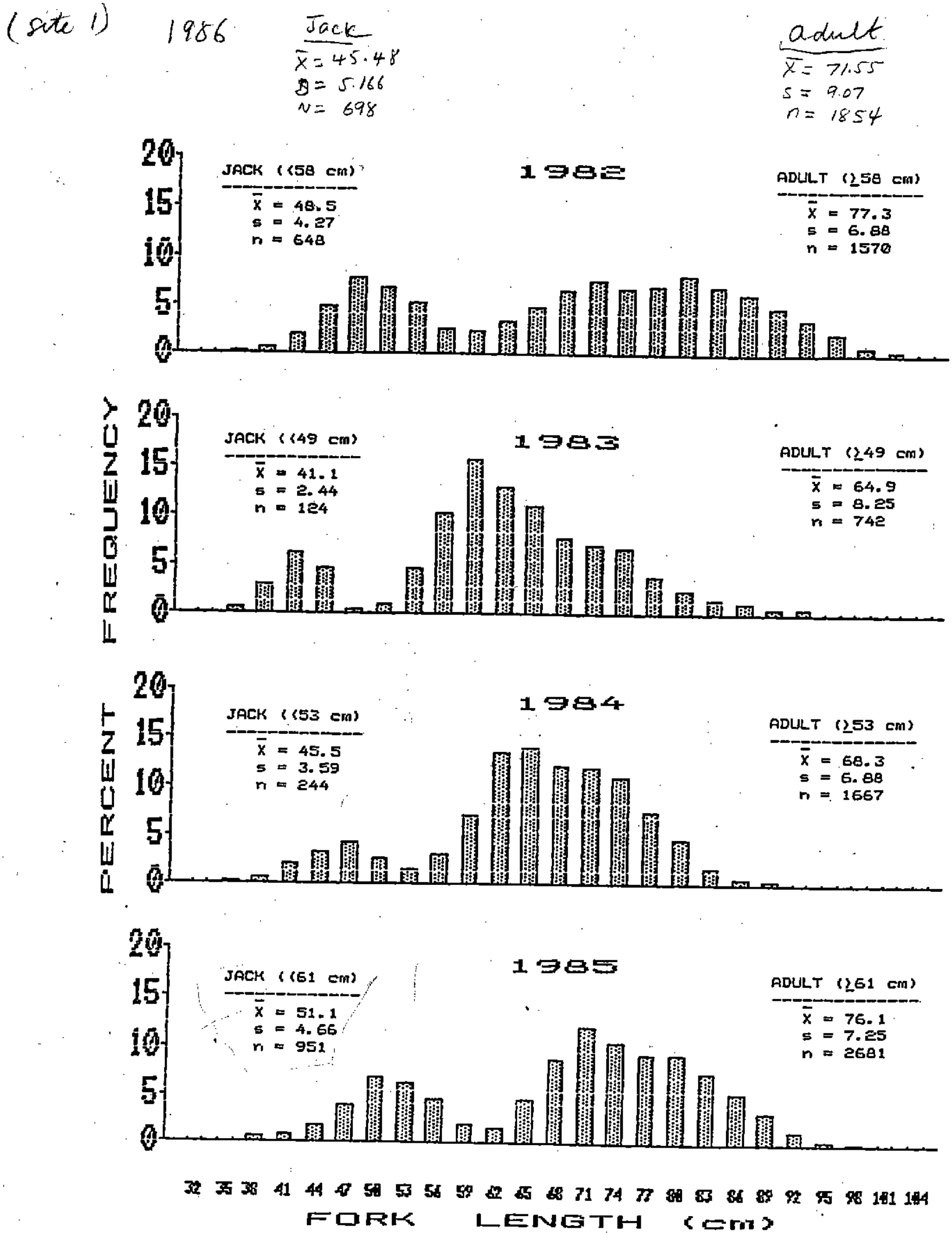

FIGURE 3. Length-frequency distributions of chinook salmon captured during beach seining operations in the Klamath River estuary during 1982-1985 (3 cm groupings with midpoints noted).

occurred on 13.7% of the jacks and 13.7% of the adults (Table 2). Left ventral (LV) fin-clipped chinook reared at Iron Gate Hatchery (IGH) occurred on 0.5% of the jacks and 10.0% of the adults. Right ventral (RV) fin-clipped chinook reared at Trinity River Hatchery (TRH) occurred on 1.5% of the adults and one of the jacks. The origin of one left pectoral (LP) fin-clipped jack could not be determined.

Mean length of fin-clipped adult chinook salmon, 75.0 cm, was significantly smaller than that of non-clipped adults, 76.4 cm (t-test; $p < 0.05$, Figure 4). This difference in lengths may be due to differing maturity schedules between hatchery and natural stocks, or from effects of the fin-clipping process. Mean length of fin-clipped jacks, 51.6 cm, and non-clipped jacks, 51.0 cm, did not differ significantly (t-test; $p > 0.05$, Figure 4).

LV and RV fin-clipped chinook salmon represent a constant fractional marking program initiated by Calif. Dept. of Fish & Game (CDFG) in 1979 to assist in estimating the proportional contribution of hatchery and natural stocks to production within the basin, and ultimately to assist in escapement estimation. This program also allows differentiation of fish by hatchery origin. An apparent difference in river entry timing continues to be observed between chinook reared at IGH, and chinook from TRH. A greater percentage of adult LV fish (60.6%) entered on or before August 22, while a greater percentage of adult RV fish (59.0%) entered after that date.

Run timing differences among fall chinook age classes were apparent in 1985. Beach seine data from 489 scale-aged fall chinook taken during the fall run period were stratified into three equal time periods, and the resultant age-class frequencies were subjected to a Pearson two-way chi-square analysis. Significant ($p < 0.05$) run timing differences by age were noted (Table 3). Age 4 chinook were the dominant age class (47.8%) during the early run period, while 2-year-olds constituted 53.3% of the sample during the latter run period. The contribution of three-year-old chinook was relatively uniform throughout the three intervals, suggesting intermediate run timing.

The early entry of age 4 chinook was also observed in 1984. The late timing of the two-year-olds appears to coincide with the late entry pattern of TRH fall chinook. This trend has also been noted in 1984 (USFWS 1984). In contrast to other Klamath River basin stocks, chinook of TRH origin appear to exhibit an accelerated maturity schedule.

TABLE 2. Mean length ($\overline{X}$) in centimeters, standard deviation (s), and sample size (n) of fin-clipped chinook captured during the 1985 beach seining operation. Percentage relative to total jacks and adults sampled.

	JACKS (<61cm)				ADULTS (≥61cm)			
Fin Clips	$\overline{X}$	s	n	%	$\overline{X}$	s	n	%
Adipose	51.3	5.09	130	13.7	73.9	6.74	368	13.7
Left Ventral	57.6	3.05	5	0.5	76.8	7.60	269	10.0
Right Ventral	--	--	1	0.1	75.3	5.30	39	1.5
Left Pectoral	--	--	1	0.1	73.0	5.94	39	1.5
Number Fin-Clipped:			137	14.4			715	26.7
Number Non-Clipped:			814	85.6			1,966	73.3
Total Sampled:			951	100.0			2,681	100.0

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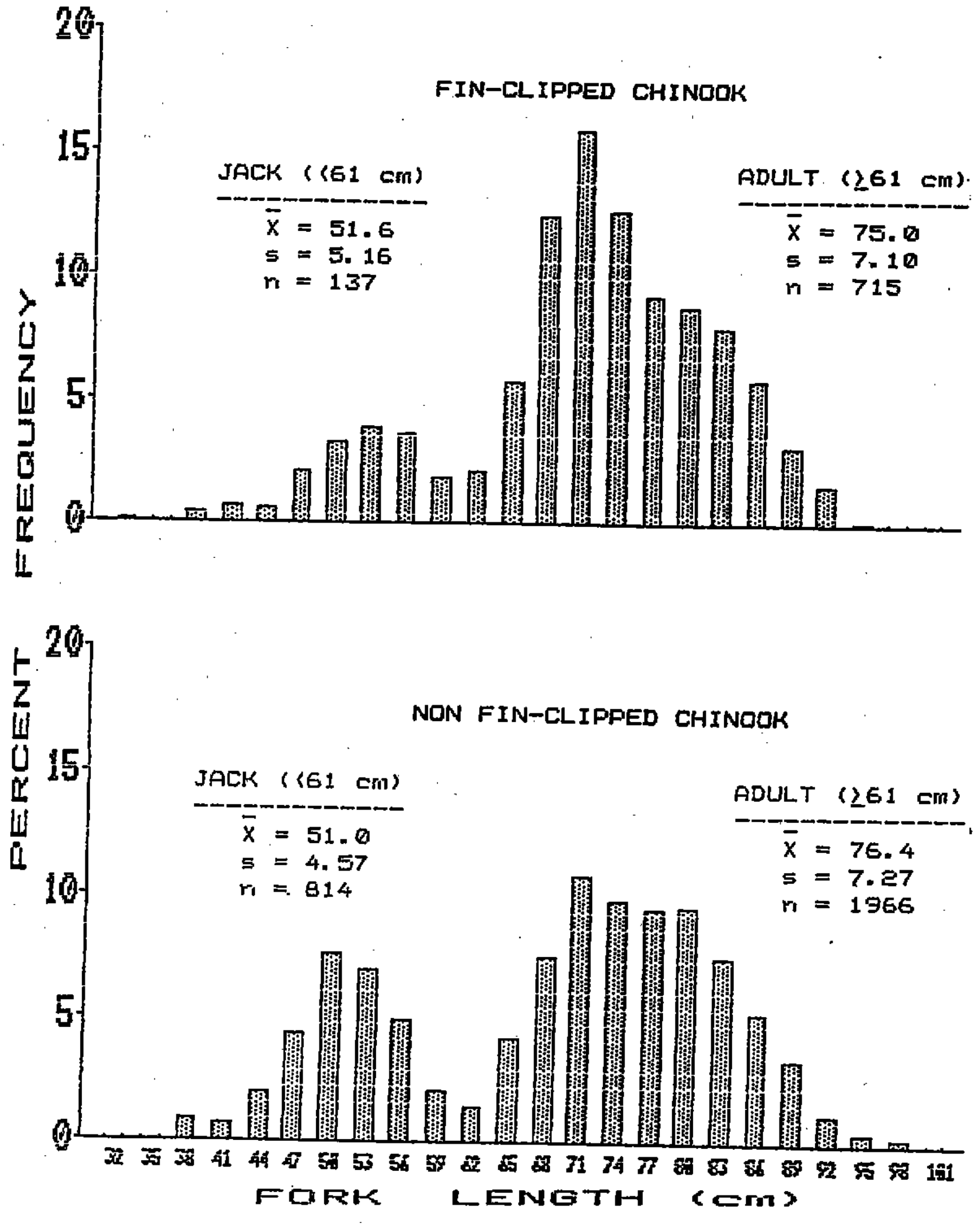

FIGURE 4. Length-frequency distributions of fin-clipped and non fin-clipped fall chinook salmon captured during 1985 beach seining operations in the Klamath River estuary (3 cm groupings with midpoints noted).

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TABLE 3. Age class contribution (%) of fall chinook salmon during three equal time intervals in the 1985 Klamath River beach seine sample, determined through scale analysis.

	RUN TIMING			
Age	7/29 - 8/15	8/16 - 9/5	9/6 - 9/25	Total
2	5 (5.6%)	96 (27.1%)	24 (53.3%)	125
3	32 (35.5%)	138 (39.0%)	16 (35.6%)	186
4	43 (47.8%)	98 (27.7%)	4 (8.9%)	145
5	10 (11.1%)	21 (5.9%)	1 (2.2%)	32
6	0 (0.0%)	1 (0.3%)	0 (0.0%)	1
Total	90 (100.%)	354 (100.%)	45 (100.%)	489

Gill-Net Marking and Hook Scarring Investigations

Gill-Net Marking Joe

Markings attributed to previous contact with gill nets were observed on 1 of 1,171 jack (0.1%) and 14 of 3,035 adult (0.5%) chinook salmon examined during beach seining activities in 1985. In past seasons a general relationship between observed marking rate and gill-net harvest levels in the estuary has been noted. This was also the case in 1985 as the overall marking rate dropped 48%, from 0.7% in 1984 to 0.4% in 1985, while over the same period gill-net harvest in the estuary decreased by 51%.

Gill-net marking rates on chinook were also examined at 3 up-river sites, as in past years, for comparison to incidence rates observed during beach seine sampling. Data from sampling on three separate occasions at TRH exhibited a marking rate of 1.4% based on a sample of 2,603 chinook. The marking rates of this sample for jacks and adults were 1.0% and 5.5%, respectively. Observations at IGH and at the Shasta River weir also showed low marking incidences, although sample sizes were too small to provide significant results. Similar results showing higher marking rates up-river have been noted in previous seasons and would be expected since the majority of in-river net harvest occurs between these sampling areas.

Reservations concerning the collection and potential use of gill net marking data on Klamath River chinook were stated in a previous Annual Report

(USFWS 1982). Meaningful gill net marking data can be collected under carefully controlled conditions; however, the utility of such information beyond provision of a very general index of net harvest rate in the basin may be discretionary.

Hook-Scarring

Scars or wounds directly attributable to hooking incidents were observed on 76 of 951 jack (8.0%) and 385 of 2,681 adult (14.4%) fall race chinook salmon examined during 1985 beach seining activities, for an overall frequency of 12.7% (Table 4). Healed scars were more common than fresh (8.1% vs. 5.6%), and moderate-major scars were more common than minor (7.4% vs. 6.4%). Two or more scars caused by separate hooking incidents were observed on 39 (1.0%) of all chinook examined. Four (0.1%) of 3,632 chinook were captured with hooks imbedded and one chinook had been blinded in one eye from a hooking incident. The percentage occurrence of all scar types was the lowest since the inception of the hook scar monitoring effort.

Categorical frequencies within the 1985 total sample of 500 scars are presented in Table 5. These frequencies do not directly convert to scarring frequencies within the total sample of 3,632 chinook as 39 multiple hook-scarred fish are represented by 78 individual scars. Scars observed on the upper jaw (51.4%) and lower jaw (23.4%) in 1985 compare closely to frequencies observed in previous years. The 1981-1985 average frequencies for upper and lower jaw locations are 49.7% and 23.5%, respectively. Frequency of scars in other locations in 1985 varied from 2.6% for the opercle area to 11.8% for the other head areas category.

A significant difference was found between mean lengths for hook-scarred (53.0 cm) and non-scarred (50.9 cm) jack chinook in 1985 (t-test; $p < 0.05$). Similar results have been noted for all previous sampling seasons except 1983. This difference may result from size dependent, differential rates of shaker mortality in the ocean troll fishery (smaller jacks may be less likely to survive a hooking incidence than their larger counterparts), which would elevate the mean length of jacks surviving hooking incidents. A size difference was observed in 1985, despite the low (8.0%) hook-scarring rate for jacks, which may suggest substantial size dependent hooking mortality. Mean length of hook-scarred adults (76.8 cm) was significantly greater (t-test; $p < 0.05$) than non-scarred adults (75.9 cm) in 1985. This is the first year such a difference has been noted. Hook-scarred adults were found to be significantly smaller than non-scarred adults during three of six previous sampling seasons. No significant differences were noted in the other three years.

Past differences in adult mean lengths have been attributed to growth interruptions caused by hooking incidents. The unusual difference observed between scarred and non-scarred adults in 1985 may be related to decreased effort in the 1984 and 1985 ocean troll fisheries due to seasonal closures. These closures may have resulted in low hooking incidence for 2-year-old fish in 1984 and 3-year-old fish in 1985 while 4- and 5-year-old fish returning in 1985 were subject to a higher probability of encountering a hook during previous seasons. If so, the mean length for hook-scarred fish would be inflated by the higher rate of hook-scars among 4- and 5-year-old fish. This was indeed reflected in 1985 age composition analysis which showed percentage

TABLE 4. Percentage occurrence of hook scars observed on 3,632 Klamath River fall chinook salmon sampled during 1985 beach seining operations.

Type of Scar	RUN COMPONENT Jack	Adult	All Chinook
Single Hook Scar[1/]	8.0	14.4	12.7
Two Hook Scars[2/]	0.6	1.2	1.0
Three Hook Scars	0.0	0.0	0.0
Fresh Hook Scar	4.2	6.2	5.6
Healed Hook Scar	4.4	9.4	8.1
Minor Hook Scar	3.8	7.3	6.4
Moderate-Major Hook Scars	4.8	8.2	7.4
Hook Imbedded	0.1	0.1	0.1
Blind In One Eye	0.0	0.04	0.03

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 incidents included in this category.

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APPENDICES

TABLE 5. Categorical frequencies (%) of hook scars within a total sample of 500 scars observed on 3,632 Klamath River fall chinook during 1985 beach seining operations.

Location	Stage	SEVERITY Minor	Moderate	Major	Total
Upper Jaw	Fresh	10.2	6.4	3.2	19.8
	Healed	14.4	6.8	10.4	31.6
	Total	24.6	13.2	13.6	51.4
Lower Jaw	Fresh	5.6	3.2	2.8	11.6
	Healed	5.6	3.4	2.8	11.8
	Total	11.2	6.6	5.6	23.4
Eye and Proximity	Fresh	0.0	0.6	0.4	1.0
	Healed	0.0	1.6	0.8	2.4
	Total	0.0	2.2	1.2	3.4
Opercle	Fresh	0.6	0.0	0.0	0.6
	Healed	0.8	0.6	0.6	2.0
	Total	1.4	0.6	0.6	2.6
Isthmus and Proximity	Fresh	1.6	0.4	0.4	2.4
	Healed	2.6	1.2	1.2	5.0
	Total	4.2	1.6	1.6	7.4
Other Head Areas	Fresh	2.4	2.4	0.8	5.6
	Healed	2.8	2.0	1.4	6.2
	Total	5.2	4.4	2.2	11.8
All Head Areas Combined	Fresh	20.4	13.0	7.6	41.0
	Healed	26.2	15.6	17.2	59.0
	Total	46.6	28.6	24.8	100.0

occurrence of hook-scars on age 3, 4 and 5 chinook to be 11.8%, 15.2% and 34.4% respectively.

Seasonal hook-scarring incidences for adult and jack chinook in 1985 were the lowest since scarring investigations were instigated in 1979 (Figure 5). The decline in scarring rates from the high level observed in 1982 appears in part to be a reflection of ocean troll fishery harvest which has declined over the same period (refer to Harvest Overview section). However, regulations governing the fishery mandated the use of barbless hooks in Northern California beginning in 1983. The influences of this regulation on scarring rates observed in this study is not yet clearly understood.

Mark-Recapture Analysis

During 1979-1985, 7,738 jaw tags were applied to fall chinook salmon during beach seine operations, and a total of 1,204 tags were recovered within the Klamath-Trinity River basin (Figure 6 and Table 6), for an overall recovery rate of 0.156. In 1985, 1,746 jaw tags were applied to fall chinook, of which 332 tags were recovered, for a seasonal recovery rate of 0.190, the highest attained during the 7-year study period. This unusually high rate may be related to large 1985 returns and associated recovery of 157 jaw-tagged chinook at IGH and TRH (Table 6).

In past seasons, recovery rates were strongly influenced by harvest levels in the Hoopa Valley Reservation Indian gill net fishery, which have been a primary source of recovery information within the basin. The lowest tag recovery rate (0.117) occurred in 1983 and was associated with the lowest observed net-harvest level during the 1979-1985 sample period.

In 1985, 200 of 332 tags recovered were accompanied with sufficient data to be used in analyses. The majority of these tags came from IGH (83) and TRH (56). The mean date of tagging was 9 days earlier for fall chinook recovered at IGH than for those recovered at TRH. Mean julian tagging dates for fall chinook returning to IGH and TRH in 1985 were 234 and 243, respectively reflecting the later entry timing of the Trinity River stock. Mean migration times from the estuary to IGH and TRH in 1985 were 50.2 and 53.8 days, respectively. Similar rates of migration to the hatcheries were observed in previous years with the exception of 1983, when fall chinook reached the facilities in about 10-15 days less than is considered usual.

In 1985, 0.0038 of all fall chinook returning to IGH exhibited USFWS jaw tags, while the equivalent rate at TRH was 0.0041. The rates of USFWS jaw-tag recovery from fall chinook returning to IGH and TRH have remained comparable between these facilities during five of the past six seasons. Despite the small USFWS tag recovery sample sizes during some years, the data suggest that USFWS beach seining operations are capturing IGH and TRH stocks in proportion relative to their run size.

Chinook from the Klamath River basin appear to migrate faster as they proceeded further upstream (Table 7). The increase in migration rate of Klamath River chinook with distance from the river mouth was also noted in previous sampling years. Fall chinook destined for the Trinity River chinook have generally not displayed this trend. A composite summary of 1979-1985 migration data indicates that Trinity River chinook migration rate does

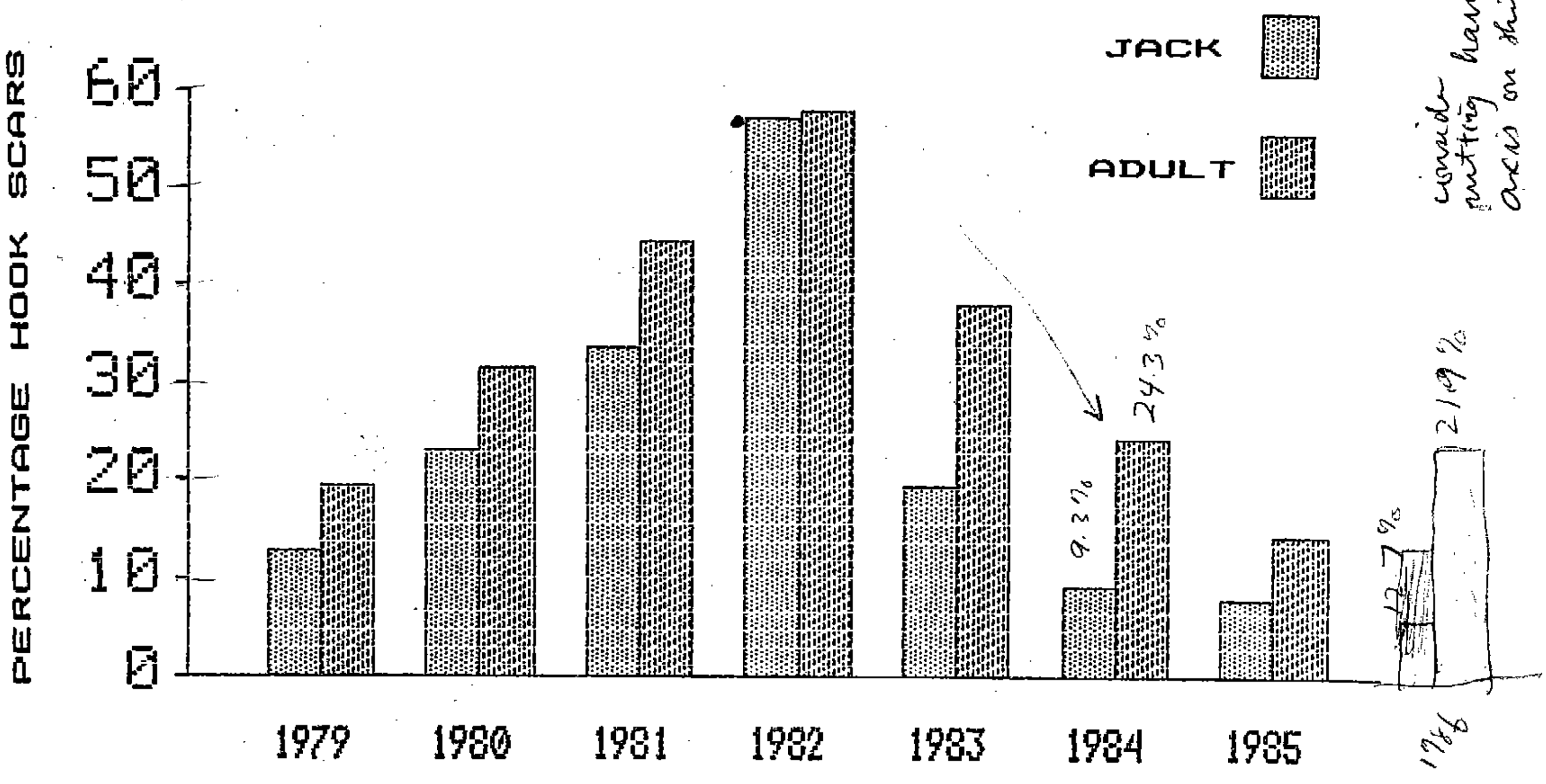
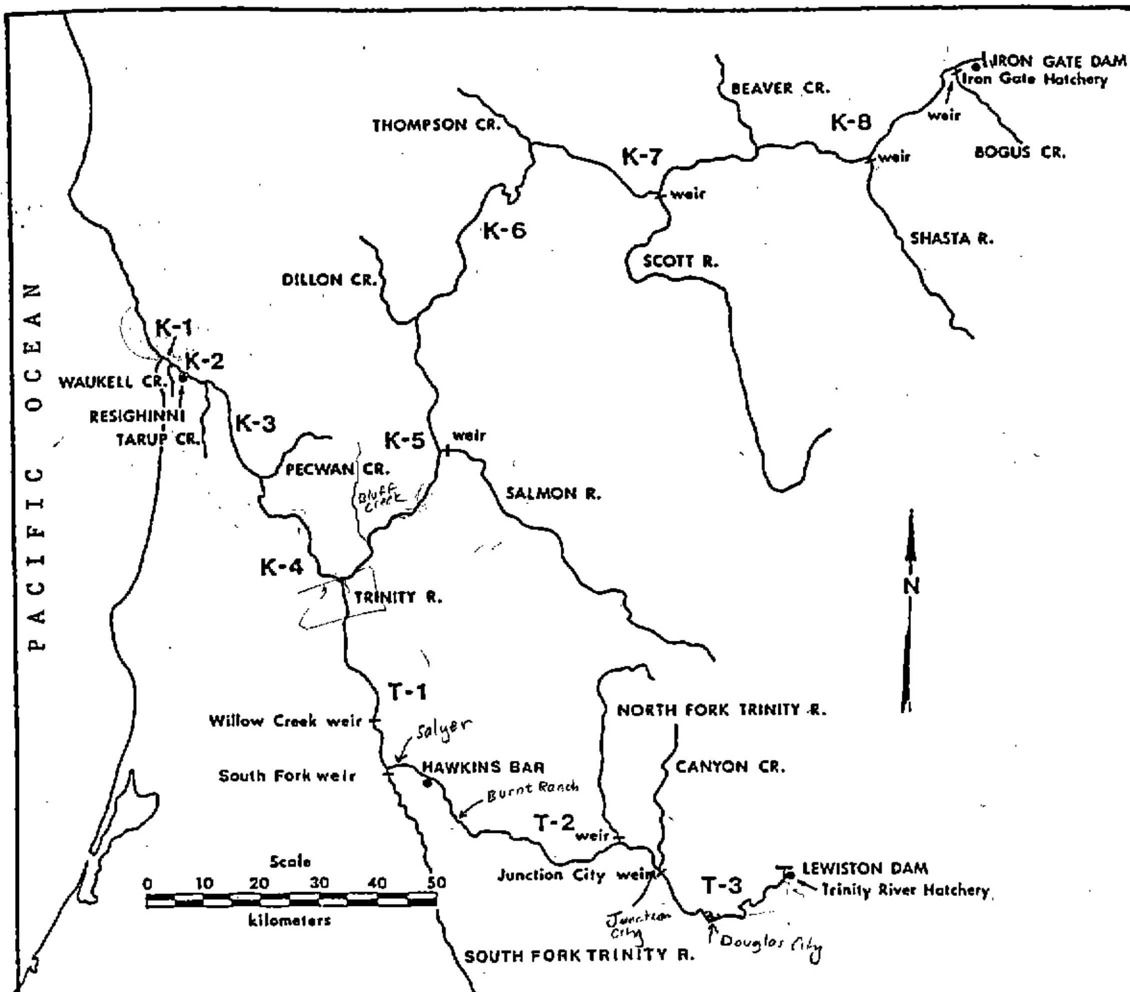


FIGURE 5. Jack and adult chinook salmon hook scarring rates observed during 1979-1985 beach seining operations in the Klamath River estuary.

1986 groupings:
K1-4 } Klamath
K5-K8 }
IGH
T1-T3 } Trinity
TRH }
(eliminated K2-K4)



AREA	
K-1	Mouth of Klamath River to Waukell Creek (km 5)
K-2	Waukell Creek to Tarup Creek (km 13)
K-3	Tarup Creek to Pecwan Creek (km 41)
K-4	Pecwan Creek to Trinity River (km 70)
K-5	Trinity River to Dillon Creek (km 136)
K-6	Dillon Creek to Thompson Creek (km 198)
K-7	Thompson Creek to Beaver Creek (km 259)
K-8	Beaver Creek to Iron Gate Dam (km 306)
T-1	Trinity River mouth to Hawkins Bar (km 134)
T-2	Hawkins Bar to Canyon Creek (km 197)
T-3	Canyon Creek to Lewiston Dam (km 249)

FIGURE 6. Overview map of the Klamath-Trinity River basin delineating recovery areas for chinook salmon tagged during 1979-1985 ~~mark-recapture~~ studies.

TABLE 6. Recovery data from 7,738 fall chinook salmon tagged by the U.S. Fish and Wildlife Service on the Klamath River during 1979-1985 beach seining operations (no tags were applied in 1981).

Source[1/]	1979	1980	1982	1983	1984	1985	Total
	NUMBER RECOVERED						
Gill Net Fishery	14	111	46	14	31	35	251
USFWS Beach Seine	22	67	14	7	20	36	166
Shasta River Weir	50	21	19	0	3	3	96
In-River Sport Fishery	14	43	13	11	7	23	111
Trinity River Hatchery	18	32	16	14	20	72	172
Iron Gate Hatchery	23	14	20	12	14	85	168
Spawning Ground Surveys	7	25	1	0	4	5	37
Bogus Creek Weir	-	-	22	1	8	21	52
Willow Creek Weir	5	6	8	4	11	22	56
CDFG Beach Seine	4	11	3	-	12	5	35
Scott River Weir	-	-	8	2	2	4	16
Junction City Weir	0	2	0	-	4	3	9
South Fork Trinity Weir	-	-	-	-	1	1	2
North Fork Trinity Weir	-	-	1	0	0	-	1
Salmon River Weir	-	-	-	-	-	4	4
Ocean	0	1	0	0	1	0	2
Other (Found Dead)	0	0	8	4	1	13	26
Totals	157	333	179	69	139	332	1,204
Number Tagged	1,016	2,363	1,018	588	1,007	1,746	7,738
Recovery Rate	.155	.141	.176	.117	.138	.190	.156

1/ Listed weirs were not in operation during years where no recovery number is presented.

TABLE 7. Migration data from 200 recoveries of jaw tagged fall chinook salmon within the Klamath-Trinity basin during 1985[1/].

IGH = Iron Gate Hatchery   TRH = Trinity River Hatchery

Area	Kilometers From River Mouth	Tag Recoveries	MIGRATION TIME (Days) Range	MIGRATION TIME (Days) Mean	MIGRATION RATE (Km/Day) Range	MIGRATION RATE (Km/Day) Mean
K-1	0 - 5	6	5-13	10.83	0.35-0.69	0.51
K-2	5 - 13	0	-	-	-	-
K-3	13 - 41	0	-	-	-	-
K-4	41 - 70	0	-	-	-	-
K-5	70 - 136	4	42-76	52.50	1.40-2.53	2.02
K-6	136 - 198	1	-	39.00	-	4.40
K-7	198 - 259	2	37-51	44.00	4.51-6.22	5.23
K-8	259 - 306	15	28-68	42.80	4.49-10.15	6.97
IGH	306	83	29-73	50.18	4.19-10.55	6.10
T-1	70 - 134	25	7-49	18.52	2.46-15.75	4.21
T-2	134 - 197	5	17-30	23.00	6.58-9.66	7.64
T-3	197 - 249	3	27-51	37.67	4.85-7.31	5.89
TRH	249	56	35-82	53.79	3.03-7.10	4.62

1/ Does not include chinook that were recaptured on the same day they were tagged, or chinook found dead on spawning grounds.

1986: J.D. 254 IGH $\bar{X}$ 6.98 L.R = 1979-1986 $Y = -10.12 + .069X$ $r^2 = .858$

accelerate upstream to the mouth of the Trinity River, but becomes highly variable once in the Trinity (USFWS 1983, 1984, 1985).

The peak adult chinook beach seine catch occurred on August 23, 1985 (Julian Day 235). The peak catch date has been used in past seasons as an indicator of run timing to the river mouth. The 1985 run timing did not differ markedly from prior seasons, with the exception of 1983, when the peak adult catch occurred on Julian Day 259. In 1983, the mean migration rate of chinook to IGH was 8.13 km/day, while the corresponding rate for 1985 is 6.10. The 1984 annual report (USFWS, 1985) detailed how in-river migration rates to IGH and peak beach seine catch date are directly correlated. Regressing 1979-1985 data on in-river mean migration rates (to IGH) against the annual peak adult catch Julian Days continues to yield a high coefficient of determination ($r^2 = .906$).

Catch/Effort and Run Timing Analysis Joc / Tom

Catch per unit effort (C/E), a standard measure of sampling success, may be used in drawing general run magnitude and timing trend comparisons between years. Such data must be used with caution however, since certain biases can influence the data in a way which may limit the applicability of results. Annual variations in physical characteristics and environmental conditions in the Klamath River estuary, and seining site locations may affect the availability of chinook to sampling gear. There appears to be no wholly reliable way to evaluate or standardize these sources of potential bias when comparing run and seine catch characteristics between years. Annual variations in the application of sampling effort may also introduce bias into resulting C/E data; however, these influences may be measured and treated. With the above understanding, C/E data from the 1985 beach seine program are presented here.

The 1985 beach seine fall chinook C/E analyses were based on 11,847 salmon caught in 234 seine haul sets; two sets with possible sampling bias have been removed. Numbers of fall chinook captured per seine haul during the 1985 sample were 11.74 for jacks and 38.89 for adults. The highest C/E occurred during low slack tides, followed by the outgoing tidal stage, coinciding with morning and mid-day sampling times (Table 8). The majority of sampling effort was during the outgoing (49.1%) and incoming tidal stages (35.9%); and by time-period, during mid-day (54.3%) and morning (26.9%) hours (Table 9). Although the highest effort (54.3%) was applied during mid-day (100-1400 hrs), the C/E was distinctly highest (49.9%) in the morning period. The data suggest that entry of chinook into the estuary in 1985 was greatest in the morning. Seine haul sets during high slack tide, and low slack tidal periods constituted 5.1 and 9.8 percent of the entire effort, respectively.

In 1985, relative to past years, greater effort was applied during the morning hours, and less during afternoon hours. The mid-day effort level was similar to that of prior years. The percent effort by tidal periods in 1985 differed little from previous sampling seasons. During 1980-1985 no clear and consistent trend is apparent from catch per seine haul data with respect to time of day or tidal period. Treatments to compensate for differing effort levels by time and tide in the 1985 beach seine program were therefore deemed unnecessary.

PUT IN #'s of sets change ?

TABLE 8. Adult chinook salmon catch per seine haul by time of day and tidal stage during 1980-1985 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
1985	Outgoing	51.71	28.49	34.87	36.47
	Low Slack	100.42	134.00	55.00	113.04
	Incoming	20.06	27.41	15.91	24.42
	High Slack	0.00	32.00	0.00	21.33
	ALL TIDES	49.98	36.54	29.80	38.89
1984	Outgoing	0.83	10.44	15.04	10.60
	Low Slack	0.00	11.92	46.67	21.15
	Incoming	2.25	8.83	15.77	11.10
	High Slack	0.00	7.13	1.00	5.45
	ALL TIDES	1.12	9.65	16.67	11.31
1983	Outgoing	8.08	3.92	3.56	4.16
	Low Slack	0.00	7.44	0.33	5.67
	Incoming	1.50	1.23	2.60	1.67
	High Slack	0.00	0.50	0.67	0.50
	ALL TIDES	4.60	2.47	2.96	2.82
1982	Outgoing	24.87	6.27	14.46	11.70
	Low Slack	11.66	10.88	17.50	12.00
	Incoming	5.08	6.54	4.60	5.86
	High Slack	0.00	1.10	0.00	0.93
	ALL TIDES	12.29	6.24	10.44	8.24
1981	Outgoing	1.00	4.54	5.38	4.29
	Low Slack	0.50	1.90	11.00	3.91
	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
1980	Outgoing	0.67	0.75	1.27	0.90
	Low Slack	0.22	1.24	2.79	1.15
	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

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TABLE 9. Number of sets and percent effort by time of day and tidal stage during 1980-1985 beach seining operations in the Klamath River estuary.

Year	Tidal Stage	HOURS OF DAY 0800-1100	1100-1400	1400-1700	All Hours
1985	Outgoing	31 (13.2%)	53 (22.6%)	31 (13.3%)	115 (49.1%)
	Low Slack	12 (5.1%)	10 (4.3%)	1 (0.4%)	23 (9.8%)
	Incoming	17 (7.3%)	56 (23.9%)	11 (4.7%)	84 (35.9%)
	High Slack	3 (1.3%)	8 (3.4%)	1 (0.4%)	12 (5.1%)
	ALL TIDES	63 (26.9%)	127 (54.3%)	44 (18.8%)	234 (100.0%)
1984	Outgoing	23 (7.4%)	70 (22.4%)	53 (16.9%)	146 (46.7%)
	Low Slack	2 (0.6%)	12 (3.8%)	6 (1.9%)	20 (6.3%)
	Incoming	8 (2.6%)	76 (24.3%)	52 (16.6%)	136 (43.5%)
	High Slack	0 (0.0%)	8 (2.6%)	3 (0.9%)	11 (3.5%)
	ALL TIDES	33 (10.6%)	166 (53.1%)	114 (36.3%)	313 (100.0%)
1983	Outgoing	12 (4.0%)	59 (19.4%)	54 (17.8%)	125 (41.1%)
	Low Slack	0 (0.0%)	9 (3.0%)	3 (1.0%)	12 (4.0%)
	Incoming	12 (4.0%)	99 (32.6%)	48 (15.8%)	159 (52.3%)
	High Slack	1 (0.3%)	4 (1.3%)	3 (1.0%)	8 (2.6%)
	ALL TIDES	25 (8.2%)	171 (56.3%)	108 (35.5%)	304 (100.0%)
1982	Outgoing	8 (3.1%)	44 (17.1%)	50 (19.5%)	102 (39.7%)
	Low Slack	3 (1.2%)	9 (3.5%)	2 (0.8%)	14 (5.5%)
	Incoming	12 (4.7%)	79 (30.7%)	35 (13.6%)	126 (49.0%)
	High Slack	1 (0.4%)	13 (5.0%)	1 (0.4%)	15 (5.8%)
	ALL TIDES	24 (9.4%)	145 (56.4%)	88 (34.2%)	257 (100.0%)
1981	Outgoing	10 (3.3%)	39 (12.8%)	21 (6.9%)	70 (23.0%)
	Low Slack	12 (3.9%)	29 (9.5%)	14 (4.6%)	55 (18.0%)
	Incoming	27 (8.8%)	78 (25.6%)	49 (16.0%)	154 (50.5%)
	High Slack	4 (1.3%)	17 (5.6%)	5 (1.6%)	26 (8.5%)
	ALL TIDES	53 (17.3%)	163 (53.5%)	89 (29.2%)	305 (100.0%)
1980	Outgoing	54 (8.5%)	59 (9.2%)	60 (9.4%)	173 (27.1%)
	Low Slack	36 (5.6%)	21 (3.3%)	19 (3.0%)	76 (12.0%)
	Incoming	89 (13.9%)	140 (21.9%)	105 (15.5%)	334 (52.4%)
	High Slack	7 (1.1%)	32 (5.0%)	15 (2.3%)	54 (8.5%)
	ALL TIDES	186 (29.2%)	252 (39.6%)	199 (31.2%)	637 (100.0%)

Adult C/E data depicting general beach seine sample magnitude and run timing trends during 1980-1985 are given in Figure 7. C/E values observed during 1985 were much greater than for previous seasons. Comparative jack and adult catch/effort (CE) values were 1.20 and 11.31 in 1984; 0.47 and 2.82 in 1983; and 3.04 and 8.24 in 1982; respectively (Table 10).

During 1979-1983, seining sites were selected on the South Spit, away from the constricted part of the channel and at varying distances from the river mouth. In 1984 and 1985, sites were chosen in more constricted areas of the channel. It appears from the high adult C/E values of 1984 and 1985, that these latter seining sites allowed for more efficient sampling. This year's site was on the North Spit. This location may have also differed from other years in that the channel depth exceeded the seine net depth during all tidal stages. Despite this, the 1985 C/E was the highest of any season since the inception of the beach seine program in 1979.

The 1985 run peak period (August 2 through September 6), was defined as that period during which adult C/E values in the peak three consecutive sets exceeded 24.0. To identify the 1985 fall chinook run peak, daily adult C/E values were plotted for the peak three consecutive sets (Figure 8). The 24.0 C/E value was chosen because it minimized: 1) the number of points with values less than 24.0 within the peak run period; and 2) the number of points with values greater than 24.0 in the outlying periods. The 1985 peak run period selected therefore reflects the major pulses of entering salmon and excludes periods of effort expended on smaller numbers of fish entering before and after this period.

During the 1985 run peak period a total of 11,555 chinook were captured in 139 sets, and total jack and adult C/E values were 18.5 and 64.6, respectively. The duration (36 days) of the 1985 peak run period did not differ markedly from previous years (33 days, 1980-1984 average). The peak run period has begun in August in five of the the past six seasons.

The above run peak period and C/E information is useful for in-season run-size estimation purposes which are described below.

Run-Size Estimation TTK

Annual post-season estimates of Klamath Basin fall chinook run sizes have been prepared by the CDFG since 1978 (Table 11). However, reliable in-season estimates have not been developed for management of the in-river fisheries. Since 1980, C/E indices from USFWS beach seine data have been developed for such purposes. These jack and adult run-strength indices were developed by multiplying C/E in the peak three sets during the defined run-peak period by the seasonal duration of these periods (number of consecutive days).

Relationships have been explored between derived indices and run size estimates provided by the CDFG. Least squares linear regressions were fitted to jack and adult run-strength indices and post-season run-size data. During 1980-1984, the jack component of the run size estimate has yielded high correlations when regressed against USFWS run strength indices. Equivalent analyses applied to the adult run-size estimates repeatedly resulted in low correlations.

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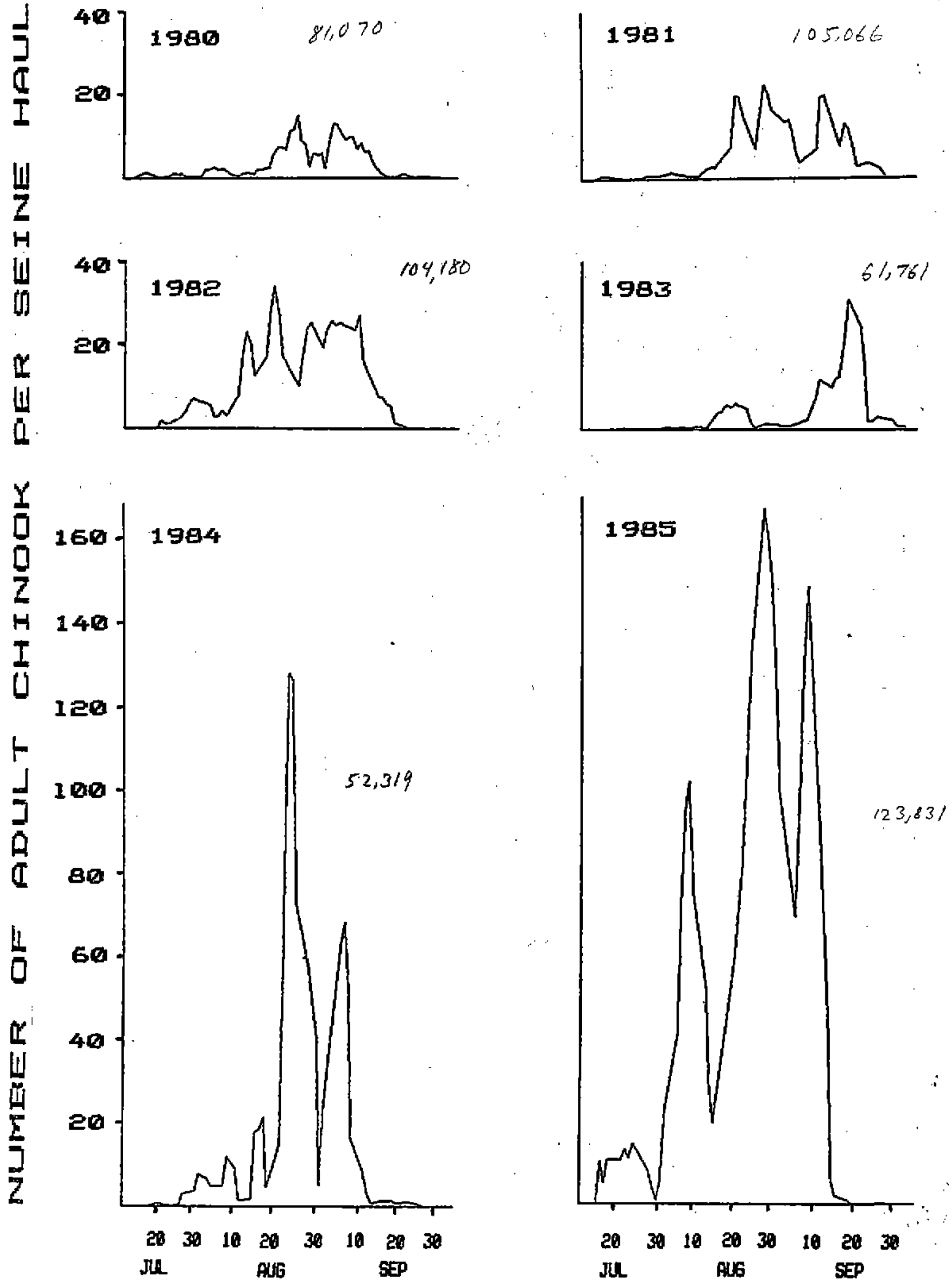

FIGURE 7. Three-day moving averages of the numbers of adult chinook salmon captured per beach seine haul (peak three sets) in the Klamath River estuary during 1980-1985. All years drawn to same scale.

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TABLE 10. Summary of catch/effort data for chinook salmon captured during 1980-1985 beach seining operations in the Klamath River estuary. The 1985 season dates reflect the fall chinook run period. The total field sampling season was from 7/15-9/25/85.

Timing	Chinook Run Component	YEAR 1980	1981	1982	1983	1984	1985
Season		7/13-9/28	7/13-9/25	7/19-9/22	7/15-10/5	7/17-9/28	7/29-9/25
All Sets	Jacks	2.40	1.90	3.04	0.47	1.20	11.74
	Adults	1.65	3.92	8.24	2.82	11.31	38.89
	Total	4.06	5.82	11.28	3.29	12.51	50.63
Peak Three Sets	Jacks	4.73	2.97	4.49	0.76	1.98	15.21
	Adults	3.41	6.55	12.19	4.46	18.36	55.15
	Total	8.14	9.51	16.68	5.22	20.25	70.21
Run Peak Period		8/18-9/10	8/18-9/15	8/9-9/9	8/13-9/18	7/27-9/7	8/2-9/6
All Sets	Jacks	5.13	4.21	5.41	0.91	1.86	18.53
	Adults	4.11	9.18	14.42	5.48	18.93	64.60
	Total	9.24	13.39	19.83	6.39	20.79	83.13
Peak Three Sets	Jacks	9.90	6.28	8.14	1.32	3.10	24.24
	Adults	8.57	14.38	21.80	8.45	31.36	91.20
	Total	18.47	20.67	29.94	9.77	34.46	114.73
Total Catch All Sets1/		2584	1774	2901	999	3914	11847
Total Catch Peak Three Sets1/		1880	1427	2303	767	3159	8847
Percent Of Total In Peak Three		72.8	80.4	79.4	76.8	80.7	74.7

1/ Jacks and adults.

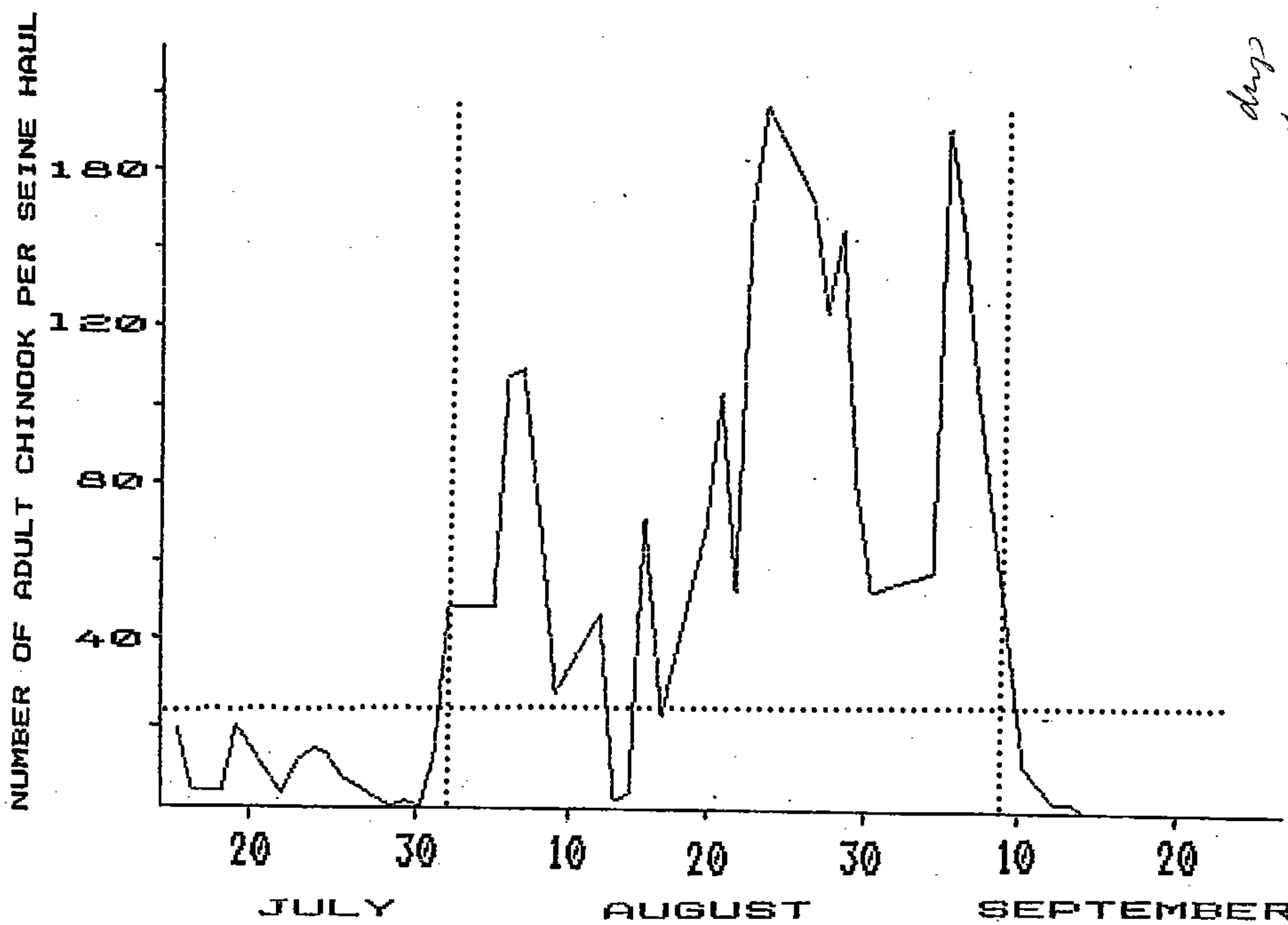

FIGURE 8. Daily numbers of adult chinook salmon captured per beach seine haul (peak three sets) in the Klamath River estuary during 1985. From this figure, the run peak period was determined to be from 8/2/85 to 9/6/85.

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TABLE 11. Post-season run size estimates for Klamath River basin fall chinook during 1980-1985[1].

	1980[2]		1981[2]		1982[2]		1983[3]		1984[3]		1985[3]	
	Jack	Adult	Jack	Adult	Jack	Adult	Jack	Adult	Jack	Adult	Jack	Adult
Spawning Escapement												
IGH	451	2,412	540	2,055	1,833	8,353	514	8,371	764	5,330	2,678	19,432
TRH	2,256	4,099	1,004	2,370	3,916	2,063	276	5,765	669	1,902	15,815	1,758
Subtotal	2,707	6,511	1,544	4,425	5,749	10,416	790	14,136	1,433	7,232	18,493	21,190
Natural	26,982	21,483	16,507	33,857	16,455	30,112	2,540	31,547	5,368	15,434	34,040	22,747
TOTAL SPAWNING ESCAPEMENT	29,689	27,994	18,051	38,282	22,204	40,528	3,330	45,683	6,801	22,666	52,533	43,937
Harvest												
Sport Angler	5,891	4,496	7,252	5,983	12,484	8,339	353	4,342	1,591	2,136	10,407	3,833
Indian Net	987	12,013	2,465	33,033	1,799	14,482	163	7,890	453	18,484	1,555	11,566
TOTAL HARVEST	6,091	14,099	9,717	39,016	13,894	22,168	516	12,232	2,044	20,620	11,962	15,399
TOTAL IN-RIVER RUN	36,597	44,503	27,768	77,298	38,997	65,183	3,846	57,915	8,845	43,286	64,495	59,336

harvest overview

1/ All estimates from the CDFG except that portion of total run size derived from net harvest data collected by USFWS FAO-Arcata, or HVBC Fisheries Department. The 1980 and 1982 jack and adult sport angler values were changed by CDFG in 1985, from previous reports.

2/ Final estimates for these years.

3/ Estimates preliminary. IGH = Iron Gate Hatchery TRH = Trinity River Hatchery

Addition of the 1985 jack run strength index into the 1980-1984 data base altered the regression line and lowered the coefficient of determination (r^2) from .919 to .804. The 1985 run strength index increased considerably from past years, but was not accompanied by a proportionate increase in the CDFG jack run size estimate. Thus, the 1985 index did not conform well to the existing data base. The high C/E indices of 1984 and 1985 are plausibly attributed to the change of beach seining sites, which in 1985, had a profound effect of increasing chinook susceptibility to capture.

The validity of using C/E-derived data for estimating in-season abundance relies on certain assumptions which were detailed in the 1983 annual report (USFWS, 1984). The 1985 C/E results do not support the assumed relationship whereby C/E levels, between years, are comparable in relative representation to run size.

Data presented here and in previous reports have described the problems encountered in estimating in-season run abundance. The influences of river mouth morphology/seine site location, and abnormal run entry timing have been significant in affecting C/E values derived and limited the utility of the in-season abundance prediction model. Although further research into model development may be pursued, it appears unlikely that accurate in-season run size prediction will be feasible through this method.

Graphics → TTK
Keith's → JCP/TTK

AGE COMPOSITION → Joe is in charge

INTRODUCTION

Continuous monitoring of the age composition of a fish stock impacted by major fisheries is essential to sound resource management. Age data, in combination with length and weight measurements, provide information on stock composition, age at maturity, mortality, growth and production. Such information may be used in setting pre-season management goals and regulations. Analyses of these parameters are also useful in judging the results and effectiveness of management practices employed. As part of a continuing effort to evaluate age composition of chinook salmon runs in the Klamath basin, scales were again collected from fall chinook salmon sampled through a beach seining program near the mouth of the Klamath River. A summary of age information collected on fall chinook entering the Klamath since 1979 is presented herein.

METHODS

Age structure of the 1985 fall chinook run was determined through analysis of scale samples collected in beach seining operations between July 29 and September 20. Scale samples collected before July 29 were excluded to avoid possible aging bias from inclusion of spring chinook in the sample. Data from CWT recoveries in the Indian gill-net fishery showed that chinook captured prior to July 29 were predominately spring race while after that date the majority were fall race.

Employing statistical analyses involving the hypergeometric distribution (Dixon and Massey 1969), it was determined that a subsample of 299 scales would estimate the age-class percentages of 2-, 3- and 4-year-old fall chinook at the 95% level of precision for a predicted run size of 120,000, assuming the least abundant age class to constitute 25% of the total cohort run. The California Department of Fish and Game (CDFG) has estimated the 1985 Klamath River fall chinook in-river run-size to be 123,800 (PFMC 1986). A total of 500 scale samples were selected for analysis in order to ensure the desired level of precision and account for some unreadable scales.

A weighted stratified random sampling method was utilized to select a 500 scale subsample from the total of 2,344 samples collected in the 1985 beach seining operation. Differential weighting was applied to compensate for an uneven scale collection pattern relative to daily beach seine catch. This method produced a sample which was distributed through time proportionately to the total catch and assumed to be representative of the entire 1985 Klamath River fall chinook run.

Cellulose acetate impressions of fall chinook scales were made utilizing a Carver Model "C" hydraulic laboratory press equipped with two variable temperature heating elements. Impressions were viewed on a Bell and Howell ABR-1020 dual lens projector. Scales were analyzed independently by two interpreters, with a third group reading which included an additional interpreter when the initial two readings differed. Scales not aged with confidence after the third reading were excluded from the cohort analysis.

Scales from known age fish (coded-wire-tag recoveries) were used to assist in age determination.

Percentage age composition of beach seine captured fall chinook was applied to the aforementioned in-river run estimate, as reported by the Pacific Fishery Management Council (PFMC). In this manner contributions by age group were assigned to the 1985 fall chinook in-river run.

RESULTS AND DISCUSSION

The majority of Klamath River fall chinook returning in 1985 were age 3 (38.0%), followed by age 4 (29.6%), age 2 (25.7%) and age 5 (6.7%) (Table 12). The 1985 run showed an increased proportion of age 2 fish (13.0% to 25.7%) and a decrease in proportion of age 4 fish (42.5% to 29.6%) compared to the 1984 run. The percentage of 3-year-old chinook in 1985 was similar to 1984. Overall percentage age composition in 1985 was similar to the 1979-1985 average. should be 45%

Estimates of age group contribution to fall chinook in-river runs for the 1979-1985 return years are presented in Table 13. It should be noted that CDFG estimates for jack and adult components of the in-river run are not in agreement with USFWS age composition data derived through scale analysis and length frequency information. As in past years, a decision was made to apply USFWS cohort percentages to CDFG total run size estimate (as reported in PFMC 1986), in order to remain consistent with overall age composition data and to allow consistent comparison of cohort groups through brood year cycles. This decision is based on the rationale that (1) data collected through beach seining operations are the only available estimates of age composition representing the entire Klamath River fall chinook run and (2) these data have proven to be valuable in estimating ocean stock size of 3- and 4-year-old Klamath River fall chinook (PFMC 1985, PFMC 1986). These estimates are presented solely for comparative purposes, and are not intended to supplant those generated by the CDFG.

Returns of all age groups in 1985 were higher than the 7-year average (Table 13). The 2-year-old return of 31,824 was considerably larger than the low estimates for 1983 and 1984 and comparable to the 1981 and 1982 returns. The estimated 3-year-old (47,506) and 4-year-old (36,654) chinook returns were 46% and 48% above respective 7-year averages and the second highest for their respective age groups. The contribution of age 5 chinook (8,297) was over 2.5 times the 1979-1985 average and twice the return of any of the previous 6 years.

Since 1976, the 1978 brood has provided the largest contribution (94,789) of in-river adult returns (Figure 9). The strength of this brood year is apparently due to the large escapement of 71,451 adult chinook in 1978 compared to 45,683 or fewer in subsequent years. The 1976 and 1977 brood in-river adult returns of 37,257 and 29,955 respectively, were severely depressed compared to 1978, 1979 (53,774) and 1980 (65,292) brood adult in-river returns. Based on 3- and 4-year-old returns of 57,506, the 1981 brood year appears similar to the 1979 and 1980 brood years in strength.

Combine 12 + table 14 one table from both!! ←

TABLE 12. Percentage age composition of Klamath River fall chinook derived from scale analysis and length-frequency information during the 1979-1985 return years.

Return Year	AGE 2	3	4	5 1/
1979	14.4	32.8	46.6	6.2
1980 2/	58.0	17.8	19.1	5.1
1981	32.9	53.6	12.0	1.5
1982	29.1	32.0	36.1	2.8
1983	12.9	54.3	31.4	1.4
1984	13.0	40.0	45.0	2.0
1985	25.7	38.0	29.6	6.7
1979-1985 Average	26.6	38.3	31.4	3.7

1/ Includes some 6-year-old fish.

2/ Based on length-frequency data only. No scales collected in the 1980 season.

TABLE 13. Estimated number of fall chinook by age entering the Klamath River during the 1979-1985 return years.

Return Year	AGE 2	3	4	5	Total
1979	8,867	20,197	28,695	3,818	61,577
1980	47,021	14,430	15,484	4,135	81,070[1/]
1981	34,567	56,315	12,608	1,576	105,066
1982	30,316	33,338	37,609	2,917	104,180[1/]
1983	7,967	33,536	19,393	865	61,761
1984	6,777	20,852	23,459	1,043	52,131
1985	31,824	47,056	36,654	8,297	123,831
1979-1985 Average	23,905	32,246	24,843	3,236	84,230

1/ Estimated total and associated numbers for 1980 and 1982 differ slightly from those published in previous annual reports due to changes in CDFG run size estimates.

Leave out ??

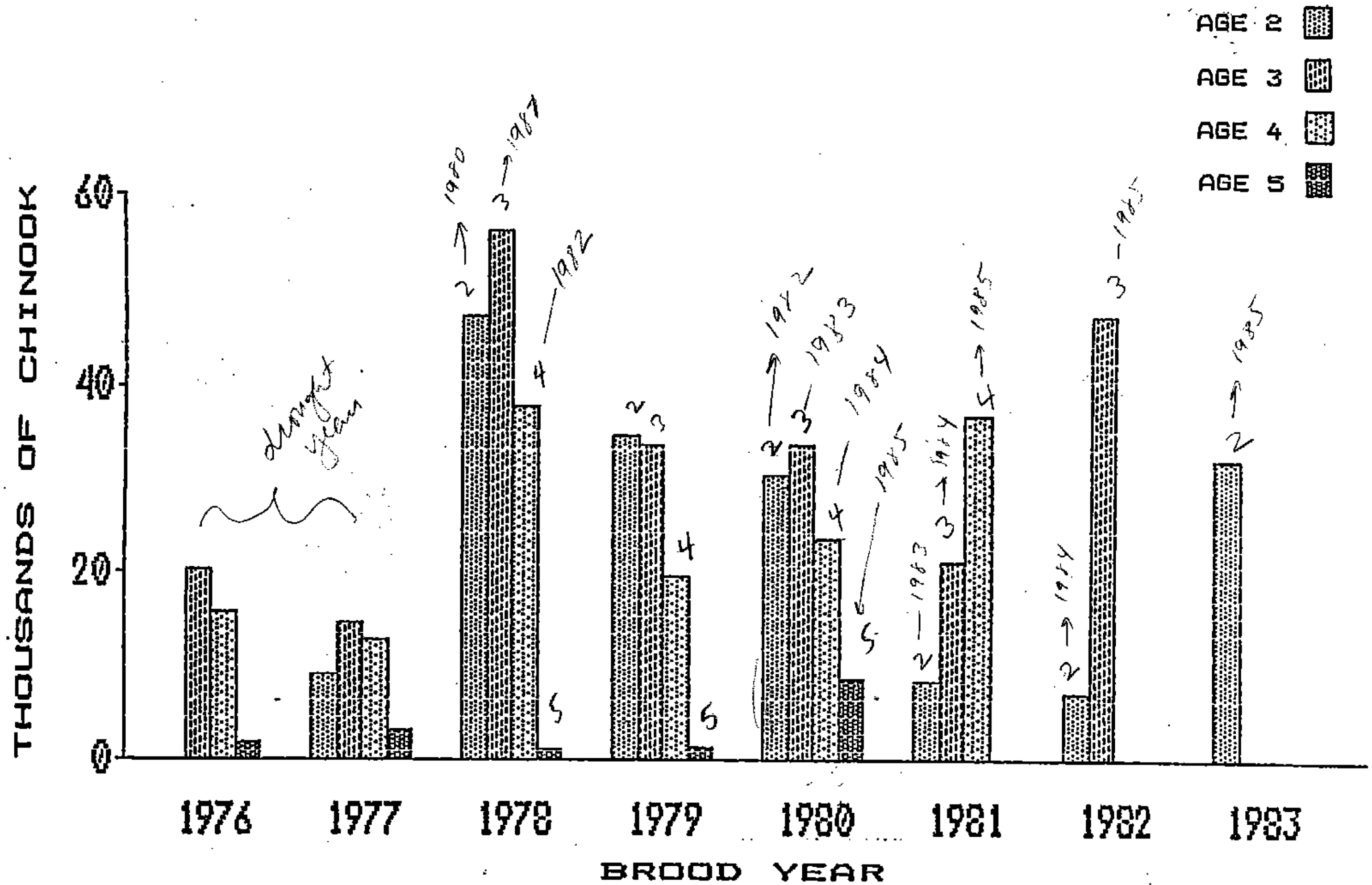


FIGURE 9. Brood year contribution by age of fall chinook salmon to the 1979-1985 Klamath River returns.

The number of 2-year-olds returning has generally been a good indicator of the strength of a given brood year. This was particularly evident for the 1979-1980 brood years. Based on this, it appeared that the 1981 and 1982 brood returns would be similar to the depressed 1976 and 1977 broods. However, the trend observed in previous years did not hold for 1981 or 1982 as subsequent 3-year-old (1981 and 1982) and 4-year-old (1981) returns were much larger than would be expected compared to 2-year-old returns for these brood years. Reductions in ocean troll fishery effort coupled with favorable environmental conditions in 1984 and 1985 may have contributed to these larger than expected returns. With a 2-year-old contribution of 31,824, the 1983 brood year appears to be similar in strength to the 1979 and 1980 year classes.

Based upon completed returns for the 1977-1980 brood years the average age composition for returning Klamath River fall chinook is 31.7% age 2, 37.4% age 3, 26.4% age 4 and 4.5% age 5. Mean ages at return for the 1977, 1978, 1979 and 1980 broods are 3.25, 2.94, 2.85 and 3.10 respectively, averaging 3.03 for the four brood years.

Mean lengths of fall chinook returning at age in 1979-1985 return years are presented in Table 14. Chinook returning as 2-, 3-, and 4-year-olds in 1985 were significantly larger (t-test; $p<0.05$) than respective age groups returning in 1983 or 1984, and similar in length to those returning during 1979-1982. Mean length of age 5 fish returning in 1985 were found to differ significantly (t-test; $p<0.05$) only from age 5 chinook that returned in 1979. The increase observed in mean lengths at age of fall chinook returning in 1985 compared to 1983 and 1984 returns, and significance regarding ocean growth conditions, are discussed in a subsequent chapter.

combine with Table 12

TABLE 14. Mean length ($\bar{X}$) cm, standard deviation (s) and sample size (n) of fall chinook returning at age in 1979 and 1981-1985 return years.

Return Year		AGE AT RETURN			
		2	3	4	5
1979	$\bar{X}$	**48.8**	**70.1**	**80.3**	**88.7**
	s	6.54	5.78	5.69	6.48
	n	97	221	314	42
1981	$\bar{X}$	**50.2**	**68.1**	**80.5**	**89.0**
	s	4.95	6.85	6.09	5.95
	n	176	287	64	8
1982	$\bar{X}$	**48.3**	**69.3**	**83.2**	**87.2**
	s	4.25	6.51	7.02	7.48
	n	161	177	200	13
1983	$\bar{X}$	**41.9**	**60.3**	**71.5**	**82.2**
	s	3.73	4.82	6.07	6.77
	n	80	338	195	9
1984	$\bar{X}$	**45.4**	**62.9**	**72.6**	**81.1**
	s	3.89	3.96	4.78	7.89
	n	123	379	426	19
1985	$\bar{X}$	**51.0**	**70.5**	**81.0**	**84.7**
	s	4.99	4.23	5.60	5.32
	n	126	186	145	32

NET HARVEST MONITORING PROGRAM

INTRODUCTION

Hoopa, Karok and Yurok Indian peoples living along the Klamath and Trinity Rivers have traditionally fished for salmon, steelhead, sturgeon and other species using a variety of fishing gear including weirs, dip nets, spears, and gill nets. Historically, salmon consumption by these people exceeded 907,000 kg (2 million pounds) annually (Hoptowit 1980). For historical accounts of the Indian fisheries see Hoptowit (1980), Bearss (1981) and USFWS (1981).

Regulations governing recent Indian fishing on the Hoopa Valley Reservation (HVR) were first published by the Department of the Interior in 1977, and FAO-Arcata biologists began monitoring net harvest levels on the Reservation in 1978 (USFWS 1981), with efforts focused on fall chinook salmon. Further progress was made in ascertaining net harvest levels with the establishment of a net harvest monitoring station in the lower Klamath River in 1980. Net harvest monitoring operations were expanded upriver beginning in 1981 for Reservation-wide coverage of the net fishery. Since 1983, FAO-Arcata biologists have focused monitoring efforts solely on the Klamath River portion of the Reservation, operating three monitoring stations based near Requa, Omagar Creek and Johnson. Responsibility for monitoring net harvest levels on the Trinity River portion of the HVR was taken over by the Hoopa Valley Business Council (HVBC) Fisheries Department in 1983.

Beginning in 1984, FAO-Arcata biologists employed a stratified random sampling methodology to assess fall season net harvest levels for chinook salmon, coho salmon, steelhead trout, and sturgeon on the Klamath River portion of the HVR in an attempt to improve the accuracy and gauge the precision of the harvest estimates. The techniques employed during former seasons yielded point estimates without associated measures of variance. Although they are considered reasonably reliable and accurate, no quantifiable measure of precision can be calculated for estimates made prior to 1984.

Because of the predicted depressed Klamath River fall chinook run in 1985, ocean troll and Indian gill net harvests of chinook were restricted in order to increase the number of spawners. Toward this goal, the Department of Interior (DOI) enacted regulations designed to reduce Indian gill net harvest of fall chinook.

METHODS

Net harvest monitoring data were collected and compiled from three contiguous areas (Estuary, Middle Klamath, and Upper Klamath) of the Klamath River portion of the HVR in 1985 (Figure 10). The Estuary Area was defined as the lower 6 km of the river from the mouth to the crossing of the Highway 101 bridge. The Middle Klamath comprised the next 27 km of river from the crossing of the Highway 101 bridge to Surpur Creek, 33 km upstream from the mouth. The Upper Klamath Area included the next 37 km stretch of river from Surpur Creek to Weitchpec. During the 1985 fall chinook fishery, DOI

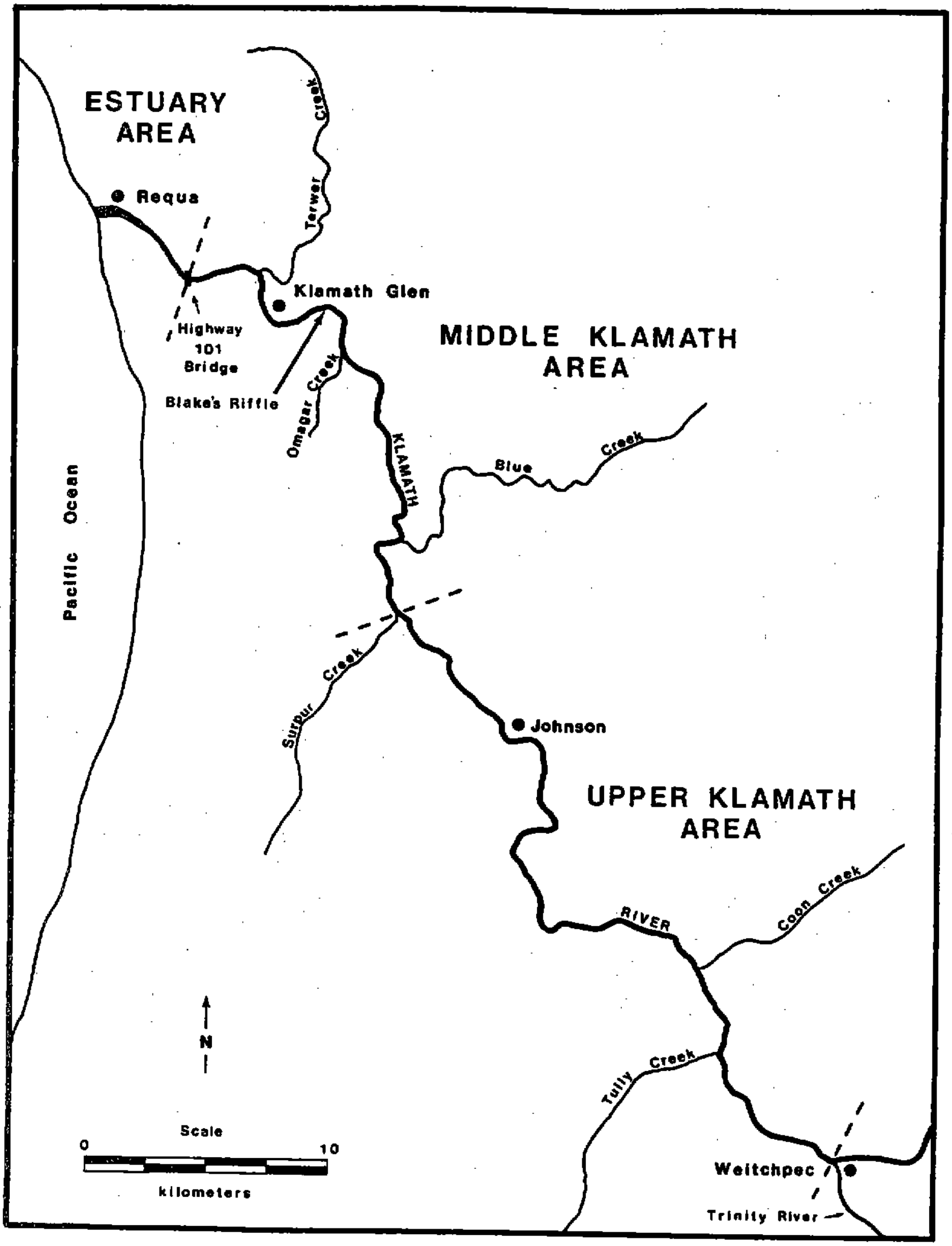


FIGURE 10. Net harvest monitoring areas for the Klamath River portion of the Hoopa Valley Reservation in 1985.

regulations divided the reservation into three management zones that differ from the above areas. These zones, coupled with time closures were designed to allow equitable distribution of harvest throughout the HVR and yet to allow fishing through the fall chinook season. Area I included the portion of Klamath River from the mouth to Blake's Riffle (River km 16). Area II began at Blake's Riffle and continued upriver to the confluence of the Trinity River (River km 70). Area III consisted of the Trinity River portion of the HVR. FAO-Arcata biologists monitored the harvest in Management Areas I and II while the HVBC Fisheries Department was responsible for estimating the harvest in Management area III. In order to keep the data as comparable to previous years as possible, data in this report will be analyzed with regard to the three monitoring areas utilized in previous years. Still, much of the data collected in 1985 will not be comparable to previous years because of the harvest restrictions imposed on the Indian net fishery and their effect on catch and effort.

Fall Fishery

The design employed by FAO-Arcata biologists to estimate harvest in 1985 involved a stratified random sampling technique with an optimum allocation of sampling effort based on the available data and associated variances. The actual estimate is comprised of two parts: an estimate or count of total effort and an estimate of average catch per net for each area and net type. Each part of the estimate has an associated variance estimate. These variances are combined to give an estimated daily variance. The daily estimates of catch and variance are expanded to total estimates of catch variance by area, net type and time period, usually semi-monthly. Following are the methodologies utilized for monitoring fall chinook harvest in each area and for subsequent data analyses.

Estuary Area

One field crew, consisting of one biologist and two Indian technicians, monitored the Estuary Area fishery from July 12 to September 30. Under pre-season DOI regulations, the Estuary (part of DOI Management Area I) was open to gill net fishing weekly from Friday at noon until Sunday at noon from July 15 to August 31 and from Saturday at noon until Sunday at noon from September 1 to September 15, however an in-season closure did occur. The crew monitored the estuary fishery every day the fishery was open between July 12 and September 14 and 4-days-per-week between September 15 and September 30. In order to improve 1985 harvest and variance estimates, the Estuary Area was subdivided into two sections. Section 1 included the area from the mouth to Panther Creek and Section 2 included the area from Panther Creek to the Highway 101 Bridge (Figure 11).

Section 1 was a high effort area where nets were fished for varied lengths of time throughout the 24 hour day. Because the harvest rate varied widely in this section during a 24 hour period, each day was stratified into three 8 hour time periods: Day (10am - 6pm), evening (6pm - 2am) and morning (2am - 10am). Field crews conducted total net counts every 2 hours when monitoring the fishery. Indian fishers were interviewed to obtain information on number of fish caught, species identification and number of nets and hours fished. Indian fishers not contacted on the river were

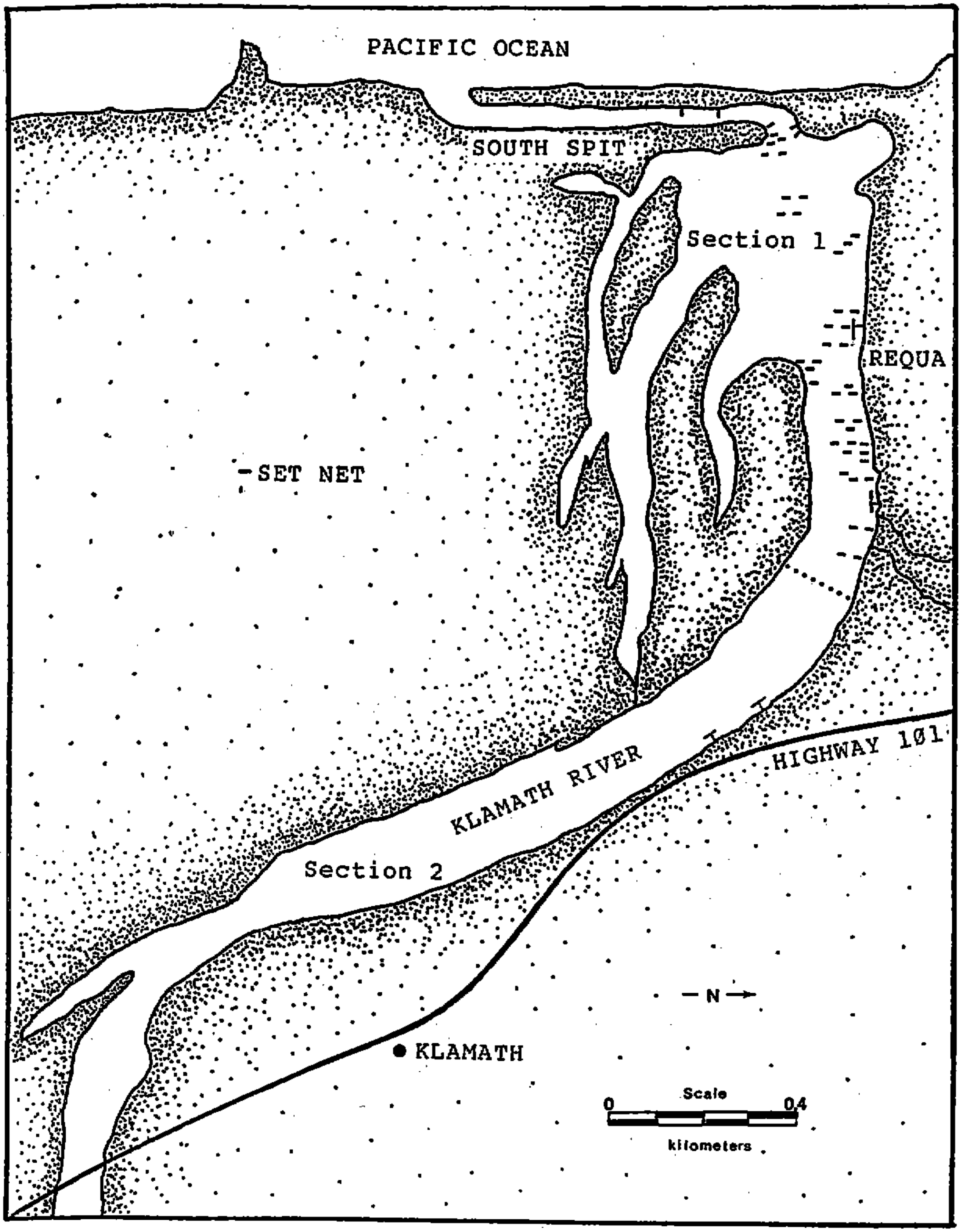


FIGURE 11. Section delineation and typical set net placement in the Estuary Area during the 1985 fall chinook salmon run.

interviewed later at their residences or camps. From this information, harvest and variance estimates were generated for each time strata.

Section 2 was characterized as having very low effort and nets were generally fished for a constant length of time (overnight). A single net count was conducted at dark each evening open to fishing. If nets were observed, the fishers were contacted the next morning at their camps. A single harvest and variance estimate was made daily. Interviews were conducted in a like manner to those in Section 1.

In addition to gathering catch data, fall chinook were bio-sampled in the estuary net fishery. Sampled fish were measured to the nearest centimeter fork length, examined for tags and fin-clips, and inspected for seal or otter-bite damage. Snouts were removed from adipose fin-clipped fish for subsequent coded-wire tag identification. A subsample of chinook in the Estuary Area were weighed to the nearest pound and these weights were then converted to kilograms. Because weight samples could not be collected from the entire fall chinook run, additional fish were weighed during beach seine operations to insure a representative sample.

Based on CWT recoveries in the estuary net fishery, it became apparent that a substantial mixed race fishery occurred during July. Contributions of spring and fall chinook to the fishery were estimated using observed ad-clip rates of known spring and fall run chinook. Length and mark sample data collected during this mixed fishery were not used in comparisons with past years data.

Middle Klamath Area

One field crew consisting of one biologist and one Indian technician, working from a camp near Omagar Creek, monitored the Middle Klamath Area from July 26 to October 27 (Figure 12). Under pre-season DOI regulations the Middle Klamath Area below Blake's Riffle was part of management Area I and as such was open to gillnetting during the same period as the Estuary Area. The Middle Klamath Area above Blake's Riffle was part of Management Area II and was open for fishing under pre-season DOI regulations two days per week, beginning Friday at noon and continuing until Sunday at noon from August 15 to September 30. An in-season closure did occur in 1985. The fishery was monitored every day the fishery was open from August 15 to September 14 and 4- to 5-days-per-week from July 26 to August 15 and September 15 to October 27. To monitor the set net fishery, a total net count was conducted by boat after dark over the entire section of river. At dawn, the crew contacted Indian fishers and sampled the set net harvest.

To monitor the drift net fishery, total net counts were conducted by boat between approximately 8:00 PM and 1:00 AM when drift netting typically occurs. The harvest was sampled either that evening or the following morning. Interviews with drift and set net fishers were conducted in a like manner to those in the Estuary Area.

Upper Klamath Area

One field crew, consisting of one biologist and one Indian technician working out of a camp at Johnson, monitored the Upper Klamath Area from

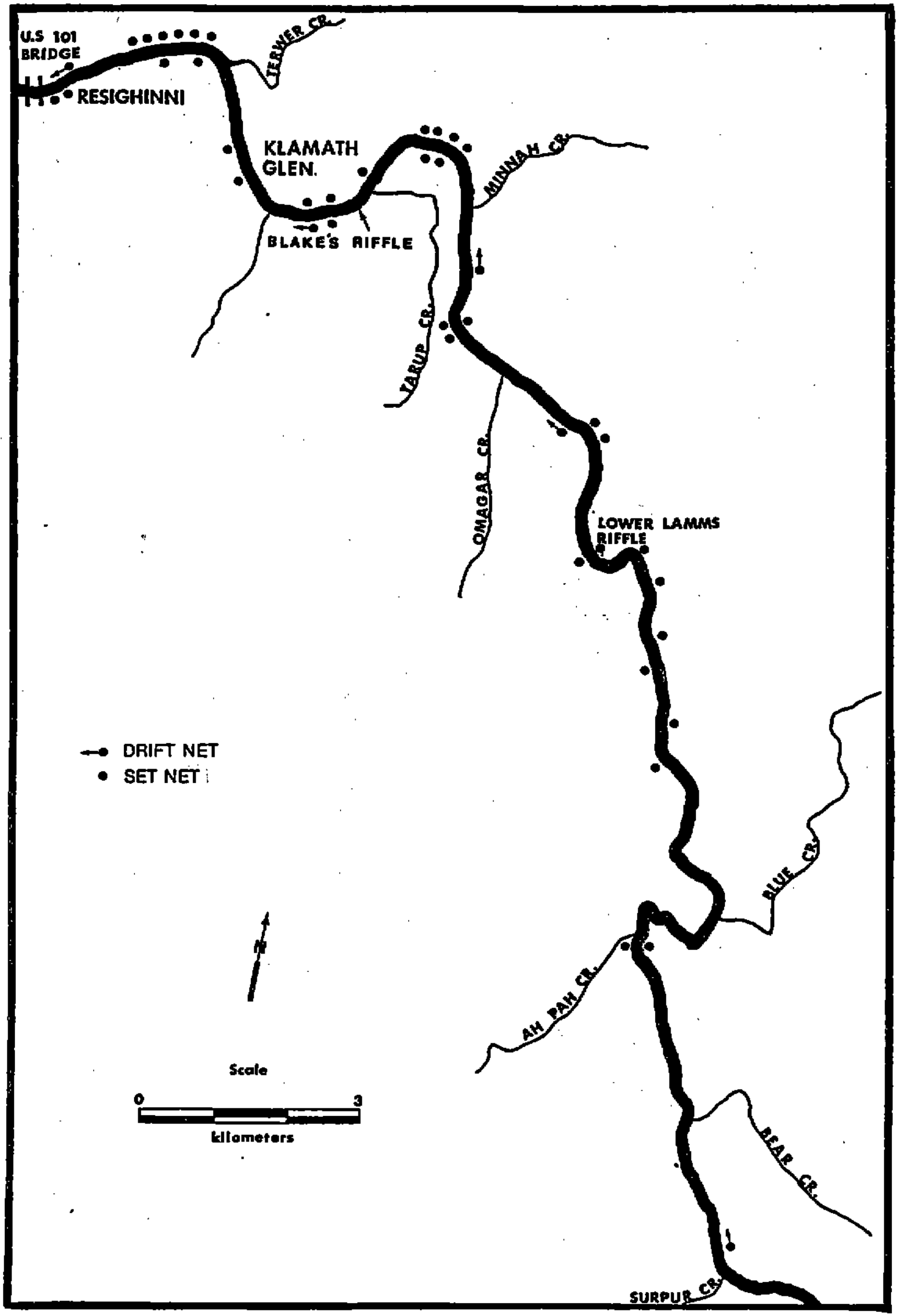


FIGURE 12. Typical net placement pattern in the Middle Klamath Area during the 1985 fall chinook salmon run.

August 1 to October 31 (Figure 13). Under DOI regulations, the Upper Klamath Area was included in management Area II and as such was open during the same period as the Middle Klamath Area above Blake's Riffle. The crew monitored the fishery every day it was open between August 15 and September 30 and 4- to 5-days-per-week from August 1 to August 14 and October 1 to October 31. The sampling methodologies for set and drift net fisheries were the same as in the Middle Klamath Area.

Data Analysis

Definitions and notations for all equations presented herein are summarized as follows:

a = Number of fishing days available in the time period.

$\overline{C}$ = Daily mean catch per net.

$\hat{C}_i$ = Estimated catch for the ith day.

$\hat{C}_{is}$ = Estimated catch for the sth strata in the ith day.

$\hat{C}_p$ = Estimated catch for the pth period.

s = Number of days sampled in the time period.

t = t value at the 95% level.

Y = Daily total number of nets fished.

y = Daily number of nets sampled.

$\hat{Y}_{is}$ = Estimated daily total number of nets fished.

$\hat{V}(\hat{C}_i)$ = Estimated variance of daily catch.

$\hat{V}(\hat{C}_{is})$ = Estimated variance for the sth strata in the ith day.

$V(\overline{C})$ = Variance of the mean catch per net.

$\hat{V}(\hat{C}_p)$ = Estimated variance of catch for the pth period.

$V(C_s)$ = Daily variance of catch.

$\hat{V}(\hat{Y})$ = Estimated variance of daily total number of nets fished.

Estuary (section 1) estimates ($\hat{C}_{is}$) of catch by strata and species were calculated by multiplying mean catch per net values by the respective estimated total number of nets fished in the strata (Hankin personal communication):

$$(1a)\quad \hat{C}_{is} = (\hat{Y}_{is})(\overline{C}_{is})$$

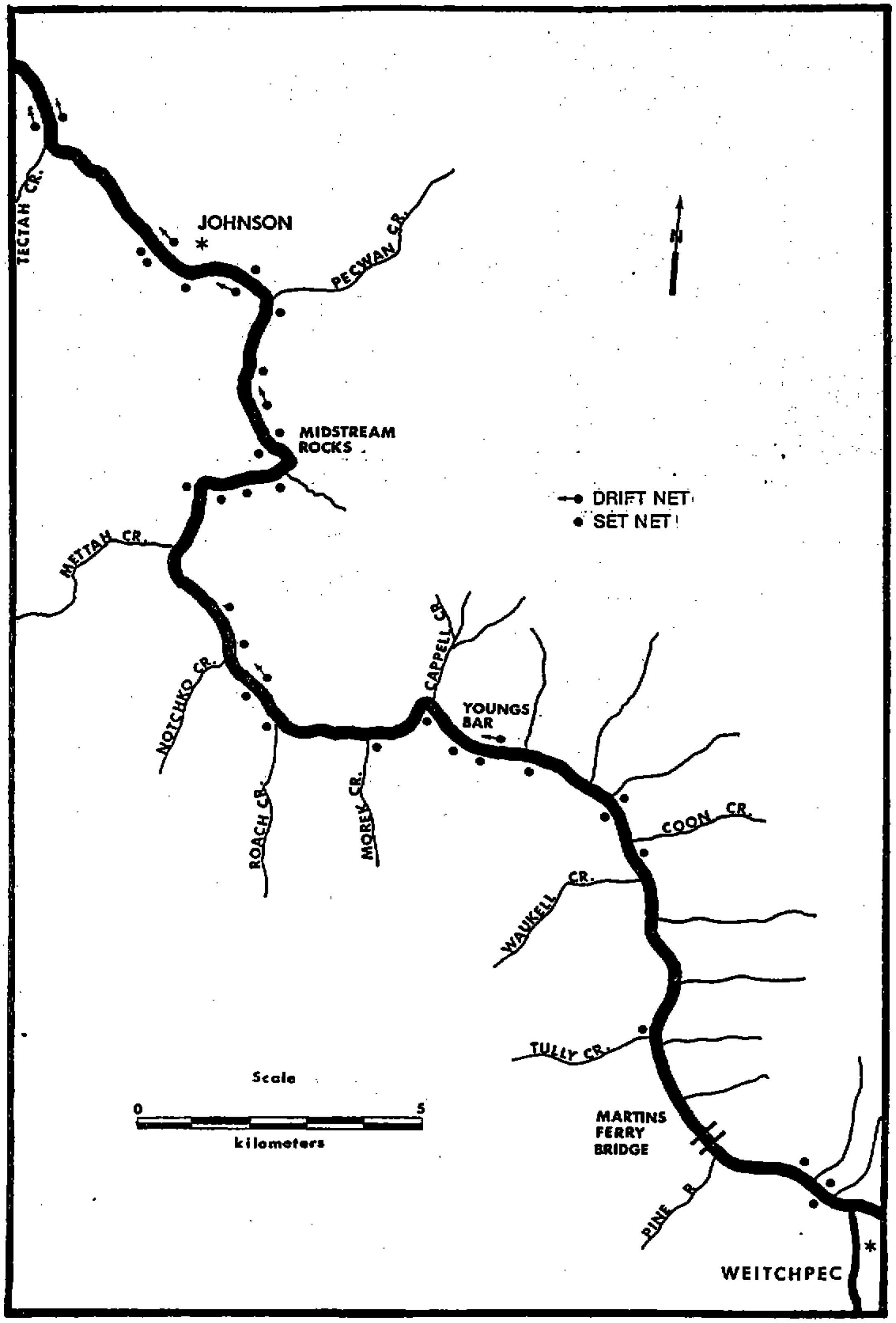


FIGURE 13. Typical net placement pattern in the Upper Klamath Area during the 1985 fall chinook salmon run.

periodic basis from April 15 to June 15. Personnel operating from the Arcata office monitored the portion of the Upper Klamath Area above Coon Creek during the same period.

During the spring monitoring period, Indian fishers were contacted while in their boats, at their riverside camps, or at boat landings in the area. Information obtained included number of fish caught, species identification, mesh size, and number of nets fished. River surveys, including net counts, were scheduled to coincide with hours when fishers typically checked their nets. Indian fishers not contacted on the river were later interviewed at their residences. Chinook were bio-sampled in the spring net fishery in the same manner previously described for the fall fishery.

Procedures used in estimating net harvest for the three Klamath monitoring areas during the 1985 spring fishing period were similar to those of previous years. Estimated daily 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 the estimated percentage of net harvest these sums were judged to represent. These judgements were based on net counts, a network of contacts on the reservation and on intimate knowledge of the net fisheries. Spring chinook harvest estimates were determined monthly for each of the three areas.

RESULTS AND DISCUSSION

Fall Chinook

FAO-Arcata biologists examined 2,566 fall chinook salmon harvested by Indian fishers on the Klamath River portion of the HVR in 1985. Of these, 2,537 were mark sampled for tags and fin-clips and 1,465 measured to fork length. Net harvest in the Klamath River portion of the reservation was estimated at 10,233 ±1,029 fall chinook salmon (Table 15), including 9,625 adults (94.1%) and 608 jacks (<61 cm). Among the three monitoring areas, 59.2% (5,700) of the adult harvest occurred in the Estuary Area. Jacks comprised 2.3% (132) of the total 1985 estuary catch. The Middle and Upper Klamath Area fisheries comprised 18.0% (1,731) and 22.8% (2,194) of the total 1985 adult harvest, respectively. Jacks accounted for a respective 14.1% (283) and 8.1% (193) of the total Middle and Upper Klamath Area catches (Table 16). Corresponding 1985 fall chinook harvest estimates for the management areas established by the DOI are 6,082 adults and 167 jacks in management area I and 3,543 adults and 441 jacks in management area II.

Daily estimates of harvest by species were calculated by summing the three strata harvest estimates.

Estuary (section 2), Middle Klamath and Upper Klamath Areas estimates ($\hat{C}_i$) of catch by species were calculated by multipling mean catch per net values by the respective total net count:

$$(1b) \quad \hat{C}_i = (Y)(\overline{C}_i)$$

Since the harvest was not sampled every day fishing occurred, the harvest was estimated for time periods using the equation:

$$(2) \quad \hat{C}_p = (\Sigma \hat{C}_i) \frac{a}{s}$$

These estimates of catch were summed to yield the season harvest estimate.

The variance associated with each Estuary (section 1) strata harvest estimate was calculated by using the equation (Goodman 1960):

$$(3a) \quad \hat{V}(\hat{C}_i) = (\overline{C})^2 [\hat{V}(\hat{Y})] + (\hat{Y})^2 [V(\overline{C})] - [\hat{V}(\hat{Y})] [V(\overline{C})]$$

The daily estimate of variance was calculated by summing the three strata estimates of variance.

The variance associated with daily harvest estimates in the Estuary (section 2), Middle Klamath and Upper Klamath Areas was calculated by using the equation:

$$(3b) \quad \hat{V}(\hat{C}_i) = V(\hat{C})(Y / y)$$

Because the catch variance is estimated on a daily basis, it must be expanded to include days fished but not sampled. The variance associated with the catch estimate for a time period is calculated by the equation (Cochran 1977):

$$(4) \quad \hat{V}(\hat{C}_p) = \frac{a(a-s) \quad \Sigma(\hat{C}_i - \overline{C})^2}{s(a-1)} + \frac{a \, [\Sigma \hat{V}(\hat{C}_s)]}{s}$$

Once the estimate and associated variance were calculated for a period, the corresponding 95% confidence interval was calculated by:

$$(5) \quad \text{95\% Confidence Interval} = \pm (t_{.975}) \sqrt{\frac{\hat{V}(\hat{C}_p)}{a}}$$

<u>Spring Fishery</u>

FAO-Arcata personnel, operating from a camp at Requa, monitored the fishery from the mouth to Coon Creek (River km 60), (including the Estuary Area, Middle Klamath Area and a portion of the Upper Klamath Area), on a

TABLE 15. Semi-monthly set and drift net harvest estimates of fall chinook salmon captured in the three Klamath River monitoring areas of the Hoopa Valley Reservation under Department of Interior promulgated regulations in 1985.

	NET HARVEST MONITORING AREA						
Time Period	Estuary	Middle Klamath Set Net	Middle Klamath Drift Net	Upper Klamath Set Net	Upper Klamath Drift Net	Semi-Monthly Totals (All Areas)	Cumulative Seasonal Total
July 1 - 15	111 1/	0	0	0	0	111	111
	21 2/	-	-	-	-		
	18.9% 3/	-	-	-	-		
	41 4/	-	-	-	-		
July 16 - 31	684	0	0	0	0	684	795
	45	-	-	-	-		
	6.6%	-	-	-	-		
	443	-	-	-	-		
August 1 - 15	4,985	134	1	104	72	5,296	6,091
	264	34	1	14	12		
	5.3%	25.4%	100.0%	13.5%	16.7%		
	2,816	71	1	60	48		
August 16 - 31	0	787	133	898	471	2,289	8,380
	-	28	17	43	24		
	-	3.6%	12.8%	4.8%	5.1%		
	-	441	85	397	324		
September 1 - 15	0	495	133	382	363	1,373	9,753
	-	25	32	308	76		
	-	5.1%	24.1%	80.6%	20.9%		
	-	343	115	156	82		
September 16 - 30	52	226	65	0	0	343	10,096
	15	10	8	-	-		
	28.4%	4.4%	12.3%	-	-		
	23	137	40	-	-		
October 1 - 15	0	21	15	44	40	120	10,216
	-	7	4	13	8		
	-	33.3%	26.7%	29.5%	20.0%		
	-	13	6	14	23		
October 16 - 31	0	4	0	12	1	17	
	-	5	-	10	5		
	-	125.0%	-	83.3%	500.0%		
	-	3	-	4	1		
Area Season Total	5,832	1,667	347	1,440	947		10,233
	345	109	62	388	125		1,029
	5.9%	6.5%	17.9%	26.9%	13.2%		10.1%
	3,323	1,008	247	631	477		5,686

1/ Harvest estimate.
2/ 95% Confidence interval.
3/ Confidence interval percentage.
4/ Accounted number of fall chinook.

TABLE 16. The number and percentage of jack and adult fall chinook caught in the net fishery on the Klamath River portion of the HVR under Department of Interior promulgated regulations in 1985.

Area	Jack	(%)	Adult	(%)	Total	(%)
Estuary	132	(2.3%)	5,700	(97.7%)	5,832	(57.0%)
Middle Klamath	283	(14.1%)	1,731	(85.9%)	2,014	(19.7%)
Upper Klamath	193	(8.1%)	2,194	(91.9%)	2,387	(23.3%)
Total All Areas	608	(5.9%)	9,625	(94.1%)	10,233	(100.0%)

Most of the salmon harvested in the Estuary Area were taken by August 10 with peak harvest occurring on August 9 (Figure 14). Fishing was prohibited between August 10 and September 15 because the harvest quota had been reached. Very few fall chinook were caught after the estuary reopened on September 15. During the time period the estuary was open, daily catch estimates for fall chinook ranged from 0 to 2,364, compared to a peak daily catch of 1420 observed in 1984. Since the number of nets fished was not substantially greater than observed during peak harvest periods in previous years, the increase in peak daily catch over 1984 may be due, in part, to 1985 harvest regulations. Whereas the estuary was open 6 nights per week in 1984, it was only open 2 nights per week in 1985 and returning chinook were able to enter the estuary for 5 days without fishing pressure, allowing the population size in the estuary to build. U.S. Fish and Wildlife beach seine data has shown chinook to hold in the estuary for an extended period (approximately 7-10 days) before moving upstream. When fishing resumed, a large number of chinook were available for harvest and fishing success rates were higher than normal on the first day of each weekly 2-day opening. The following day's harvest averaged only 40% of the first day's harvest indicating a reduction in the available Estuary Area chinook population and a resumption of harvest rates commensurate with those observed in previous years.

Comparison of 1985 catch per net night indices and peak harvest with those of previous seasons are not possible considering the above mentioned influence on harvest. However, river flow continues to be the primary factor influencing total Estuary Area net fishery success. Annual seasonal net fishery catch per effort levels observed are inversely porportional to mean Klamath River summer flows (USFWS 1985). Higher flows impact the net fishery by creating more turbulent currents which reduce the amount of time a net will properly fish without being pulled out of the vertical fishing position or pulled off the bottom. The increase in the volume of water in the estuary

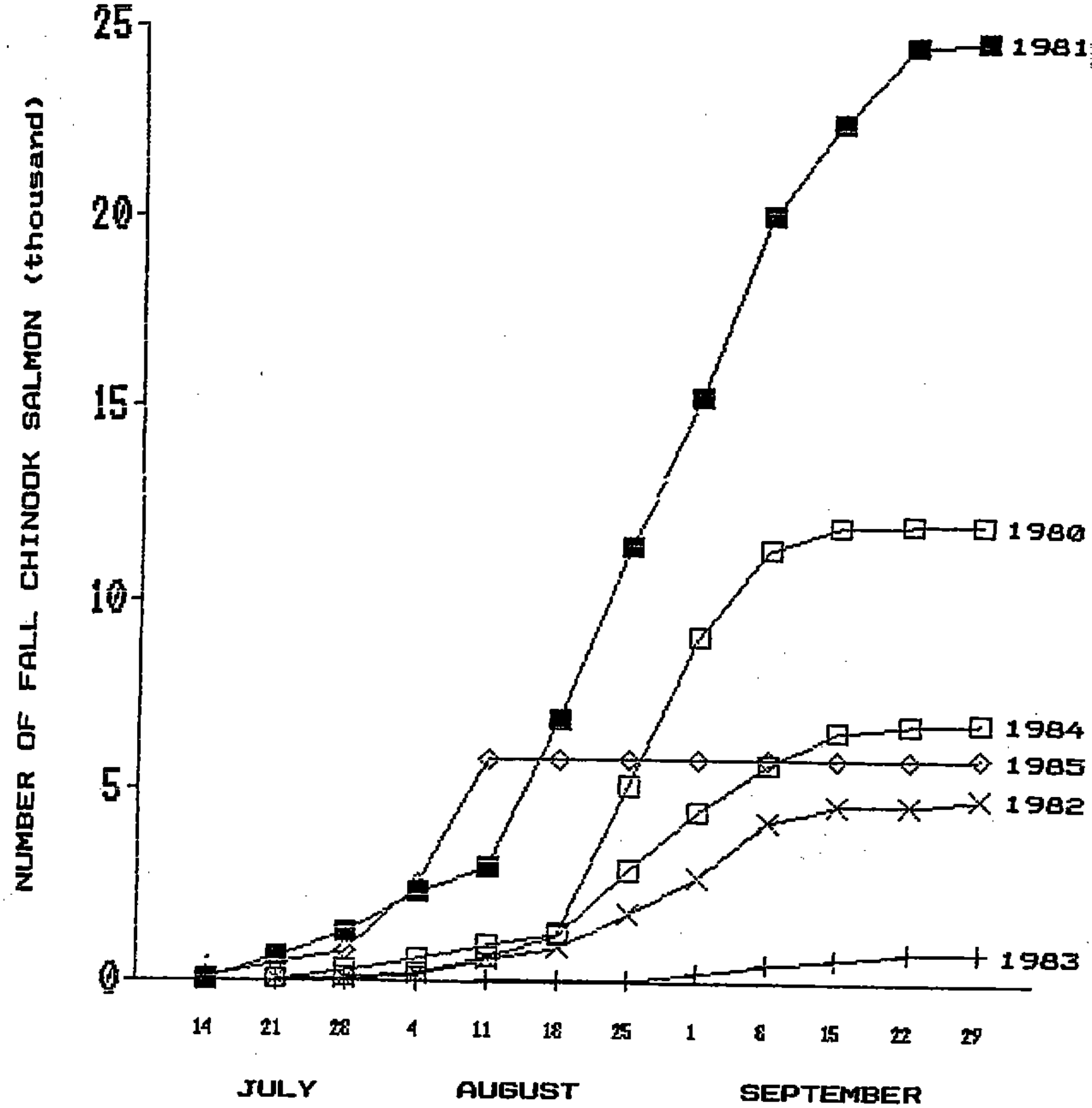


FIGURE 14. Cumulative estimated number of fall chinook salmon caught by Indian fishers in the Estuary Area of the Klamath River during 1980-1985.

during high flow periods presumably also make it less likely for fish to encounter the nets. During 1985, lower than average summer flows, 3570 cfs compared to an average of 4281 cfs, appear to have influenced the high daily catches observed.

As was the case in the Estuary Area, the Middle and Upper Klamath Areas were managed using time closures and quotas. Peak 1985 harvest rates of 13.6 and 18.3 chinook per set and drift net, respectively, in the Middle Klamath Area and 8.1 and 40.0 chinook per set and drift net in the Upper Klamath Area, were observed during the weekend of September 6-7. Both upriver areas were closed after September 7.

The portion of the Middle Klamath Area below Blake's Riffle (within DOI Management Area I) reopened to chinook harvest on September 15. Some chinook were harvested after September 15, but the species composition had shifted to 44% chinook and 56% coho. After September 30, 93% of the catch in this portion of the Area was coho.

The impact of 1985 regulations (two days per week open) in the upriver fisheries was different than that described for the Estuary fishery; The weekly closures allowed more fish to pass the fishery. The difference can clearly be seen in the 1985 catch per net values, which in the upriver areas are comparable to those observed during previous year's reflecting that once the chinook pass the estuary they accelerate their migration rate and become less available for harvest. The beach seine mark-recapture data, which show that chinook migration rates increase markedly once the fish have passed the estuary, further support this observation.

River flow does not appear to be a major influencing factor in the success of the upriver net fisheries. Annual seasonal catch per effort levels for the Indian fishers in the Middle and Upper Klamath Areas show no significant correlation with mean summer flows (USFWS 1985).

The length-weight relationship $\log W = -4.562 + 2.858 \log L$ was determined from a sample of 192 chinook salmon ranging in fork length from 43 to 91 cm and in weight from 1.2 to 11.8 kg (Figure 15). Chinook jacks taken in the 1985 Klamath River net fishery averaged 50.9 cm fork length and 2.0 kg in weight, and adults averaged 77.2 cm and 6.8 kg. Combining jack and adult samples, the average fall chinook salmon captured in the Klamath River net fishery in 1985 measured 75.5 cm fork length and weighed 6.4 kg.

Based on annual length-weight regressions, a 75 cm chinook would on the average have weighed 6.3 kg in 1985. For comparison, a 75 cm chinook would have weighed 6.9 kg in 1984, 5.6 kg in 1983, 6.1 kg in 1982 and 6.3 kg in 1981. From this information the body condition of fall chinook appears to have recovered from the effects of the 1982-1983 El Niño.

Length-frequency comparisons of fall chinook harvested in the Estuary Area fishery over the last 4 years (Figure 16), show the 1985 fall chinook adult mean length, 78.1 cm, to be significantly greater ($p<0.05$) than the respective mean length of adults in the 1984 and 1983 but significantly smaller than the mean length in 1982. The mean length of jacks harvested in the Estuary Area in 1985 (49.2) was significantly greater ($p<0.05$) than in 1984 and 1983, but not significantly different ($p>0.05$) than in 1982.

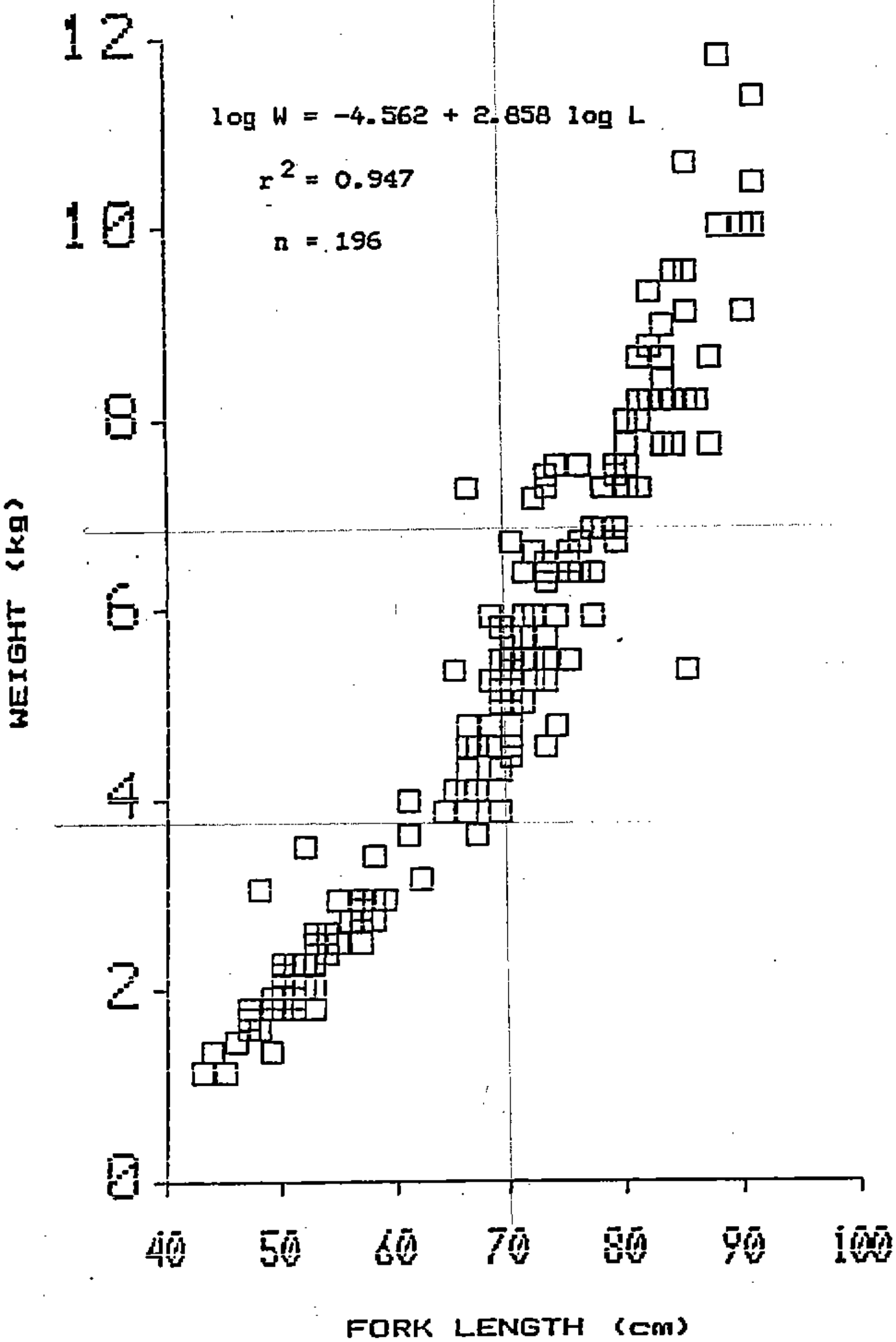


FIGURE 15. Length-weight relationship of fall chinook salmon caught by Indian fishers on the Lower Klamath River in 1985.

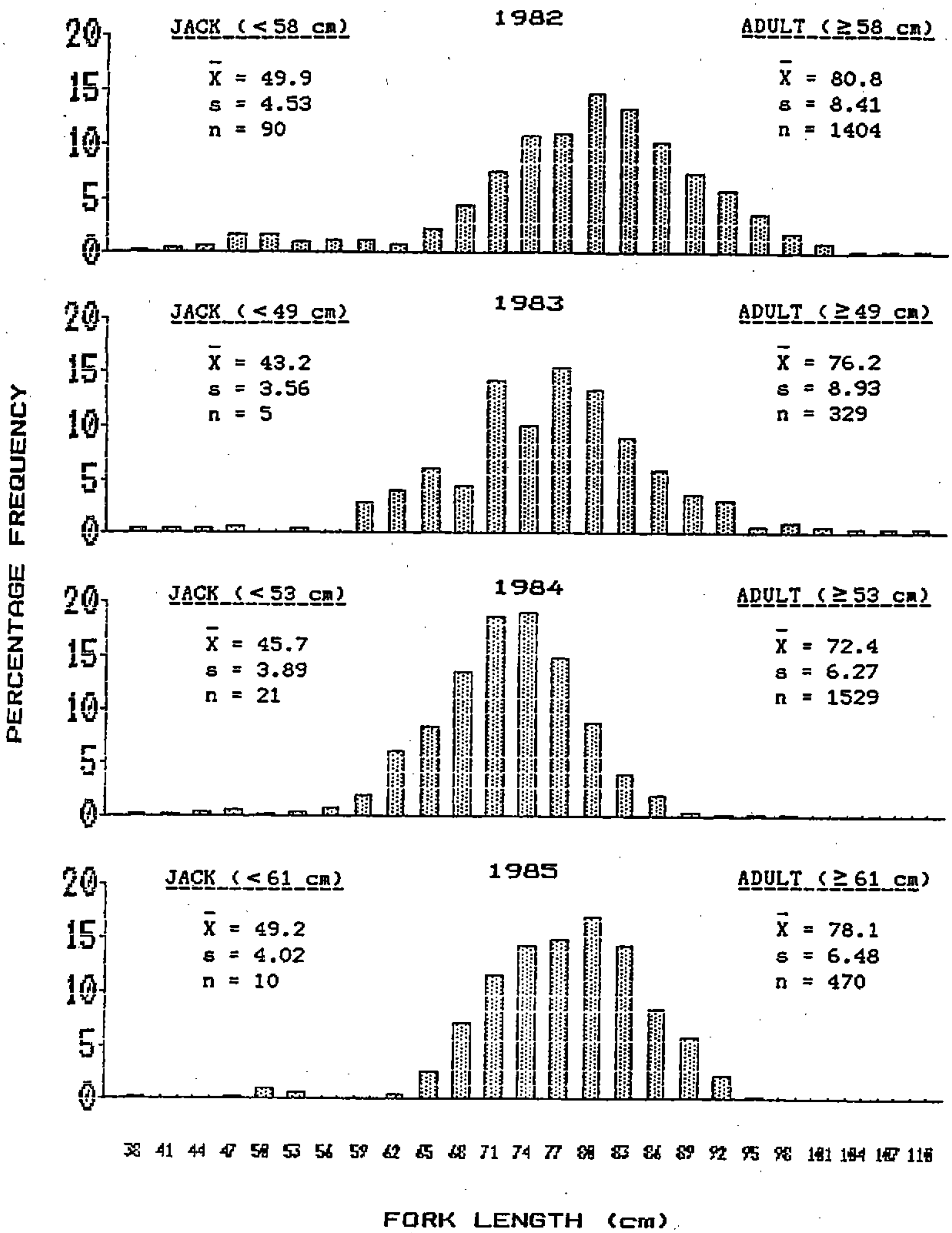


FIGURE 16. Length frequency distributions of fall chinook salmon caught by Indian gill net fishers in the Estuary Area during 1982-1985 (3 cm groupings with midpoints noted).

Length-frequency comparisons of adult fall chinook harvested in the three Klamath Areas in 1985 show that mean fork length in the estuary was significantly greater ($p<0.05$) than the Upper and Middle Klamath Areas (Figure 17). However, a mean fork length comparison of adult chinook taken in the Middle and Upper Klamath Area fisheries showed no significant difference ($p>0.05$). Jacks displayed no significant differences ($p>0.05$) in mean fork length between the three areas.

Length-frequency distributions of fall chinook measured in the 1982-1985 combined net fisheries on the Klamath River portion of the HVR are presented in Figure 18. Mean lengths of adult chinook sampled in 1985 were significantly greater ($p<0.05$) than in 1983 and 1984, but were significantly smaller ($p<0.05$) than in 1982. Mean lengths of jacks sampled in 1985 were signicantly greater ($p<0.05$) than the three previous years.

Chinook exhibiting adipose fin-clips, representing various hatchery CWT release groups, comprised 10.3% of the total 1985 fall chinook net harvest in the Klamath River portion of the HVR, including 9.2, 11.2, and 10.3% of the harvest in the Estuary, Middle Klamath and Upper Klamath Areas, respectively (Table 17). Adipose-clipped adult chinook averaged 74.5 cm fork length and were significantly smaller ($p<0.05$) than non-clipped adult chinook, which had a mean length of 77.4 cm.

TABLE 17. Fin-clipped fall chinook salmon observed in the 1985 Indian gill net fishery on the Klamath River portion of the Hoopa Valley Reservation.

		FIN CLIPS					
		AD		LV		RV	
Area	Mark Sample	N	%	N	%	N	%
Estuary	826	76	9.2	64	7.7	5	0.6
Middle Klamath	993	111	11.2	53	5.3	10	1.0
Upper Klamath	718	74	10.3	56	7.8	3	0.4
Total	2,537	261	10.3	173	6.8	18	0.1

Right and left ventral (RV and LV) fin-clipped fall chinook, representing a constant fractional marking program for Iron Gate (IGH) and Trinity River (TRH) hatcheries, entered the net fishery as 3-, 4- and 5-year-olds in 1985. Totals of 173 LV (IGH) and 18 RV (TRH) clipped chinook were sampled in the 1985 Klamath River net harvest, with 41.9, 30.0 and 28.1% of

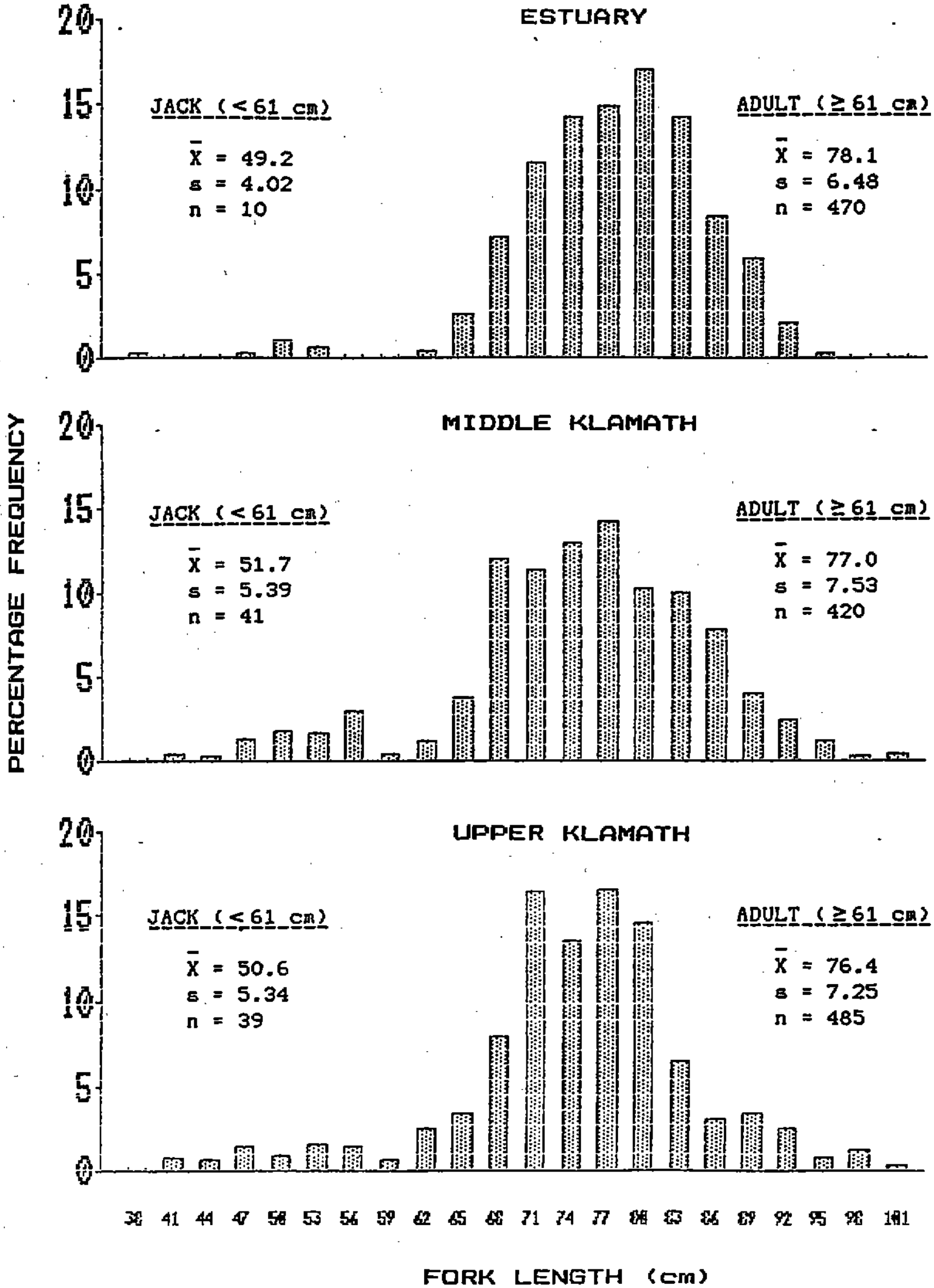


FIGURE 17. Length frequency distributions of fall chinook salmon caught by Indian gill net fishers in the Estuary, Middle Klamath, and Upper Klamath Areas in 1985 (3 cm groupings with midpoints noted).

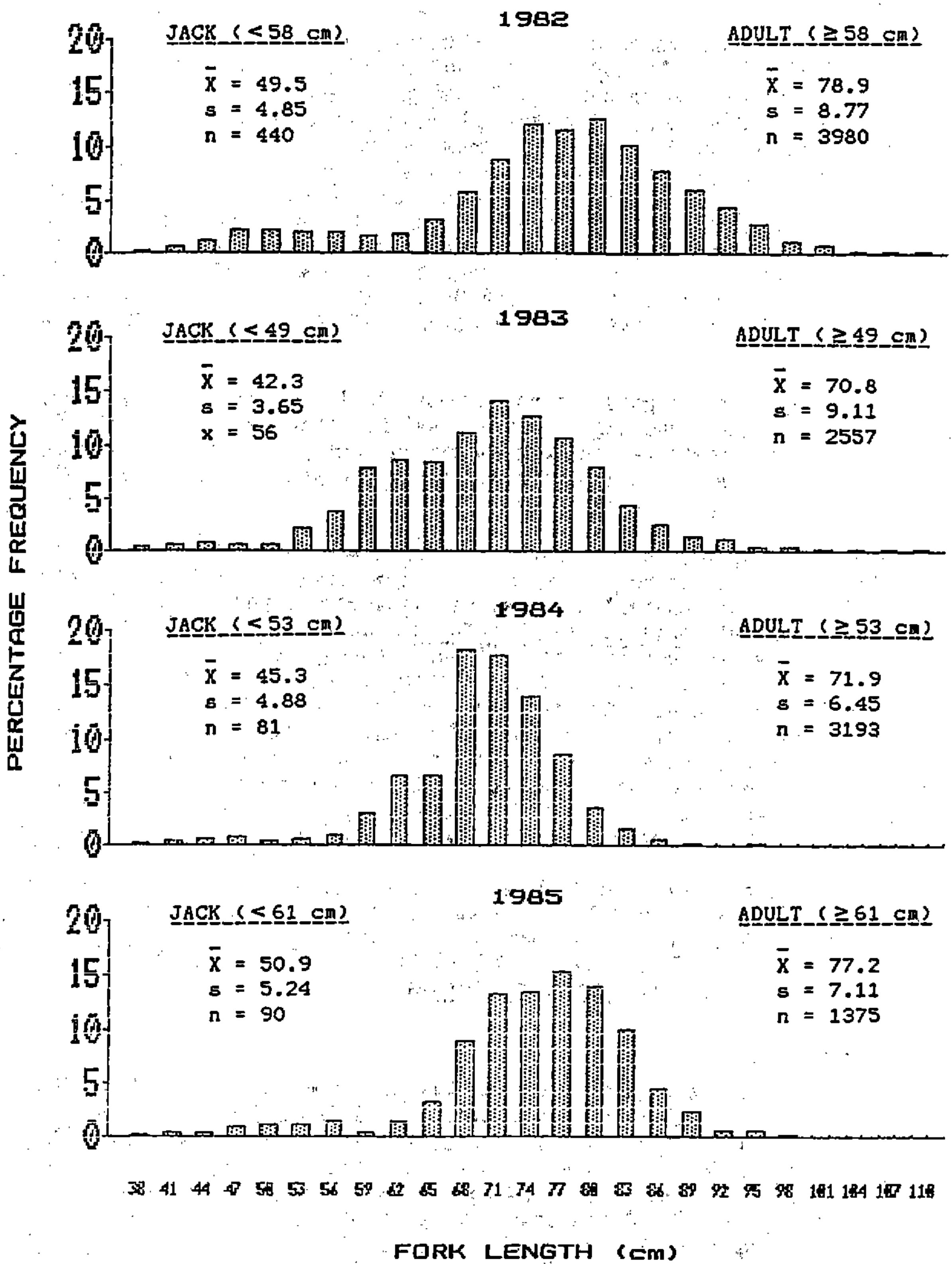


FIGURE 18. Length frequency distributions of fall chinook salmon caught by Indian gill net fishers on the Klamath River portion of the Hoopa Valley Reservation during 1982-1985 (3 cm groupings with midpoints noted).

the ventrally-clipped fish observed in the Estuary, Middle Klamath and Upper Klamath Areas (Table 17). In 1985, mean lengths of RV-clipped adult chinook sampled in the net fishery were not significantly different (p>0.05) than LV-clipped and non-clipped adults. Similarly, LV-clipped adult chinook were not significantly different (p>0.05) in mean length from non-clipped adults. In previous years, LV-clipped fish were observed earlier in the net fishery than RV-clipped fish. However, only 21 RV-clipped chinook were captured in 1985 as compared to 49 in 1984. The low number of RV-clipped chinook observed in the harvest is felt to reflect, in part, the closure in the latter portion of the harvest when the majority of TRH chinook are typically harvested. In addition, a smaller porportion of the 1982 brood year TRH fall chinook were constant fractionally marked (RV-clipped) before release than previous brood years.

When mean lengths of clipped and non-clipped fall chinook were compared, non-clipped chinook were found significantly (p>0.05) greater in mean length (Figure 19). The difference may reflect either reduced growth of fin clipped fish caused by the actual clipping or differences in growth rate or maturity schedule between hatchery and natural chinook.

Seal and otter depredation to chinook salmon taken in the Klamath River net fisheries continues to be a problem. In the Estuary Area 3.2% of the sampled 1985 fall chinook harvest was observed with seal (Phoca vitulina) or sea lion (Zalophus californianus and Eumetopias jubatus) bites. This is about half the percentage observed in 1984 and probably reflects the reduced time available for fishing. With reduced fishing time, fishers tended their nets more closely which reduced the availability of chinook for depredation. Seal bites were also observed in the upper river areas, but these could have occurred while the fish were in the lower river. It should be noted that depredation percentages presented here represent minimum values, since they do not take into account fish removed from nets by predators or severely damaged fish discarded and not reported by Indian fishers.

In the Middle and Upper Klamath Areas, 1.7% and 4.4% of the sampled 1985 fall chinook salmon netted exhibited bite marks, apparently from river otter Lutra canadensis. These are comparable to previous years percentages and should also be considered minimums. Netted fish were also reported being removed and eaten by black bear Ursus americanus.

Spring Chinook

Spring chinook 1985 net harvest on the Klamath River portion of the HVR was estimated at 1119, including 1074 adults and 45 jacks (<52 cm). Harvest of spring chinook began in April and continued through July with the majority of the catch occurring in July. The Estuary Area fishery accounted for 54.4% of the Klamath River harvest, followed by the Upper Klamath Area(28.6%) and the Middle Klamath Area (17.0%) fisheries, respectively (Table 18). The mean length of adult spring chinook harvested in the net fishery in 1985 (75.8 cm) was significantly greater (p<0.05) than that of fish taken in 1982-1984 (Figure 20).

In 1985, adipose fin-clipped salmon comprised 19.4% of the 36 spring chinook salmon sampled during spring time net harvest monitoring. The ad-clip rate in the net fishery reflected the percentage of tagged 1981 brood

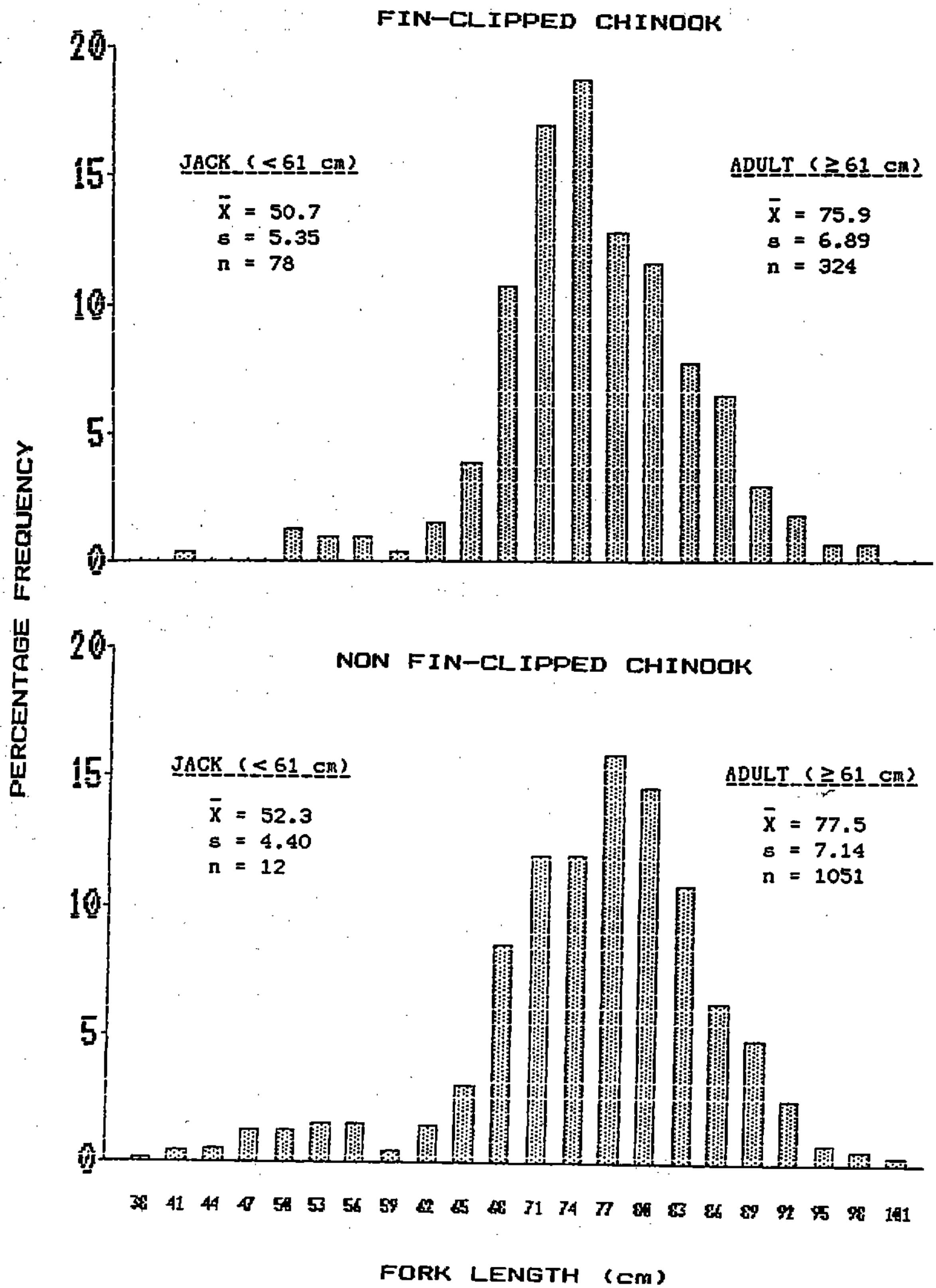


FIGURE 19. Length frequency distributions of all clipped and non-clipped chinook salmon caught by Indian gill net fishers on the Klamath River portion of the Hoopa Valley Reservation in 1985 (3 cm groupings with midpoints noted).

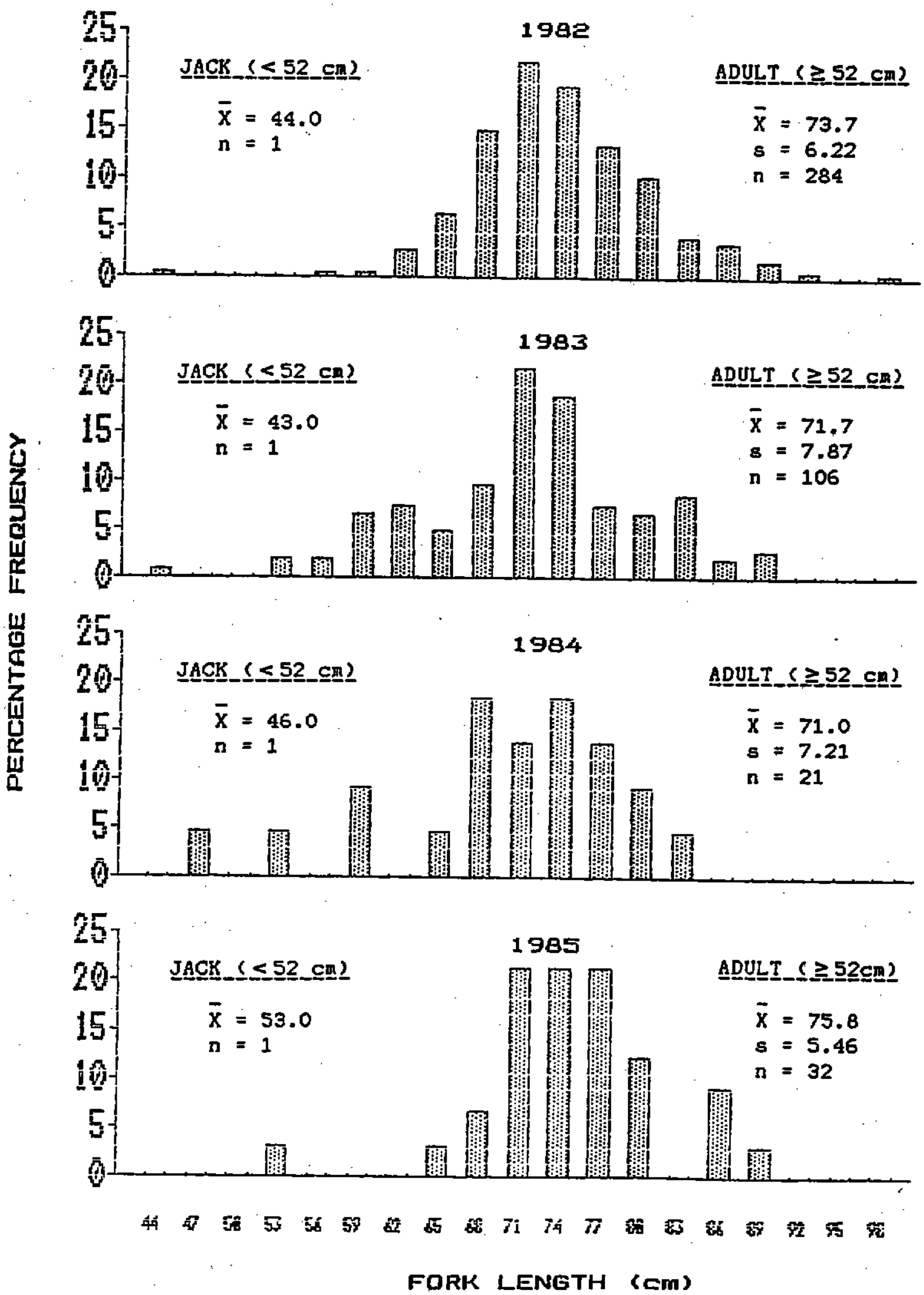


FIGURE 20. Length frequency distributions of spring chinook salmon caught by Indian gill net fishers on the Klamath River portion of the Hoopa Valley Reservation during 1982-1985 (3 cm groupings with midpoints noted).

spring chinook released from the Trinity River Hatchery. The similarity of ad-clip rates appears to indicate that the Indian gillnet fishery was primarily supported by hatchery produced spring chinook.

TABLE 18. Monthly net harvest estimates of spring chinook salmon captured in the three Klamath River monitoring areas of the Hoopa Valley Reservation in 1985.

	NET HARVEST MONITORING AREA				
Month	Estuary	Middle Klamath	Upper Klamath	Cumulative Monthly Total (All Areas)	Seasonal Total
April	5	49	51	105	105
May	2	96	104	202	307
June	33	35	75	143	450
July	569	10	90	669	1119
TOTAL	609	190	320	1119	
PERCENTAGE	54.4%	17.0%	28.6%		

Table 19 summarizes spring and fall chinook harvest estimates for the years 1977-1985.

TABLE 19. Final harvest estimates of spring and fall chinook salmon taken in the net fishery on the Hoopa Valley Reservation during 1977-1985[1/].

Year	SPRING CHINOOK			FALL CHINOOK		
	Jacks	Adults	Total	Jacks	Adults	Total
1977	--	--	--	2,700	27,300	30,000
1978	--	--	--	1,800	18,200	20,000
1979	--	--	--	1,350	13,650	15,000
1980	20	980	1,000	987	12,013	13,000
1981	57	2,807	2,864	2,465	33,033	35,498
1982	45	3,155	3,200	1,799	14,482	16,281
1983	10	585	595	163	7,890	8,053
1984	12	627	639	455	18,670	19,125
1985	160	2,074	2,234	1,555	11,566	13,121

1/ Estimates for 1983-1985 Trinity River net fishery were obtained from the Hoopa Valley Business Council, Fisheries Department. All other harvest estimated by the U.S. Fish and Wildlife Service by methods described in previous annual reports.

CODED-WIRE TAG RECOVERY INVESTIGATIONS

INTRODUCTION

Two hatcheries operated by the California Department of Fish and Game (CDFG) are located in the Klamath River basin. Trinity River Hatchery (TRH), at the base of Lewiston Dam, lies 249 river kilometers from the mouth of the Klamath River. Located near the base of Iron Gate Dam on the Klamath River, Iron Gate Hatchery (IGH) lies 306 river kilometers from the mouth. In recent years, these hatcheries have released on-site (at the hatchery) three basic groups of coded-wire tagged (CWT) juvenile chinook salmon: fingerlings in June, yearlings in October, and yearling-plus in March. Trinity River Hatchery also trucked CWT fingerlings downriver to release at off-site (away from the hatchery) locations. The Hoopa Valley Business Council (HVBC) operates a small hatchery at Supply Creek near Hoopa on the Trinity River, 90 river kilometers from the mouth of the Klamath River.

Since these release programs differ as to site, time and size of release, differing environmental conditions between release and maturity result in varying biological characteristics between release groups upon return. These variations between groups must be analyzed in order to evaluate the effectiveness of the hatchery release programs and the impacts of fisheries operating on the stocks. Toward this end, FAO biologists conducted CWT recovery efforts in conjunction with 1985 net harvest monitoring activities on the Indian gill net fishery on the Klamath River portion of the Hoopa Valley Reservation.

METHODS

Methods of acquiring CWT samples during net harvest monitoring field activities were previously described in this report. Coded-wire tags from the field samples were recovered from salmon heads by dissection utilizing a magnetic field detector and decoded with the aid of an American Optical 507 dissecting microscope. If no tag was detected, the head was dissolved in Potassium Hydroxide (KOH) for 48 hours. A magnet was then stirred through the resultant slurry to recover tags which did not activate the magnetic field detector. Recovery data for each CWT group were expanded to estimate contribution to the net harvest by time and area employing a procedure similar to that used by the Oregon Department of Fish and Wildlife (ODFW) in estimating contributions of CWT to the Oregon ocean troll fishery. The expansion adjusts for the portion of the harvest not sampled, the non-recovery of heads from observed adipose fin-clipped fish and tags lost during dissection:

$$(1)\quad \text{Harvest Sampling Rate} = \frac{\text{Total Estimated Net Harvest}}{\text{Number of Fish Examined for Marks}}$$

$$(2)\quad \text{Head Recovery Rate} = \frac{\text{Number of Ad-clipped Fish Observed}}{\text{Number of Heads Recovered}}$$

$$\text{(3) Lost Tag Rate} = \frac{\text{Number of Heads with Tags}}{\text{Tags Decoded}}$$

The three derived rates were multiplied to yield an expanded tag factor for each CWT group by area and time. The recovery data were then multiplied by the respective expanded tag factors to produce the estimated harvest of each CWT group. Harvest estimates of CWT groups were generally derived monthly (April-June) or semi-monthly (July-October) by area, except when low sampling rates or abbreviated sampling schedules called for deviations from these time periods. Coded-wire tag codes originating from outside the river basin were expanded at a rate of 1:1. The number of heads dissected from which tags were not recovered were expanded using a no-tag expansion factor. The no-tag expansion factor is the product of (1) Harvest Sampling Rate and (2) Head Recovery Rate.

Contribution rates of CWT groups to the Indian net fishery were calculated for each tag code:

$$\text{(4) Contribution Rate (\%)} = \frac{\text{Estimated CWT Harvest}}{\text{Number of Tagged Fish Released}} \times 100$$

The contribution rate compensates for unequal release-size bias and allows comparison between release strategies. Age composition was determined by summing individual CWT group contribution rates and then calculating the percentage contribution of groups in each age class.

When comparing data presented here with previous years, it should be noted that the 1982 and 1983 Indian net fishery CWT expansions were recalculated in 1984 and these recalculations are presented only in the 1984 annual report (USFWS 1985).

FAO Arcata has been collecting and analyzing CWT recovery data from the Hoopa Valley Reservation Indian net fishery since 1980. During these years, several noteworthy trends have surfaced with respect to basin hatchery release practices. In general, these trends have been discussed at length in previous annual reports. In an attempt to simplify the following discussion, only a brief review is presented in attempt to highlight these trends. Many other comparisons are possible but are left to the reader. The information necessary for such comparisons is contained in the accompanying tables. Results that differ from the general trends are presented.

RESULTS AND DISCUSSION

Fall Chinook

Coded-wire tag recoveries from fall chinook in the 1985 Indian net harvest totalled 106, all of which were obtained through the net harvest monitoring program (Table 20). The mark-sampled recoveries expanded to an estimated 983 fall chinook representing 26 release groups: 13 from the TRH, 12 from the IGH and 1 from the Bonneville Hatchery on the Columbia River. Additionally, an estimated 334 (25.4%) of the ad-clipped fall chinook harvested did not contain CWT's and could not be assigned to a rearing origin.

Contribution rates of fall chinook from IGH and TRH CWT release groups to the 1982-1985 Indian net fishery varied with the type and site of release (Table 21). In general, juveniles from both facilities which were released at a larger size contributed to the net fishery at a higher rate. For example, from TRH on-site releases, the highest average contribution rate of 1979, 1980 and 1981 brood years occurred among yearling-plus (0.174) followed by yearling (0.080) and fingerling (0.006) groups. The release site also affected the contribution rate, with off-site releases generally contributing to the gillnet fishery at a higher rate than on-site releases. For example, TRH fingerlings planted off-site (0.051) contributed at a rate over eight times that of on-site releases (0.006).

Fall chinook from the HVBC CWT 1981 brood year release group (06-52-01) did not contribute to the 1985 net fishery, which is surprising since the corresponding 1984 contribution was much higher than for comparable TRH releases. At least two possible explanations are possible. This stock is of Trinity River origin and as such it returns later in the season; since the net fishery on the Klamath River portion of the HVR was closed during the period the majority of these fish would be expected to return, they were less vulnerable to harvest. Another explanation is that the majority of the release may have matured as 3-year-olds in 1984 and few 4-year-olds were available for harvest in 1985.

In general, releases from Iron Gate Hatchery contribute to the gillnet fishery at a higher rate than releases from Trinity River Hatchery. Comparing the two hatcheries in 1985, IGH fall chinook contributed at a rate over 2 1/2 times that of the TRH fall chinook. In past years, the difference in contribution was felt to represent differences in survival, vulnerability to capture by gill nets and maturation schedules between the two hatchery stocks; however, TRH stocks are also harvested later in the season than IGH stocks. Since an in-season closure occurred in the estuary from August 15 through September 15 1985 a higher porportion of TRH chinook escaped the net fishery than in previous years.

Coded wire tag groups have shown an inverse relationship between size at release and mean length at harvest (Table 22). For example, returning 4-year-old TRH adult chinook released as fingerling (06-59-07) grew to an greater mean length than TRH chinook released as yearlings (06-59-18).

Mean lengths of coded-wire tag groups harvested in 1985 were compared to previous years data and found to be significantly greater than mean lengths of comparable groups harvested in 1983 and 1984 ($p<0.05$). Most mean length comparisons between CWT groups harvested in 1985 and those harvested prior to the 1982-1983 El Niño significant difference ($p>0.05$). One 1981 group (06-61-02) was significantly greater ($p<0.05$) in mean length (4.7 cm) than the comparable 1985 group (06-61-19).

The age composition of CWT fall chinook harvested in the 1985 Indian net fishery was 10.2% 2-year-olds, 56.0% 3-year-olds, 30.5% 4-year-olds, 2.8% 5-year-olds and 0.4% 6-year-olds. Age composition in the harvest shifted from mostly 4-year-olds in 1984 to predominately 3-year-olds in 1985.

TABLE 20. Actual and expanded (underlined) CWT groups recovered during mark sampling of fall chinook salmon in the 1985 gill net fishery on the Klamath River portion of the Hoopa Valley Reservation.

Tag Code	Brood Year	Hatchery[1/] of Origin	Release[2/] Type	RESERVATION MONITORING AREA Estuary		Middle Klamath		Upper Klamath		All Areas	
06-50-10	1982	IGH	Y	1	4	2	10	1	8	4	22
05-50-11	1982	IGH	Y	1	15	4	19	2	16	7	50
06-56-08	1983	TRH	F[3/]	0	0	2	27	0	0	2	27
06-56-09	1982	TRH	Y[3/]	1	4	2	18	0	0	3	22
06-56-10	1982	TRH	Y[3/]	1	4	1	13	1	2	3	19
06-56-11	1982	TRH	Y[3/]	5	52	0	0	3	18	8	70
06-56-12	1983	TRH	F[3/]	0	0	1	13	0	0	1	13
06-59-04	1981	IGH	Y	2	19	2	10	2	10	6	39
06-59-06	1980	IGH	Y	1	15	1	5	0	0	2	20
06-59-07	1981	IGH	F	10	105	2	18	1	2	13	125
06-59-08	1982	IGH	Y	1	15	10	87	5	27	16	129
06-59-09	1982	IGH	F	3	23	0	0	0	0	3	23
06-59-10	1982	IGH	F[3/]	1	15	1	36	2	9	4	60
06-59-11	1982	IGH	Y[3/]	1	15	2	41	0	0	3	56
06-59-14	1980	IGH	Y[3/]	2	8	0	0	0	0	2	8
06-59-18	1981	IGH	Y	1	15	1	9	1	8	3	32
06-59-19	1981	IGH	Y	2	29	0	0	1	8	3	37
06-61-17	1979	TRH	F[3/]	1	4	0	0	0	0	1	4
06-61-19	1981	TRH	F	2	10	1	5	0	0	3	15
06-61-22	1981	TRH	Y	1	15	1	36	0	0	2	51
06-61-23	1982	TRH	F[3/]	1	4	0	0	0	0	1	4
06-61-24	1982	TRH	F	1	4	1	5	0	0	2	9
06-61-26	1983	TRH	F	3	33	1	13	1	2	5	48
06-61-29	1982	TRH	Y	2	29	1	13	4	44	7	86
06-63-01	1983	TRH	Y+	0	0	1	13	0	0	1	13
07-24-26	1981	BONN	F	0	0	0	0	1	1	1	1
TOTAL TAGS				44	437	37	391	25	155	106	983
AD - NO TAGS				13	121	9	60	19	153	41	334

1/ IGH - Iron Gate Hatchery
TRH - Trinity River Hatchery
BONN - Bonneville State Fish Hatchery - Columbia River

2/ F (Fingerling) - May or June release
Y (Yearling) - Late September to November release
Y+ (Yearling-Plus) - March release

3/ Off-site release

TABLE 21. Contribution rate of CWT age 3 and 4 fall chinook to the Indian net fishery on the Klamath River portion of the Hoopa Valley Reservation.

Tag Code	Brood Year	Rearing[1/] Facility	Release[2/] Type	NUMBER HARVESTED[3/] 3	4	Total	Number[4/] Released Tagged	Contribution[5/] Rate
06-59-02	1979	IGH	Y	26	59	85	91,000	.093
06-59-03	1979	IGH	F	81	21	102	189,420	.054
06-61-09	1979	TRH	Y	49	32	81	90,995	.089
06-61-16	1979	TRH	F	14	5	19	188,727	.010
06-61-17	1979	TRH	F[6/]	141	49	190	193,897	.098
06-61-20	1979	TRH	Y+	105	39	144	82,982	.174
06-59-05	1980	IGH	F	50	47	97	185,857	.052
06-59-06	1980	IGH	Y	28	254	282	87,450	.322
06-61-18	1980	TRH	F	0	0	0	201,090	0
06-61-21	1980	TRH	Y	25	37	62	104,160	.060
06-52-01	1981	HVBC	F	72	0	72	34,000	.212
06-59-04	1981	IGH	Y	0	39	9	65,385	.060
06-59-07	1981	IGH	F	154	125	279	159,092	.175
06-59-18	1981	IGH	Y	0	32	32	25,586	.125
06-59-19	1981	IGH	Y	0	37	37	30,781	.120
06-61-19	1981	TRH	F	0	15	15	192,795	.008
06-61-22	1981	TRH	Y	18	51	79	94,991	.083
06-50-10	1982	IGH	Y	22	-	22	39,127	.056
06-50-11	1982	IGH	Y	50	-	50	39,997	.125
06-56-07	1982	TRH	Y[6/]	0	-	0	88,854	0
06-56-09	1982	TRH	Y[6/]	22	-	22	20,765	.106
06-56-10	1982	TRH	Y[6/]	19	-	19	20,902	.091
06-56-11	1982	TRH	Y[6/]	70	-	70	21,223	.330
06-59-08	1982	IGH	Y	129	-	129	70,171	.184
06-59-09	1982	IGH	F	23	-	23	158,824	.014
06-59-10	1982	IGH	F[6/]	60	-	60	83,023	.072
06-59-11	1982	IGH	Y[6/]	56	-	56	13,880	.403
06-61-23	1982	TRH	F[6/]	4	-	4	90,242	.004
06-61-24	1982	TRH	F	9	-	9	138,801	.006
06-61-29	1982	TRH	Y	86	-	86	96,583	.089

1/ IGH - Iron Gate Hatchery
TRH - Trinity River Hatchery
HVBC - Hoopa Valley Business Council Hatchery

2/ F (Fingerling) - May or June release
Y (Yearling) - Late September to November release
Y+ (Yearling-Plus) - March release

3/ Estimated number of coded-wire tagged fall chinook

4/ From Pacific Marine Fisheries Commission CWT release data (PMFC 1985)

5/ Contribution rate = number harvested / number released tagged X 100

6/ Off-site release

TABLE 22. Mean fork length, standard deviation and number of recoveries for 26 fall chinook CWT groups harvested in the Klamath River portion of the Hoopa Valley Reservation in 1985.

Tag Code	Brood Year	Hatchery[1/] of Origin	Release[2/] Type	RESERVATION MONITORING AREA Estuary	Middle Klamath	Upper Klamath	All Areas
06-61-17	1979	TRH	F[3/]	77.0[4/]	---	---	77.0
				---[5/]	---	---	---
				1[6/]	0	0	1
06-59-06	1980	IGH	Y	79.0	76.0	---	77.5
				---	---	---	2.1
				1	1	0	2
06-59-14	1980	IGH	Y	78.5	---	---	78.5
				3.5	---	---	3.5
				2	0	0	2
06-59-04	1981	IGH	Y	83.5	82.5	77.0	81.0
				4.9	0.7	2.8	4.0
				2	2	2	6
06-59-07	1981	IGH	F	80.8	82.7	88.0	81.5
				5.1	1.4	---	4.9
				10	2	1	13
06-59-18	1981	IGH	Y	75.0	84.0	75.0	78.0
				---	---	---	5.2
				1	1	1	3
06-59-19	1981	IGH	Y	80.5	---	72.0	77.7
				4.9	---	---	6.0
				2	0	1	3
06-61-19	1981	TRH	F	73.5	76.0	---	74.3
				2.1	---	---	2.1
				2	1	0	3
06-61-22	1981	TRH	Y	80.0	84.0	---	82.0
				---	---	---	2.8
				1	1	0	2
07-24-26	1981	BONN	F	---	---	69.0	69.0
				---	---	---	---
				0	0	1	1
06-50-10	1982	IGH	Y	73.0	72.0	71.0	72.0
				---	2.8	---	1.8
				1	2	1	4
06-50-11	1982	IGH	Y	74.0	71.8	73.0	72.4
				---	1.5	4.2	2.2
				1	4	2	7
06-56-09	1982	TRH	Y[3/]	81.0	72.0	---	75.0
				---	4.2	---	6.0
				1	2	0	3

1/ TRH - Trinity River Hatchery
IGH - Iron Gate Hatchery
BONN - Bonneville Hatchery

2/ F (Fingerling) - May or June release
Y (Yearling) - Late September to November release
Y+ (Yearling-Plus) - March release

3/ Off-site release

4/ Mean fork length

5/ Standard deviation

6/ Number in sample

TABLE 22. (Continued)
Mean fork length, standard deviation and number of recoveries for 26 fall chinook CWT groups harvested in the Klamath River portion of the Hoopa Valley Reservation in 1985.

Tag Code	Brood Year	Hatchery[1/] of Origin	Release[2/] Type	RESERVATION MONITORING AREA: Estuary	Middle Klamath	Upper Klamath	All Areas
06-56-10	1982	TRH	Y[3/]	66.0	72.0	63.0	67.0
				---	---	---	4.6
				1	1	1	3
06-56-11	1982	TRH	Y[3/]	72.2[4/]	---	65.7	69.8
				7.8[5/]	---	11.8	9.3
				5[6/]	0	3	8
06-59-08	1982	IGH	Y	72.0	73.1	71.6	72.6
				---	5.5	2.6	4.6
				1	10	5	16
06-59-09	1982	IGH	F	72.0	---	---	72.0
				3.6	---	---	3.6
				3	0	0	3
06-59-10	1982	IGH	F[3/]	68.0	73.0	69.5	70.0
				---	---	7.7	5.0
				1	1	2	4
06-59-11	1982	IGH	Y[3/]	70.0	69.5	---	69.7
				---	7.7	---	5.5
				1	2	0	3
06-61-23	1982	TRH	F[3/]	65.0	---	---	65.0
				---	---	---	---
				1	0	0	1
06-61-24	1982	TRH	F	66.0	76.0	---	71.0
				---	---	---	7.1
				1	1	0	2
06-61-29	1982	TRH	Y	77.0	72.0	68.8	71.6
				5.6	---	6.2	6.3
				2	1	4	7
06-56-08	1983	TRH	F[3/]	---	53.0	---	53.0
				---	2.8	---	2.8
				0	2	0	2
06-56-12	1983	TRH	F[3/]	---	51.0	---	51.0
				---	---	---	---
				0	1	0	1
06-61-26	1983	TRH	F	50.7	57.0	55.0	52.8
				0.5	---	---	3.0
				3	1	1	5
06-63-01	1983	TRH	Y+	---	42.0	---	42.0
				---	---	---	---
				0	1	0	1

1/ TRH - Trinity River Hatchery
IGH - Iron Gate Hatchery
BONN - Bonneville Hatchery

2/ F (Fingerling) - May or June release
Y (Yearling) - Late September to November release
Y+ (Yearling-Plus) - March release

3/ Off-site release

4/ Mean fork length

5/ Standard deviation

6/ Number in sample

Spring Chinook

Coded-wire tag recoveries from spring chinook salmon in the 1985 Indian net harvest totalled 58, all of which were obtained from the net harvest monitoring program (Table 23). These recoveries expanded to an estimated 188 spring chinook representing five release groups, all from Trinity River Hatchery.

Contribution rates of age 3 and 4 spring chinook from TRH CWT release groups to the Indian net fishery varied with release type (Table 24). In general, trends observed in the fall chinook fishery were also evident during the spring fishery; juvenile chinook reared to the yearling size contributed to the fishery at a higher rate than those released as fingerlings. The 1978-1982 brood year average contribution rate for yearling releases was over 10 times that of fingerling groups. No recoveries were observed from spring chinook 1981 brood fingerling release (06-61-35) and 1982 brood fingerling (06-61-41) contributions appeared low. A full evaluation of (06-61-41) is not possible until the 4-year-old component of this group returns in 1986.

The age composition of CWT spring chinook salmon harvested in the 1985 Indian net fishery was 3.2% 2-year-olds, 43.6% 3-year-olds, 38.8% 4-year-olds and 15.4% 5-year-olds. This represents a shift from a predominance of 4-year-olds in the Indian gill net harvest during 1982-1984 (USFWS 1985) toward 3-year-olds in 1985. The shift in age composition may in part be due to the poor contribution of the 1981 brood year fingerling release (06-61-35) returning as 4-year-olds in 1985.

Mean length of TRH CWT spring chinook released as yearlings and returning as 3- and 4-year-olds in 1985 were not signicantly different ($p>0.05$) from recoveries observed in previous years except when compared to the 1980 brood year. The 1980 brood, which was influenced by the 1982-1983 El Niño was significantly smaller (12.0 and 6.1 cm) both as 3- and 4-year-old returns than comparable age 1985 recoveries ($p<0.05$).

In-River Net Versus Ocean Fisheries

The annual ratio of ocean (commercial and sport catches combined) to Klamath River Indian gill net harvest of Klamath River CWT fall chinook in 1985 (4.5:1) was below the 1980-1985 average of 5.3:1 (Table 25). The 1985 ratio reflects a near average in-river harvest of CWT fall chinook (983 versus an average of 956) and a somewhat reduced ocean harvest of Klamath River CWT stocks. The ratio of ocean to in-river harvest of CWT 3-year-olds was greater than that of 4-year-olds for a given brood year. Table 26 reveals a greater ocean harvest of 3-year-olds and a lower ocean harvest of 4-year-olds when compared to the in-river fishery. Two-year-old CWT groups contributed little to either ocean or in-river net harvest.

Klamath River CWT fall chinook groups contributed primarily to the fisheries operating between Fort Bragg, California and Newport, Oregon. Over 99% of the 1985 ocean recovery of Klamath River CWT occurred at these ports and of these recoveries, 66.4% were of IGH origin (Figure 21). Oregon ports landed the largest percentage of Klamath River CWT fall chinook (68.7%), followed by California (31.1%) and Washington (0.1%). This represents a northerly shift from 1984 (USFWS 1985) and can be attributed to the 1985

TABLE 23. Mean fork length, standard deviation, and actual and expanded (underlined) recoveries for spring chinook CWT groups harvested in the net fishery on the Klamath River portion of the Hoopa Valley Reservation in 1985.

Tag Code	Brood Year	Hatchery[1/] of Origin	Release[2/] Type	CWT Recoveries		Mean Fork Length	Standard Deviation
06-61-37	1981	TRH	Y	8	73	78.1	4.9
06-61-38	1982	TRH	Y	15	76	68.0	4.2
06-61-39	1980	TRH	Y	3	29	76.3	5.0
06-61-40	1983	TRH	Y	1	4	43.0	0.0
06-61-41	1982	TRH	F	1	6	65.0	0.0
TOTALS				28	188		

1/ TRH - Trinity River Hatchery

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

TABLE 24. Contribution rate of CWT age 3 and 4 spring chinook to the Indian net fishery on the Klamath River portion of the Hoopa Valley Reservation.

Tag Code	Brood Year	Rearing Facility[1/]	Release Type[2/]	NUMBER HARVESTED[3/] 3	4	Total	Number[4/] Released Tagged	Contribution[5/] Rate
06-61-11	1978	TRH	F[6/]	163	47	210	192,800	0.109
06-61-12	1978	TRH	F	69	11	80	170,800	0.047
06-61-30	1978	TRH	Y	126	541	667	191,916	0.348
06-61-31	1978	TRH	Y+	25	351	376	134,948	0.279
06-61-32	1979	TRH	F	0	15	15	187,494	0.008
06-61-33	1979	TRH	F[6/]	40	73	113	181,134	0.062
06-61-34	1979	TRH	Y	44	30	73	86,594	0.084
06-61-36	1979	TRH	Y+	0	10	10	35,666	0.028
06-61-39	1980	TRH	Y	10	39	49	34,601	0.142
06-61-35	1981	TRH	F	0	0	0	182,635	0.000
06-61-37	1981	TRH	Y	9	73	82	98,637	0.083
06-61-38	1982	TRH	Y	76	-	-	96,461	0.079
06-61-41	1982	TRH	F	6	-	-	146,194	0.004

1/ TRH - Trinity River Hatchery

2/ F (Fingerling) - May or June release
Y (Yearling) - Late September to November release
Y+ (Yearling-Plus) - March release

3/ Estimated number of coded-wire tagged spring chinook

4/ From Pacific Marine Fisheries Commission CWT release data (PMFC 1985)

5/ Contribution rate = number harvested / number released tagged X 100

6/ Off-site release at Trinity River kilometer 40.0 (Willow Creek)

TABLE 25. Estimated contributions of Trinity River Hatchery and Iron Gate Hatchery fall chinook CWT groups to the 1980-1985 ocean troll and Indian gill net fisheries.

	TRINITY RIVER HATCHERY			IRON GATE HATCHERY			TOTAL		
	Ocean[1/] Harvest	Gill Net[2/] Harvest	Ratio Ocean/Gill Net	Ocean Harvest	Gill Net Harvest	Ratio Ocean/Gill Net	Ocean Harvest	Gill Net Harvest	Ratio Ocean/Gill Net
1980	5,068	562	9.0:1	-	-	-	5,068	562	9.0:1
1981	4,413	1,587	2.8:1	2,410	311	7.7:1	6,823	1,898	3.6:1
1982	5,239	676	7.8:1	4,609	554	8.3:1	9,848	1,230	8.0:1
1983	1,767	153	11.5:1	1,519	208	7.3:1	3,286	361	9.1:1
1984	201	154	1.3:1	974	548	1.8:1	1,175	702	1.7:1
1985	1,498	381	3.9:1	2,955	601	4.9:1	4,453	982	4.5:1
Total	18,186	3,563	5.1:1	12,467	2,222	5.6:1	30,653	5,735	5.3:1

1/ Combined commercial and sport returns in Washington, Oregon and California compiled from preliminary data provided by WDF, ODFW and CDFG.

2/ Includes only those fish landed on the Klamath River portion of the HVR.

TABLE 26. Estimated contributions of age 3 and 4 fall chinook CWT groups to the 1980-1985 ocean troll and Indian gill net fisheries.

	AGE AT HARVEST					
	3			4		
Brood Year	Ocean[1/] Harvest	Gill Net[2/] Harvest	Ratio Ocean/Gill Net	Ocean Harvest	Gill Net Harvest	Ratio Ocean/Gill Net
1976	---	---	---	2,547	270	9.4:1
1977	2,521	263	9.6:1	2,599	878	3.0:1
1978	4,109	871	4.7:1	2,707	748	3.6:1
1979	7,092	416	17.0:1	2,247	205	11.0:1
1980	997	140	7.1:1	672	411	1.6:1
1981	488	244	2.0:1	503	299	1.7:1
1982	2,943	550	5.4:1	---	---	---
Total	18,150	2,484	7.3:1	11,275	2,811	4.0:1

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

2/ Gill net harvest in 1980-1982 adjusted to reflect only those fish caught on the Klamath River portion of the Hoopa Valley Reservation.

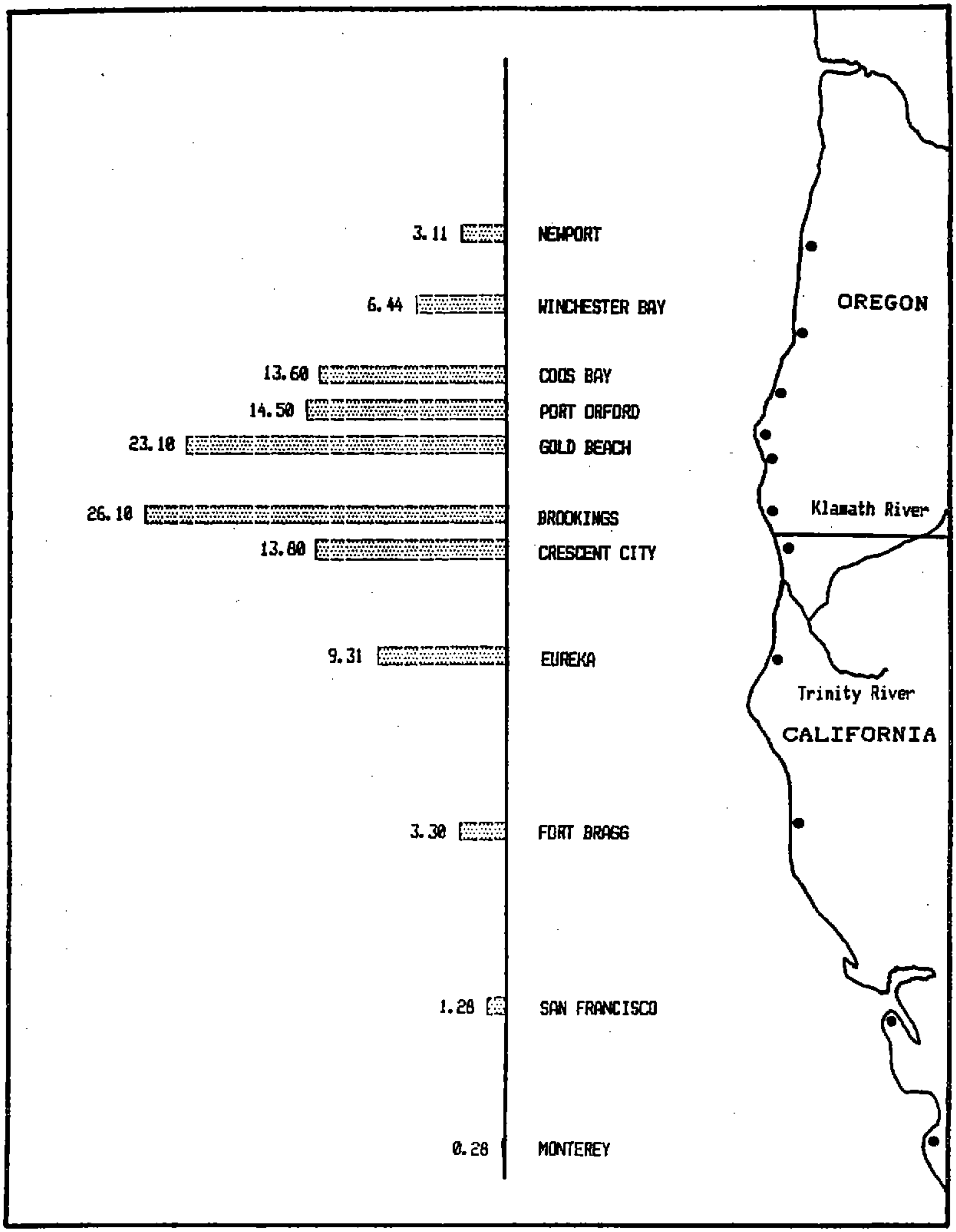


FIGURE 21. Relative contribution indices of CWT Klamath River fall chinook to 1985 ocean landings at California, Oregon and Washington ports (calculated from preliminary data provided by CDFG, ODFW and WDF).

commercial fishing closure between Cape Blanco, Oregon and Point Delgada, California.

In 1984 the CWT net fishery expansion methodology was modified and the 1982 and 1983 CWT expansions recalculated to account for a high percentage of ad-clipped chinook that did not contain CWTs (USFWS 1985). In 1985, 27.9% of the ad-clipped fall chinook sampled did not contain CWT. In 1982, 1983 and 1984 corresponding no tag rates were 11.5%, 23.4% and 26.1%. Other stocks occurring in the ocean landings exhibit considerably lower tag loss rates; for example, Sacramento CWT stocks have a shedding rate closer to 10% (PFMC 1985). These high Klamath River no tag rates have important management implications. When the ocean contribution rates are calculated, it is assumed that all tag codes have equal shedding rates. However, unequal shedding rates occurring in the stocks landed in the northern California and southern Oregon ocean fisheries may cause the ocean contribution of Klamath River fall chinook to the ocean troll and sport fisheries to be underestimated. The ratio between CWT occurrence in ocean and in-river fall chinook fisheries remains unaffected, however, because the no tag rates in this case may correctly be assumed to be equal.

The 1985 ratio of ocean-river harvest of Klamath River CWT spring chinook increased from that observed in 1984 and matched the 1980-1985 average (Table 27). As in past years, ocean fisheries harvested spring chinook 3-year-olds at a higher ratio than 4-year-olds (Table 28). Two-year-old CWT groups contributed little to either ocean or in-river catches.

TABLE 27. Estimated contributions of Trinity River Hatchery spring chinook CWT groups to the 1980-1985 ocean troll and Klamath River gill net fisheries.

	TRINITY RIVER HATCHERY		
	Ocean[1/] Harvest	Gill Net[2/] Harvest	Ratio Ocean/Gill Net
1980	588	167	3.5:1
1981	2,273	419	5.4:1
1982	2,786	1,034	2.7:1
1983	724	153	4.7:1
1984	103	48	2.1:1
1985	680	188	3.6:1
Total	7,154	2,009	3.6:1

1/ Combined commercial and sport returns in Washington, Oregon and California compiled from preliminary data provided by WDF, ODFW and CDFG.

2/ Includes only those fish landed on the Klamath River portion of the HVR.

TABLE 28. Estimated contributions of age 3 and 4 spring chinook CWT groups to the 1980-1985 ocean troll and Klamath River gill net fisheries.

	AGE AT HARVEST					
	3			4		
Brood Year	Ocean[1/] Harvest	Gill Net[2/] Harvest	Ratio Ocean/Gill Net	Ocean Harvest	Gill Net Harvest	Ratio Ocean/Gill Net
1976	---	---	---	469	153	3.1:1
1977	119	14	8.5:1	126	21	6.0:1
1978	2,072	383	5.4:1	345	950	0.4:1
1979	2,438	84	29.0:1	640	128	5.0:1
1980	57	10	5.7:1	38	39	1.0:1
1981	55	9	6.1:1	---	---	---
1982	421	111	3.8:1	69	73	0.9:1
Total	5,162	611	8.4:1	1,687	1,364	1.2:1

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

2/ Gill net harvest in 1980-1982 adjusted to reflect only those fish caught on the Klamath River portion of the Hoopa Valley Reservation.

CHINOOK SALMON HARVEST OVERVIEW

INTRODUCTION

The harvest of fall chinook in the Indian gill net fishery of the Hoopa Valley Reservation, presented earlier in this report, is but one component of the overall fisheries impacts incurred by Klamath River fall chinook stocks. In order to provide a broader perspective, data from the other fisheries operating on Klamath River fall chinook as published by the Pacific Fishery Management Council (PFMC) are presented here. In addition, a brief discussion of noncatch mortality factors is provided to afford a complete view of total fisheries impacts on the stocks.

The following analysis concerns adult fall chinook data only. The reader should employ discretion when making comparisons with analyses presented in previous reports, since methodologies employed have changed.

HARVEST OVERVIEW

In an attempt to protect the depressed stocks of Klamath River fall chinook salmon, the 1985 commercial troll fishery along the Northern California and Southern Oregon coast from Point Delgado in the south to Cape Blanco in the north was closed entirely. Commercial troll fisheries operating outside of this management area were regulated under various in-season closures and gear restrictions.

California ocean commercial troll chinook landings in 1985 totalled 360,300, representing an increase of 20.2% from 1984 (299,800) but only 64% of the 1971-1975 average (562,700). North Coast landings (including the ports of Fort Bragg, Eureka and Crescent City) of 154,300 chinook increased 98% over the 1984 landings (78,100) but were only 52% of the 1971-1975 average (298,600). It should be noted that 97% of the total 1985 North Coast commercial troll landings were reported from the port of Fort Bragg (PFMC 1986).

The 1985 California ocean recreational fishery was regulated through various in-season closures, gear restrictions and bag limits. Landings in the ocean recreational fishery of 160,600 chinook represent an increase of 81% from 1984 (88,600). North Coast landings of 49,100 represent an increase of 440% from 1984 landings (9,100) and an increase of 211% over the 1971-1975 average (15,800) (PFMC 1986).

Landings for the 1985 Oregon ocean commercial troll fishery totalled 212,200 chinook, an increase of 243% from 1984 (61,800) and 1% above the 1971-1975 average of 209,200. Troll landings in 1985 south of Coos Bay totalled 161,600 chinook, a rise of 304% from 1984 (40,000). It should be noted that 96% (155,600) of this total was reported from the port of Coos Bay. The 1985 Oregon ocean recreational landings totalled 55,900 chinook; 229% above the 1984 total (17,000) but 1% below the 1974-1975 average (56,200). The 1985 landings south of Coos Bay totalled 45,600 chinook, an increase of 228% from 1984 (13,900) (PFMC 1986).

Various contribution rate estimates of Klamath River fall chinook to the ocean fisheries operating between Fort Bragg, California and Coos Bay, Oregon have been used to analyze the influence of offshore regulations on Klamath River stocks. California Department of Fish and Game (CDFG) has used contribution rates of 40% (CDFG 1980) and 21% (CDFG 1983) while PFMC has used a contribution rate of 30% (PFMC 1983). A report by the Technical Advisory Team to the Klamath River Salmon Management Group (KRTT 1986a) recommends using an estimate of 28% for the contribution rate to ports of Eureka, Crescent City and Brookings. Estimates of contribution rates were generally derived through analysis of code wire tag (CWT) recovery data. This report will use a 30% contribution in presenting ocean landings from Coos Bay to Fort Bragg during 1978-1985. Through analysis of CWT return data, the CDFG has estimated that an average of 90% of the total ocean harvest of Klamath River fall chinook occurs in the Fort Bragg to Coos Bay area. This analysis will assume the same.

Using the contribution and distribution values derived from CWT data, and applying these to the ocean landings, the 1978-1985 combined ocean fisheries have landed approximately 141,000 Klamath River fall chinook annually.

The Klamath River Indian gill net adult fall chinook harvest, discussed previously in this report, declined 38% from 18,670 in 1984 to 11,570 in 1985, or 19% of the 1985 CDFG adult in-river run size estimate. The net fishery has harvested an average 16,190 adult fall chinook during the 1978-1985 period.

The Klamath River 1985 sport fishery harvest of 3,830 adult fall chinook was 79% above the 1984 harvest of 2,140 but 7% below the 1978-1985 average harvest of 4,120. The 1985 adult sport harvest comprised 6% of the in-river run size estimate.

The harvests presented here do not perfectly represent the impact of these fisheries on the resource. Such data do not account for noncatch mortality caused by fisheries or the harvest of fish which would otherwise have died from natural causes prior to spawning. While such information is difficult to address and therefore generally not factored into harvest estimates, a brief discussion of these factors appears worthwhile. The reader should consult appropriate references to gain insight on methods used to assess noncatch mortality.

Noncatch mortality of chinook in the ocean troll fishery has been discussed by Ricker (1976), O'Brien et al (1970), Wright (1972) and others and appears to approximate 30-50% of the coastwide ocean harvest. Recently the KRTT adopted a value of 30% to represent the offshore fisheries operating on Klamath River stocks (KRTT 1986b).

Noncatch mortality of chinook in the in-river net fishery occurs primarily through pinniped depredation on the fish trapped in nets prior to removal. Pinniped depredation has been estimated to be 13.2% of the fall chinook gill net harvest in the Klamath River estuary (Herder 1983). This estimate accounts for all pinniped damage; however, a portion of the pinneped damaged chinook are kept for consumption and these are already included in harvest estimates. Data collected by FAO-Arcata indicates that approximately

3% of all salmon impacted by the Reservation-wide net fishery are lost or damaged because of pinniped depredation and are not included in net harvest estimates. Further, FAO-Arcata data indicate that an additional 5% of all salmon impacted by the net fishery are lost due to drop out. These fish become enmeshed in gill nets, subsequently escape and die as a result of the encounter and are not included in harvest estimates. These noncatch mortality factors have been adopted by the KRTT for determining gill net fishery impacts on the Klamath River fall chinook stocks (KRTT 1986b). Further information on gill net noncatch mortality may be found in French and Dunn (1973), Jewell (1970) and Parker (1960).

Noncatch mortality of chinook in the Klamath River sport fishery has not been estimated, but is assumed to be minimal. A review of available data by the KRTT has led to the adoption of a noncatch mortality rate of 2% of total impact for the in-river sport fishery (KRTT 1986b).

A major difference between the ocean and terminal fisheries with regard to noncatch mortality concerns the existence of size limits in the ocean, while the terminal fisheries have none. Hence, fish captured in the terminal fisheries that are below the legal size limits of the ocean fisheries are generally kept. This makes direct comparison of total harvest data from ocean and terminal fisheries misleading. To allow data comparability, adult harvest only in the terminal fishery was compared with ocean landings.

Harvest of fish which would otherwise have died of natural causes prior to spawning is even more difficult to assess. Natural mortality is a more significant factor in regards to the ocean fisheries than the terminal fisheries because the in-river fisheries impact a fully mature, terminal population. For purposes of this analysis, natural mortality will not be addressed further.

Tables 29 and 30 present an overview of the harvest data discussed. These data result in mean annual ratios of 2.3:1 ocean landings to river returns, 7.0:1 ocean landings to terminal harvest and 4.0:1 total fishery harvest to spawning escapement (Figure 22).

TABLE 29. Estimated numbers of Klamath River fall chinook in total ocean landings, 1978-1985.

Year	TOTAL CHINOOK LANDINGS[1] N. Ca. Troll	N. Ca. Sport	S. Or. Troll	S. Or. Sport	N. Ca./S. Or. Area Total	Klamath[2] Area Contribution	Klamath Total Contribution
X 1971-1975	298,600	15,800	153,000	17,400[3]	484,800	145,440	161,600
1978	346,700	6,700	114,100	12,100	479,600	143,900	159,900
1979	492,600	13,800	192,600	10,900	709,900	213,000	236,700
1980	294,300	7,900	143,200	10,100	455,500	136,700	151,900
1981	298,200	9,800	110,400	13,400	431,800	129,500	143,900
1982	346,700	16,000	178,700	25,600	567,000	170,100	189,000
1983	115,700	11,000	41,800	19,000	187,500	56,300	62,600
1984	78,100	9,100	40,000	13,900	141,100	42,300	47,000
1985	154,300	49,100	161,600	45,600	410,600	123,200	136,900
X 1978-1985	265,830	15,430	122,800	18,820	422,880	126,900	141,000

1/ Landings in N. CA. include Fort Bragg, Eureka and Crescent City and in S. Or. include Brookings and Coos Bay. All data are from PFMC 1986.

2/ Since CWT analysis shows varying yearly contribution rates of Klamath River stocks it should be recognized that use of a 30% contribution rate may overestimate or underestimate the contribution of a given year but should be representative of these years on the whole.

3/ 1974-75 Average only, S. Or. sport.

TABLE 30. Estimated contribution of Klamath River adult fall chinook to the ocean, inland sport and Indian gill net fisheries, 1978-1985[1].

Year	Klamath Ocean Catch	In-River Run Size	In-River Sport Catch	In-River Gill Net Catch	Total Spawning Escapement	Ratio of Ocean Catch to In-River Run Size	Ratio of Ocean Catch to Terminal Catch	Ratio of Total Catch to Spawning Escapement
1978	159,900	91,350	1,690	18,200	71,450	1.8:1	8.0:1	2.5:1
1979	236,700	50,060	2,140	13,650	34,270	4.7:1	15.0:1	7.4:1
1980	151,900	44,500	4,500	12,010	27,990	3.4:1	9.2:1	6.0:1
1981	143,900	77,300	5,980	33,030	38,280	1.9:1	3.7:1	4.8:1
1982	189,000	65,180	8,340	14,480	42,360	2.9:1	8.3:1	5.0:1
1983	62,600	57,920	4,340	7,890	45,680	1.1:1	5.1:1	1.6:1
1984	47,000	43,290	2,140	18,670	22,670	1.1:1	2.3:1	3.0:1
1985	136,900	59,340	3,830	11,570	43,940	2.3:1	8.9:1	3.5:1
X 1978-1985	141,000	61,120	4,120	16,190	40,830	2.3:1	7.0:1	4.0:1

1/ All data are from the USFWS or from PFMC 1986.

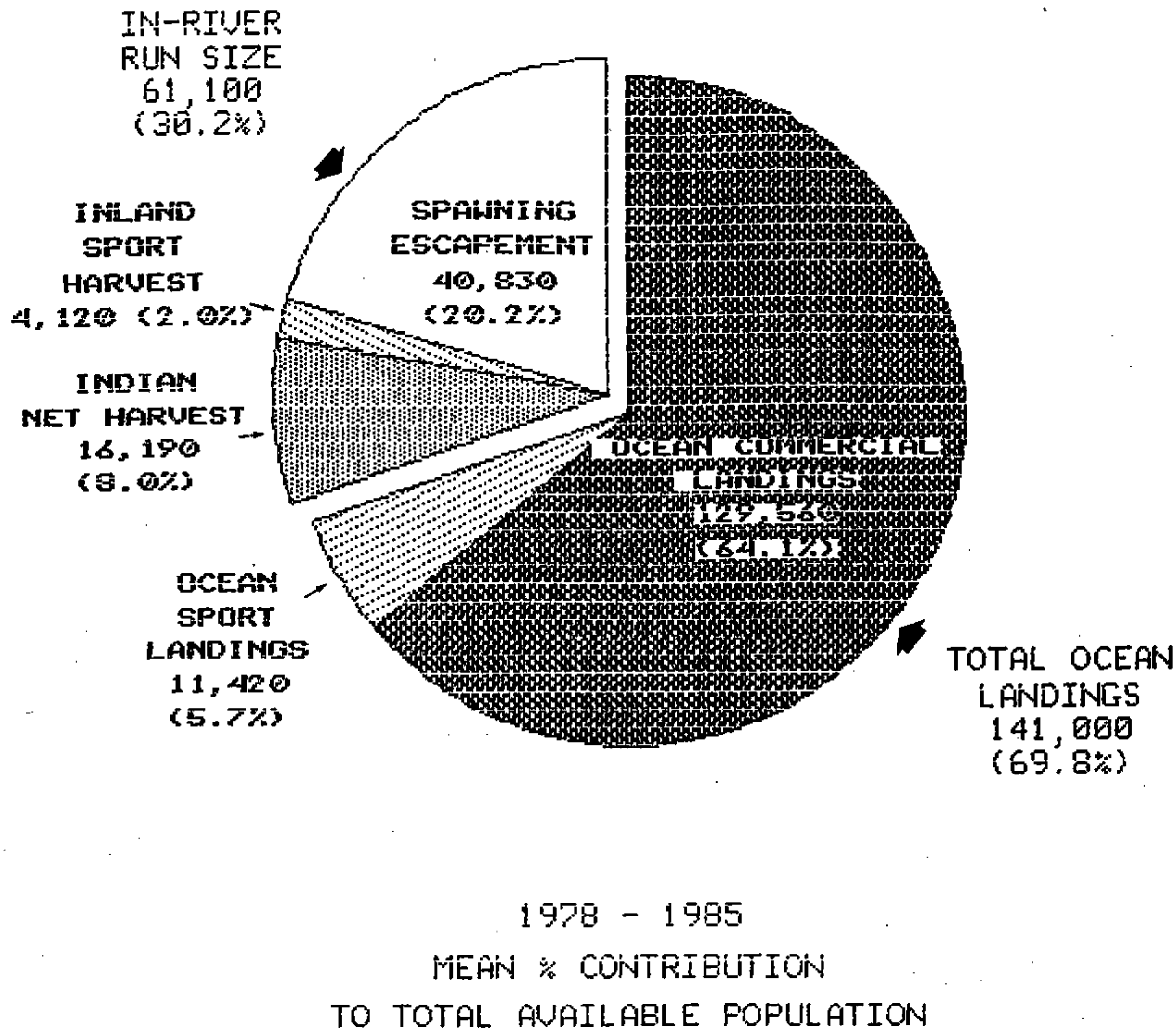


FIGURE 22. Estimated mean annual contributions of Klamath River adult fall chinook to the ocean and in-river fisheries compared with spawning escapement during 1978-1985.

EL NIÑO

INTRODUCTION

During the El Niño of 1982-1983 a breakdown of the normal weather patterns and a shift of wind and water currents caused a reduction in the upwelling that normally occurs along the Pacific coast off California. As a result of reduced upwelling and associated nutrients, production at each trophic level of the food chain decreased. Refer to the El Niño section of the 1983 annual report (USFWS 1984) for a further description of the El Niño event.

Data collected during the beach seining and net harvest monitoring operations have provided an indication of the impacts of El Niño on the Klamath River fall chinook population and on that population's subsequent recovery as oceanic conditions returned to normal. The effects on Klamath River fall chinook in 1983 included significant decreases in size at age, reduced condition factors and growth rates, and a northerly shift in ocean distribution. The response of Klamath River fall chinook to improved oceanic conditions in 1984 was evident with increases in size at age and growth rates over 1983 levels, but these remained below pre-El Niño levels.

With a return of normal weather and ocean conditions in 1984 it was anticipated that normal growth patterns would resume and continue through the 1985 growth season. Following is a summary of findings from the 1983-1985 data which pertain to El Niño.

METHODS

Methods utilized in treating beach seine, age composition, and length frequency data for use in describing El Niño impacts were the same as described in previous sections of this report.

RESULTS AND DISCUSSION

Mean fork lengths of jacks and adults returning to the Klamath River in 1985, 51.1 cm and 76.0 cm respectively (as observed in the beach seining program), were significantly larger than those returning in 1983, 41.1 cm and 64.9 cm, and in 1984, 45.5 cm and 68.3 cm (t-test; $p<0.05$). Jack and adult chinook returning in 1985 were also significantly larger than the pre-El Niño (1979-1982) averages, 47.9 cm and 75.6 cm (t-test; $p<0.05$).

Length data on fall chinook were collected at the Shasta River weir in a cooperative effort between the United States Fish and Wildlife Service (USFWS) and California Department of Fish and Game (CDFG) during 1982-1985. Analysis of a limited number of samples from 1985 shows the mean fork length of jacks returning to the Shasta River in 1985 (50.7 cm) was significantly greater than in 1983 and 1984; 42.4 and 45.8 cm, respectively ($p<0.05$), but not significantly greater than 1982, 49.4 cm ($p>0.05$). Mean fork length of adults returning to the Shasta River in 1985 (75.1 cm) was significantly greater than in 1982-1984, 73.3 cm, 64.3 cm and 65.2 cm, respectively

($p<0.05$) (Figure 23). The Shasta River weir data represent a discrete upstream stock, primarily of natural origin, and corroborate trends exhibited in the beach seining data which represent a combination of basin-wide stocks of both natural and hatchery origin.

Growth rates of fall chinook between ages 2 to 3, 3 to 4, and 4 to 5, as observed during the 1985 growth year, were greater than those observed in the 1982-1984 growth years (Table 31). Growth rates were severely impacted during 1983 but recovered quickly, with 1985 growth rates actually exceeding those of 1982 (representing pre-El Niño growth). Plates 4 and 5 show scales exhibiting differences in growth patterns between two 5-year-old chinook salmon, one exposed to El Niño and one exhibiting more consistent annual growth patterns. It is apparent that growth during 1983 was greatly reduced compared to growth of the fish not exposed to El Niño. In previous annual reports (USFWS 1984, 1985) growth rates for fingerling and yearling release groups between age 3 and 4 were determined from coded-wire tag (CWT) recoveries, but due to the small sample size obtained this year comparable data for the 1985 growth year are not available. Trends shown by CWT analyses in previous reports parallel those presented in Table 31.

Data on percent change in mean lengths from 1979-1982 (pre-El Niño) for 2-, 3-, and 4-year-old chinook returning in 1983, 1984, and 1985 exhibit how age classes were affected to varying extents by the El Niño event (Table 32). An inverse relationship exists between age and both decrease in mean length at age in 1983 and recovery of the affected fish to pre-El Niño lengths. Among the three age classes, two-year-old chinook showed the greatest decrease in mean length in 1983 but also recovered faster than 3- or 4-year-olds in 1984 and 1985. Two-year-old chinook returning in 1984 were still substantially smaller than the 1979-1982 average while fish of the same cohort returning in 1985 as 3-year-olds had fully recovered from El Niño with an increase in mean length of 2.0% above the 1979-1982 average. Four-year-old chinook were the slowest to respond to improved oceanic conditions but this group also reached pre El-Nino mean lengths during the 1985 growth year.

Trends in length at maturity of fall chinook returning to the Klamath River during 1979 and 1981-1985 also serve to illustrate how El Niño depressed mean lengths of all age groups in 1983 and 1984 (Figure 24). Mean lengths for all age classes returning in 1983 and 1984 were greatly reduced from 1979-1982 means. Two-year-old chinook returning in 1985 did not encounter poor oceanic conditions and thus exhibited normal growth. Jacks returning in 1985 were the largest in the six year data base. Three-year-old chinook returning in 1985 were able to take advantage of improved oceanic conditions; whereas this cohort was smaller than average in 1984 as 2-year-olds, in 1985 they were slightly larger than average as 3-year-olds. Following the 1985 growth year the mean length of 4-year-old chinook was approximately equal to pre-El Niño levels while 5-year-olds remained well below average. These two age classes, exposed at an older age to the effects of El Niño during major growth periods, were initially impacted to a lesser extent than their younger age classes, but were slower to recover from these impacts.

Returns of 2- and 3-year-old chinook in 1984 and 3- and 4-year-olds in 1985 were expected to be depressed due to decreased survival of fish exposed to El Niño. Returns of 2- and 3-year-olds were depressed in 1984 but returns

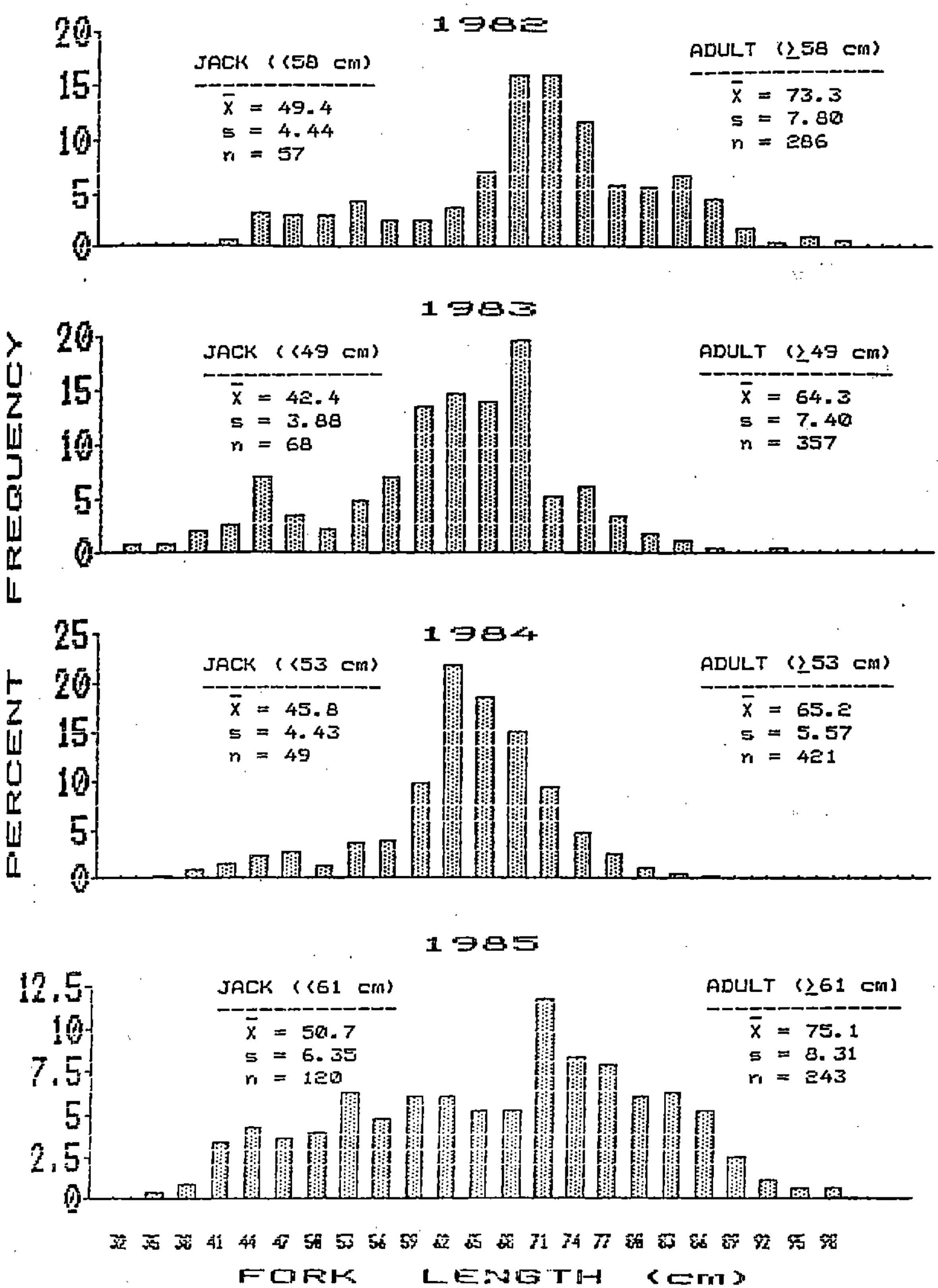


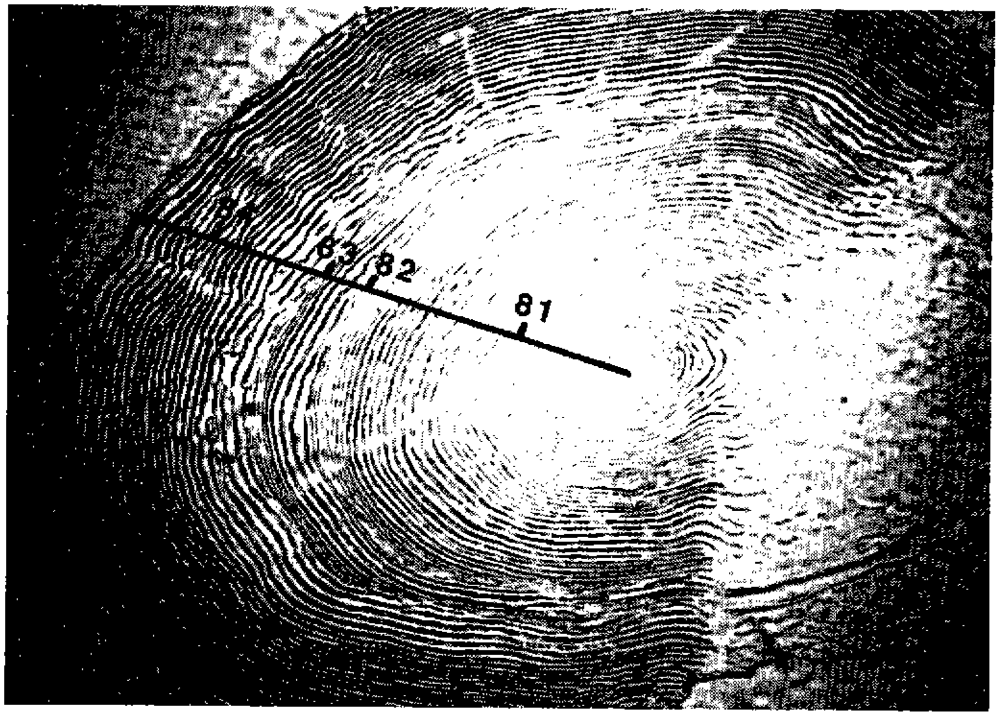
FIGURE 23. Shasta River weir fall chinook length-frequency distributions for 1982-1985 (3 cm groupings). Note: relative representation of jacks and adults for 1985 is not necessarily in proportion with total run.

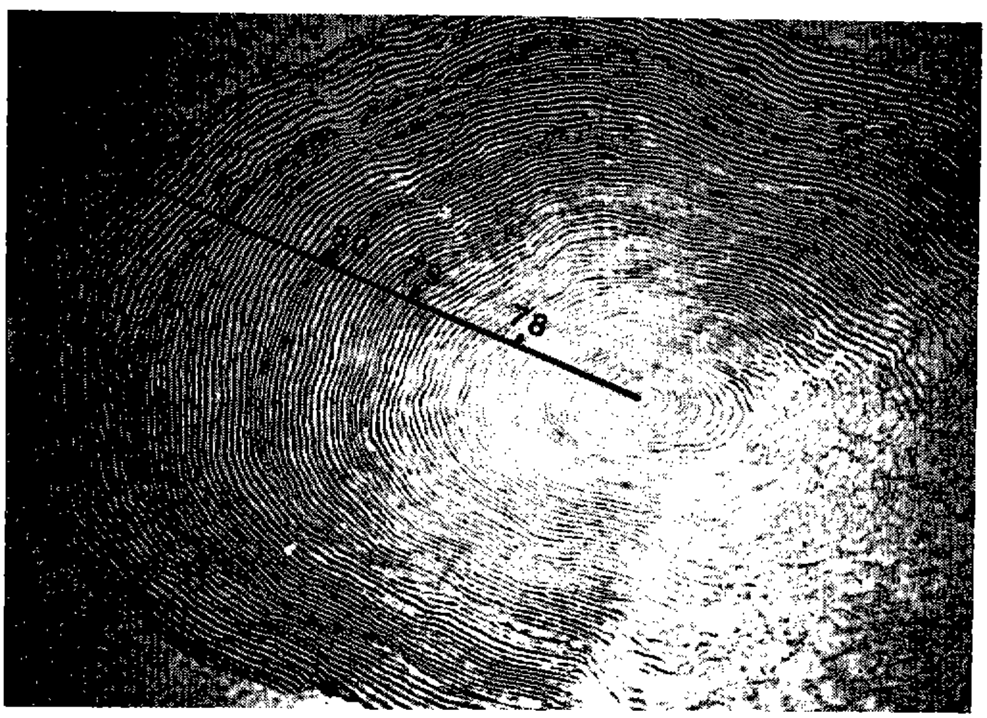
Table 31. Growth between ages 2 to 3, 3 to 4, and 4 to 5 during 1982-1985, of Klamath River fall chinook captured during beach seining operations.

Growth Year	GROWTH RATE (cm/yr) Age 2-3	Age 3-4	Age 4-5
1982	19.1	15.1	6.7
1983	12.0	2.2	-1.0
1984	21.0	12.3	9.6
1985	25.2	18.1	12.2

Table 32. Mean lengths (cm) of 2-, 3-, and 4-year-old Klamath River fall chinook returning in 1979-1982 (pre-El Niño years) and in 1983, 1984, and 1985, and percent changes for 1983, 1984, and 1985 from the 1979-1982 mean by age group.

Age	1979-1982 Mean	1983 Mean	% Change From Mean 1979-1982	1984 Mean	% Change From Mean 1979-1982	1985 Mean	% Change From Mean 1979-1982
2	49.1	41.9	-14.7	45.4	-7.5	51.0	+3.9
3	69.2	60.3	-12.9	62.9	-9.1	70.6	+2.0
4	81.3	71.5	-12.1	72.6	-10.7	81.0	-0.4





PLATES 4 and 5. Scales from two 5-year-old fall chinook returning to the Klamath River in 1985 (above) and 1982 (below). The upper fish exhibits reduced growth during 1983, attributable to the El Niño event, while the lower fish shows a normal growth pattern.

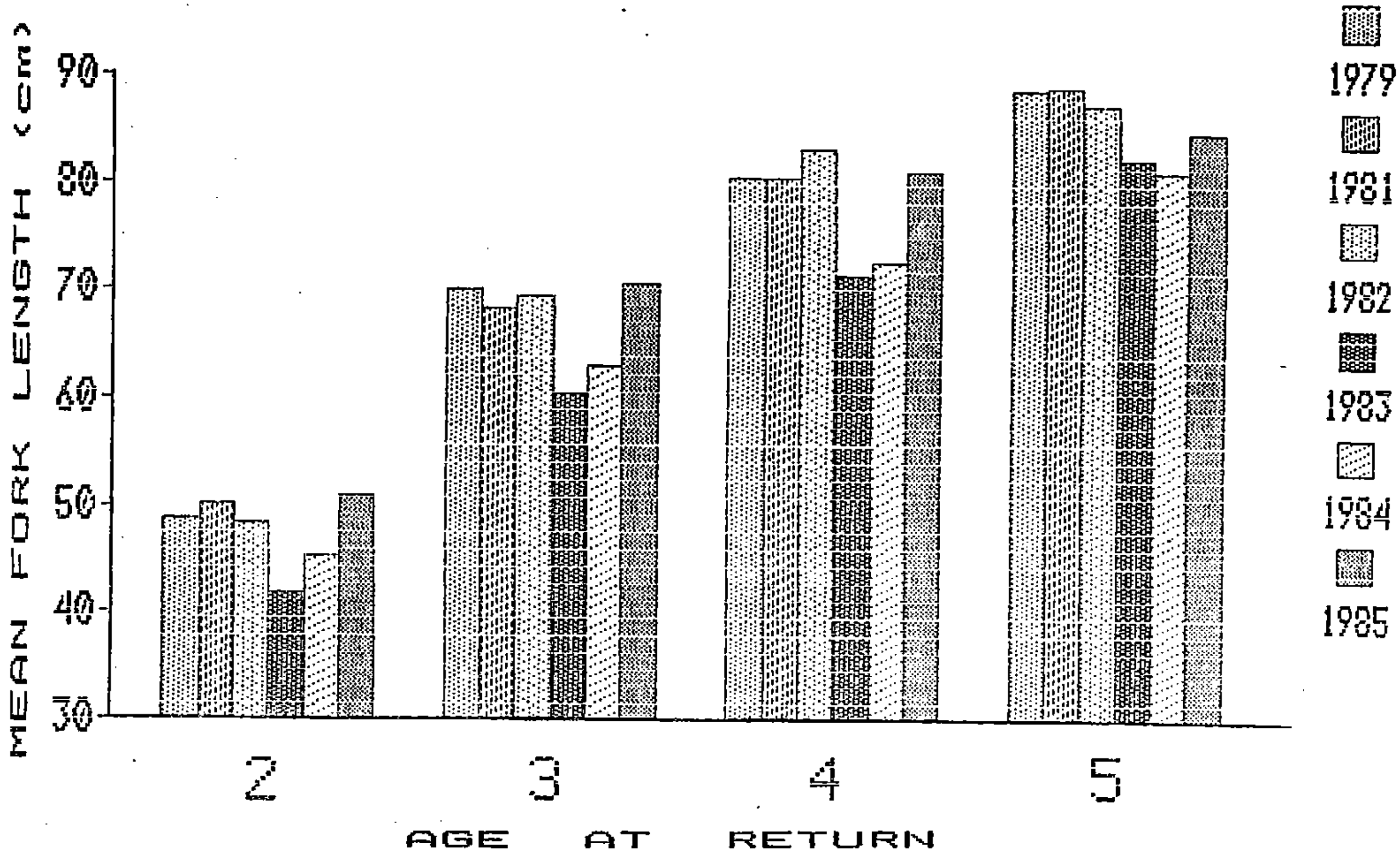


FIGURE 24. Mean fork length (cm) at age for 2 to 5-year-old fall chinook salmon in 1979 and 1981-1985 return years.

of all age classes in 1985 exceeded average levels (See Age Composition Section). The high 1985 returns of 3- and 4-year-olds may be due partly to a delay in maturity schedules resulting from the impacts of El Niño, partly to elevated survival with improving ocean conditions, and partly to the previously discussed reductions in the 1984 and 1985 ocean troll fishery landings.

Recovery of mean size at age as a result of compensatory growth, as suggested in the 1983 annual report (USFWS 1984), did occur for most age classes, and 1985 growth rates actually exceeded pre-El Niño levels. With no El Nino currently forecast for 1986, it appears that fall chinook populations returning to the Klamath River will exhibit growth rates and lengths at age similar to those of pre-El Niño years. One influence of El Niño that may surface in the near future is poor production from the 1983 brood, which exhibited decreased fecundity and possibly lower survivorship of eggs.

COHO SALMON, STEELHEAD TROUT AND STURGEON INVESTIGATIONS

ABSTRACT

A total of 61 coho salmon, including 7 jacks, were captured during 1985 beach seining operations in the Klamath River estuary. Adipose fin-clipped coho comprised 49.1% of the beach seine sample and 34.0% of the total sample was hook scarred. Based on scale samples collected from 52 coho, age composition of returning coho was 84.3% 3-year-olds and 15.7% 2-year-olds. Jaw tags were placed on 45 coho; 3 tags were recovered. An estimated 1,943 coho salmon, including 49 jacks, were harvested by Indian gill net fishers on the Klamath River portion of the Hoopa Valley Reservation in 1985. Adipose fin-clipped coho comprised 45.0% of the harvest sample. A total of 14 coded-wire tags (CWT) representing 9 release groups were recovered.

A total of 358 steelhead trout, including 111 half-pounders, were captured during 1985 beach seining operations in the Klamath River estuary. Mean length for adults and half-pounders were 53.0 cm and 40.6 cm, respectively. Steelhead were captured throughout the course of the beach seining operation beginning in mid-July, with peak catches occurring in late August. The estimate for fall steelhead captured in the 1985 Indian gill net fishery on the Klamath River portion of the Hoopa Valley Reservation is 278, including 46 half-pounders. Adults comprised 97 fish in the harvest sample with a mean length of 56.2 cm, while 17 half-pounders sampled showed a mean length of 36.5 cm.

A total of 3 white and 41 green sturgeon (34 adults and 7 juveniles) were observed during the 1985 net harvest monitoring program activities in the Klamath River portion of the Hoopa Valley Reservation. Green sturgeon observed ranged from 45 to 208 cm total length and white sturgeon from 98 to 215 cm total length. An estimated 351 green sturgeon were harvested in the Indian gill net fishery on the Klamath River portion of the Hoopa Valley Reservation in 1985. Peak net harvest occurred in the April-July period during the annual upstream spawning migration. No sturgeon were captured during the 1985 beach seining operation.

COHO SALMON, STEELHEAD TROUT AND STURGEON INVESTIGATIONS

INTRODUCTION

The 1985 coho salmon, steelhead trout and sturgeon runs in the Klamath River were observed through the previously described net harvest monitoring and beach seining programs. Coho and steelhead are not target species for the Indian net fishery and their harvest is generally considered incidental to that of fall chinook salmon. The FAO-Arcata beach seining operation, similarly, does not target on steelhead, coho or sturgeon and data on these species are collected incidentally to that on fall chinook salmon. Sturgeon are targeted by the Indian net fishery particularly in spring.

METHODS

Methods used in collecting and analyzing beach seine and net harvest data for coho, steelhead and sturgeon are the same as previously described for chinook salmon.

RESULTS AND DISCUSSION

Coho Salmon

Beach Seining

A total of 61 coho salmon including 8 jacks (<53 cm) were captured in beach seining operations near the mouth of the Klamath River from July 15 through September 25, 1985.

The mean lengths (cm) of both jacks (49.0) and adults (66.6) were significantly greater (t-test, $p<0.05$) than jack (48.0) and adult (59.8) mean lengths in 1984.

Of 45 adult coho examined, 21 (46.7%) were adipose fin-clipped and 16 (35.6%) where hook-scarred. Of 8 jacks examined, 5 (62.5%) were adipose fin-clipped; none were hook-scarred. Jaw tags were placed on 45 (84.9%) of the 53 coho examined. Two tags were recovered, both at Trinity River Hatchery (TRH), for a recovery rate of 4.4%. Mean time from tagging to recovery for the two coho was 58.5 days.

Scales were collected from 52 coho to determine age composition and growth trends (see "Methods" section of age composition section). The age composition of coho returning in 1985 showed a dominance of 3-year-old individuals (84.3%), followed by 2-year-old (15.7%) salmon. Mean lengths for coho returning at age 2 and 3 were 49.6 and 66.7 cm, respectively. The age group contributions and associated mean lengths presented may not be representative of the entire Klamath River coho population as the beach seining operation targeted on chinook salmon and sampling was terminated prior to the peak of the 1985 coho run.

Net Harvest

An estimated 1,943 coho, including 49 jacks (<53 cm) were netted on the Klamath River portion of the Hoopa Valley Reservation (HVR) in 1985. Coho caught in the Middle and Upper Klamath River net fisheries accounted for 45.5% (885) and 40.7% (791) of the total harvest estimate, respectively (Table 33). Coho first appeared in the Klamath net fishery in early September, with peak catches occurring in late September and early October. The 1,943 coho harvested on the Klamath River portion of the HVR and the total of 3,128 (including harvest on the Trinity River) in 1985 represents the largest catch recorded during the 1980-1985 data base period (Table 34). The increase in coho catch may be due to a larger run size and an increase in effort in the latter part of the season brought on by closures during the traditional fall chinook fishing season.

A total of 438 coho were sampled during the 1985 net harvest program. Mean lengths of adults (73.1 cm) were significantly greater than those observed in each of the years 1982-1984 (t-test, $p<0.05$). Jacks (50.0 cm) showed no significant difference in mean length from 1982, but were significantly greater ($p<0.05$) in mean length than in 1984 (Figure 25). Adipose fin-clipped coho comprised 44.8% of the adult and 55.5% of the jack sample. Mean lengths of adult (73.4 cm) and jack (49.8 cm) adipose fin-clipped coho did not differ significantly from non-clipped fish ($p>0.05$).

Adipose fin-clipped coho comprised 44.8% of the adult and 55.5% of the jack sample. Mean lengths of adult (73.4 cm) and jack (49.8 cm) adipose fin-clipped coho did not differ significantly from non-clipped fish ($p>0.05$).

A total of 14 coded-wire tags (CWT) were recovered from coho salmon in the 1985 Klamath river net fishery. These CWT recoveries were not expanded to total harvest because of the small sample size. Three-year-old coho (1982 brood) comprised 92.9% of the CWT harvest sample. Seven tags recovered from four release groups (1982 brood year) from TRH (06-56-46, 06-56-47, 06-56-48, 06-56-49) had a combined mean length of 73 cm. One other TRH CWT, 06-56-51, (1983 brood year) had a length of 51 cm. Six tags recovered from four release groups (1982 brood year) from the Iron Gate Hatchery (06-59-56, 06-59-57, 06-59-58, 06-59-59) had a combined mean length of 72.6 cm.

Steelhead Trout

Beach Seining

A total of 358 fall steelhead trout, including 111 half-pounders (<44 cm), were captured during beach seining operations from July 15 through September 25, 1985. This represents an overall catch/effort value of 1.23 steelhead per seine haul, which is similar to other catch/effort values observed during the 7-year study period (USFWS 1985). Peak steelhead catches in the beach seine sample occurred from August 9 to August 21 (Figure 26).

Adult steelhead sampled in 1985 showed a mean length (53.0 cm) significantly greater ($p<0.05$) than 1982 (47.6 cm) but showed no significant difference in mean length from 1983 (53.8 cm) or 1984 (53.5 cm) (t-test; $p>0.05$). The mean length of half pounder steelhead (40.6 cm) was

TABLE 33. Semi-monthly set and drift net harvest estimates of coho captured in the three Klamath River monitoring areas of the Hoopa Valley Reservation under Department of Interior promulgated regulations in 1985.

	NET HARVEST MONITORING AREA						
Time Period	Estuary	Middle Klamath Set Net	Middle Klamath Drift Net	Upper Klamath Set Net	Upper Klamath Drift Net	Semi-Monthly Totals (All Areas)	Cumulative Seasonal Total
September 1 - 15	0[1/]	3	0	0	0	3	3
	-[2/]	3	-	-	-		
	-[3/]	100.0%	-	-	-		
	-[4/]	3	-	-	-		
September 16 - 30	84	276	101	0	0	461	464
	11	37	13	-	-		
	13.1%	13.4%	12.9%	-	-		
	35	105	41	-	-		
October 1 - 15	183	323	140	334	213	1193	1657
	61	35	16	47	18		
	33.3%	10.8%	11.4%	14.1%	8.5%		
	29	165	66	77	103		
October 16 - 31	0	42	0	110	134	286	
	-	6	-	20	21		
	-	14.3%	-	18.2%	15.7%		
	-	26	-	56	44		
Area Season Total	267	644	241	444	347		1,943
	72	81	29	67	39		293
	27.0%	12.6%	12.0%	15.1%	11.2%		15.1%
	64	299	107	133	147		750

1/ Harvest estimate.

2/ 95% Confidence interval.

3/ Confidence interval percentage.

4/ Accounted number of coho.

TABLE 34. Final harvest estimates of coho salmon taken in the gill net fishery of the Hoopa Valley Reservation during 1980-1985[1/].

	COHO CHINOOK		
Year	Jacks	Adults	Total
1980	-	-	1,500
1981	163	1,470	1,633
1982	49	951	1,000
1983	4	121	125
1984	261	738	999
1985	119	3,009	3,128

1/ Estimates for 1983-1985 Trinity River net fishery were obtained from the Hoopa Valley Business Council, Fisheries Department. All other harvest estimated by the U. S. Fish & Wildlife Service by methods described in previous annual reports.

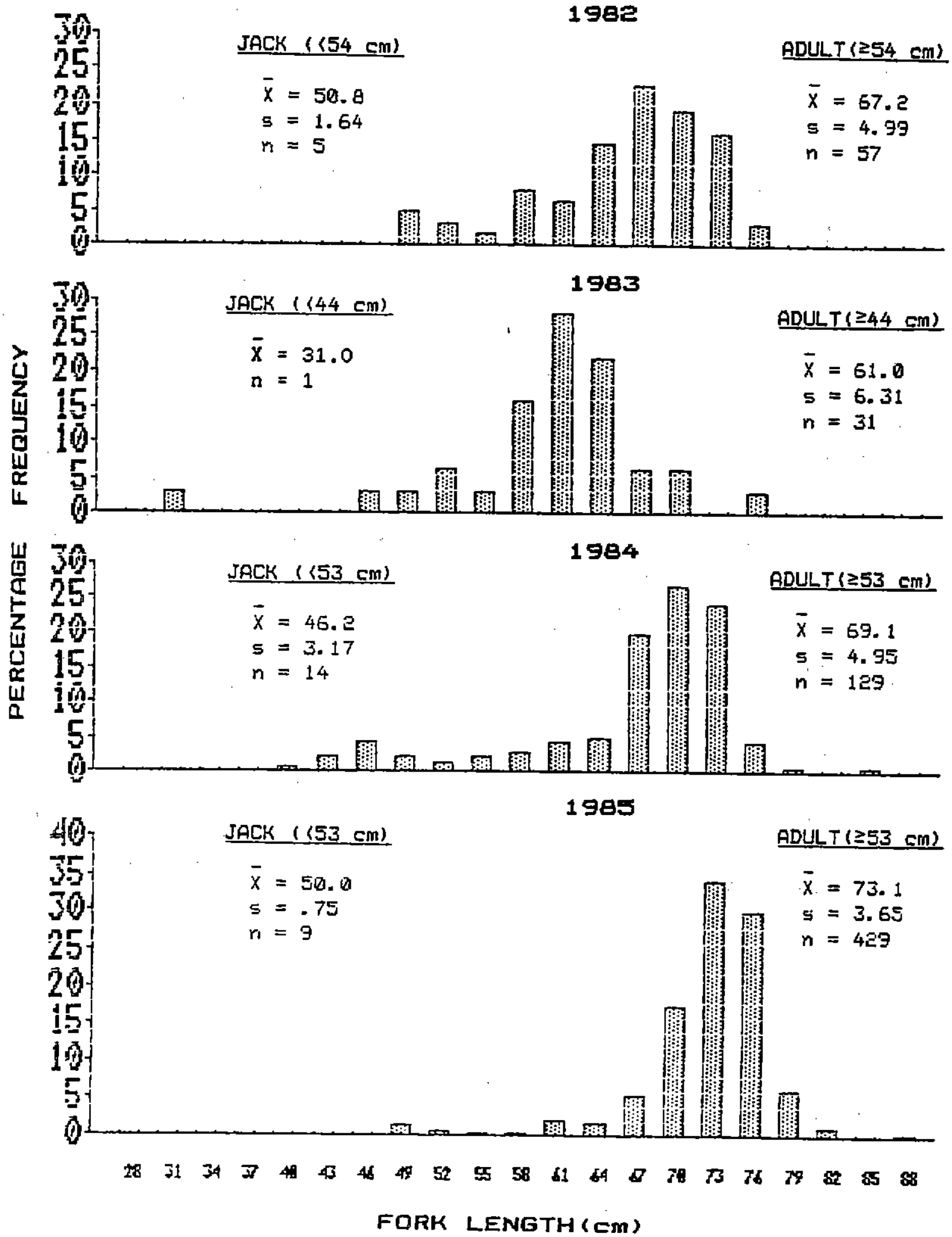


FIGURE 25. Length-frequency distributions of coho salmon caught by Indian gill net fishers on the Klamath River portion of the Hoopa Valley Reservation during 1982-1985 (3 cm groupings with midpoints noted).

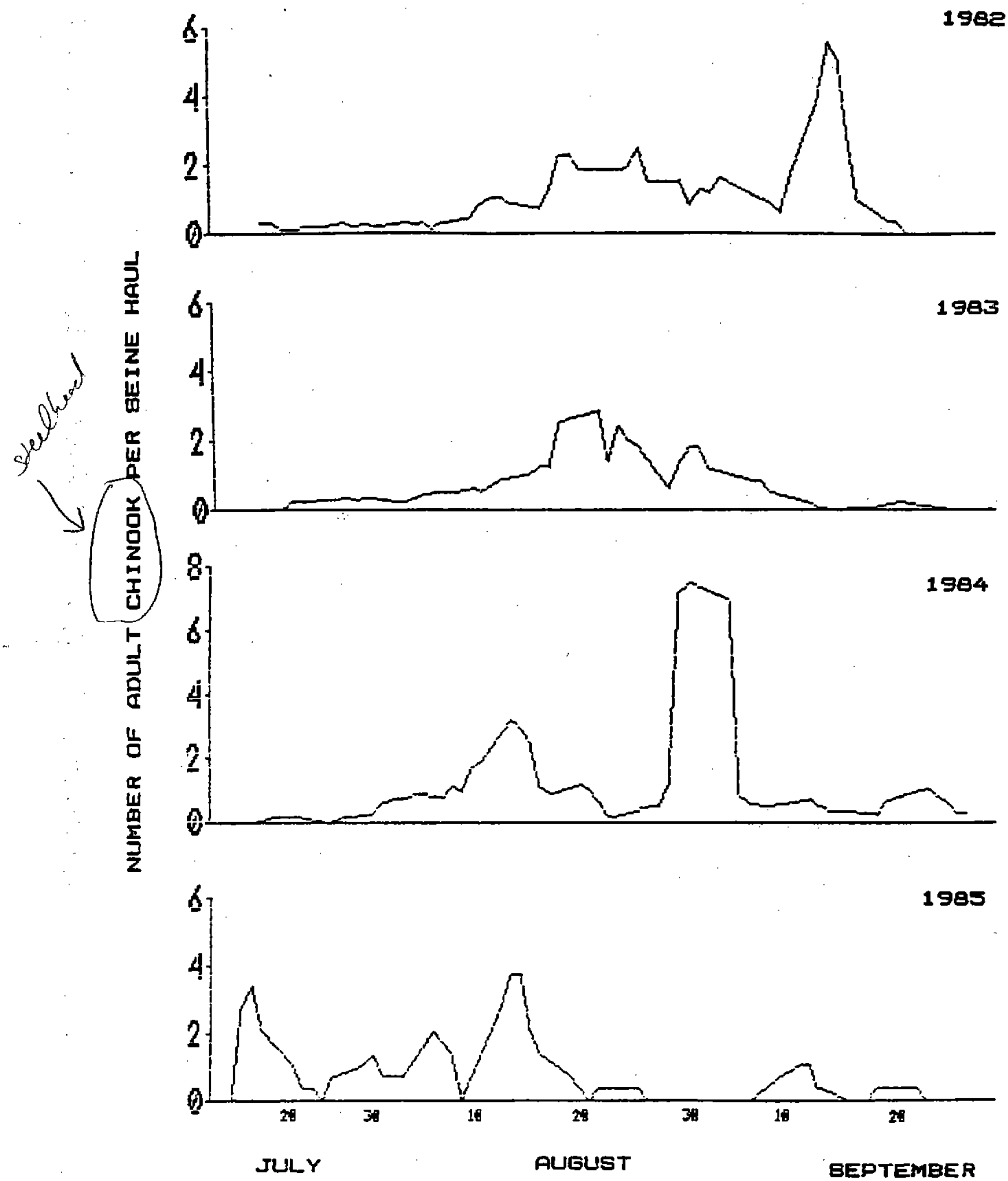


FIGURE 26. Three-day moving averages of numbers of fall steelhead trout captured per beach seine haul in the Klamath River estuary during 1982-1985.

significantly greater ($p<0.05$) than those sampled in 1982 (35.0 cm), 1983 (34.7 cm), or 1984 (38.7 cm).

Length information on fall steelhead half-pounders captured in the beach seine should be viewed with caution as many individuals are released unmeasured. This practice is necessary due to the simultaneous occurrence of large numbers of fall chinook salmon in the seine which often physically damage the smaller steelhead. These small half-pounders also tend to become gilled in the seine net and as a result, are too stressed to handle without a high rate of mortality. This practice tends to inflate the sample mean length of half-pounders but is necessary to minimize half-pounder mortality.

Net Harvest

An estimated 278 fall steelhead trout including 46 half-pounders (<44 cm), were netted on the Klamath River portion of the Hoopa Valley Reservation in 1985 (Table 35). Fall steelhead were observed from early July to the end of October in the Klamath River gill net fishery. Determination of a run peak period is difficult to ascertain due to fishery closures. Table 36 summarizes net harvest estimates for steelhead trout on the HVR during 1980-1985.

Mean length of adult steelhead harvested by Indian fisheries in 1985 (56.2 cm) was significantly less than in 1984 (59.9 cm) ($p<0.05$) and significantly greater than in 1982 (51.3 cm) ($p<0.05$), but not significantly different than in 1983 (58.2 cm) ($p>0.05$, Figure 27). The 1985 half-pounder sample showed no significant difference in mean length (36.5 cm) from 1983 (34.0 cm) or 1984 (35.2 cm) ($p>0.05$) but was significantly greater than in 1982 (32.0 cm).

<u>Sturgeon</u>

Beach Seining

No sturgeon were captured during 1985 beach seining activities in the Klamath River estuary.

Net Harvest

An estimated three white and 351 green sturgeon were harvested in the Indian gill net fishery on the Klamath River portion of the Hoopa Valley Reservation during 1985 (Table 37).

All of the white sturgeon were captured in the lower 10 km of the Klamath River and may have been coastal migrants rather than spawning migrants. Some of these individuals may have originated from other river systems.

An estimated 320 adult green sturgeon (≥ 130 cm total length) were netted on the Klamath River portion of the HVR in 1985 with the harvest of upstream migrants during the April-July period accounting for 64.4% of the total. Most of the adult green sturgeon netted during the August-October period were apparently downstream migrant post-spawners. The 1985 harvest of 320 adult green sturgeon on the Klamath River portion of the Reservation is

TABLE 35. Semi-monthly set and drift net harvest estimates of fall steelhead captured in the three Klamath River monitoring areas of the Hoopa Valley Reservation under Department of Interior promulgated regulations in 1985.

Time Period	NET HARVEST MONITORING AREA Estuary	Middle Klamath Set Net	Middle Klamath Drift Net	Upper Klamath Set Net	Upper Klamath Drift Net	Semi-Monthly Totals (All Areas)	Cumulative Seasonal Total
July 1 - 15	8 1/ 3 2/ 37.5% 3/ 3 4/	0 - - -	0 - - -	0 - - -	0 - - -	8	8
July 16 - 31	13 2 15.4% 10	0 - - -	0 - - -	0 - - -	0 - - -	13	21
August 1 - 15	17 4 23.5% 9	12 6 50.0% 5	0 - - -	16 3 18.8% 8	6 2 33.3% 4	51	73
August 16 - 31	0 - - -	19 2 10.5% 8	5 2 40.0% 3	22 2 9.1% 10	24 5 20.8% 22	70	142
September 1 - 15	0 - - -	9 1 11.1% 6	0 - - -	0 - - -	0 - - -	9	151
September 16 - 30	10 2 20.0% 4	3 1 33.3% 1	6 1 16.7% 3	0 - - -	0 - - -	19	170
October 1 - 15	0 - - -	5 1 20.0% 4	3 2 66.7% 1	17 4 23.5% 6	39 6 15.4% 18	64	234
October 16 - 31	0 - - -	10 2 20.0% 4	0 - - -	4 1 25.0% 2	30 8 26.7% 7	44	
Area Season Total	48 11 22.9% 26	58 13 22.4% 27	14 5 35.7% 7	59 10 16.9% 26	99 21 21.2% 51		278 60 21.6% 137

1/ Harvest estimate.

2/ 95% Confidence interval.

3/ Confidence interval percentage.

4/ Accounted number of fall steelhead.

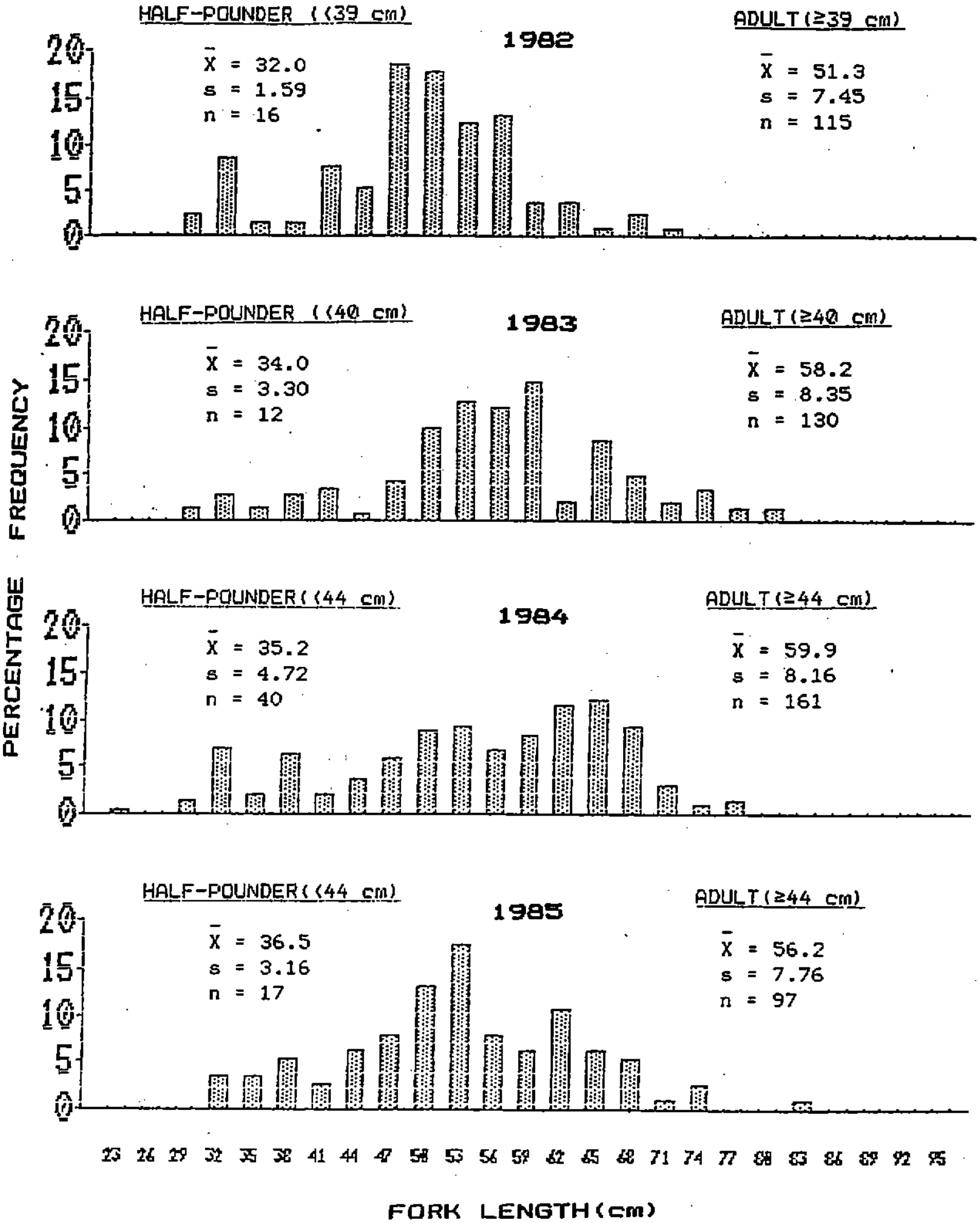


FIGURE 27. Length-frequency distributions of fall steelhead trout caught by Indian gill net fishers on the Klamath River portion of the Hoopa Valley Reservation during 1982-1985 (3 cm groupings with midpoints noted).

TABLE 36. Final harvest estimates of steelhead trout taken in the gill net fishery on the Hoopa Valley Reservation during 1980-1985[1/].

Year	FALL STEELHEAD TROUT		
	H-P	Adults	Total
1980	-	-	300
1981	181	535	716
1982	48	352	400
1983	23	340	363
1984	110	696	806
1985	46	457	503

1/ Estimates for 1983-1985 Trinity River net fishery were obtained from the Hoopa Valley Council, Fisheries Department. All other harvest estimated by the U. S. Fish & Wildlife Service by methods described in previous annual reports.

TABLE 37. Net harvest estimates of green and white sturgeon captured on the Klamath River portion of the Hoopa Valley Reservation in 1985.[1/]

	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
ESTUARY	0	0	0	60	2	0	13	39	2	0	13	99
MIDDLE KLAMATH	0	1	0	132	0	0	18	55	0	1	18	187
UPPER KLAMATH	0	0	0	34	0	0	0	0	0	0	0	34
ALL AREAS	0	1	0	226	2	0	31	94	2	1	31	320

1/ Estimates for gill net harvest on the Klamath River portion of the HRV only-no snag or sport harvest coverage, Trinity River not included.

TABLE 38. Final harvest estimates of green and white sturgeon taken in the gill net fishery on the Hoopa Valley Reservation during 1980-1985.[1/]

	WHITE			GREEN		
	JUV	ADULT	TOTAL	JUV	ADULT	TOTAL
1980	10	3	13	30	300	330
1981	10	5	15	25	810	835
1982	10	5	15	53	347	400
1983	10	0	10	89	406	495
1984	2	0	2	21	394	415
1985	2	1	3	31	330	361

1/ Estimates for 1983-1985 Trinity River net fishery were obtained from Hoopa Valley Business Council, Fisheries Department. All other harvest estimated by the U. S. Fish & Wildlife Service by methods described in previous annual reports.

down 21.4% from the 6-year average (407). Including 1985 data provided by the Hoopa Valley Business Council Fisheries Department, the corresponding 6-year average net harvest of adults on the entire Hoopa Valley Reservation is 431 (Table 38).

Total lengths were recorded for 3 white and 41 green sturgeon observed during net harvest monitoring activities. Two immature white sturgeon with lengths of 98 cm and 115 cm were examined, along with a single 215 cm adult white sturgeon. A total of 34 adult green sturgeon were examined, ranging from 130 cm to 208 cm total length with a mean of 174.8 cm (Figure 28). This mean is similar to the 6-year sample mean of 173.9 cm.

In 1985 seven juvenile (<130 cm) green sturgeon ranging from 45 cm to 125 cm total length, with a mean of 101.1 cm were observed in the Klamath River. All but one were observed during the months of July-September in the Estuary Area gill net fishery. Data from previous seasons indicate that abundance of juvenile green sturgeon peaks in the estuary during this time period (USFWS 1985).

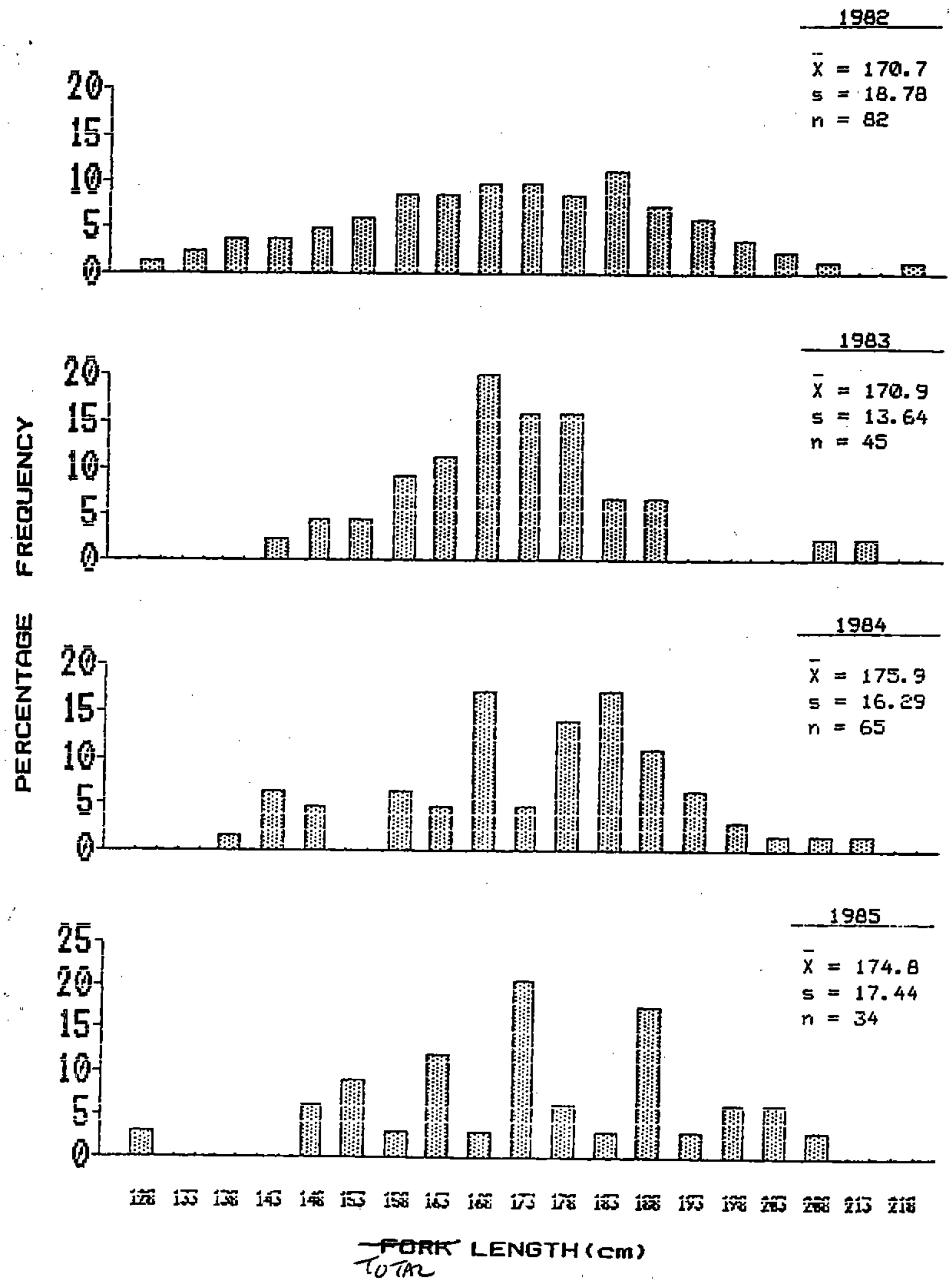


FIGURE 28. Length-frequency distributions of Klamath River adult green sturgeon captured by beach seine, gill net and hook and line during 1982-1985 (5 cm groupings with midpoints noted).

PROGRAM PLANNING

INTRODUCTION

The course of the Klamath River Fisheries Investigation Program (KRFIP), 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 Agreement and the Critical Issues Management System, the USFWS Management By Objectives program, and a variety of other past and present Departmental and external factors. Further direction has been received through the Service Management Plan (USFWS 1982b), through the preparation of a Regional Resource Plan by the USFWS Region One directorate (USFWS 1982c) and through a Statement of Responsibilities and Role (USFWS 1985b) of the Fishery Resources Program. Bureau of Indian Affairs (BIA) planning processes involving fisheries resources of the Hoopa Valley Indian Reservation (HVR), including the Klamath River Basin Fisheries Resource Plan (USDI 1985), will continue to exert a strong influence on program direction. The passage of P.L. 98-541, the Trinity River Basin Fish and Wildlife Management Program, on October 24, 1984, may also exert an influence on program direction. Details of other actions with potential relevance to FAO-Arcata programs have been presented in previous Annual Reports.

The ultimate goal of FAO-Arcata is to provide assistance by conducting various specialized field programs which address specific problems as they are recognized. This project has neither the funding to support or the authority which would mandate a more comprehensive approach to basin fisheries work. With this in mind, flexibility must be maintained in order to react to changing needs in current fisheries management while at the same time reserving the ability to conduct longer term monitoring programs such as are reported here.

PROGRAM PLANNING

Anadromous fishes of the Klamath-Trinity basin have been identified as high priority and have been listed in order of preference for investment in restoration (USFWS 1982c). The KRFIP has and will continue to focus on five of these stocks: fall chinook, spring chinook, fall steelhead, coho salmon and green sturgeon, which have been recognized as fitting the criteria of being depressed stocks, largely of natural origin, with high value to fisheries and good restoration potential. FAO-Arcata biologists have also recommended that field programs be expanded to cover winter run steelhead trout, another important basin species.

For the priority species, FAO-Arcata programs will continue to center on: (1) collection of necessary baseline information on population characteristics, (2) monitoring of annual adult spawning migrations and juvenile populations, (3) monitoring of in-river net harvest levels and (4) analysis and presentation of pertinent information in a timely manner to those agencies responsible for managing this important resource. FAO-Arcata programs will be conducted to the extent possible in cooperation with those of other agencies involved with the Klamath River fishery resource.

The KRFIP was initiated through the USFWS in 1977 at the request of the BIA in order to provide data necessary for management of the Klamath River fishery resource, in context of the expanding in-river net fishery. The USFWS was selected for program initiation because of recognized expertise in fisheries management, there being no such capacity within the BIA or local Indian groups at that time. At such time as fisheries expertise is developed among local Indians part or all of existing FAO-Arcata programs will be transferred to these groups. Such transfer of programs began with the establishment in 1981 of the Hoopa Valley Business Council (HVBC), Fisheries Department, and the hiring of two biologists by the Tribe. Former FAO-Arcata programs operating on the Trinity River under MOA with the BIA have been entirely transferred to the HVBC. However, current office programs are considered of an on-going monitoring nature and are expected to continue within the USFWS, the BIA or local Indian groups as long as Department of the Interior or Indian-regulated fisheries are in operation on the Klamath River. With this in mind, a major aspect of FAO-Arcata operations continues to be the training and education of local Native Americans in fisheries science. Specific directions anticipated for FAO-Arcata field activities in the near future are as follows:

(1) Beach Seining Operations are considered of a monitoring nature and should be continued on a yearly basis. Primary emphasis will remain with fall chinook. FAO-Arcata beach seining operations currently provide the only available estimates of Klamath River fall chinook population age composition. Such data have proven useful in generating annual ocean stock size projections for use in fisheries management. The collection of such data should continue. Other biological data collected, including monitoring of migration behavior through mark-recapture studies are valuable and should continue. ~~Derivation of C/E indices of in-season population abundance has proven less useful, never-the-less research into this subject will continue at a somewhat lower level of prio~~rity. It should be clearly understood that the beach seining and harvest monitoring programs together provide two key interactive components of the FAO-Arcata database. De-emphasis of either program would seriously impact the other as well as overall ability to address fishery problems in the basin. Both should be viewed as on-going monitoring programs to be continued indefinitely and not as baseline studies which will soon reach a point where necessary input has been supplied.

(2) Harvest Monitoring Operations provide the only presently available estimates of Indian gill net harvest of spring and fall chinook, coho, steelhead and sturgeon within the Klamath River portion of the Hoopa Valley Reservation and collection of this critical information should continue. As discussed in this report, a stratified random sampling methodology was first employed in 1984 to derive the fall chinook net harvest estimates. FAO-Arcata biologists should continue to work toward improving net harvest estimation methodologies. It should be recognized however that such improvement may be limited by available funding. Research into data on size selectivity, the relationship between net harvest and river flow, models to predict net harvest and escapement associated

with specific management options, and other management-oriented aspects of the fishery should continue. Collection of a variety of baseline biological data from the net harvest, including recaptures of fish tagged during beach seine operations, appears valuable and should continue. Recoveries of coded-wire tags through monitoring of the net fishery is important to management of the fisheries and of hatchery stocks within the basin and should continue. FAO-Arcata staff should work toward improving CWT sampling rates in the net harvest.

(3) Juvenile Salmonid Investigations were discontinued after Fiscal Year 1982 due to lack of funding. Monitoring of juvenile populations of priority species in the basin, however, provides important information for management. At present, limited studies on juvenile populations are being conducted by the California Department of Fish and Game (CDFG) and the HVBC in the basin, but information is still incomplete. Expansion of such studies would provide needed information on migration, production, growth, survival, hatchery-natural interactions and other characteristics of juvenile populations within the basin. During 1985, FAO-Arcata staff initiated a limited sampling schedule in the lower Klamath River and associated tributaries in attempt to augment current CDFG programs. Of particular interest is production generated from Blue Creek, the largest tributary in the lower river area. Additional funding is being sought to support expanded field work on juvenile production in the upcoming fiscal year.

(4) Other Programs. In recent years, FAO-Arcata staff have proposed and sought funding for various new field projects. In Fiscal Year 1984, study proposals were prepared for investigation into harvest patterns and population characteristics of anadromous species not previously covered by the program, specifically winter run steelhead trout and Pacific lamprey. Additional field work for the purpose of involvement in the rapidly expanding stream enhancement and artificial propagation programs now occurring in the basin, including an update of the Inventory of Reservation Waters (USFWS 1979), was also proposed in 1984. A proposal to study gill net size selectivity in the HVR fall chinook net fishery was prepared for inclusion in FAO-Arcata activities during Fiscal Year 1986. As mentioned above, support for expanded juvenile studies has also been solicited. Unfortunately, funds have not been attracted for any of this work. Such efforts will continue, however, since it is believed that augmentation of current programs would greatly benefit the data base and therefore enhance management capability.

(5) Program Planning, Direction and Coordination will remain essential and on-going parts of FAO-Arcata activities. Coordination of programs with and dissemination of information to other groups and agencies involved with the Klamath-Trinity fishery resource are recognized as high priorities. Frequent meetings will continue to be held with biologists representing the BIA, CDFG, USFS, HVBC, ODFW, NMFS and other groups. Coordination with the Trinity River program under P.L. 98-541 is essential. Continuing involvement in

the Department of Interior technical team, as well as with the recently formed Klamath River Salmon Management Group is indicated. Such activities are crucial to the effective provision of fisheries assistance.

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