YAKIMA RIVER SPRING CHINOOK ENHANCEMENT STUDY FISHERIES RESOURCE MANAGEMENT YAKIMA INDIAN NATION

Annual Report 1983

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YAKIMA RIVER SPRING CHINOOK ENHANCEMENT STUDY

FISHERIES RESOURCE MANAGEMENT

YAKIMA INDIAN NATION

ANNUAL REPORT 1983

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ABSTRACT

The purpose of this project is to evaluate enhancement methodologies that can be used to rebuild runs of spring chinook to the Yakima River system. In January, 1983, 100,000 fish raised at Leavenworth National Fish Hatchery were transported to Nile Springs Rearing Ponds on the Naches River. These fish were allowed a volitional release as smolts in April. An additional 100,000 smolts were transported from Leavenworth Hatchery in April and immediately released to the Upper Yakima River. (RM 147-170) All fish in both groups were coded wire tagged and adipose clipped (different codes were given to each group) and 10% of each group was given a distinguishing freeze brand. Relative survival of smolts from their points of release to a trap at Prosser (RM48) was 1.69:1 for fish from Nile Springs, versus the trucked smolts. The fish from Nile Springs arrived at Prosser and McNary Dam approximately 1 week earlier than the transported fish. Mean length of hatchery fish was 140.8 mm, wild fish averaged 126.4 mm.

A smolt trap at Prosser captured 26,909 wild spring chinook smolts, 14,375 hatchery spring chinook, 22,403 wild fall chinook, anti 11,608 wild steelhead. Estimated survival from egg deposition to snoltification following the method of Major & Mighell (1969) for spring chinook was 6.0%, which is at the lower range for historical levels recorded in the Yakima River. A smolt trap on the Naches River a major tributary of the Yakima captured 292 wild spring chinook and 127 wild steelhead.

To better determine the magnitude and location of releases distribution and abundance studies were undertaken. No fish

were captured in beach seining surveys below River-mile 118 from May to November ,undoubtedly due to excessive water temperatures (23°C). The greatest number of fish caught in beach seining during the summer months on the mainstem Yakima River were located between RM135 and RM169, encompassing the Yakima and Ellensburg Canyons. There is a decrease in abundance from upstream areas over time, indicating a general downstream movement.

In the Naches System, the lower Naches River is heavily utilized by juvenile spring chinook during the early summer .In addit ion, juveniles move from spawning areas in the American River to the Upper Naches system throughout the summer.

A preliminary study were undertaken May 17th to evaluate physical limitations of production. On a single evening 67 fish were killed on diversion screens at Chandler Canal. This constituted 5.76 of the wild spring chinook entering the canal and 8.22 of the fall chinook. The larger hatchery spring chinook sustained a 2.3% loss. Observations of large numbers of fish stranded in a dewatered canal following the migration season indicated that large numbers of fishare passing the screens at Roza Canal.

Adult returns resulted in 443 redds in the Yakima System, with 360 in the Yakima River and 83 in the Naches System. Total estimated escapement in 1983 was 1,239 spring chinook. Tribal fisherman harvested 84 spring chinook in dipnet fisheries in 1983.

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INTRODUCTION

The population of Yakima River spring chinook (Oncorhynchus tshawytscha) has been drastically reduced from historic levels reported to be as high as 250,000 (Smoker, 1956). This reduction is the result of a series of problems; mainstem Columbia dams, dams within the Yakima itself, severely reduced flows due to increased irrigation diversions, increased thermal and sediment loading, and over fishing. Despite these problems, the native run of spring chinook in the Yakima River is continuing at levels ranging from 400-2,000 during the last few Years.

Studies by Major and Mighell (1969) showed a high survival from egg deposition to the smolt stage, and preliminary data based on releases of spring chinook. into the Wenatchee River from 1977-1981 indicate an ocean harvest rate of approximately 11% (Washington Department of Fisheries, unpublished report). These factors, coupled with the fact that smolts 1 eaving the Yakima River have only four mainstem Columbia dams to navigate make the Yakima River Watershed an ideal mid-Columbia drainage to develop spring chinook enhancement techniques.

In October, 1982, the Bonnevi 1 le Power Administration funded the Yakima Indian Nation to develop methods to increase production of spring chinook to the Yakima System. The Yakima Nations policy of enhancement encompasses an approach of maintaining as much as possible the genetic integrity of the spring chinook stock native to the Yakima Basin. Relatively small numbers of cultured fish have been released into the

basin in past years, and data from the Wenatchee System indicates a return rate from hatchery smolts of less than .25% (Mullan, 1982). The low return rates indicate that few fish would have returned from these small releases. With this informat ion, it was decided that any fish introduced into the Yakima System would be coded wire tagged to evaluate the efficiency of various release methodologies and to distinguish the origin of returning adults.

The goal of this study is to develop data that will be used topresent alternatives for management of spring chinook runs to the Yakima River. The approach is two fold. First, studies to determine the distribution, abundance and survival were begun in 1983. Examinations of the naturally produced fish will be used to determine if the natural runs can be sustained in the face of present harvest and environmental conditions. This information will be gathered through spawning ground surveys, counting of adults at Prosser and Roza fish ladders, and through monitoring the tribal dipnet fishery. Concurrent studies will examine potential habitat limitations within the basin. Presently, survival to emergence studies, in conjunction with substrate quality analysis is being undertaken. Water temperature is monitored throughout the basin, and seining takes place monthly to evaluate distribution and abundance. The objective of this phase of the investigation is to determine if habitat limitations require supplementation of the wild stocks, and if so, how can the hatchery stocks be introduced in an effective manner that minimizes the impacts on the wild stocks.

The second objective of this study is to determine relative

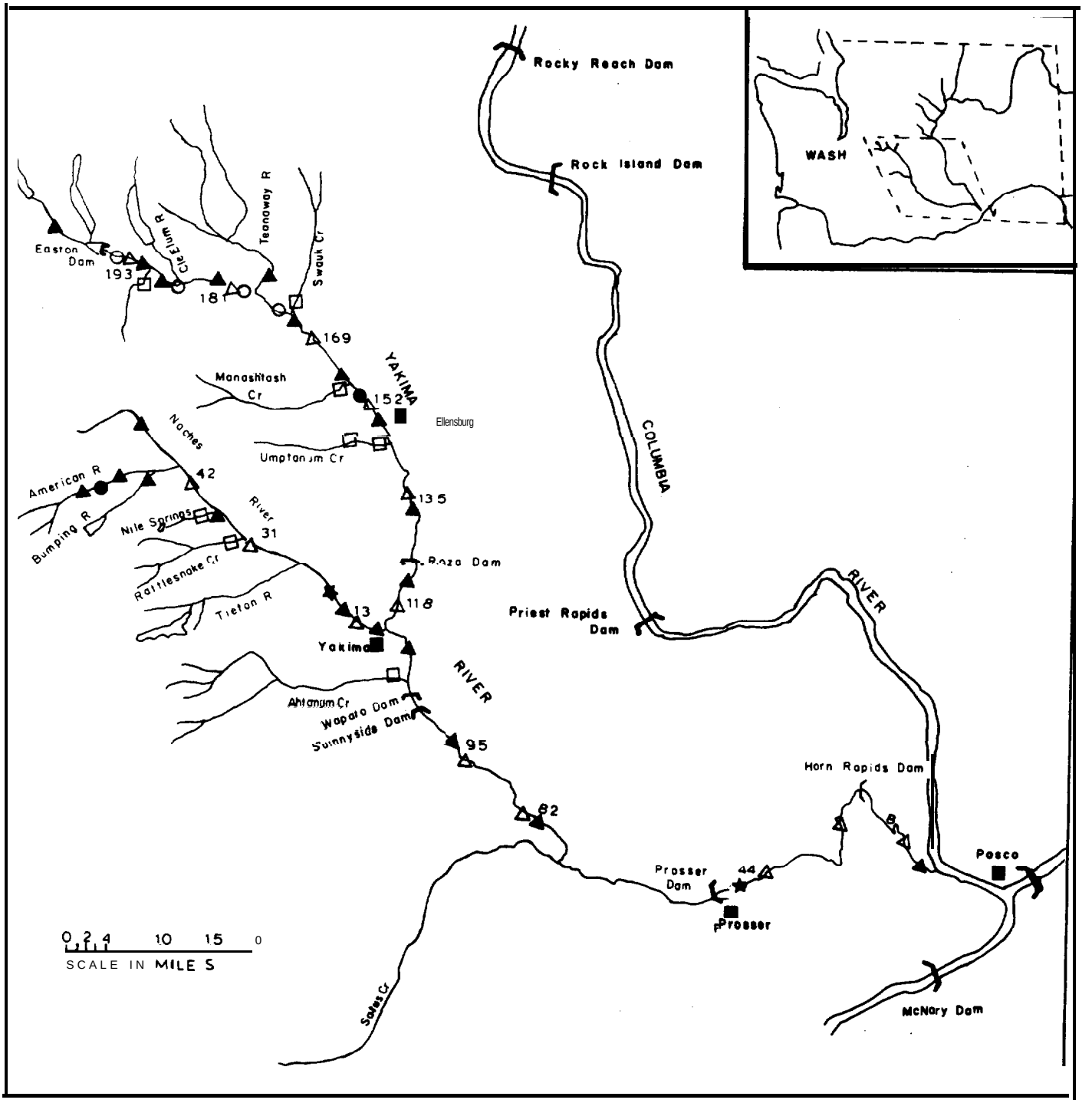
effectiveness of different methods of hatchery supplementation. This analysis is broken into four divisions. (1) When should fish be released. Smolt releases are the norm, but fingerlings will be released in June, September, and November, 1984 & 1985, and adult returns will be monitored. In addition, downstream survival of these smolt6 will be evaluated. (2) Where should fish be released. Based on distribution studies, fish will be released in areas that minimize competitive interactions with wild fish. This will be done by scatter planting fish so densities in the river will low enough to minimize competition for food or space of both the hatchery and wild stocks. (3) How should fish be released. In the past, fish have either been transported from a hatchery and released into the Yakima River, or raised in rearing ponds. These methods, as well as the use of acclimation ponds will be evaluated. (4) Which stocks should be released. Smolts will be released as hatchery x hatchery, hatchery x wild, and wild x wild crosses to determine relative success of these releases. Success will be measured by the number of adults returning, as well as whether spawning timing is similar to that found with the wild stock.

This project is a multi-year undertaking that will evaluate different management and enhancement strategies. At the conclusion of this study, a series of alternatives will be presented to the Yakima Nation that can be used to determine how best to manage the runs of spring chinook in the Yakima Basin.

DESCRIPTION OF STUDY AREA

The Yakima River is located in central Washington and flows 217 miles from its headwaters in the Cascade Mountains (elevation 2448 ft) to the Columbia River near Richland at rivermile 335 (Fig. 1). It drains an area of approximately 6,000 mi^2. The Naches River is the largest tributary, entering the Yakima at rivermile 101 and extending 51 miles to the junction of the Bumping and Little Naches Rivers. The upper watershed is heavily forested above rivermile 180, while ssgebrush and deciduous trees predominate in the lower river. Average annual run off is 3 l/2 million acre feet. Approximately 500,000 acres are present ly under irrigation, consuming 2 l/4 million acre feet each year. There are numerous dams and irrigation diversions on the river. These include Horn Rapids, Prosser, Sunnyside, Wapato, Rosa, and Easton. Except at Easton, a screening structure is associated with each of these dams. For an extensive description of the Yakima Basin, see Bryant and Parkhurst (1950).

In the Yakima system, reservoir storage acts to regulate flows. Lake Kachess, Lake Racheelus, and Lake Cle Elum in the upper Yakima and Bumping and Rimrock Lakes on the Naches River are the major storage sites. These storage areas supplement flows during the irrigat ion season (March-October) and store water in the winter. Irr igat ion and power diversions generally reduce flows in two lower sections of the Yakima River. Sunnyside and Wapato dams near rivermile 108 divert approximately one-half the total river flow at each site into diversions in the summer and fall for irrigation. Prosser diversion



★ SMOLT TRAP

. FRY TRAP

A SEINING SITE

□ SUMMER ELECTROFISHING SITE

O SNORKELLING SITE

▲ WINTER ELECTROFISHING SITE

(DAM

fig. 1 Study sites on the Yakima River

removes approximately 1400 cfs for irrigation and power production throughout most of the year. Due to the large irrigation diversions at Prosser and Parker, flows drop dramatically in the lower river from June to October(Fig 2.) Approximately 50% of the flows withdrawn at diversion sites reenter the river downstream after being used for irrigation or hydropower.

Prior to 1980, flows remained high on the spawning grounds in September and October for irrigation purposes downstream. Many fish that spawned at this time deposited their eggs near the bank. At the end of the irrigation season, when flows were decreased these redds were often dewatered. Following court action,in 1981 irrigation flows were decreased during the first week of September so that this problem would not reoccur. To offset the reduction of flows in the upper Yakima in September, flow is increased in the Naches River.

Water temperatures at sites downstream from Prosser were similar from June through November (Table 1.) Temperatures averaged 20 degrees C and 22 degrees C in June and July. Peak temperatures were recorded in August, and averaged 24 degrees C Between Granger and Selah (RM82-118) Water temperatures were moderately cooler in June and July, averaging 17 - 19 degrees C respectively. Monthly temperatures decreased further upstream and high water temperatures recorded in the Yakima Canyon (RM135) may have been due to warm water entering the canyon from Wilson Creek, which acts as a return conduit from irrigated lands. Water temperatures were similar throughout the Yakina River beginning in October. In the Naches River, water temperatures never exceeded 18 degrees C. (Fig. 3). There is little irrigation in the upper Naches

watershed so return flows have less effect on temperature than in the Yakima River. Bumping and Rimrock Reservoirs both draw water from the bottom of their storage basins, which would also tend to decrease temperatures.

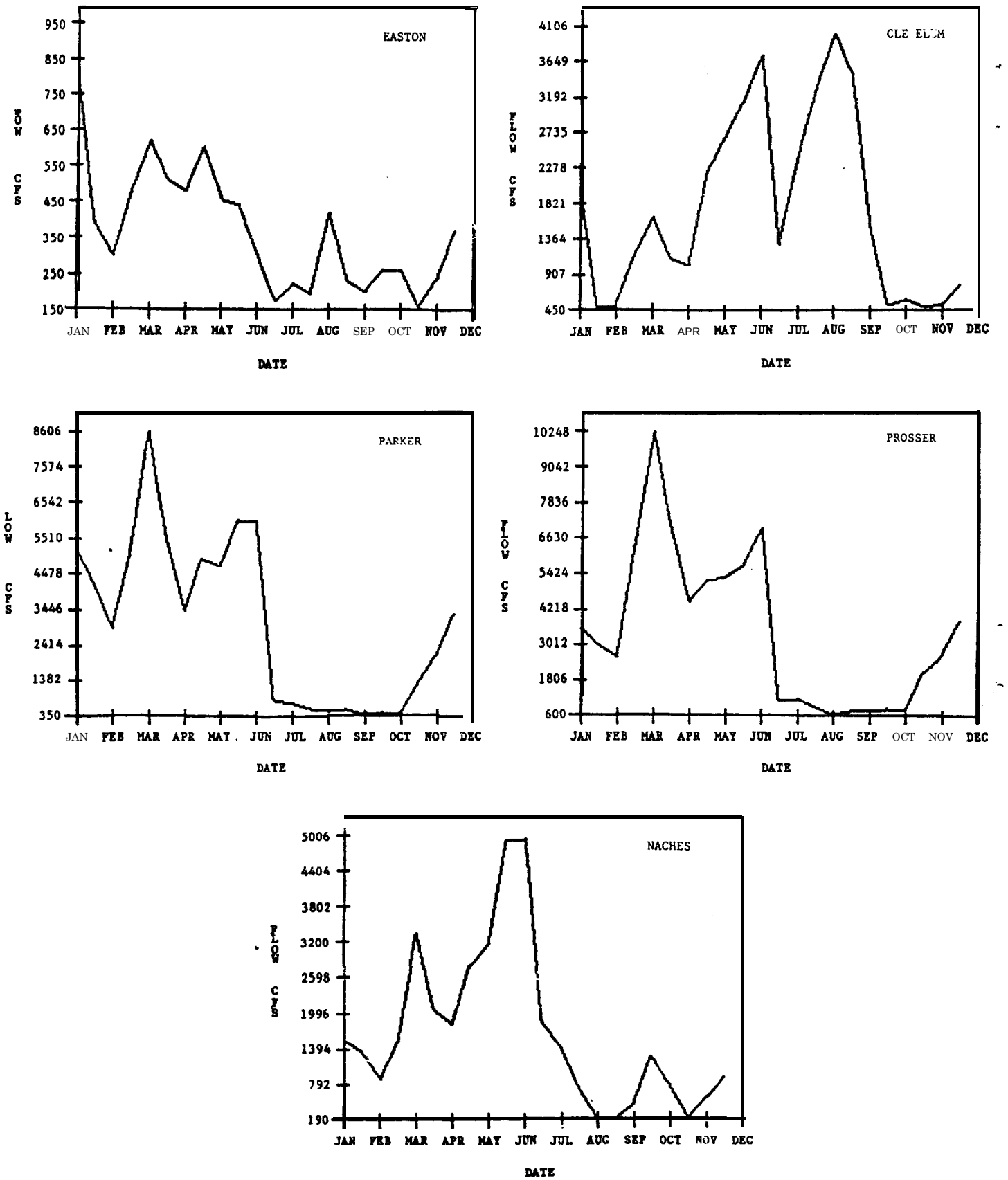


Fig. 2. Monthly flows (cfs) measured at five sites throughout the Yakima system, 1983.

TABLE 1. Water temperatures (° C) at index sites along the Yakima River, 1983.

Locat ion	June	July	August	September	October	November
West Richland	20	21	24	20	12	7
Benton	20	22	24	19	12	6
Prosser	20	22	- -	20	12	6
Granger	17	- -	- -	18	12	7
Toppenish	17	20	19	18	12	8
Selah	- -	18	18	--	11	7
Yakima Canyon	- -	16	11	16	11	8
Ellensburg	13	12	15	—	19	7
Ellensburg Canyon	13	11	- -	- -	10	7
Cle Elum	13	12	- -	- -	10	7
Easton	14	15	17	- -	10	6

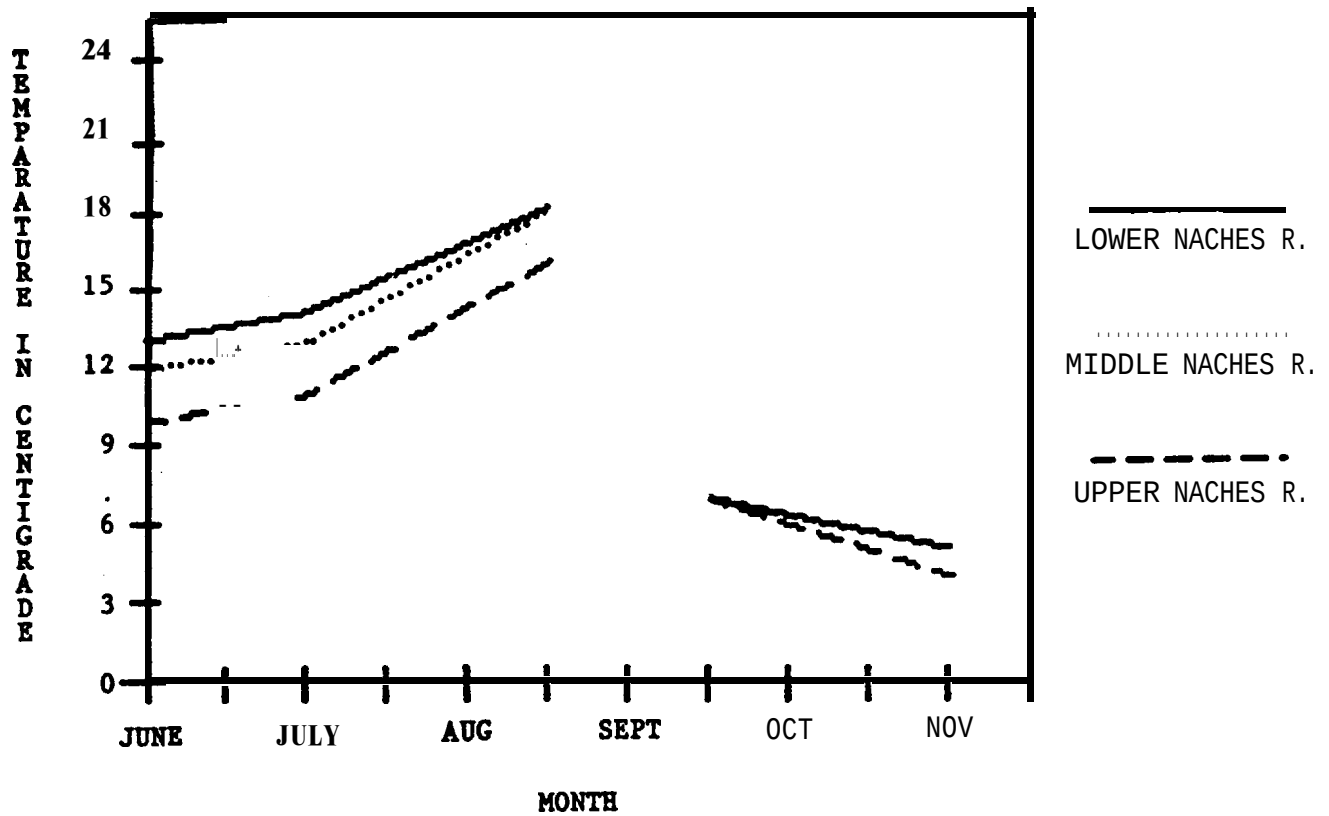


Fig. 3. Mean monthly temperatures (^{o}C) at index sites along the Naches River, 1983.

METHODS

Rearing and Release of Hatchery Spring Chinook Smolts

A key objective of this study is to determine the effectiveness of releases of hatchery reared spring chinook with regard to downstream survival and adult returns. In 1983, 200,000 spring chinook snolts of 1981 Leavenworth brood stock were raised at Leavenworth National Fish Hatchery. Two groups of 100,000 fish each were given' coded wire tags and had their adipose fins removed (AD-CWT) from December 1-12, 1982. The average size of fish at this time was 28/lb. No disease treatment other than routine cleaning and removal of mortalities was used. Studies performed by the U.S. Fish and Wildlife Service in April, 1983 reported an incidence of BKD at Nile Springs Rearing Pond of 26.7 to 36.7%. Estimates at Leavenworth National Fish Hatchery were 1.7%

On January.26 and 27, 1983, 100,000 fish were transported from Leavenworth hatchery to Nile Spring Rearing Pond on the Naches River (Fig. 1). This group was used to determine the efficacy of rearing fish in ponds with volitional release directly to the river versus transporting fish from the hatchery as smolts and releasing them directly into the river.

On March 14 and 15, cold brands were applied to 8,192 (8.2%) tagged fish at Leavenworth and on March 16 and 18, brands were applied to 9,905 (9.9%) fish at Nile Springs. Capture of branded fish at a smolt capturing facility at Prosser (to be described later) was used to determine relative survival of transported fish and those reared in acclimation ponds.

Table 2 summarizes rearing, marking, and release of these fish. Recovery of coded wire tags will allow for determination of interception rates for fish bound for the Yakima River in the ocean and in the Columbia River,as well as in the Yakima River itself. Adult counting facilities are located at Prosser and Roza Dam Efficacy of releases will be measured based on return of adults to the Yakima as well as those captured in various fisheries. Naturally produced fish will be distinguished from hatchery fish based on the presence or absence of an adipose fin. Relative efficacy of acclimation pond versus transported fish be based on coded wire tag data. Freshwater survival was based on brand data collected at Prosser and at McNary and John Day Dams by the National Marine Fisheries Service.

Determination of Abundance and Distribution

Beach Seining

Three sites in the Naches River,and 11 on the Yakima River, were chosen as distinct geomorphological areas (Fig.1). It was impractical to attempt seining in the majortributaries of the Yakima and Caches Rivers due to high gradient and large substrate.

At each site, 5 sein hauls were made with a 100 x 8 foot net with .25 inch mesh. Seining was usually conducted in glides at the interface between the main current and slower water near the bank. Water depth was usually less than 3 feet except in lower portions of the river where water depth next to the bank was often greater. All 5 hauls were usually set on the same gravel barand each site was sampled monthly beginning in May on the Yakima, and June on. the Naches. High flows precluded sampling in the upper Yakima in August and

Table 2. Rearing ,marking and release informat ion for juvenile chinook used to evaluate enhancement methods.

Brood Stock	Carson	Car son
Rearing Site	Leavenworth	Nile Springs"
Rearing Facility	Raceway	Acclimation Pond
Release type	Trucked	Volitional Release
Release Site	Yakima River Ellensburg to Cle Elum	Naches River
Release Date	April 18-22, 1983	April 20-May 1, 1983
Number of branded fish	8,192	9,905
Brand	Left anterior 7H upward orientat ion (LA7Hl)	Left Anterior 3K upward orientation (LA3Kl)
Number released with Ad-Cwt	94,198	94,539
Number released with Ad but no Cwt	2,522	5,186
Number released unmarked	3,385	291
Tag Code	5-13-39	5-13-38
Tag retention	97.1%	94.8%
Size at release	19.5/lb.	17.6/lb.
Comments	Bacterial kidney disease measured in 1.7% of individuals tested	Bacterial kidney disease measured in 27-37X of sampled population**

*-Fish transported to Nile Springs from Leavenworth Hatchery on January 26 and 27,1983

**-Determined by Eric Pelton U.S. Fish and Wildlife Service, Lower Columbia River Fish Health Center

early September. Sets were conducted by an individual running with the sein towards midstream, and then arching downstream until the net was extended. A second individual guided the net out and a third anchored the lead line to the shore. A boat with a jet pump was used in sites where deep water prevented running with the net.

Only salmonids were enumerated in sein hauls. Data collected included total numbers of each species, fork length and weight. Scales were taken from a portion of the fish captured. Water temperatures were recorded once each month at each site during seining operations.

Smolt Traps

To determine total smolt yield of the Yakima Basin and for measurement of downstream survival of hatchery reared smolts, a trap was built on the by-pass pipe of the Chandler Canal at Prosser (RM 43, Fig. 1). The trap follows the design and location of Major and McGhell (1969). Prosser Dam is a 3 meter dam which creates a pool whereby water is diverted down the canal; rotary screens divert fish from the canal to a by-pass pipe which enters the river 300 meters downstream. The trapping structure (Plate 1) is located over the pipe, and when the trap is operating, all fish are captured. When a gate is shut at the trap, all water in the by-pass pipe upwells over a series of stop logs and into a series of troughs. All larger fish are prevented from entering the troughs by a series of PVC pipes, and reenter the pipe at the rear of the trap. Smaller fish fall between the PVC pipes into the troughs, where the water carries them into a live well. This facility was operated continuously from April 4 until June 25, except on June 9 and 10 when a retaining structure in the trap failed. After June 25, it

was operated for a 24-hour period one day each week until October 15, when the canal was dewatered and the screens removed.

Fish were removed from the live box every two hours during the peak of the migration, and at least once every six hours thereafter. Each fish was anesthetized (MS-222), counted, identified as to species, and examined for brands and absence of an adipose fin. A subsample was measured (fork length) and weighed, and scales were taken for age and growth determinations. Fish we allowed to recover and returned to the by-pass pipe.

Trap efficiency tests using the mark-recapture method were attempted to estimate total seaward migration, but this approach proved to be unsuccessful. Branded smolts released 2 km upstream were recaptured over a three week period, and interim fluctuations in river discharge precluded an estimation of trapping efficiency. An analysis is presently being developed to determine trapping efficiency based on the temporal incidence of recapture of branded fish. If this method proves successful, data for 1983 will be recalculated to estimate total migration.

A second smolt trap was constructed on the Naches River near the town of Naches on the by-pass ditch of the Wapatox Canal (Fig. 1) A 1.5meter dam was built in the ditch, and a 10 meter length of 10 cc PVC led from a hole in the dam to a live box. This trap was in operation from March 29 to May 27, at which point high flows rendered the trap inoperable until June 5. At this time, the trap was repaired and operations continued until August 8. The trap was checked at least two times each week. All fish were identified and examined for brands and a

subsample was weighed and measured and scales were taken for later analysis. As at Prosser smolt trap, when trapping efficiency is calculated, data will be expanded to calculate the number of smolts migrating downstream.

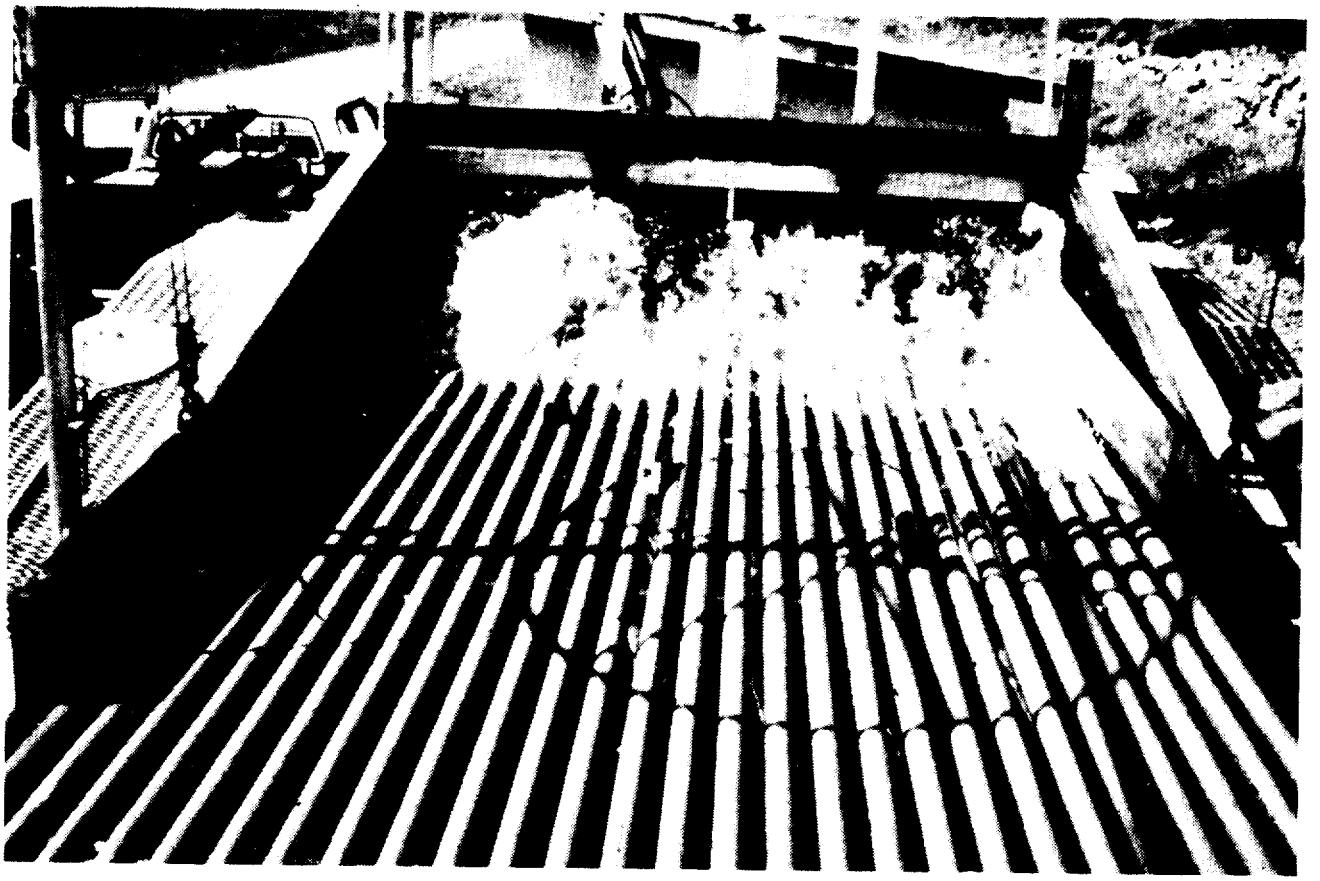


Plate I. Upwelling area and separator of Prosser smolt trap

Plate II. Fry trap on the Yakima River near Ellensburg

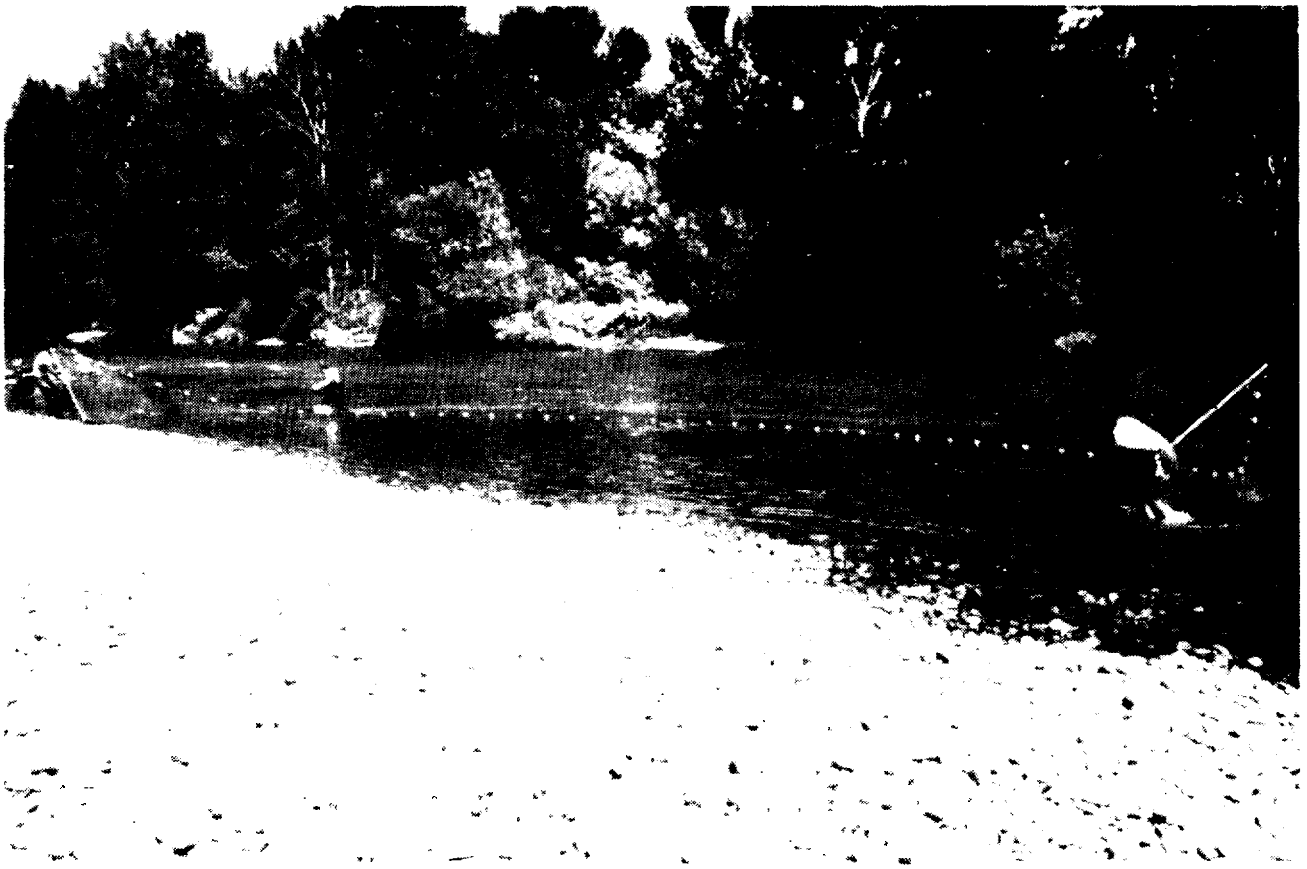


Plate III. Beach seining on the Yakima River near Toppenish

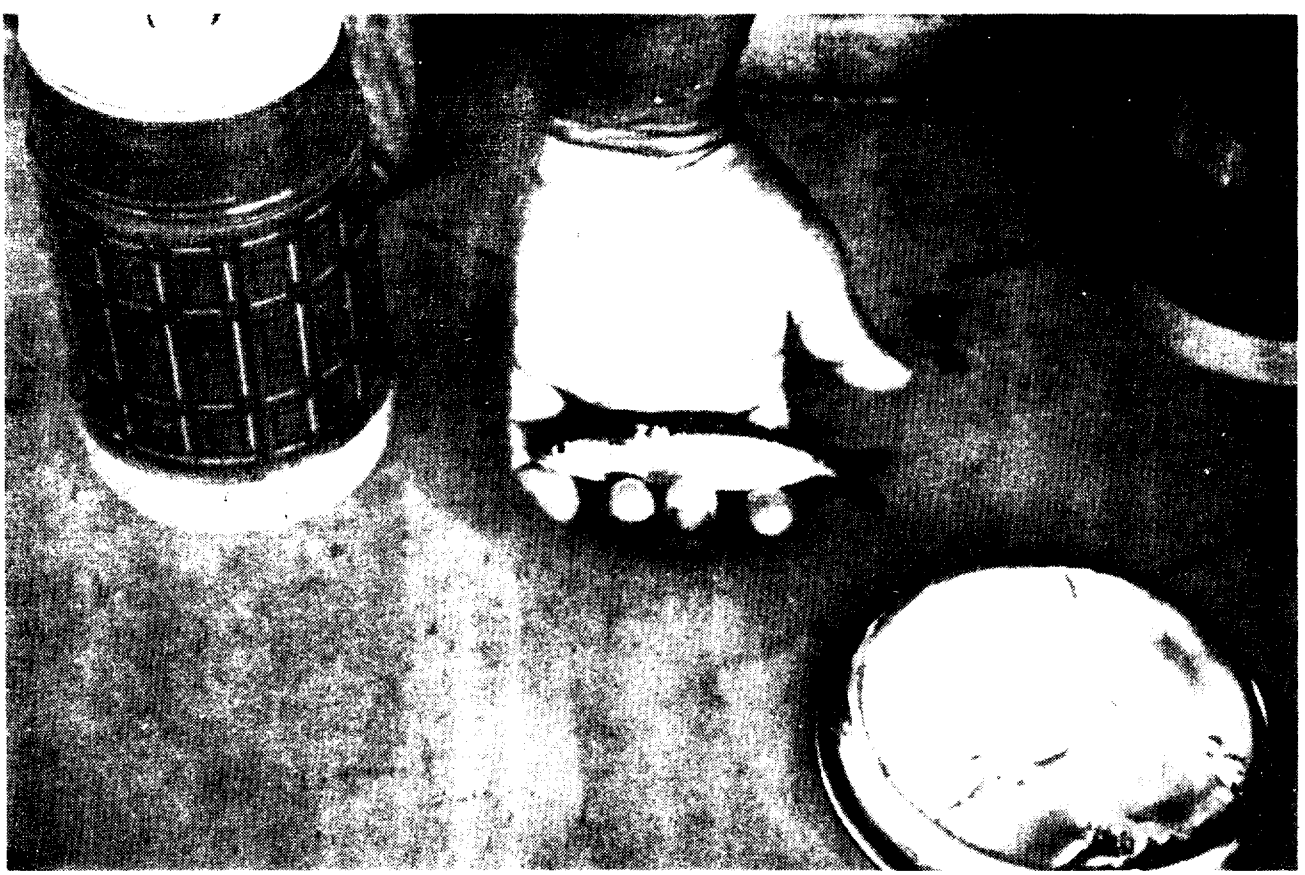


Plate IV. Spring chinook with a "7H" freeze brand

Electroshocking for Determination of Winter Habitat Utilization and Sumner Rearing Areas

Electroshocking began in November, 1932 and coontinued through January, 1983 to determine the winter distribution of juvenile spring chinook. Fish were collected using a Smith-Root Type VII backpack electroshocking unit. Sampling sites were located throughout the system, (Fig. 1) and were confined to small side channels and stream margins. At sites where stop nets could be emplaced, density estimates (fish/m2) were made using the two pass Seber-LeCren method. Where excessive velocities precluded the use of stop nets, catch per unit effort (CPUE) was calculated. In these instances, a single pass was made in an upstream direction. CPUE was calculated as the number of fish captured per minute of electrofishing. At sites where a two pass method was employed, CPUE was calculated from the first pass only, since CPUE would decline after some fish had been removed.

Captured fish were anesthetized with MA-222 Data collected included species, fork length, and weight and scale were taken from a subsample Stream temperature was recorded at each time with a hand held thermometer.

In July and August, 1983, selected tributaries of the Yakima and Nahces Rivers were sampled to determine if they were used by juvenile spring chinook, and if so, the extent of upstream utilization. Tributaries sampled were Swauk, Manastash, Little, Umptanum and Antanum Creeks on the Yakima River, and Rattlesnake and Nile Creeks on the Naches River, (Fig. 1). Sampling sites varied in length from 50-150 meters. Samp 1 ing was conducted using a Smith Root Type VII

electroshocker. A single pass was made. Fish collected were anesthetized and identified, and fork length was measured.

From September through November mainstem areas near Prosser, Roza, and Horn Rapids Dams were surveyed with a Smith-Root Type X boat electroshocker to examine winter utilization of these areas by spring chinook.

Determination of Fry Abundance and Emergence Timing

Fry traps were installed in the American River at Wells Crossing Campground and in the Yakima River near Ellcnsbur;, (Fig. 1) The American River trap was installed on March 8 and operated through June 6. The Yakina trap was installed on March 25 and operated through April 21. At this time, high flows rendered this trap inoperable until June 16. The trap was rebuilt and continued to operate until June 30.

Both traps consisted of a v-shaped fence constructed from 1/4 inch hardware cloth attached to wooden frames 8 feet. in length and 3 feet tall. The fence extended from one bank 1/4 to 1/3 of the way across the stream. (Plate 2). The apex of the fence pointed downstream, and sand bags were placed at the base of the fence to reduce scouring. A 4 inch PVC tube extended from the apex downstream to a live box. Upon approaching the panels, the fish swam down to the apex, through the tube and into the iive box. Each trap was checked daily. Fry were anesthetized with MS-222 identified, enumerated measured (fork length) and freeze branded and released.

The purpose of this trapping was three fold: (1) To determine emergence timing; the date of the first captures indicated the beginning of emergence. The fry were just buttoned up when captured suggesting

that emergence had occurred within the previous 48 hours. (2) Determination of thermal units required for emergence. Temperature data collected from thermographs installed by the U.S. Fish and Wildlife Service will be used for determination of thermal requiremer(3); Freshwater survival estimates. If a sufficient number of brands are applied to fry, the percentage of branded fish recaptured as smolts (expanded to include smolt trapping efficiency) will be equivalent to the survival rate from emergence to the smolt stage.

Emergence Trapping to Determine Survival from Egg Deposition to Emergence

Survival to emergence testing began in 1983 to determine the percentage of eggs deposited that resulted in emergence of fry. Methodology generally followed that of Taggart (1976). Female spring chinook were observed on individual redds. If the fish had an eroded caudal fin and no male was observed nearby, it was assumed that she was spent. Female6 were snagged or jaw hooked with a weighted fly cast with a fly rod. In this manner, repeated attempts could be made without startling the fish. Once captured, the abdomen was compressed to insure that most of the eggs had been deposited. If so, the body cavity was opened and the number of eggs retained was counted. Body length was meaaured as fork length, and from the mid-eye to the hypural plate. A length-fecundity model is presently being developed.

The perimeter of each redd was measured and located relet ive to a pair of wooden stakes set into the, banks. Location relative to these benchmarks was identified using bisecting tapes extending from each stake to various points on the redd. The margins of the redd, as well

as the location of the crown were located and measured. In January, 1984, nets will be placed over the redds to trap emergent fry. For each redd, survival from deposition to emergence will be calculated from an estimate of the number of eggs deposited (based on the length-fecundity model) and the number of fry captured in the emergence trap.

Four gravel samples were taken with a McNeil cylinder (McNeil, 1959) on each riffle associated with a measured redd. Substrate quality analysis Taggart 1976) will take place in 1984. This analysis will be used to determine if gravel quality is limiting production, and to measure the general quality of spawning gravels in the basin.

Incidence of Mortality a& Diversion Screens and Irrigation Canals

During the operation of Prosser smolt trap it became apparent that many fish were dying at the ten diversion screens that shunt fish through a by-pas6 port from Chandler Canal back to the Yakima River. To further investigate this problem, an individual was stationed at the screen installation for a 24-hour period on May 17, 1983. During this time a 11 dead f ish found on the screens were removed at one hour time intervals. In the intervals between fish removals, screens were checked to insure that no fish were being passed over the top. Fish were placed in separate buckets to determine which screens were associated with the greatest mortality. Screen one was located on the right bank. On April 27, water velocity measurements were taken directly in front of each screen with a Marsh-McBirney velocity meter to determine approach velocities.

At the tennination of the irrigation season each October, irrigation canals are dewaterea. Low points in the canal collect water, and

reports of fish stranded in these pools led to surveys in Roza Canal on November 3. Two pools were electrofished, one near Roza Dam and one near the town of Zillah. On November 30, the entirety of Roza Canal was aerially surveyed to count the number of pools so that estimates of the total number of fish stranded could be made.

RESULTS

Fry Trapping

The daily captures of fry are listed in Table 3. Trap captures were quite low, particularly at the Ellensburg site where high water rendered the trap inoperable after April 20. It appears that emergence was underway before the traps began operating on March 28. Future operations will begin February 1. The largest number of fish were captured on May 3 at the American River site. With so few fish captured, efficiency tests were impossible. However, this trap encompassed one-third of the river at this point. Since fry travel down the margins of the stream and are generally poor swimmers immediately after emergence, it is likeiy that at least one-third of the fish travelling downstream were captured. All redds on the American River (11 in 1982) were located upstream from the trapping site, and only 36 fry were captured, yielding an estimate of 108 fish.

Table 3. Daily Captures of spring chinook fry, 1983.

Date	Number of Fish Captured American River	Number of Fish Captured Yakima River near Ellensburg
3/28/83	1	1
3/29/83		4
3/31/83		4
4/05/83	4	
4/9/83	2	
4/10/83	1	
4/13/83		6
4/14/83		2
4/19/83	3	
4/20/83	2	Trap inoperable
5/03/83	14	" "
5/5/83	3	" "
5/6/83	1	" "
5/9/83	3	" "
5/17/83		" "
5/20/83	1	" "
5/27/83	1	
Total	36	17
Mean length	34.8mm	34
Standard deviation	= 1.64	.94

Prosser Smolt Trap

Captures and Migration Estimates

The capture of juvenile salmonids at Prosser collection facility is summarized bimonthly in Table 4. Spring chinook were differentiated from fall chinook based on two criteria; (1) the body shape of fall chinook appeared much stouter than spring chinook, this allowed for visual discriniiiation; (2) size of fall chinook was generally smaller than spring chinook. Figure 4 presents length frequency histograms for spring and fall chinook for April, May, and June. The nadir in each curve represents the separation value between the two groups. Since a random sample was taken, the percent of sprint; chinook (represe ntcd by the larger node in the histogram) was multiplied by the total number of fish captured during that time period to calculate the number of spring and fall chinook captured. Scale analysis agreed with the length-frequency histogram data. Fish from the smaller mode were age 0 (typically fall chinook) and scales taken from the iarger fish were age 1+, which was representative of spring chinook.

A third group of fish, smaller in size than the fall chinook, were captured from June 15-30. A total of 190 of these fish were captured thought the entire monitoring season. Based on the small size of these fish, they were considered to be spring chinook fry.

The trap was inoperable from April 9-10 and June 25-26. For each of these two day periods, the number of captures for the two days predeeding and subsequent to difficulties were averaged number calculated values were used to estimate passage on those days.

Table 4. Captures of smolts at Prosser Collection Facility from April 4 through July 31, 1983.

DATES	WILD SPRING CHINOOK	HATCHERY SPRING CHINOOK	NILE SPRINGS	LEAVENWORTH CAPTURED	FALL CHINOOK CAPTURED
04/04/83-04/10/83	1830	0	0	0	0
04/11/83-04/17/83	533s	0	0	0	0
04/18/83-04/24/83	8814	44	0	0	35
04/25/83-04/30/83	2928	1419	92	24	276
05/01/83-05/07/83	2865	7255	417	118	2215
05/08/83-05/14/83	2098	2314	54	69	1839
05/15/83-05/21/83	1410	2825	31	102	6235
05/22/83-05/31/83	1084	988	15	30	2693
06/01/83-06/07/83	119	12	1	0	a35
06/08/83-06/21/83	144	8	0	0	1427
06/15/83-06/21/83	207	13	2	0	3962*
06/22/83-06/30/83	75	0	0	0	1866*
07/01/83-07/31/83	0	0	0	0	1020
TOTAL	26,909	14,878	612	343	22,403

* 190 fry were captured during the two week period of 06/15 - 06/30.

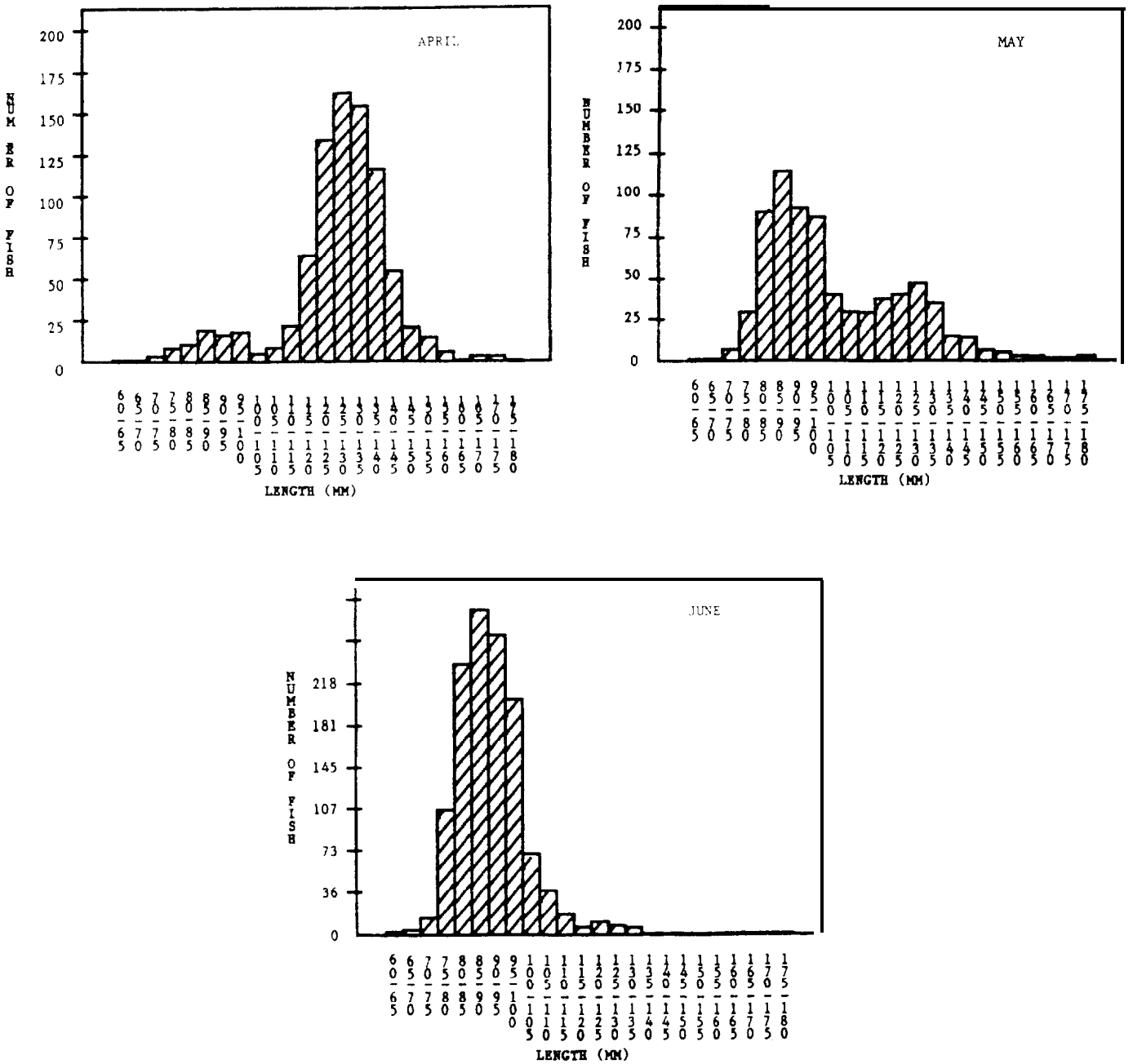


Fig. 4. Length-frequency histograms for spring and fall chinook smolts, April-June, 1983.

counts are found in Appendix Table 1.

A total of 26,909 wild spring chinook were cpatured in 1983. The actual magnitude of the passage was larger however, since 85 spring chinook were captured in the trap on the first day of operations.

There were approximately 200,000 hatchery smolts released into the Yakima and Naches systems in 1983, of which 14,878 were captured. Fall chinook captures totalled 22,403 fish. Data for steelhead is presented in Table 5. A total of 64,810 steelhead smolts were released from Nelson Springs Hatchery on the Naches River on April 8. At Prosser, hatchery steelhead were distinguished from wild based on the presence of a stubbed dorsal fin. All trout were considered to be steelhead based on their silvery appearance. From the Nelson Springs release 2,323 steelhead were captured. 11,608 wild steelhead were captured as well.

Downstream Survival of Hatchery Smolts

Table 6 presese to the Naches River frnts survival estimates for hatchery released as smolts. Fish at Nile Springs Rearing Pond were allowed a volitional release to the Naches River from April 20 to May 1 while those released into the Yakima River were transported from Leavenworth National Fish Hatchery and immediately released (April 18-22). Relative survival estimates were based on the number of branded fish recaptured and the number of fish lacking an adipose fin divided into the number of fish released.

Fish released from Nile Springs werefound to have 32% higher survival than those transported directly to their release sites based on the number of branded fish captured at Prosscr. Chi-square analysis indicates that a significant difference (P5.05) in downstream survival

Table 5. Steelhead smolt cpatures at Prosser Collection Facility, 1983.

Dates	Wild Steelhead Captured	Hatchery Steelhead Captured
4/4/83-4/10/83	562	
4/11/83-4/17/83	775	27
4/18/83-4/24/83	1709	101
4/25/83-4/30/83	1317	179
5/1/83-5/7/83	1645	506
5/8/83-5/14/83	1135	550
5/15/83-5/21/83	2709	567
5/22/83-5/31/83	1425	368
6/1/83-6/7/83	47	4
6/8/83-6/14/83	118	5
6/15/83-6/21/83	134	15
6/22/83-6/30/83	32	1
Total	11608	2323

Table 6. Relative survival estimates of hatchery reared salmonids released into the Yakima River System in April, 1983.

Release Site	Species	Number Released	Fish Captured			
			Wapatox	Prosser	McNary**	John Day**
Nile Springs (Branded)	Spring Chinook	9905		612	224	13
Up Yakima (Branded)	Spring Chinook	8225		343	193	10
Yakima System* (ad-cwt)	Spring Chinook	196445		14878		
Nelson Spring6	Steelhead	64810		2323		
			Recapture Rate			
Nile Springs (Branded)	Spring Chinook			.062		
Up Yakima (Branded)	Spring Chinook			.042		
Yakima System* (ad-cwt)	Spring			,079		
Nelson Springs	Stee lhead			.036		
			Survivae		1	
Nile Springs	Spring Chinook			0.78	17.6	(44.7)***
Up Yakima (Branded)	Spring Chinook			0.53	16.2	(44.5)***
Yakima System* (ad-cwt)	Spring			1.00		
Nelson Springs	Steelhead			0.45		

*AD-CWT=adipose clipped-coded wire tag. This group included branded fish released from Nile Springs and the Upper Yakima River. From this group 7708 fish were released with a clipped adipose fin but no coded wire tag. Of the 196445 fish released, 99725 were released from Nile Springs and 96720 were released directly into the Yakima River.

**Data from McNary and John Day dams was supplied by National Marine Fisheries Service, Northwest and Alaska Fisheries Center.

*** Numbers in parentheses are actual survival rates based on data provided by NMFS.

exists between these tvo groups.

Relative survival was greatest when all adipose clipped fish were taken as a group. Relative survival rates vere 1:.78:.53 for all fish, Nile Springs
and transported fish respectively. Relative downstream survival to Prosser, estimated from the 64,810 steelhead released from Nelson Springs, was .45.

Migration Timing

Figure 5 depicts migration timing of wild spring chinook captured at Prosser. Smolt enumeration began on April 4, 1983, at which point the migration had already begun. April 21 was found to be the median Point of the migration based on analysis from cumulative frequency curves (Figure 8). Migration past Prosser was 98% completed by May 28.

Figure 6 illustrates run timing of hatchery reared fish. Release began on April 18 and concluded by April 25. The large difference between hatchery and wild timing is undoubtedly due to the release date. However, there is a substantial difference in migration timing between smolts from Nile Springs and those transported from Leavenworth Hatchery. The distance from Nile Springs to Proeser is approximately 98 miles while the distance from the mean point of release of the transported fish to Prosser is 118 miles; a difference of 20 miles. The median date of capture of Nile Springs fish is May 4; those fish transported and released have a median capture date of May 10, six days later. Rate of travel for Nile Springs fish is 7 miles/day while for the trucked fish the rate is 5.9 miles/day.

Figure 7 illustrates the timing of these same fish to McNary Dam,

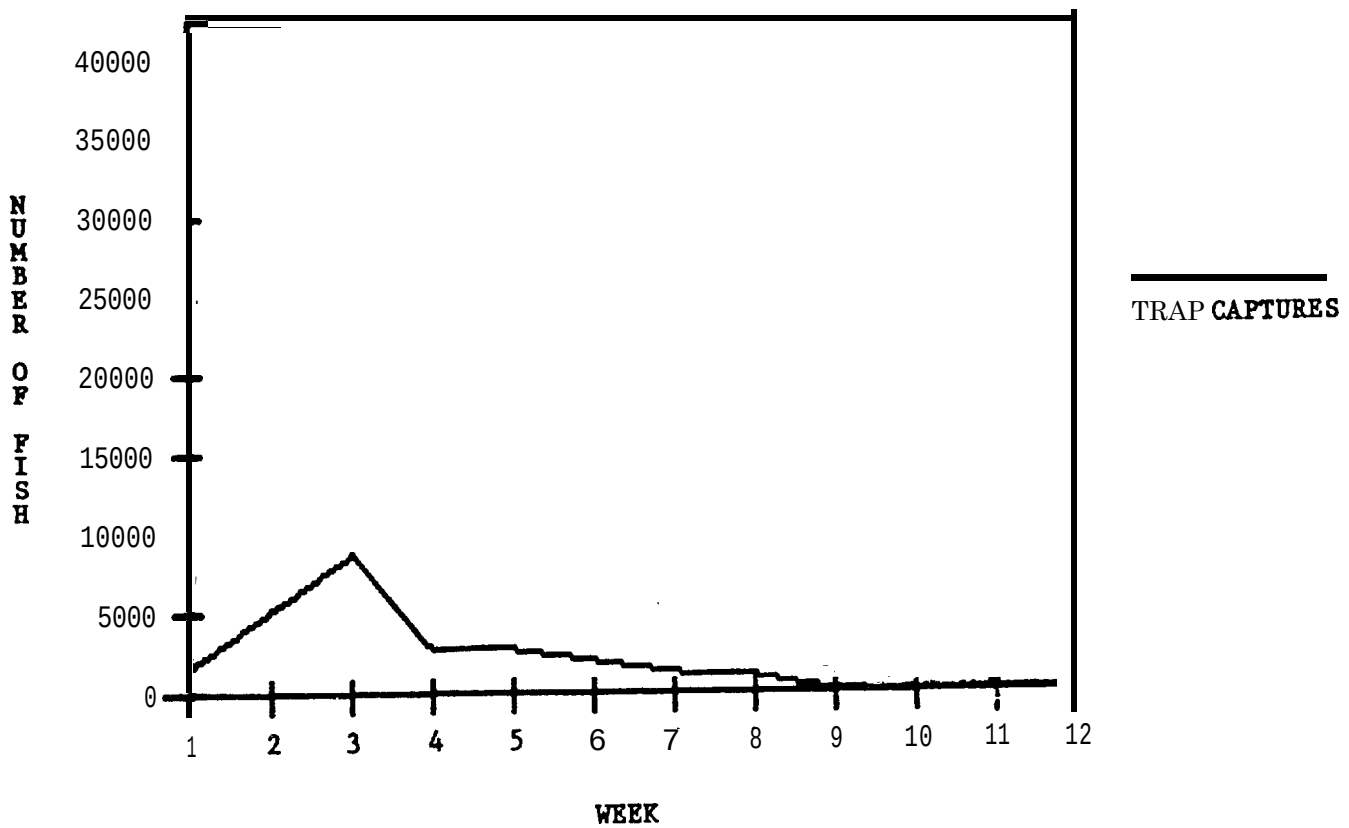


Fig. 5. Captures of wild spring chinook smolts at Prosser, 1983. Weed one begins on April 4.

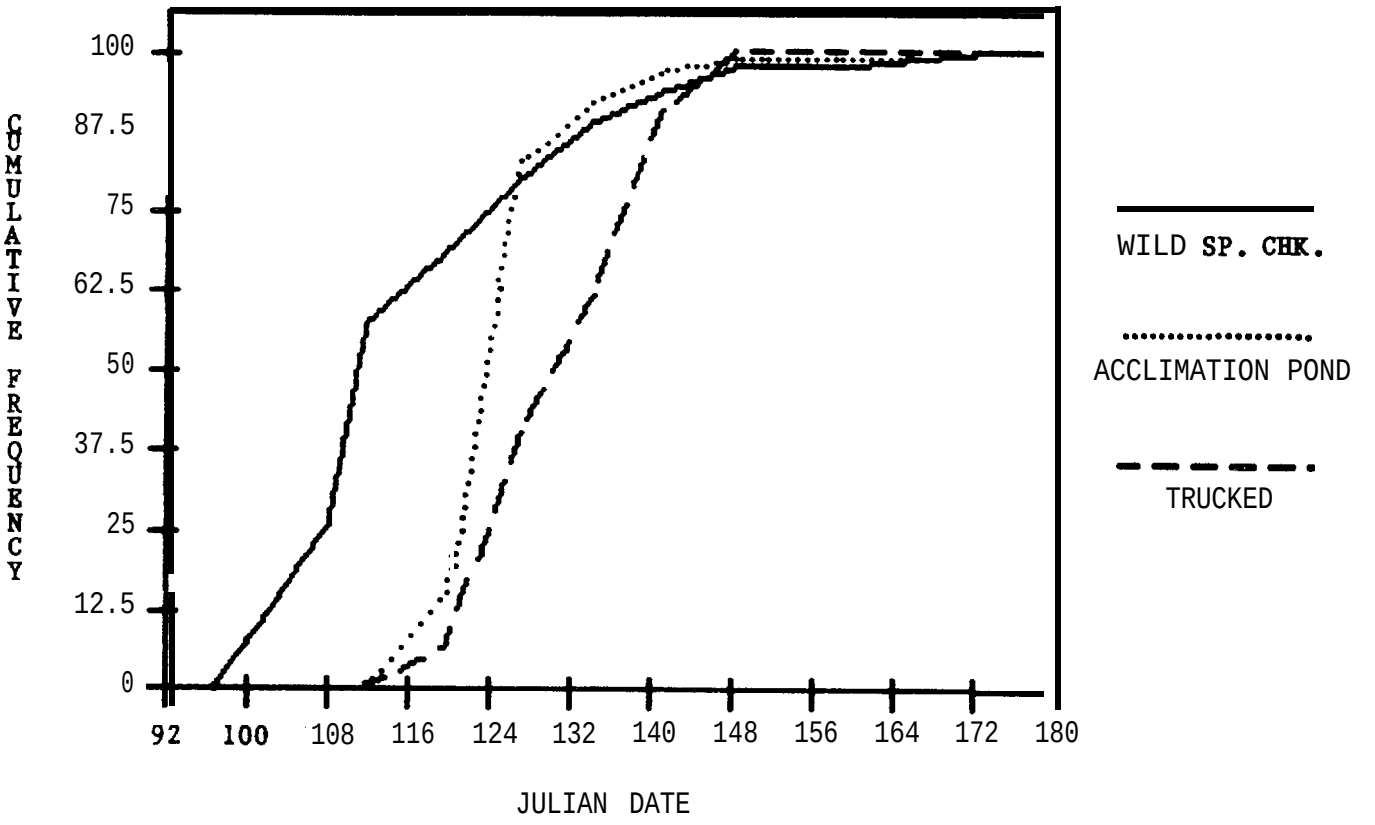


Fig. 6. Spring chinook smolt captures at Prosser, 1983. April 10 is Julian day 100.

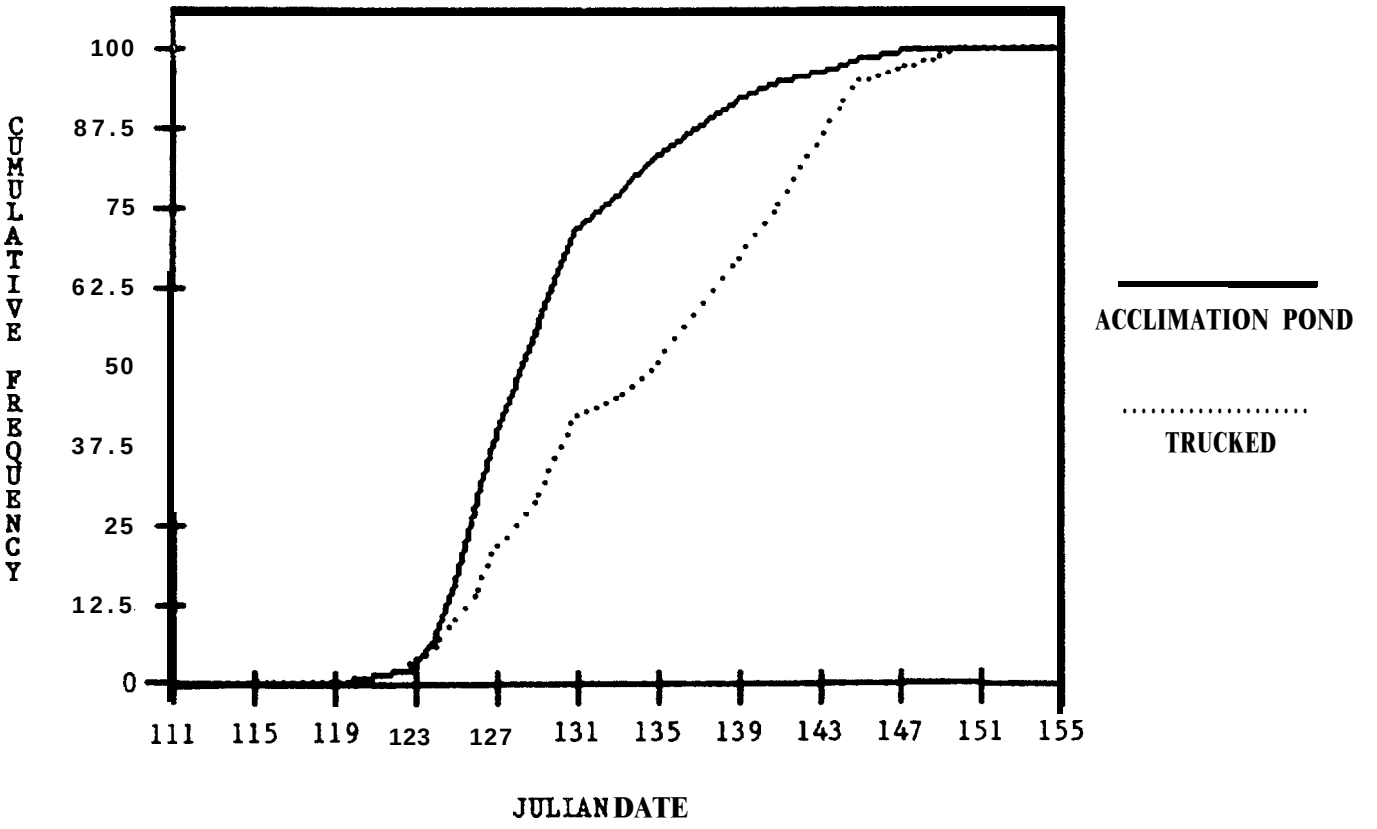


Fig. 7. Cumulative frequency of hatchery Spring Chinook smolt captured at McNary Dam, 1983 that were released from Nile Springs, and those that were transported. (NMFS) .

an additional distance of 90 miles from Prosser (data supplied by the Nat ional Marine Fisheries Service). This distance was travelled by the Nile Springs at a rate of 11.25 miles/day and transported fish at 18 miles/day.

There is a 7 day difference in median arrival date, with the transported fish lagging behind, Travel time from Prosser to McNary Dam of Nile Springs and transported fish is 8 and 5 days respectively, so differences in arrival of hatchery fish at McNary Dam is not as large as that seen at Prosser.

Timing of steelhead smolts to Prosser is illustrated in Figure 8. Note that steelhead were released from Nelson Springs on April 8, (Julian day 98) ,well after the wild migration began. This would account in part for the timing differences observed between wild and hatchery fish. The distance from Nelson Springs to Prosser is 73 miles which yields a median rate of travel of 2 miles/day.

Figure 9 shows the dispersion in migration timing between spring and fall chinook based on length-frequency analysis. The med ian migration date for fall chinook was May 22, a full month after the median date for spring chinook. The migration of fall chinook in 1983 was found to have a bimodal distribution.

Wapatox Smolt Trap

Captures and Migration Estimates

The captures and estimates of fish passage at Wapatox smolt trap are found in Table 7. An total of 292 wild spring chinook anti 1704 hatchery spring chinook were captured. Daily captures are summarized in Appendix Table 2. From April 29 to June 10, 1,704 adipose clipped and

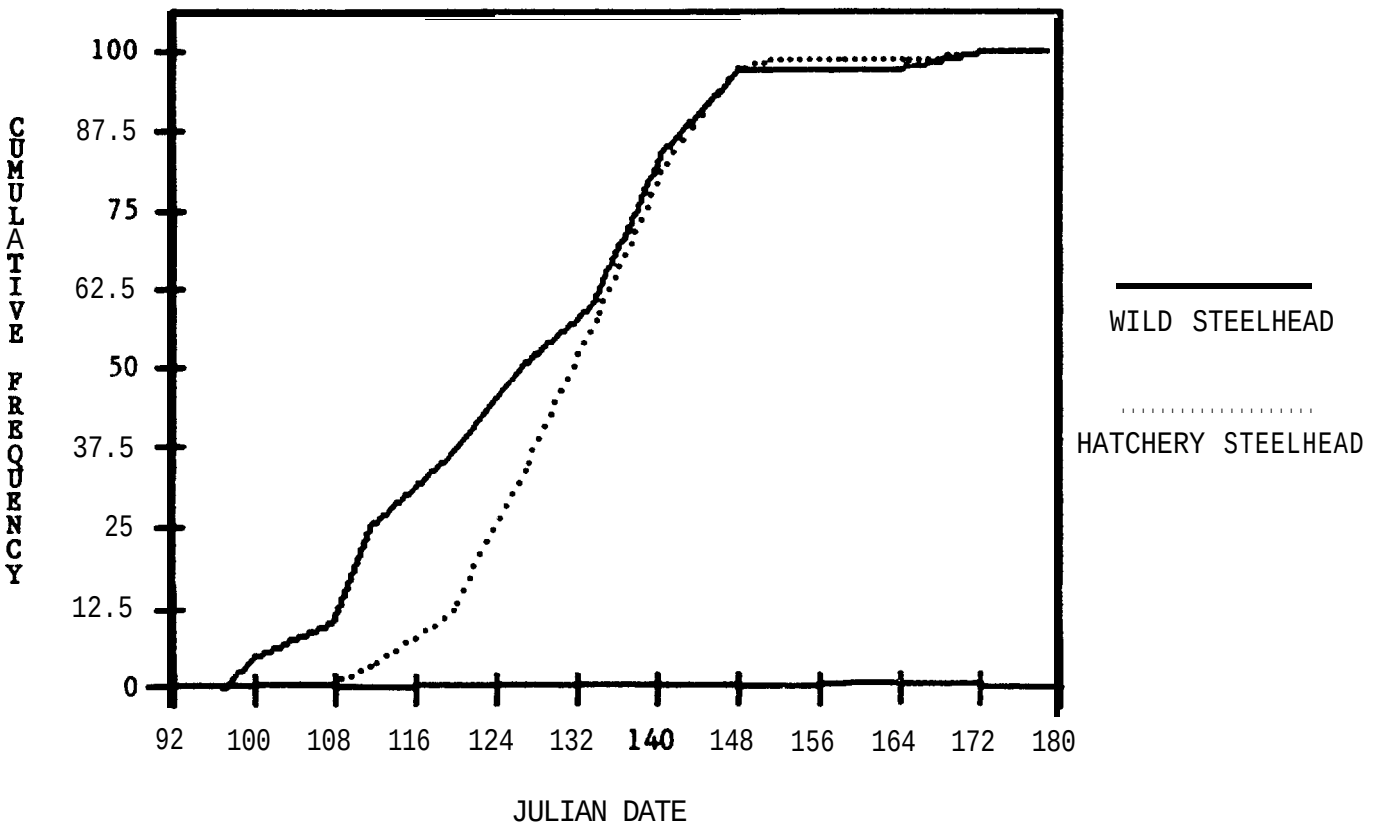


Fig. 8. Steelehad smolt captures at Porsser, 1983.
April 10 is Julian date 110.

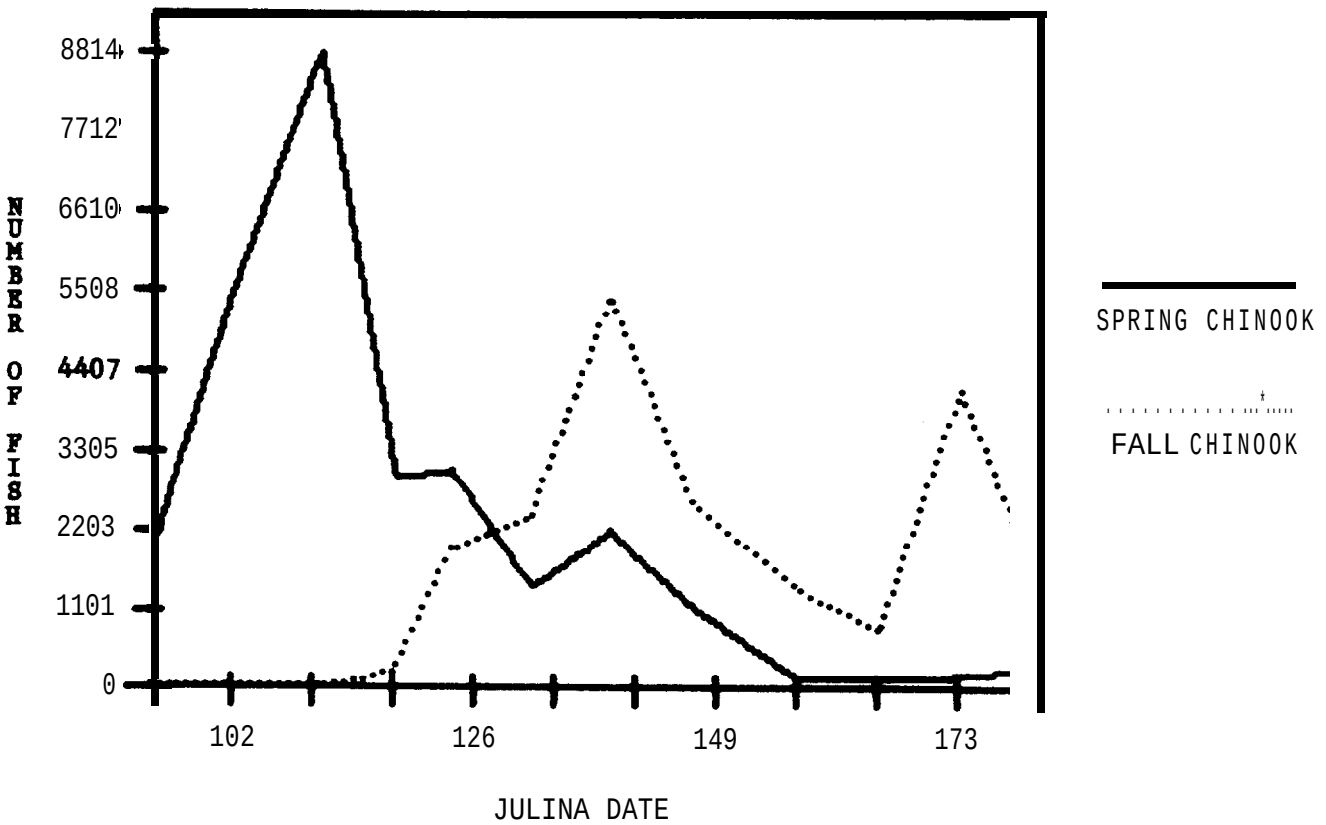


Fig. 9. Spring and fall chinook smolt captures at Prosser, 1983. April 12 is Julian date 102.

Table 7. Captures of salmonids at Wapatox Smolt Trap.

Date	Wild Spring Chinook Capture6	Hatchery Spring Chinook Captures
3/29/83-4/14/83	7	0
4/15/83-4/30/83	86	718
5/1/83-5/14/83	99	875
5/15/83-5/30/83	70	110
6/1/83-7/15/83*	30	1
Total	292	1704

	Nile Springs Captures	Steelhead Captures
3/29/83-4/14/83	0	1
	75	17
5/1/83-5/14/83	68	93
5/15/83-5/30/83	11	15
6/5/83-7/15/83	0	1
Total	154	127

*Wild spring chinook captured after June 1 were all fry, hence the actual number of molts captured was 262.

coded wire tagged fish were captured. A total of 99,725 AD-CWT fish were released from Nile Springs resulting in a recovery rate of .017. From a release of 9,905 branded fish, 154 smolts were captured, resulting in a recovery rate of .015. There is no statist ical difference between captures of branded and unbranded fish.

Migration Timing

The migration timing of wild and hatchery spring chinook is iilustrated i n Figure 10. The median release date for fish released from Nile Spring was April 21 (Julian date 111) and the first fish arrived at Wapatox two days later. This is a distance of approximately 12 river miles for a daily rate of 6 miles/day. The median capture date was April 30, for an average daily rate of of 1.3 miles/day. The captures of the released group rises rapidly with 752 passing Wapatox by May 3. The captured date associated with the 75th percentile of wild fish occurs on May 11. The volitional release from Nile Springs produced a component associated with a rapid downstream migrat ion that was not observed in the transported fish from Leavenworth. Migration rate calculated from the median date of arrival at Wapatox to the madian date of arrival at Prosser (a distance of 86Miles) was 14.3 miles/day.

Figure 11 compares migration timing of tagged fish (AD-CWT) and those that are tagged and branded. The similarity in timing of these fig 10 two groups indicates that branding does not adversely effect timing of juvenile spring chinook. This information coupled with the similarity in capture and survival rates at Wapatox demonstrates that branded fish were representative of the AD-CWT fish at large. Figure 12 shows migration timing of steelhead passing Wapatox. This run was found

to occur about one week later than for spring chinook with a peak occurring on May 12.

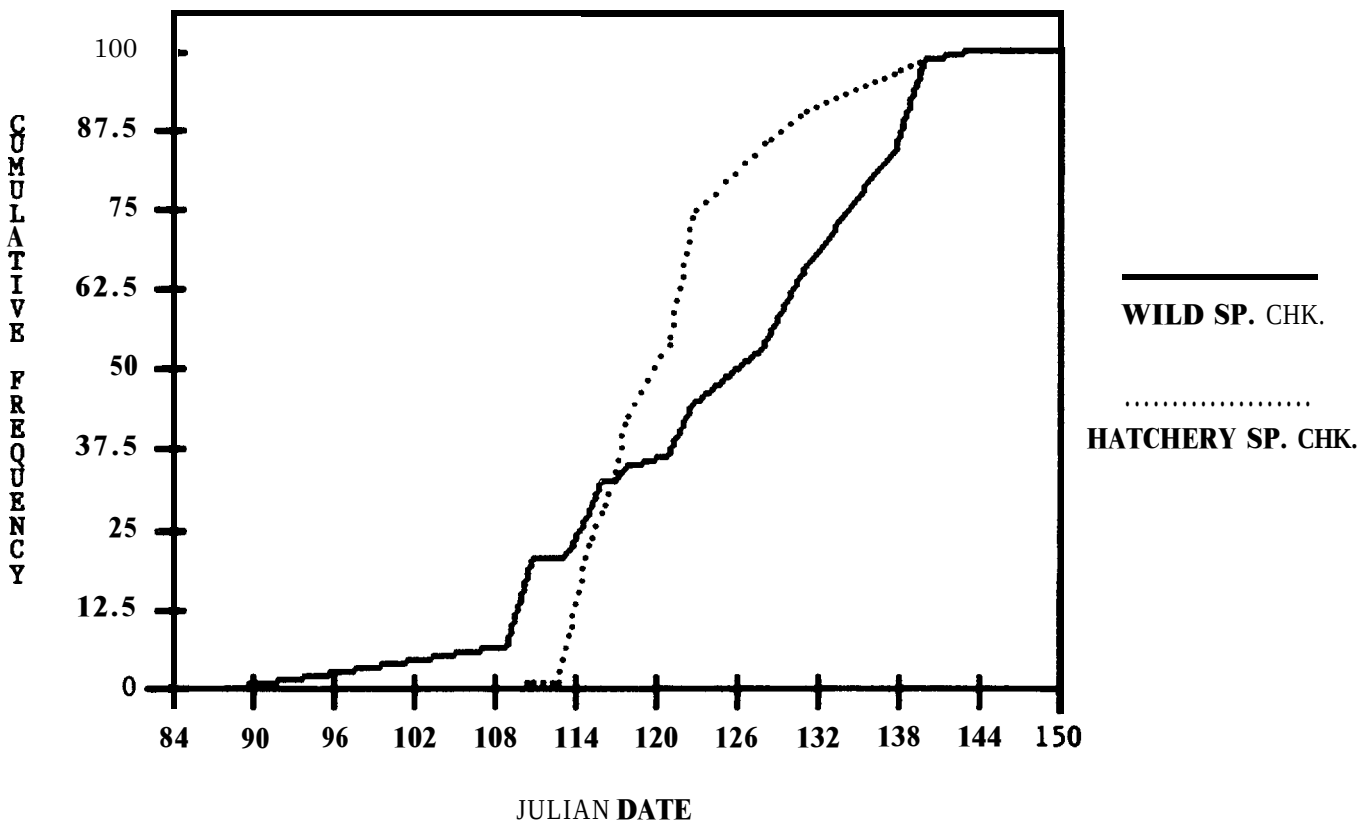


Fig. 10. Spring chinook smolt captures at Wapatox smolt trap, April 12 is Julian date 102.

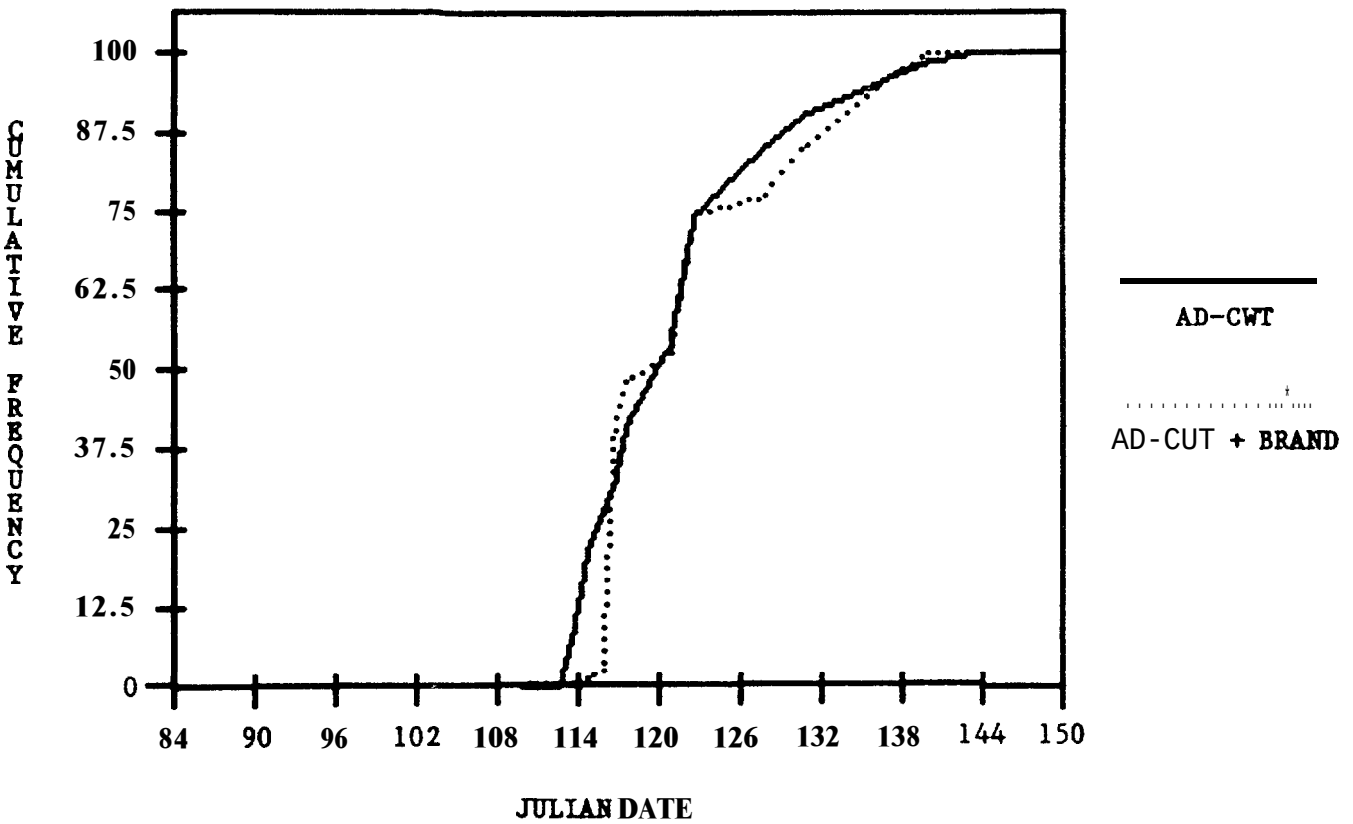


Fig. 11. Captures of hatchery spring chinook smolts at Wapatox smolt trap, 1983. April 12 is Julian date 102.

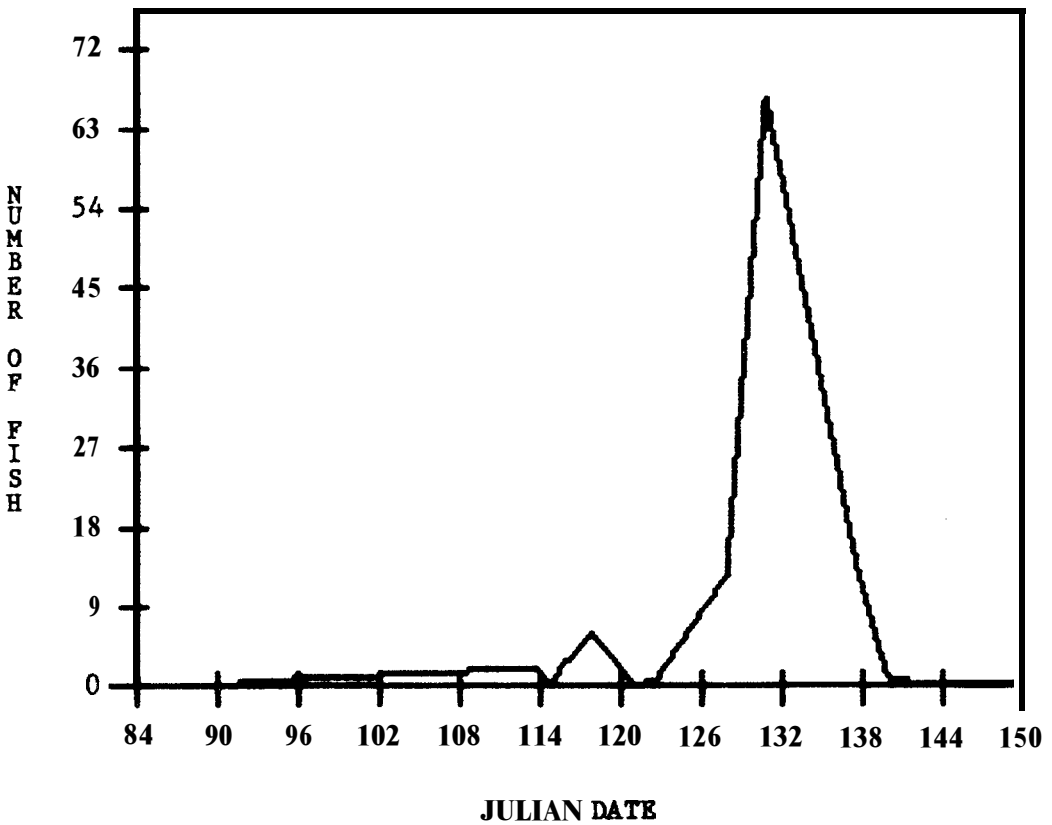


Fig. 12. Steelhead smolt captures at Wapatox smolt trap, 1983. April 12 is Julian date 102.

Distribution of Spring Chinook in the Yakima Basin

Beach Seining

Beach seining was conducted from May through November, 1983. High water due to irrigation flows in late August and early September precluded seining from RM152 to 195 in the Yakima River and the entirety of the Naches River. Figure 13 shows the total number of fish captured in five sein haul6 at each Sample site for each month. Low numbers of captures throughout the basin from September through November are probably due to a number of factors. Low flows in September and October rendered many sites unusable, and fish were probably redistributed in different microhabitats. Additional sein hauls at different sites did no t increase captures, In November, water temperature6 approached 4° C and it would appear that juveniles burrowed into the substrate naking capture difficult. No spring chinook were captured using the electroshocking boat in deep pools behind Roza, Prosser, and Horn Rapids Dam. Stream margins throughout the Yakima were electrofished and no fish were encountered. Prosser trap was operated once each week from August 1 through October 15 and no spring chinook were captured. This would make it unlikely that the low number6 of fish encountered is the result of a large migration of spring chinook out of the Yakima System in the fall. Appendix Table 3 summarizes sein captures from May through November at sample sites along the Yakima River. Extremely co ld temperatures and ice along the margins of the river did not allow for seining in December.

Figure 14 summarize seining data for each season. Spring

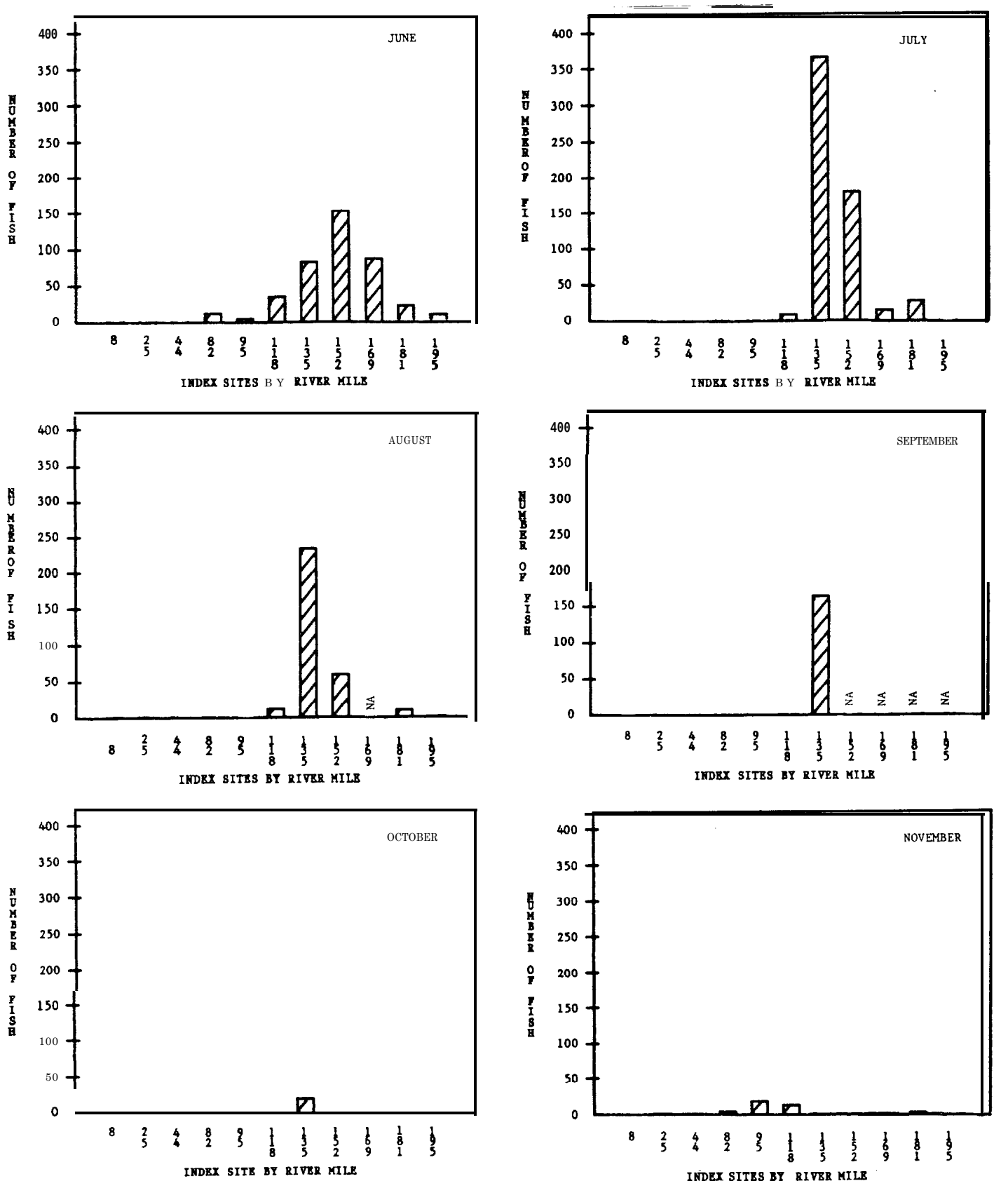


Fig. 13. Monthly captures of juvenile spring chinook in five sein hauls at sample sites on the Yakima River, 1983.

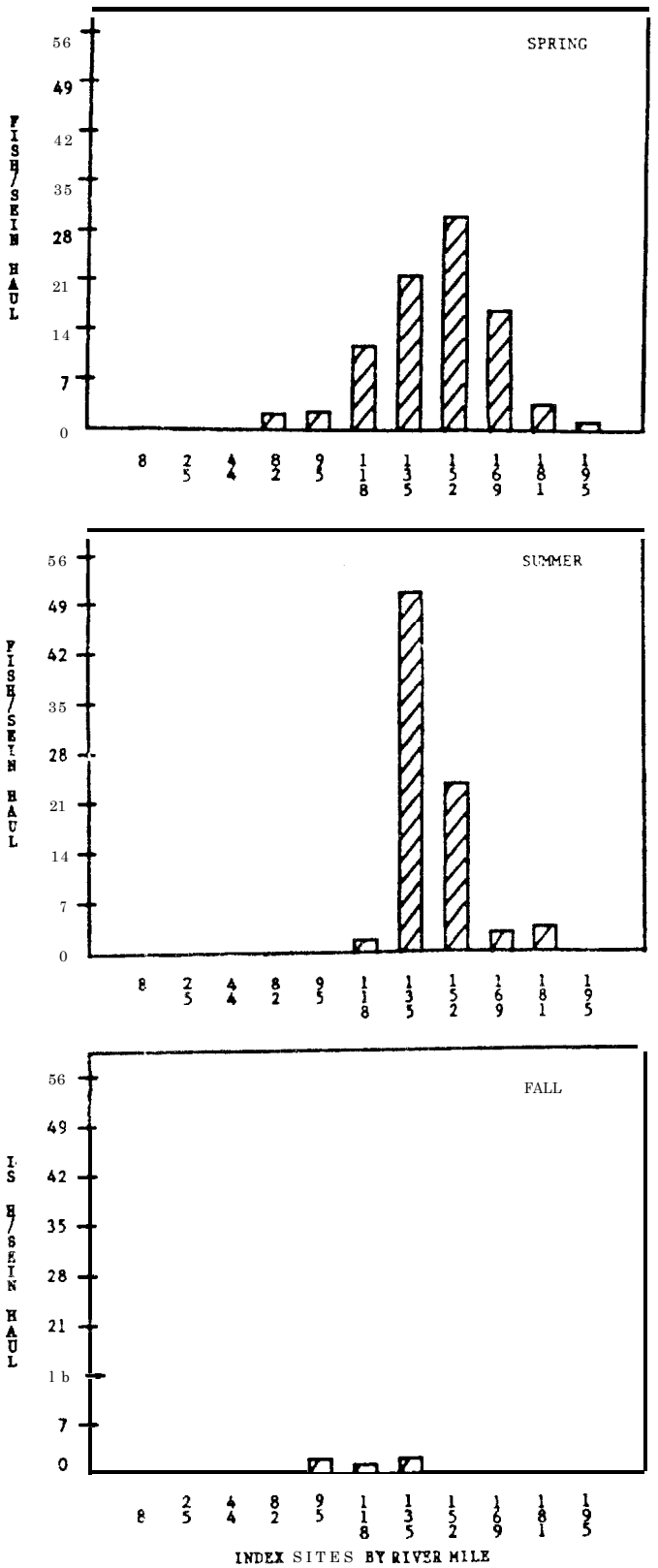


Fig. 14. Seasonal captures of spring shinook during seining operations on the Yakima River, 1983.

encompasses May and June; summer includes July, August, and September; fig 13 and fall includes data from, October, and November. The rearing distribution of juvenile spring chinook in the Yakima River during the spring extended from Prosser (RM44) to the most upstream index site at Eas ton Dam (RM202). The Yakima River from Selah (RM118) to Ellensburg Canyon (RM169) contained 89% of the fish captured. Abundance was highest in the 17 miles between the Yakima Canyon (RM135) and the town of Ellensburg (RM152) where 58% of the fish captured were located. These sites had an average of 22 and 30 fish/haul respectively.

This data suggests that the spring and summer distribution does not encompass the extreme lower reaches of the Yakima River. Spawning areas are located above RM 169, which means that the largest majority of fish do not rear in areas immmediately adjacent to areas where they emerged; rather, there is a general downstream movement.

The lower limit of spring chinook distribution moved upstream from Prosser (RM44) in the spring to Selah (RM118) during the summer. Water temperatures reach 24°C in the lower river during this time Period, which would account for this change in distribution. In addition, stream flows below Sunnyside Dam (RM108) are drastically reduced during the period when irrigation is at a maximum. This may act to increase temperatures and reduce populations. Based on the total number of fish captured during the summer, 95% were located between river-mile 118 and 169 with 90% at the two adjacent sites in the Yakima Canyon and Ellensburg. There was a 230% increase in the number of fish captured at the Yakima Canyon site since spring and this comprised 62% of all fish captured. There appears to be a general trend for fish to move from

upstream areas to the Yakima Canyon during this time period. There was a decrease from 12 to 2 fish/haul from spring to summer at the Selah site and at this time it is unknown where these fish migrate to or whether this decrease is due to losses from predation.

In the fall, the distrrbution of spring chinook moved downstream as far as Granger (RM82) Rearing distribution and abundance elsewhere in the river remains somewhat obscure. As previously discussed, it was extremely difficult to capture any fish. The largest number of fish were again located in the Yakima Canyon with distribution again extending as far upstream as Easton. Data shows there is a general trend for fish to move downstream with the onset of cooler temperatures and increased flows. Discharges below Sunnyside Dam increase dramatically after the close of the irrigation season (Fig. 2),which probably increases downstream movement.

Seining in the Naches River was init iated in June, 1983 when 93 juvenile spring chinook were captured. The greatest number of fish were captured at the lower site (RM9) and accounted for 56% of the total (Fig. 15).

In July, abundance was still greatest at the lower river site And had increased since June. The number of fish caught at the upper river site (RM42) doubled in July and abundance was considerably greater than at RM31. Abundance decreased at RN9 in August and increased further upstream. Only 27% were captured in the lower river and relat ive abundance increased from 30 to 40% at the upper river site.

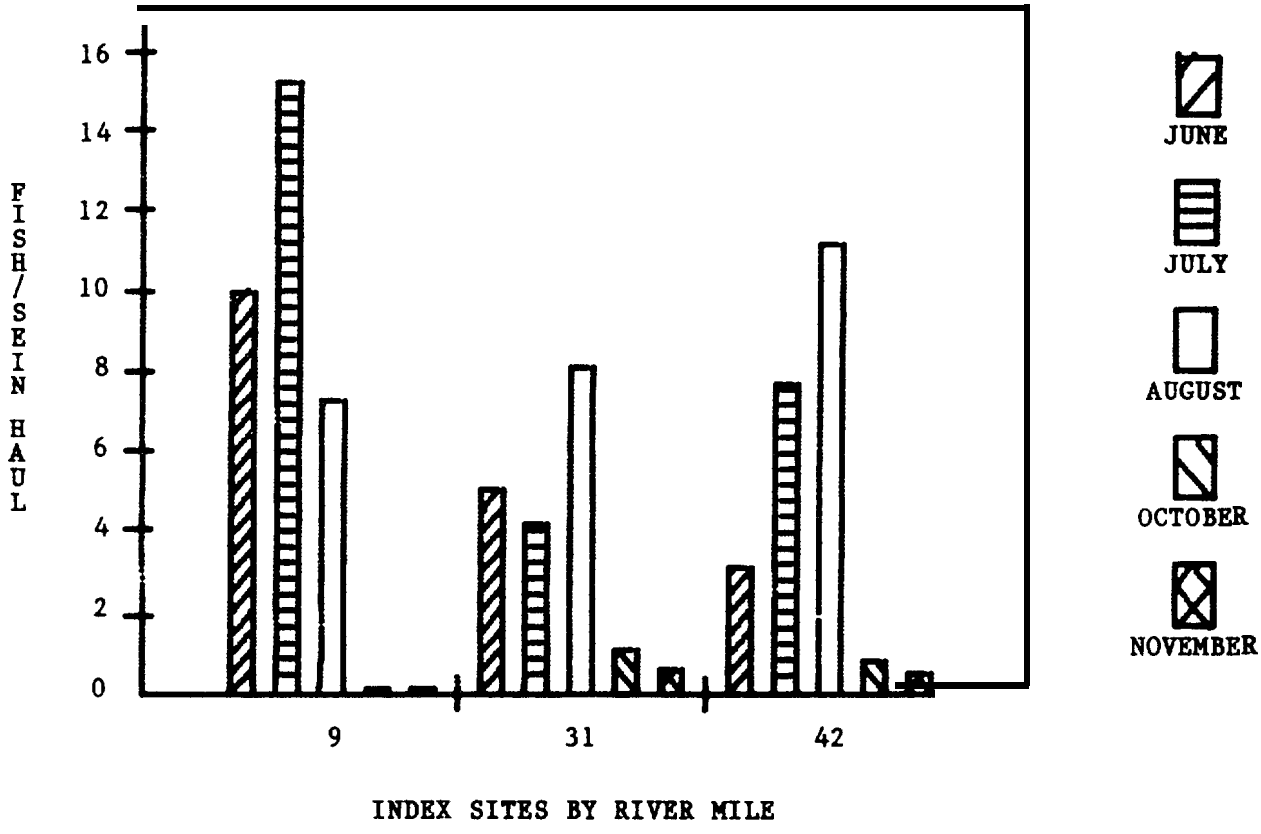


Fig 15. Monthly mean number of spring chinook captures in five sein hauls at index sites along the Naches River,1983.

Sampling was not undertaken in September due to high irrigation flows in the Naches River. As in the Yakima River, catch per unit effort declined dramatically in October and November. Only 14 fish were captured at all sites for these two months compared to 131 fish captured in August alone.

Spring chinook fry were first captured at Wapatox trap on April 19. A total of 5 fry were collected in April and 11 in May. Since all spawning occurs upstream from the Wapatox trap, fry must begin moving downstream from spawning areas soon after emergence. Seining showed an increase in abundance in the lower Naches River through July. The data shows a general downstream movement of fish from spawning areas to the lower river during the summer months. The decrease in catch in August may be due to decreased stream flows, (Fig. 16). Flow declined dramatically from July, when mean discharge was 1,032 CFS to 203 CFS in August. This may have reduced suitable rearing habitat thus forcing juvenile chinook to migrate into the Yakima River. Downstream migration into the lower Naches River may not be have decreased but emigration may have exceeded immigration.

There was a steady increase in spring chinook abundance from June to August in the upper Naches River. This undoubtedly resulted from fish emigrating from upstream tributaries; American, Bumping and Little Naches Rivers. Fry trapping in the American River during April and May resulted in an estimated 108 fry moving downstream. Snorkelling surveys in spawning areas on the American River (RM5.9-8.0) in July revealed only 6 fish.

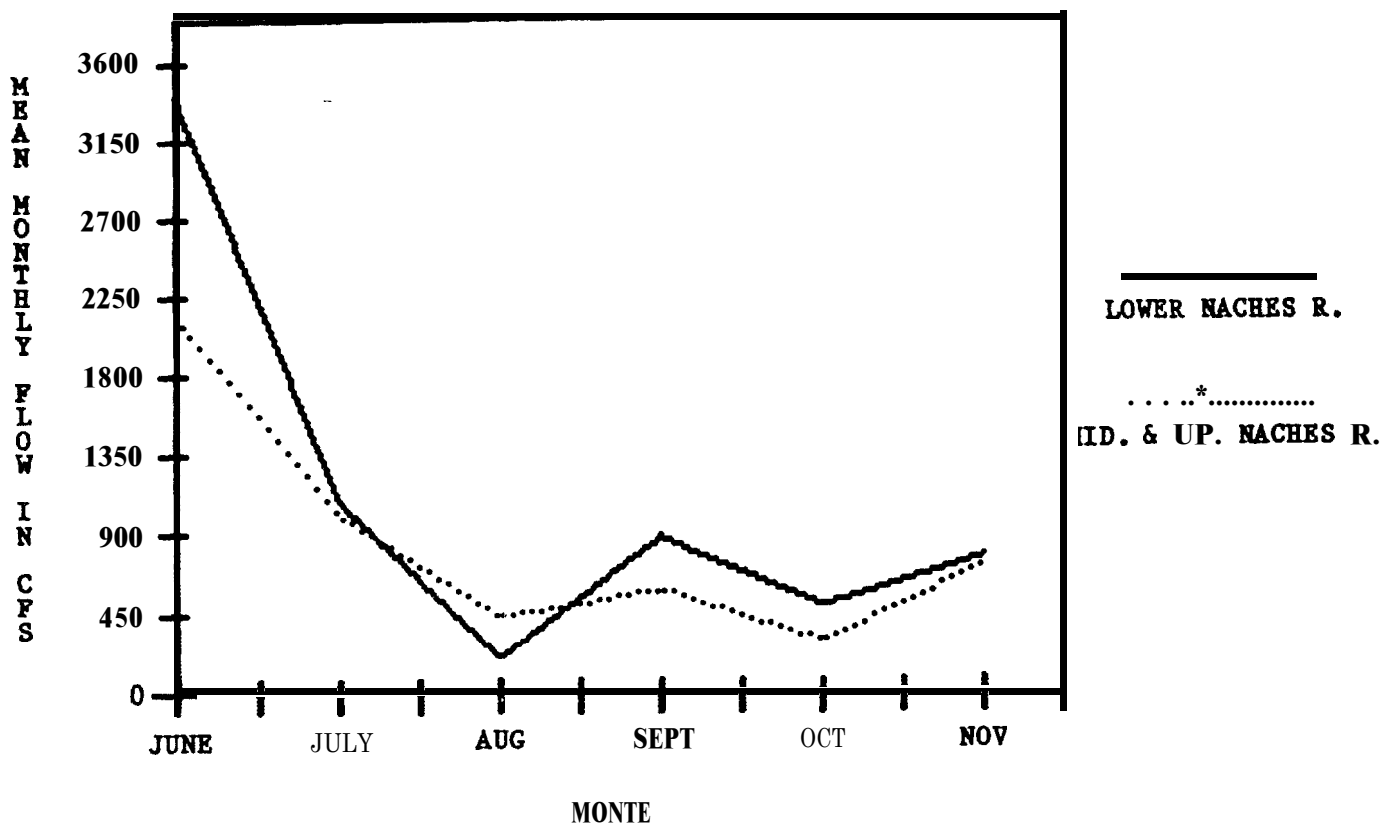


Fig. 16. Mean monthly flows(cfs) at index sites along the Naches River,1983.

Electrofishing Surveys

Results of electrofishing in the Yakina River from November, 1982 to January, 1983 are presented in Table 8. A back pack electroshocker was used, which limited survey areas to stream margins and side channels. Density estimates and catch per unit effort (CPUE) were generally low throughout the basin. In areas where stopnets could be placed, densities ranged from 0 to .04 fish/m^2. Spring chinook were not found at the site above Easton Dam (RM 202), however, the presence during the summer of juvenile spring chinook has been documented by Yakima Nation Fisheries staff (unpublished, 1980) in Cabin Creek, a tributary to the Yakima i.5 miles upstream from Lake Easton.

Spring chinook were distributed as far downstream as West Richland (RM4.8) during the winter. Therefore, fish are distributed over the entire length of the basin with no areas of particularly high density. The highest CPUE was measured in the lower portion of the Cle Elum River where in 198577 redds were located. It is not known whether the large numbers of fish found there were the result of those redds, an active movement of fish from the mainstem into this tributary, or a greater capture efficiency.

Densityof spring chinook was similarly low ($\leq$.05 fish/m^2) throughout the Naches system (Table 9). In the American River, the great es abundance was located between 5.8 and 9.6,which constituted the primary spawning area and location of least gradient.

Spring chinook were round in the Little Naches only nearits confluence. Again fish were found throughout the Naches Basin during

Table 8. Summary of electroshocking data for spring chinook in the Yakima River System, winter, 1982/1983

River	Sample Date	R.M.	Chinook/min. shocking	Chinook/ m^2	Avg.Length (mm) x	sd	n	Habitat
Yakima	11-24	210.0	0.0	-x-	--	--	--	lj
"	11-23	202.0	0.24	.01	103	6.3	19	sc
"	11-18	190.5	0.0	-x-	--	--	--	ms
"	11-18	190.8	0.48	- -	105	10.9	12	ms
"	11-19	180.0	0.11	- -	103	13.1	4	sc
"	11-19	180.0	0.05	- -	106	8.7	3	sc
"	11-22	177.3	0.78	.04	100	8.2	40	sc
"	11-29	169.9[a]	0.11	.01	101	12.2	7	ms
"	11-30	161.3	0.27	.02	93	4.6	9	sc
"	11-30	161.3	0.63	- -	100	7.9	16	ms
"	12-01	148.0	0.06	.01	106	2.0	3	sc
"	01-06	134.0	0.0	-x-	--	--	--	sc
"	12-22	122.4[b]	0.0	-x-	--	--	--	ms
"	01-21	110.0	0.34	.03	110	12.8	8	sc
"	01-21	110.0	0.07	- -	106	—	1	sc
"	01-21	110.0	0.15	.01	95	13.0	3	sc
"	12-28	110.0	0.0	-x-	--	--	--	sc
"	01-26	99.0	0.32	.02	103	16.6	10	sc
"	01-26	98.0	0.0	-x-	--	--	--	sc
"	01-24	79.1	0.21	- -	108	7.9	6	sc
"	01-25	4.8	0.03	- -	124	5.7	2	sc
CleElum	12-09	1.5	0.96	- -	95	7.4	29	sc
"	01-12	1.5	0.33	.02	99	6.7	21	sc
Teanaway	01-14	4.2	0.0	-x-	--	--	--	

a - sampled in the confluence of Swauk Creek.
b - sampled in the confluence of Wenas Creek.
ms= mainstem lj= log jam sc= side channel

Table 9. Summary of electroshocking data for spring chinook in the Naches River System, winter, 1982/1983.

River	Sample Date	R.M.	Chinook/min. shocking	Chinook/ m^2	Avg.Lenght (mm) x	o	n	Habitat
American	01-28	11.5	0.04	.01-	75	--	1	sc
"	11-17	9.6	0.33	- -	74	7.9	20	ms
"	11-17	9.6	0.44	- -	73	10.7	14	1j
"	11-16	5.8	0.87	- -	80	7.7	22	ms
"	11-16	5.8	0.39	- -	79	6.1	13	SC
"	01-28	0.5	0.0	.00	- -	- -	- -	ms
mping	01-07	0.9	0.12	.02	90	8.0	11	SC
Naches	11-08	0.1	0.27	- -	84	5.7	23	sc
"	11-01	6.6	0.0	- -	--	--	--	sc
"	11-03	3.4	0.0	- -	--	--	--	SC
"	11-02	- -	0.0	- -	--	--	--	sc
Naches	01-04	41.9"	0.23	.02	82	13.2	8	sc
"	Oi-04	34.8	0.04	- -	89	--	1	SC
"	12-30	30.5	0.27	.02	95	9.2	18	SC
"	01-18	26.5	0.49	0 05	89	8.4	26	SC
"	01-03	16.0	0.09	.03	96	7.6	7	SC
"	01-05	9.7	0.27	.05	94	10.8	7	SC
"	12-29	4.8	0.06	- -	105	5.3	4	SC
"	01-05	1.2	0.06	- -	108	16.3	2	sc
rtlsnak	01-18	0.2	0.0	- -	- -	- -	- -	SC
"	01-25	4.8	0.03	- -	124	5.7	2	SC
CleElum	12-09	1.5	0.96	- -	95	7.4	29	SC
"	01-12	1.5	0.33	.02	99	6.7	21	SC
Teanaway	01-14	4.2	0.0	-x-	- -	- -	- -	

a - sampled in the confluence of Swauk Creek.
b - sampled in the confluence of Wenas Creek.
ms= mainstem 1j= log jam sc= side channe l
Rtlanak=Rattlesnake Creek

the winter, generally in low numbers. Electrofishing with a backpack electroshocker was relatively ineffective in assessing populations in the main channel and investigations were limited to stream margins and side channels.

In July and August, selected tributaries to the Yakima and Naches River were electrofished to determine which streams were being utilized and the extent of upstream residence. Results arc presented in Table 10. There have been no reports of spawning in any of these tributaries so the presence of juveniles probably indicate an active upstream movement. Spring chinook were found as far as .7 and .8 miles upstream in Swauk and Manastash Creeks. Water temperatures were 5°C warmet than the mainstem due to naturally occurring low flows and water use for irrigat ion purposes Few fish were found in tributaries of the naches system, The Yakima Nation Fisheries Resource Management staff conducted surveys in October, 1980 in Pile Up, Jungle and Quarts Creeks; tributaries to the Little Naches River and Kettle, Union and Timber Creeks; tributaries to the American River. No juvenile spring chinook were found in these areas, which is not unexpected since these tributaries enter their mainstems upstream from primary spawning areas.

The results of these surveys indicate that while upper Yakima River tributaries were utilized as rearing areas, sometimes a considerable distance from the confluence with the mainstem Yakima, densities were quite low. However, these areas may have potential as future enhancement sites and as escapements increase, utilization of these areas as summer rearing sites may increase as well. Clustering of fish was not found through electroshocking surveys during the winter months.

Table 10. Summary of electroshocking data for spring chinook in tributaries of the Yakima and Naches Rivers, summer, 1983.

Stream	Date	R.N.	x	SD	n	CPUE fish/min	Temp°C
Little	08-18	0.3	83	10.5	18	--	--
Swauk	07-26	0.8	71	4.6	4	0.20	17
Swauk	07-28	0.7	71	5.4	6	0.16	20
Manastach	07-22	0.7	88	5.7	12	0.39	20
Manastash	07-22	1.4	--	--	0	0.00	--
Manastash	08-18	0.7	90	2.9	7	.18	16
Umptanum	07-22	4.5	--	--	0	0.00	21
Umptanum	07-22	0.2	--	--	1	--	--
Ahtanum	07-18	0.3	--	--	0	0.00	20
Rattlesnake*	07-25	0.2	--	--	1	0.03	13
Nile*	07-25	0.9	--	--	0	0.00	--

* - tributary to the Naches River

Fish were distributed throughout the basin in low numbers. Most fish must over-winter above Prosser however, as large numbers of smolts were captured at the trap in spring, and estimates of survival from egg deposition to smolt were high based on estimates from Prosser smolt trap.

Grovth

Mean length of spring chinook fry in the Naches and Yakima Rivers was 34 and 34.8mm respectively and were not significantly different. Figure 17 depicts the mean length of spring chinook fingerlings throughout the basin in June, 1983. Note that fingerlings from the Naches System *were* the smallest in the basin. There is a general trend which shows that fish are smaller in the upper areas of the watershed ($P \leq .05$ r.-83). Appendix Table 5 presents mean fork length values for fish captured throughout the year. Data collected in January, 1983 (from an earlier year class) also show that fish rearing in upstream areas were smaller than those from the downstream areas (fig. 18) ($P<.05$ $r=.85$). Fish captured in the upper Naches s ite were probably from the American River. The American River is quite cold and the cold water temperatures may be reducing growth of spring chinook in the American River.

The size of smolts differed between the Naches and Yakima River, with Yakima River fish the larger of the two groups. (Fig. 19). Wild smolts captured at Prosser were from the Yakima and Naches System so the actual size of smolts that rear outside the Naches system is larger then indicated. In addition, hatchery smolts captured at Prosser were comprised of fish from Nile Springs and those transported from Leavenworth.

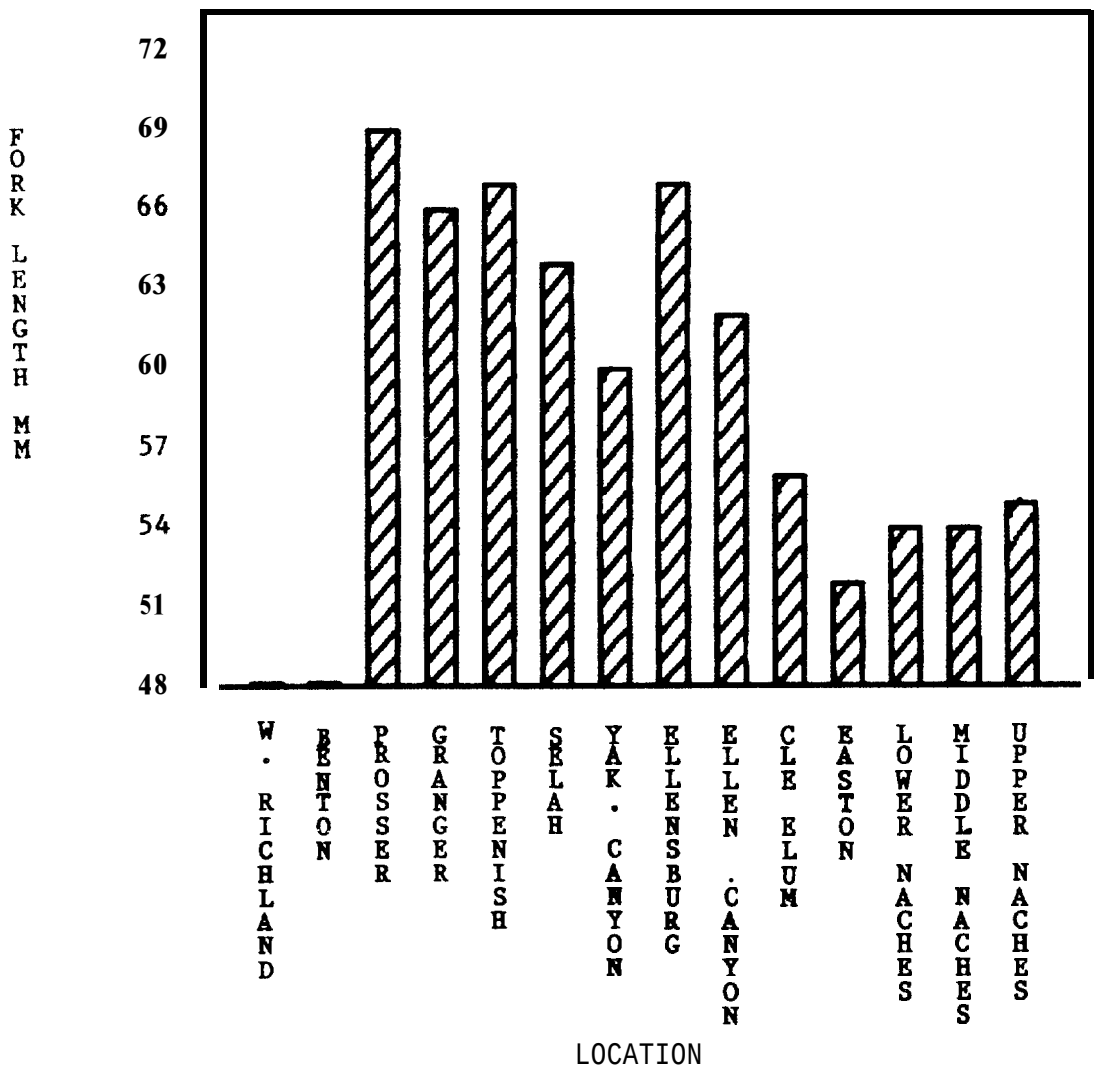


Fig. 17. Mean fork length (mm) of juvenile spring chinook in the Yakima basin, June, l983.

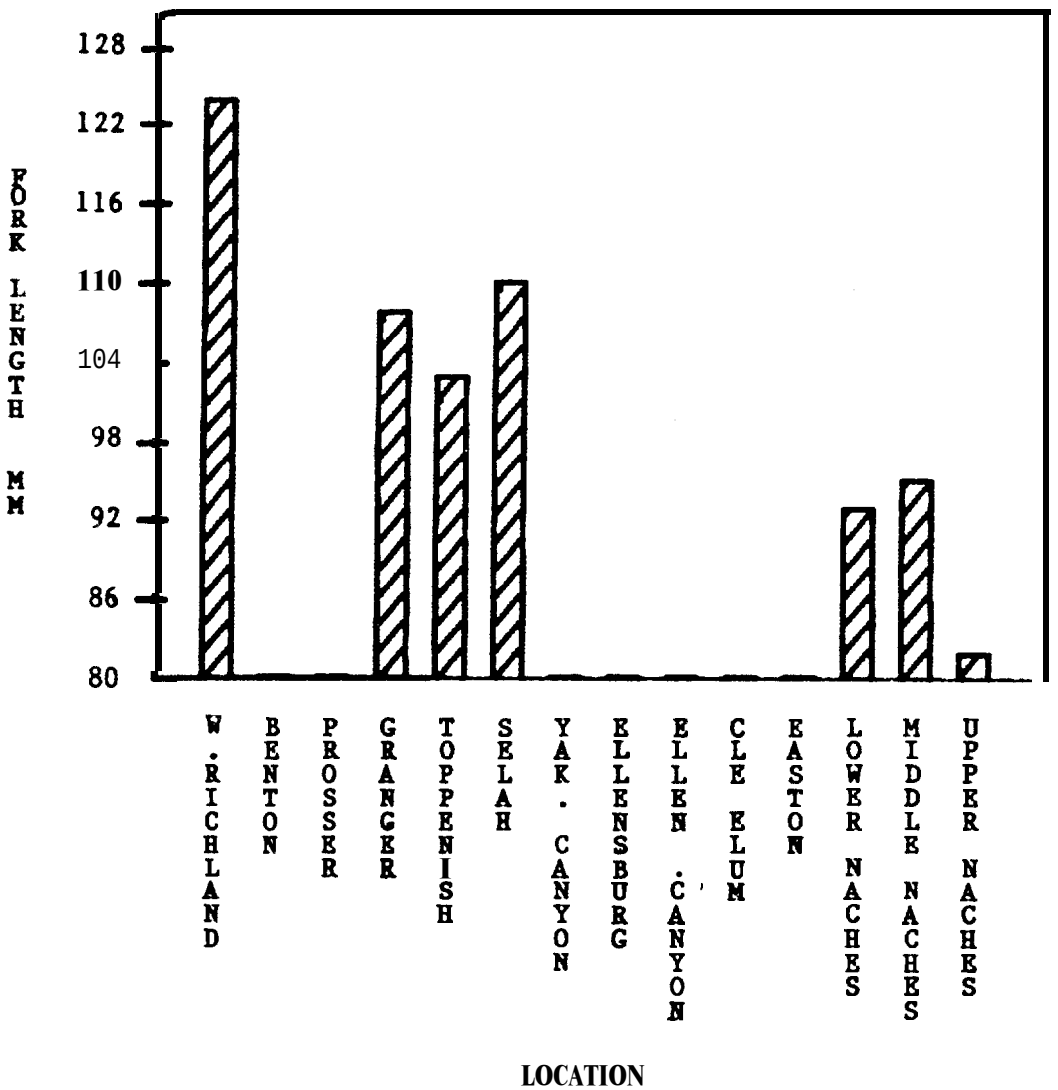


Fig. 18 Mean fork length (mm) of juvenile spring chinook in the Yakima basin, January, l983.

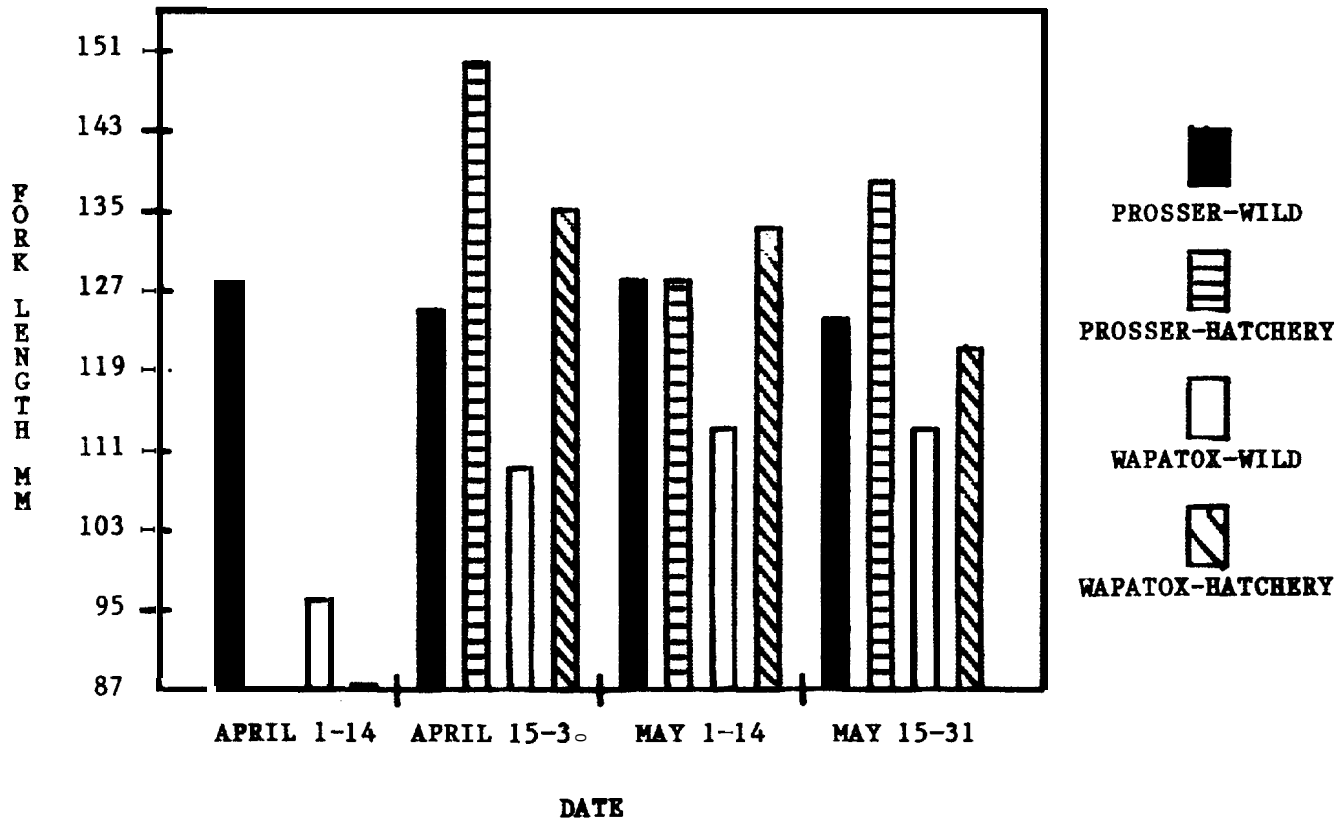


Fig 19. Mean fork length (mm) of spring chinook smolts in the Yakima basin,1983.

Fish released into the basin were larger than those naturally produced. Fish reared at Leavenworth were the largest of all chinook measured. Table 11 presents a bi-monthly break-down of length of fish captured at Wapatox and Prosser trap. Condition factor was calculated for each group and no significant difference could be detected ($P \leq .05$). Fish released from Nile Springs and captured at Wapatox trap were considerably smaller than hatchery fish captured at Prosstr. Those fish captured at Prosser were comprised of Nile Springs fish as well as transported smolts.

Length-frequency tables for wild and hatchery steelhead are presented in Table 12. Hatchery steelhead appeared to be quite thin and lacked the robust appearance observed of wild smolts The students t-test showed a significant difference in condition factor (calculated as weitht/lenght3) between the two groups ($P<.05$) with the mean condition of wild and hatchery steelhead equal to 10.026x10-6 ($SD=1.48 \times 10^{-6}$) and 8.571×10^{-6} ($SD-.90 \times 10^{-6}$) respectively.

Survival to Emergence Studies

From September 19 to 30, 10 redds were selected for survival to emergence studies (Table 13). All redds were located on the Yakima River from Easton Dam to the confluence of the Cle Elum River. Egg retention by the females was generally low, with many of the eggs much smaller and more opaque than usually observed in normal, fully developed eggs. These were called immature eggs. In no case were more than 42 eggs found. Mean length and width of the redds were 5.4 meters (SD=l.2) and 2.87 meters (SD1=.64) respectively. Mean fork length of these

Table 11. Mean fork length of spring chinook smolts captured at Wapatox and Prosser Traps, 1983.

DATES	Wild Spring Chinook L	sd	n	w	sd	n	Hatchery Spring Chinook L	sd	n	w	sd	n
WAPATOX												
04/01-14	95.8	3.3	5	9.9	1.1	5						
04/15-30	108.8	15.6	71	n/a			134.6	10.4	82	26.6	4.98	12
05/1-14	112.7	15.2	83	16.1	6.1	77	133.4	11.0	74	25.5	7.51	59
05/15-30	113.0	10.7	63	16.8	4.7	36	120.7	28.1	20	23.2	4.50	14
MEAN	107.5			14.3			129.6			25.1		

DATES	Wild Spring Chinook L	sd	n	w	sd	n	Hatchery Spring Chinook L	sd	n	w	sd	n
PROSSER												
04/01-10	128.2	15.0	216	23.5	7.9	90						
04/11-17	130.3	10.0	192	24.8	6.0	172						
04/18-30	122.5	17.4	432	21.6	13.3	376	150.2	20.1	35	35.1	10.5	37
05/01-07	127.7	11.1	62	24.3	10.7	21	137.9	12.5	96	30.7	6.4	17
05/08-14	128.3	13.3	38	17.7	10.6	3	137.3	15.5	59	28.4	10.7	39
05/15-21	125.5	12.7	55	25.1	8.5	7	136.6	11.7	61	29.9	3.2	20
05/22-30	122.6	12.3	85	n/a			142.0	11.7	31	n/a		
MEAN	126.4			22.8			140.8		31			

L = mean length w = mean weight sd = standard deviation

n/a = data not available

Table 12. Length-frequency analysis of wild and hatchery steelhead smolt at Prosser, 1983.

	Prosser Wild Steelhead		Prosser Hatchery Steelhead		Wapatox Wild Steelhead	
	April	May	April	May	April	May
70-80						
80-90	2	2			1	
90-100	2	2			0	
100-110	4	2			0	
110-120	9	4			0	
120-130	11	5	1	5	0	
130-140	11	15	3	0	1	1
140-150	30	25	0	0	0	2
150-160	33	37	0	4	3	3
160-170	59	37	0	2	3	17
170-180	64	50	0	6	1	17
180-190	57	55	0	10	4	10
190-200	64	38	1	10	1	13
200-210	64	22	4	21	2	4
210-220	73	28	1	22		2
220-230	61	13	3	17		0
230-240	36	9	1	7		0
240-251	20	1		4		0
250-260	8	0		4		1
260-270	5	0		1		0
270-280	4			1		0
280-290	4	1				
290-300	0	0				
300-310	2	1				
310-320	2	1				
320-330	1					
Mean	193.5	182.3	8.74	207.2	168.75	179.4
sd	36.1	29.3	38.3	28.9	28.7	18.6

Table 13. Size of females and test redds for survival to emergence studier.

Redd #	Date Measured	Size of Redds(mm) Length	Width	Size of Female(c,m) Fork length	ME-HP*	Number/Eggs Retained mature/immature
1	09/19/83	4.5	1.9	68.0	55.3	20/0
2	09/20/83	6.0	3.2	88.5	68.2	2/0
3	09/20/83	7.1	2.1	67.3	54.6	2/0
4	09/26/83	6.5	3.2	68.2	57.0	2/21
5	09/26/83	4.0	3.4	68.2	57.6	0/0
6	09/29/83	5.0	3.1	69.8	58.8	11/4
7	09129183	5.0	2.1	71.6	59.4	0/25
8	09/29/83	7.3	2.6	73.6	61.4	12/30
9	09/30/83	4.1	3.7	66.2	56.0	5/7
10	09/30/83	4.7	3.4	75.2	62.6	0/0
Mean (sd)		5.4(1.2)	2.87(.64)	71.7(6.56)	59.1(4.1)	

*ME-HP = mideye to hypural plate length

females was 71.7 cm (SD=6.56).

Mortalities Associated with Chandler Diversion Screens and Roza Canal

The results of water velocity measurements taken in front of the screens at Chandler Canal are presented in Table 14. Washington Department of Fisheries standards require that approach velocities not exceed .5 ft/sec. Note that very few of these readings met the criteria. Surface velocities were highest at screens 9 and 10.

A total of 67 salmonids were captured on the screens on May 17. (Table 15). Fall chinook comprised 50.6% of the total and hatchery and wild spring chinook were 32%. Captures of fall and spring chinook on May 17 at Prosser trap were 41 and 33X respectively. The large percentage of fall chinook was largely due to the timing of this evaluation. The main period of the spring chinook migration had arleady occurred, and the fall chinook were near the peak of the migration Spring chinook was the dominant species found on the screens during earlier observations.

Figure 20 illustrates which screens were associated with the greatest number of dead fish. Clearly screens 9 and 10 created the largest problem. Water velocity measureuents indicated that these screens had the greatest approach velocities.

Figure 21 indicates that most of the screen mortalities occorred from 9:00 p.m. - 4:00 a.m. Therefore, the casual observer who visits the screens during daylight hours would see few fish impinged on the screens . The greatest number of fish were killed on the screens at the same time that most fish were captured at the trap; usually a six hour period beginning at sunset.

Table 14. Water velocity measurements (ft/sec) taken at Chandler fish screens April 27, 1983.

Depth (ft)	Screen Number									
	1	2	3	4	5	6	7	8	9	10
Surface	1.1	1.5	1.5	1.2	1.3	1.4	1.7	.5	2.0	2.1
1'	1.5	2.0	2.1	2.0	2.2	2.7	1.4	2.4	1.5	1.2
2′	1.3	1.2	1.5	1.5	1.7	2.2	.9	2.3		
3′	1.0	.7	.6	.5	.6	1.0	.9	1.1	.3	.2
4′	.6	.6	.7	.3	.3	.8	1.0	.1		

Table 15. Captures of salmonids on Chandler Canal fish screens, May 17,1984.

Time	Screen Number 1	2	3	4	5	6	7	8	9	0
5/16										
1800 - 1900										
1900 - 2000										
2000 - 2100										1
2100 - 2200	2		1						5	6
2200 - 2300			1				1			1
2300 - 2400			1	3	1	3			1	3
5/17										
2400 - 100				2	1				1	
100 - 200			1				1		1	4
200 - 300	1	1			1	1			2	3
300 - 400	1									
400 - 500						1				1
500 - 600										
600 - 700										
700 - 800										1
800 - 900										
900 - 1000										1
1000 - 1100	1		1							3
1100 - 1200										
1200 - 1300									1	1
1300 - 1400				1						1
1400 - 1500										
1500 - 1600										
1600 - 1700										
1700 - 1800										
TOTAL	6	2	3	7	4	6	2		11	26

Grand Total---67

Catch composition at Chandler fish screens

	Fall chinook	Spring Chinook	Hatchery Chinook	Rough Fish
Total	41	16	10	14
%	50.6	19.7	12.3	17.3

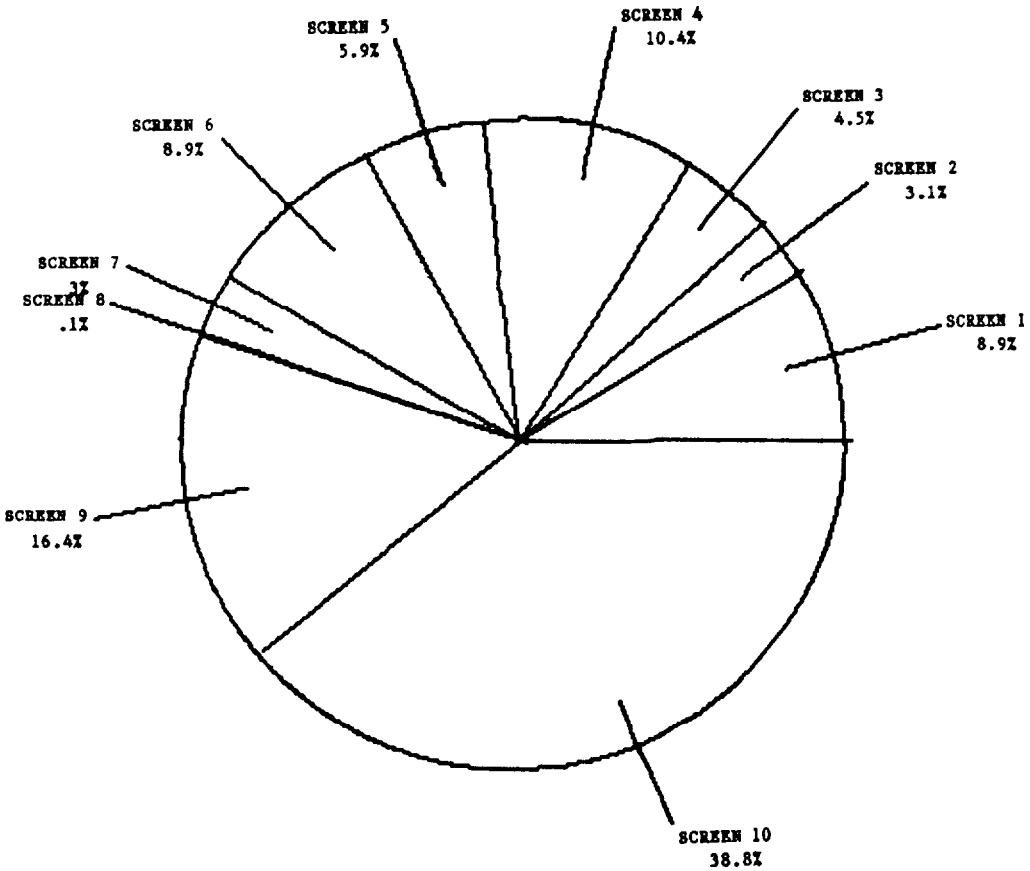


Fig. 20. Hourly captures of Salmonids at Chandler Fish Screens, May 17, 1983.

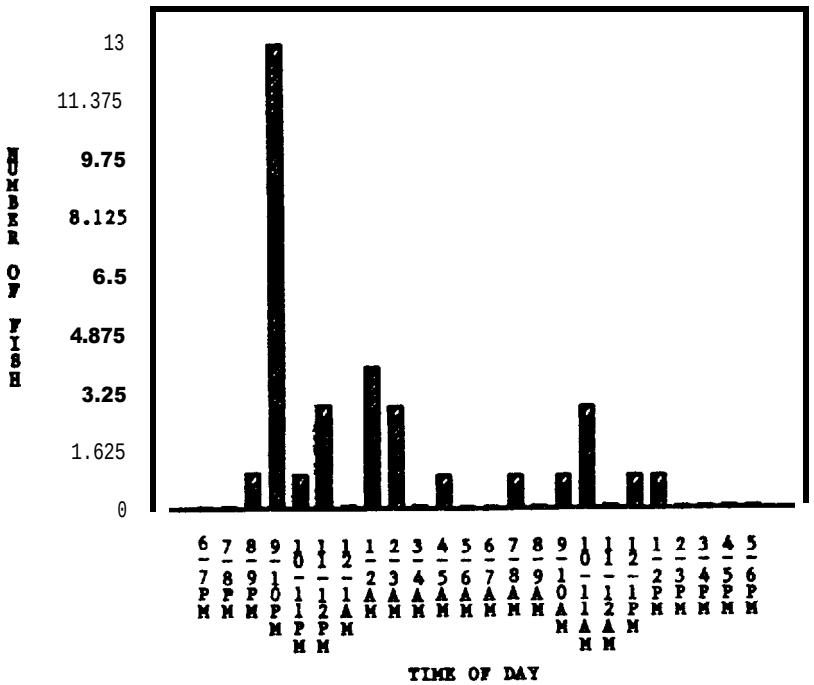
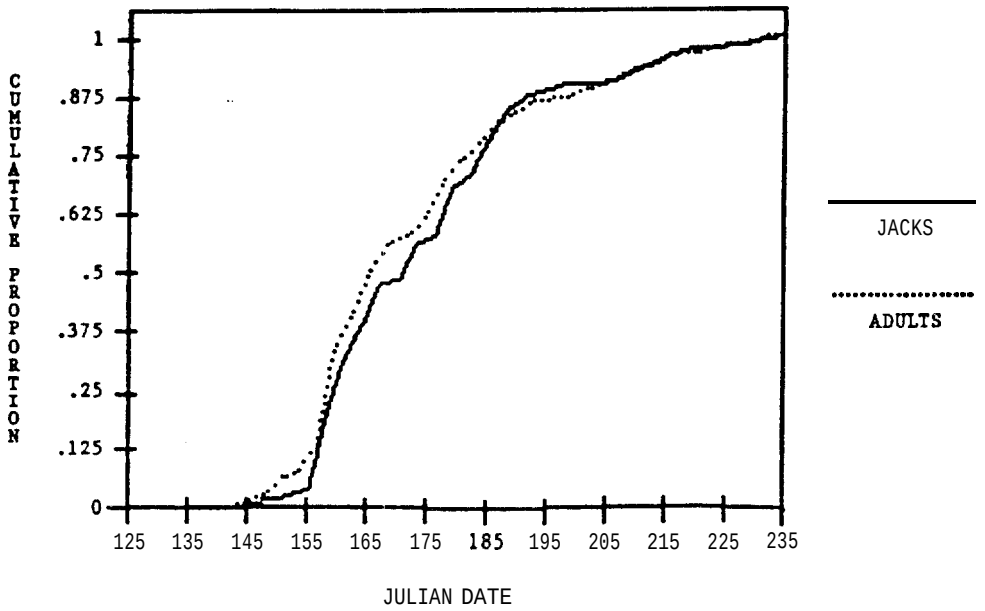


Fig. 21. Percentage of kill at each screen at Chandler Canal, May 17, 1983.



22. Cumulative frequency distributions for spring chinook adults and jacks, 1983.

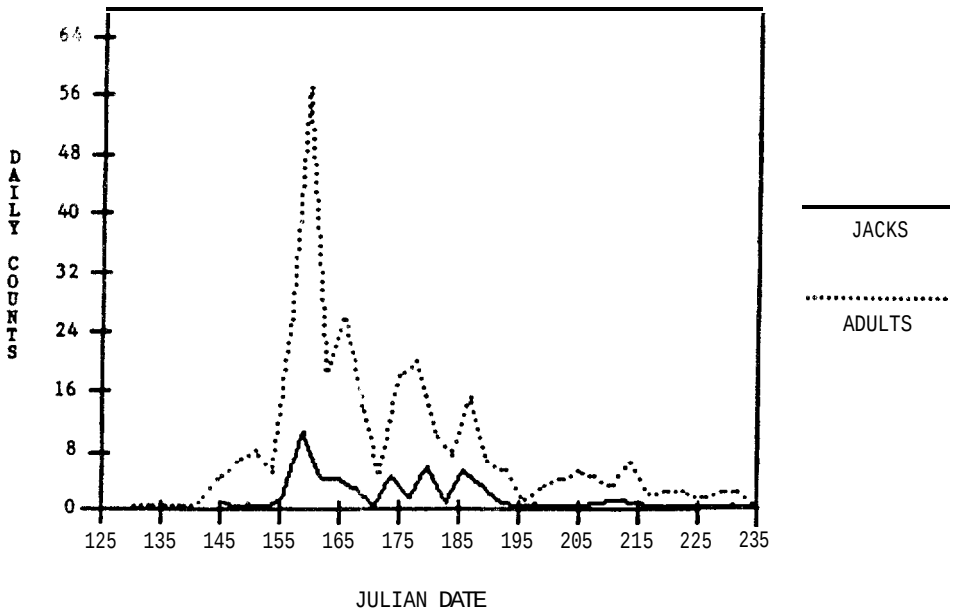


Fig. 23. Daily counts of adult and jack spring chinook at Roza Dam, 1983.

On May 17, 263 spring chinook, and 438 fall chinook were captured at Prosser Trap and 16 and 41 spring and fall chinook were captured on the screens. Therefore, 5.7% of the spring chinook entering the canal and 8.5% of the fall chinook were killed on the screens. This is a minimum estimate due to the high levels of predation taking place in the canal upstream from the fish screens. Fish accumulate in front of the screens and predatory birds were observed feeding on fish. In addition to the loss of wild fish, there was a loss of 2.3% of hatchery fish. It appears that mortality rate may be a function of the size of fish contacting the screens. Fall chinook are smallest and sustain the greatest loss and hatchery spring chinook and steelhead are larger fish and few losses are seen. More extensive work over a number of days is required to better quantify the effects of these screens,

In two pools electrofished in Roza Canal near Roza Dam and Zillah on November 3, 1983, 30 and 53 juvenile spring chinook were captured. Two juvenile steelhead were captured near Roza Dam as well. Each pool was approximately 50 meters long. An aeriai survey of Roza Canal showed that at least 60 pools were present in the canal at that time. Since the pools were separated by dry canal bottom, there was no opportunity for the fish to escape; so it must be assumed that all fish died.

There are three other major canals in the Yakima Basin and many smaller ones. If an equivalent loss of fish takes place in these other canals as well, these operations will dramatically reduce smolt yield and adult returns to the Yakima System. Note that the mortality associated with stranding of juvenile salmonids after the irrigation

season is an absolute minimum. Once fish enter the canals, several hundred miles of laterals allow fish to be lost in additional irrigation systems and on agricultural lands.

A final interesting point to consider is the size of the fish captured in the canals. The mean length and weight of these fish was 134.7 mm (SD=11.5) and 30.9 gms (SD=4.17) respectively. This was considerably larger than the mean size of wild smolts captured at Prosser in the spring of 1983. Scale analysis showed that these fish were less than one year old, as compared to 1+ smolts captured at Prosser. Therefore, these fish were growing at a very high rate. Observations by the Bureau of Reclamation (Red Nichols, personal communication) report that fry size individuals were carried over the screens into the canal during the spring. It would seem likely that it was these fish that were residing in the canal.

Adult Returns

An adult counting station at Prosser Dam was operated by the Yakima Nation Fisheries staff and the Washington Department of Fisheries from April 25 to July 11. High flows resulted in damage to the trap during the peak of the migration, so all migrating adults were not counted. A total of 765 adults, and 102 jacks were enumerated at the adult trapping facility.

Adults migrating through the fish ladder at Roza Dam were counted by Yakima Nation Fisheries Resource Management staff from May 5th to August 25. A total of 860 adult spring chinook, 147 jack chinook and 43 steelhead were counted. One-half of the migration was completed by June 22 and only 1% of the run passed Roza after July 5th (Fig. 22).

Captures of spring chinook is illustrated in Figure 23. Daily fish counts can be found in Yakima Indian Nation Fisheries Resource Management Technical Report 83-l.

Spawning escapement estimates were based on walking and floating surveys conducted by the Yakima Nation Fisheries staff, the U.S. Fish and Wildlife Service, and the Washington Department of Fisheries. A total of 360 redds were counted with 81.1% found in the upper Yakima River. Spawning was first observed on September 8 and continued through October (Table 16). Redd density in an index area from RM191 to RM202 was 12.4 redds/mile.

There were 83 redds counted in the Naches River System, with the median spawning date occurring during the week of September 8th. Figure 24 illustrates the time course of spawning, and indicates that spawning occured considerably earlier in the Naches River System. Table 16 presents spawning ground data for localized areas and tributaries within the Yakima River Basin. A more detailed analysis of spawning ground surveys can be found in the Yakima Indian Nation Fisheries Resource Management Technical Report 83-2.

There is presently no commercial or sport fishery for spring chinook on the Yakima River. The Yakima Nation dipnet subsistence fishery harvested 84 spring chinook in 1983 (Yakima Indian Nation Technical Report 84-2, in press).

Table 16. Results of Spring Chinook Spawning ground surveys, 1983.

Location	Number of Redds	% of Entire System
Yakima River	360	81.3
Easton to Teanaway	297	67.0
Teanaway to Ellensburg	45	10.2
Cle Elum River	18	4.1
Naches River	83	18.7
Naches River RM21-44	27	6.1
American River	36	8.1
Bumping River	7	1.6
Little Naches River	9	2.0
Ratt lesnakt Creek	4	0.9
Total	443	

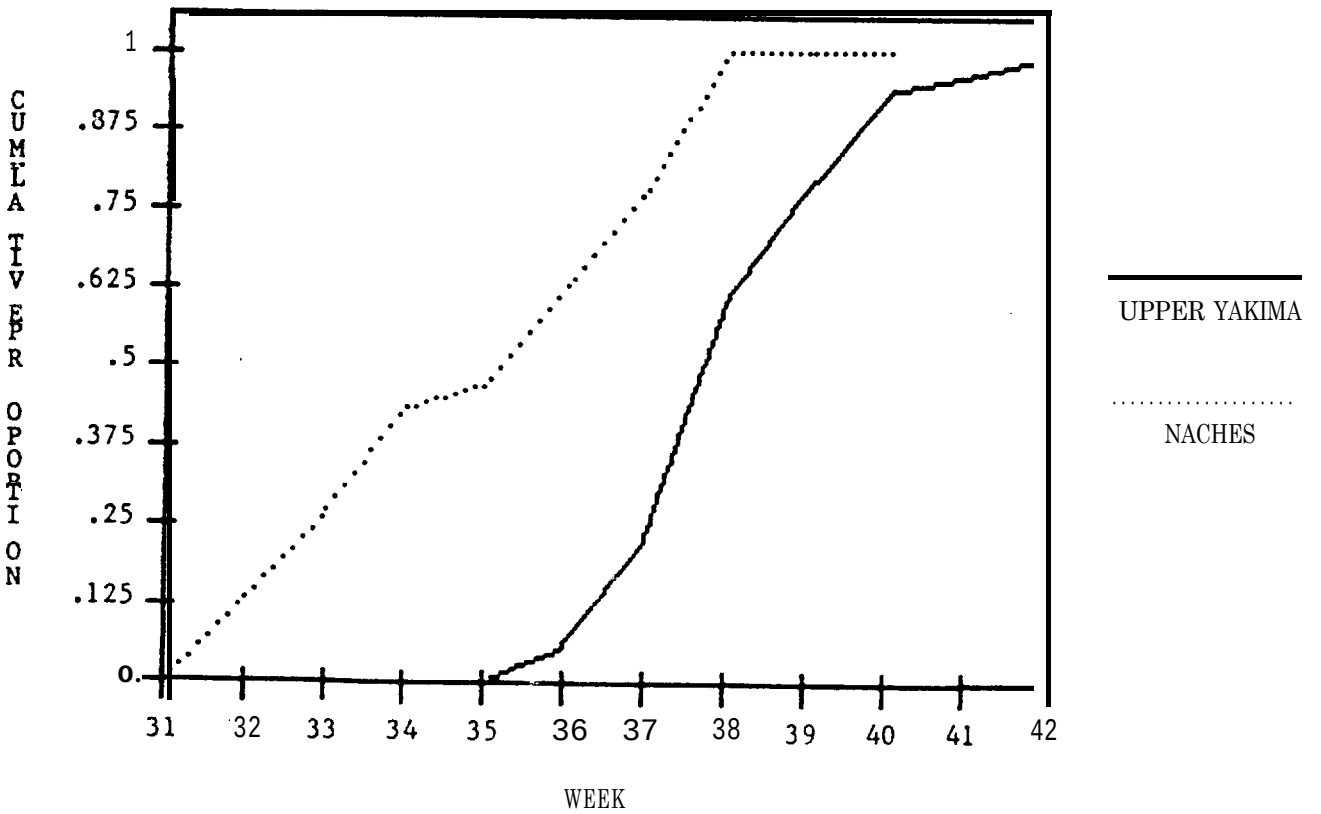


Fig. 24. Comparative cumulative frequency distributions of spawning timing of spring chinook salmon between the Yakima system and the Naches system, 1983.

DISCUSSION

Hatchery Operations

Nearly 40% more smolts released from Nile Springs successfully migrated to Prosser than was observed for fish transported and directly released into the Yakima River. These differences were not as dramatically seen at NMFS juvenile fish counting projects at John Day and McNary Dams on the Columbia River and the final proof will be seen in adult returns. However, spring chinook smolts have been released from Nile Springs for 8 years and no large increase in returns have been observed. This will be carefully studied in 1985 when these fish begin to return.

Arrival at Prosser occurred sooner for the Nile Springs releases than for those transported to the river as smolts. This difference is not due only to the differences in the distance from the point of release to Prosser. Two factors other than the general fitness of the fish may explain the difference. First, the transported fish must navigate Roza Pool near the mouth of the Yakima Canyon while fish from Nile Springs do not have a similar slack water area to travel through. Second, transported fish mustacclimate to a stream environment immediately. If one examines the date at which 75% of each group pass Prosser, the Nile Springs fish take two weeks while the transported fish require a full month. This could account for the lower survival rate of this group. A longer period of time spent in the river without migrating may result in increased losses due to predation. The difference in timing also has implications in that spill over the mainstem dams is regulated to some degree to pass fish effectively. If

transported fish drastically lag behind the norm, spill may not be optimum when the fish reach the dams in the Columbia River.

Fish released from the Leavenworth Hatchery complex generally return as five year olds. Naches returns are comprised, to a large extent, of 5 year olds (particularly females), while fish returning to the Yakima usually spend only 2 years at sea (four year olds). Acclimation and release directly to the Yakima rather than to the Naches system may prove more beneficial for two reasons. First, fish with a proclivity to return at four years might have better long term success in reestablishing runs in a similar system. Secondly, ocean mortality will be less for individuals spending two versus three years at sea. This is off-set by the fact that a five year old female is generally larger, and therefore more fecund than those a year younger. The relative value of a larger fish is, therefore greater if the intent is to reestablish naturally rearing populations. Future analysis will address the trade-off of early returns of smaller spring chinook versus later returns of larger more fecund individuals. This analysis will be based on the relative magnitude of adult returns as a result of smolt releases, and survival through the various life stages in each system.

There was a two to three week intervals between the time first spring chinook were captured at Prosser (the first day of trapping) and the beginning of smolt release. Sp ills over the mainstem dams were adequate at this time, but release dates should be set earlier to coincide with natural migration and water budget management. Fish were not allowed to leave Nile Springs Pond until April 20, but in this case, the median date of arrival at Wapatox was earlier for hatchery fish

than for wild. Fish from Nile Springs and transported fish will be released in early April, If transported fish spend a considerable time in areas of release, adverse competitive interactions (competition for food or adequate holding areas) may take place with wild fish that have not yet begun to migrate. By scheduling release far early April, most wild smolts will be migrating, and interactions may be diminished.

There is a large difference in size of wild and hatchery smolts as well. The average size of hatchery smolts 8 is 14.4 mm larger at Prosser, and 22.lmm larger at Wapatox. Anglers reported catching juvenile spring chinook vith missing adipose fins as late as June and July in the upper Yak ima River. The poor survival of these fish may be due to residualism because the size at release was too large. However, the size will be a function of feeding rate at the pond and the inherent size of smolts of that stock. Smith (1980) shoved a 350-400% increase in adult returns to the Willamette River from spring chinook released in fall rather than during the spring. The best return rates were achieved when released fish had attained a size greater than 15 cm and when flows were high (Smith, personal communication). Preliminary results from the Deschutes river show similar results (Brian Cates, USFWS, pers. communication) Fish that vere larger than 13 mm that appeared to undergo smoltification in the fall returned as well, if not better than fish held at the Warm Springs Hatchery until spring. A release is scheduled for the Yakima River in November, 1984. Fish will be tagged and 10% will be freeze branded. Trapping operations at Prosser coupled with data collected from returning adults in 1986 and 1987 will indicate if this is an effective enhancement method. It is unknovn whether fish from the

Deschutes river migrate to the ocean immediately upon release. The importance of migration timing concerns spills over mainstem dams. If fish released in the fall overwinter in the Yakima and migrate in early spring, this migration may not be coincident with optimum spills. The same is true if these fish migrate during fall when spill over the mainstem dams may not be optimal.

Distribution

The movement of fish in the Yakima Basin appears to be dictated by changes in water temperatures. The lover Yakima River has limited potential for rearing spring chinook from June when water temperatures may exceed 20°C until temperatures decrease in the fall. Based on results from this first year of study, it appears that there is a general downstream movement of fish from the spawning areas with the Yakima Canyon as the most important site for summer rearing. A large proportion of the spring chinook rear from rivermile 135 to approximately 169. Large releases of hatchery fry and pre-smolts in this area may have a negative impact on the wild fish due to competition and predation, especially if there is a high incidence of residualism and if run sizes continue to increase. Smolt releases as well should be made at points upstream for the same reasons. There are generally fev fish found in the tributaries, no doubt because of high water uses for irrigation purposes. The establishment of higher instream flows may increase the rearing capabilities of these tributaries. As fish vere located in some tributaries some distance from their confluence with the Yakima (Manestash and Swauk Creeks), these areas could have potential as rearing sites for fry. Fish should be scatter planted as flows will

reduce available habitat. If fieh are spread over a large area densities will be lower and competition for food and space lessened.

The distribution of juvenile spring chinook during the winter months is difficult to ascertain. After the on-set of cooler temperatures and increased flow in the upper Yakima in September, few fish were captured. Regression analysis did not show a significant relationship between the number of fish captured in beach seining operations and flows, so this does not appear to be &he reason that the number of fish captured during the winter months declined. Electroshocking surveys were also unsuccessful in capturing fish. 40,000 smolts were captured at Prosser in the spring of 1983, so it appears that the fish had not left the Yakima System . Bustard and Narver (1975) and Hartman (1965) showed that coho salmon congregate in densely packed groups in deep pools and near over-hanging banks when water temperatures are low. Tschaplinski and Hartman (1983) showed a large movement of coho into backwater sloughs and tributaries with the on-set of fall freshmets. Electroshocking surveys in the Yakima Basin did not provide evidence that this occurs with spring chinook. It would, therefore, appear that these fish remain in the mainstem Yakima during the winter months.

If the fish are burrowing into the substrate, captures in beach seins will be low. As winter mortality often accounts for the largest post emergence loss of production, it is important to determine how great a loss is occurring and the causes. Branded fish released in September will allow for this determination to be made. Few branded fish captured during seining operations or at Prosser smolt trap would

indicate that a problem exists. Furthermore, if it is found that the optimum time of release is in November, it is important to determine the best release sites. Extensive electroshocking surveys in 1984 will further address this question.

The general downstream movement of fish with the on-set of cooler water temperatures in the fall results in the loss of fish. Based on first year observations of mortality caused by screen removal during the winter, impingement of fish on the screens, and from fry that pass the screens when they are operational, new installations must be constructed to effectively increase runs of salmon to the Yakima River.

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Appendix Table 1. Daily capture of salmonids at Prosser Smolt Trap.1983.

Date	Wild SpChin	Hatchery SpChin	Nile Sp. Release	Trans-ported	Wild Steelhead	Hatchery Steelhead
April						
4	85				49	
5	169				107	
6	367				155	
7	616				115	
8	171				36	
9	211				50	
10	211				50	
11	251				64	
12	172				75	
13	242				85	
14	390				100	
15	975				133	3
16	1960				157	15
17	1345				161	7
18	1083				225	1
19	2625				280	41
20	1136				295	26
21	1301				291	0
22	1153				199	3
23	844	14			227	8
24	672	28			192	22
25	522	58		1	268	7

DATE	Wild SpChin	Hatchery SpChin	Nile Sp. Release	Trans-ported	Wild Steelhead	Hatchery Steelhead
26	366	78	2	1	167	7
27	357	57	3	1	181	24
28	432	137	4	0	167	33
29	449	298	22	5	190	47
30	802	791	58	16	344	61
May						
1	647	1227	66	16	283	46
2	556	1817	101	23	298	71
3	501	1301	87	20	287	130
4	338	750	59	19	207	79
5	484	997	47	24	22	92
6	231	593	36	6	167	37
7	302	570	21	10	181	51
S	186	353	16	9	134	66
9	126	185	7	8	105	32
10	117	161	2	1	117	25
11	157	216	7	6	152	41
12	189	316	7	10	120	121
13	339	507	10	14	160	200
14	357	576	5	21	347	65

Appendix Table 1. (continued)

DATE	Wild SpChin	Hatchery SpChin	Nile Sp. Release	Trans ported	Wild Steelhead	Hatchery Steelhead
15	265	521	7	29	373	55
16	209	445	6	11	369	86
17	363	417	5	9	371	85
18	393	391	2	19	353	65
19	268	336	2	8	333	76
20	264	366	4	8	357	94
21	543	349	5	18	553	106
22	422	464	8	17	570	148
23	292	315	7	9	418	136
24	116	85		4	184	43
25	122	62			112	17
26	60	23			35	6
27	32	13			25	7
28	28	14			32	6
29	44	6			25	3
30	44	3			13	2
31	15	3			11	
June						
1	20	3			12	
2	11	1			5	1
3	6	5			4	
4	13	2			6	
5	15	1			2	1
6	39				5	

DATE	Wild SpChin	Hatchery SpChin	Nile Sp. Release	Trans-Ported	Wild Steelhead	Hatchery Steelhead
7	15				13	2
8	29				20	
9	27	4			13	
10	30	2			15	1
11	12				14	3
12	15	1			13	1
13	16				19	
14	15	1			18	
15	7	3			24	2
16	40	2			21	4
17	29	1			20	1
18	69	2			21	3
19	13	3	1		8	2
20	24	2	1		21	2
21	16				19	
22	6				14	
23	11				2	
24	16				6	
25						
26						
27	9				4	
28	26				4	
29	7				2	
30						

Appendix Table 2. Salmonid captures at Wapatox, 1983.

DATE	SPRING CHINOOK CAPTURES	SPRING CHINOOK ESTIMATE	HATCHERY SP.CHK. CAPTURES	HATCHERY SP.CHK. ESTIMATE	NILE SPRINGS CAPTURES	NILE SPRINGS ESTIMATE	STEELHEAD CAPTURES	STEELHEAD ESTIMATE
830329	1	10	0	0	0	0	0	0
830330	1	10	0	0	0	0	0	0
830401	2	21	0	0	0	0	0	0
830402	1	10	0	0	0	0	0	0
830404	0	0	0	0	0	0	1	10
830406	2	19	0	0	0	0	0	0
830419	12	160	0	0	0	0	2	27
830420	17	144	0	0	0	0	2	17
830421	20	290	10	145	0	0	2	58
830423	1	15	9	138	1	15	0	0
830424	4	63	142	2253	14	222	2	32
830425	13	203	239	3734	20	312	0	0
830420	13	197	87	1318	14	212	3	45
830427	1	15	84	1272	14	212	0	0
830428	5	77	147	2261	12	185	6	92
830501	4	67	202	2730	7	95	0	0
830502	11	157	86	1228	6	86	0	0
830503	10	143	268	3828	28	400	1	14
830504	2	29	11	162	0	0	1	15
830505	3	18	52	928	5	89	5	89
830508	20	400	133	2660	0	0	13	260
830511	27	397	81	1191	12	176	67	985
830512	7	92	37	487	5	66	6	79
830514	15	192	5	64	5	64	0	0
830517	1	11	0	0	0	0	0	0
830518	29	333	68	782	8	92	13	149
830519	24	267	18	200	1	11	1	11
830520	14	171	12	146	1	12	1	12
830521	1	15	5	76	0	0	0	0
830522	0	0	6	109	1	18	0	0
830523	1	20	1	20	0	0	0	0
830601	2	50	0	0	0	0	0	0
830623	2	10	0	0	0	0	0	0
830701	6	32	1	5	0	0	0	5
830705	1	5	0	0	0	0	0	0
830715	4	16	0	0	0	0	0	0
830725	15	45	0	0	0	0	0	0
** TOTAL **	292	3704	1704	25737	154	2267	126	1900

Appendix Table 3. Number of juvenile spring chinook captured in seining operations on the Yakima River, 1983.

LOCATION	MAY			JUNE			JULY			AUG			SEPT			OCT			NOV		
	n	x	%	n	x	%	n	x	%	n	x	%	n	x	%	n	x	%	n	x	%
W.Rich.	NA			0	0	0	0	0	0	0	0	0	0	0		0		000	0	0	0
Benton	NA			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prosser	NA			1	.2	.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Granger	NA			11	2.2	3.0	0	0	0	0	0	0	0	0	0	0	0	0	3	.6	a
Toppenish	21	4.2	9	5	1.0	1.0	0	0	0	0	0	0	0	0	0	0	0	0	19	3.8	51
Selah	a2	16.4	34	35	7.0	9.0	8	1.6	1.0	12	2.4	4	NA			0	0	0	14	2.8	38
Yakima Can	136	27.2	56	82	16.4	21.0	367	73.4	62.0	233	46.6	74	165	33	100	20	4	83	0	0	0
Ellensburg	NA			152	30.4	39.0	176	35.2	30.0	59	11.8	19	NA			1	.2	4	0	0	0
E. Canyon	NA			83	16.6	2i.o	14	2.8	2.0	NA			NA			0	0	0	0	0	0
Cle Elum	3	.6	1	la	3.6	5.0	26	5.2	4.0	9	1.8	3	NA			2	.4	a	1	.2	3
Easton	NA			7	1.4	2.0	0	0	0	0	0	0	NA			1	.2	4	0	0	0
L.Naches	NA			52	10.4	56.0	74	14.8	56.0	36	1.2	22	NA			0	0	0	0	0	0
M.Naches	NA			25	5.0	27.0	20	4.0	15.0	42	8.4	32	NA			9	1.8	69	2	.4	67
U.Naches	NA			16	3.2	17.0	37	7.4	28.0	53	10.6	40	NA			4	.8	31	1	.2	33

n = number of fish captured in 5 sein hauls
x = mean number of chinook captured per haul
% = percentage of the total number of fish caught during the month that were captured at that site.

Appendix Table 4. Captures of juvenile spring chinook in sein hauls on the Naches River, 1983. Captures are totals for five sein hauls.

River Mile	June	July	Aug	Sept	Oct	Nov
9	52	74	36	--	0	0
31	25	20	42	--	9	2
42	16	37	53	--	4	1

Appendix Table 5. Mean fork length (mm) of spring chinook in the Yakima Basin, 1983.

Location/River Mile		Jan	May	June	July	Aug	Sept
Yakima System							
W.Richland	8	124.0					
Benton	25						
Proser	44			69.5			
Granger	82	108.2		66.5			
Toppenish	95	102.9	59.5	67			
Selah	118	110.5	51.6	63.6	82.8	89.8	
Yakima Canyon	135		55.9	60.5	85.7	88.5	109.4
Ellensburg	152	106		66.7	72.1	87.9	
E. Canyon	X69	100.7		62.2.	69.6		
Cle Elum	181	101.0		56.1	67.1	82.9	
EastOn	195	103.7		51.			
Naches System							
lower	13	93.1		54.3	71.8	77.9	
Middle	31	94.9		54.6	61.3	72.7	
Upper	42	82.4		55.4	52.3	63.1	
American		77.3					
Bumping		90.3					
Tieton		109.3					