KRIS edition

Annual Report

Study 3a1

Shasta and Scott River Juvenile Steelhead Trapping

2000

California Department of Fish and Game
Steelhead Research and Monitoring Program
Yreka, CA.

prepared by :
William R. Chesney

Dec. 2000

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Abstract

This report summarizes the first year findings for steelhead *(Oncorhyncus myskiss irideus*) captured during rotary screw trap operations on the Shasta and Scott rivers. Data collected included weekly sum of catch, fork length, and estimated trap efficiencies. The first year of sampling determined that rotary screw traps were an effective sampling tool on these Klamath River tributaries.

The trap on the Shasta River was located at the Department of Fish and Game's Shasta River Fish Counting Facility, located one quarter mile upstream from the confluence with the Klamath River. It was operated from February 26th to July 16th, and fished a total of 2,384.6 hours. A total of 4,631 steelhead, 212 coho and 32,409 chinook and other native (non-salmonid) and non-native fish were trapped. Peak outmigration of steelhead smolts occurred during the week ending May 6th. The greatest total weekly catch of steelhead parr was recorded during the week ending July 1st. The rotary screw trap, with some modifications, proved effective in capturing fish in fluctuating flows (40-425 c.f.s.) and keeping mortality of fish low despite large amounts of algae in the catch. On June 12th, the trap was equipped with a time lapse video system that recorded the catch as it passed through the open live car. From the video tapes, we were able to distinguish between age 0 steelhead and age 1 and 2 steelhead, but we were unable to identify the life stage of the fish (parr, silvery parr and smolts).

The Scott River trap was located approximately on river mile 5, upstream of Scott Bar, just downstream from the Pat Ford tributary. Site selection in the lower Scott River Canyon was difficult with limited vehicle access to the river. The trap was operated from March 19th to July 18th and fished for a total of 1,254.3 hours. A total of 2,393 steelhead, 873 coho, and 10,239 chinook and other native and non-native fish were trapped. Peak outmigration of steelhead smolts occurred during the week ending May 6th , and the peak outmigration of steelhead parr occured during the week ending July 1st . Shasta River chinook outmigrated earlier and at a larger size than the Scott River. Steelhead smolts and parr outmigrations showed similar peaks for both systems but the weekly mean size of steelhead smolts were consistently larger in the Shasta River than those outmigrating from the Scott River.

Background

Outmigrant trapping is an established method used to study the timing, species composition, abundance, life stage composition, and health of out-migrating salmonids. Various forms of outmigrant traps have been used on the tributaries to the Klamath River. In 1955, Coots conducted a study on Fall Creek comparing the outmigration of wild chinook and hatchery reared chinook using a flume trap (Coots 1955). In 1981, Paulsen attached five McBain traps to the Shasta Racks from February 8th through May16th to study the relationship between river flow, temperature and the outmigration of juvenile chinook (Paulsen1981). In 1984, juveniles were captured in the late spring and summer using a 50 foot by 8 foot seine (Mills,1984). From 1986 through 1990 California Dept. of Fish and Game's Natural Stocks Assessment program used funnel nets with modified fyke boxes to collect chinook for coded wire tagging. These traps were operated on the Shasta River and Bogus Creek from January to July, compiling species composition by julian week (CDFG, unpublished data). In 1994 and 1997 the U.S. Forest Service (Klamath National Forest, Scott River District) trapped two locations on the Scott River using funnel nets and fyke boxes. The focus of these studies has been on salmon, the information collected on steelhead outmigration is limited due to the duration of the projects.

<u>Shasta River Rotary Screw Trap Methods</u>

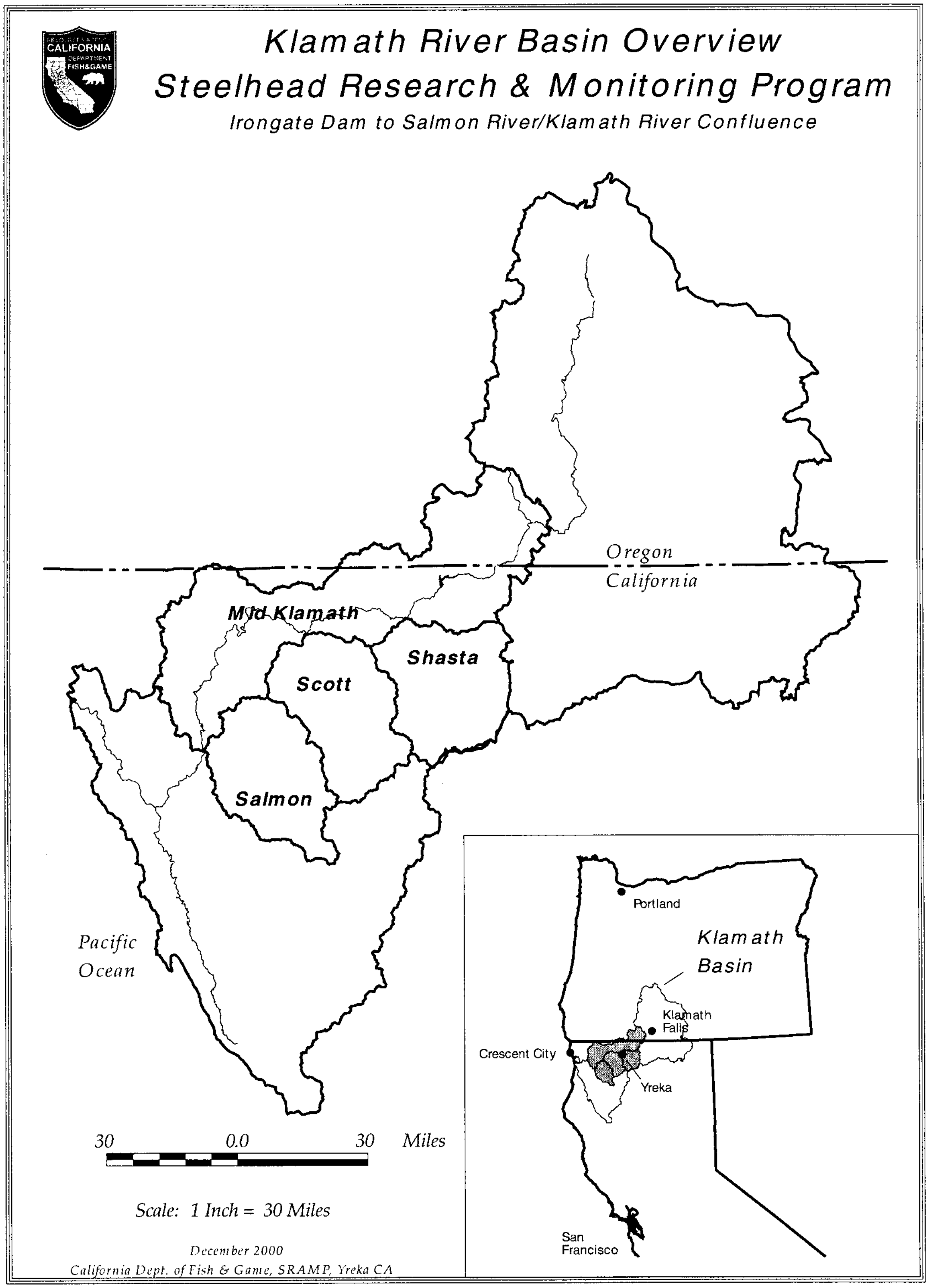
Previous efforts to monitor salmonid out-migration from the Shasta River have had the best results by using funnel nets equipped with conventional and modified fyke boxes. The use of these traps is limited by conditions that occur annually in the Shasta River. Nets can be submerged by high flows and filled with gravel and debris, and at low flows there may not be enough velocity at the net intake to capture fish. The Shasta River produces large amounts of filamentous algae that can quickly plug a net and fill a live car. Late season sampling with fyke nets has been very difficult due to this algae problem. In this study, our objective was to evaluate the effectiveness of a rotary screw trap in a river that has challenged other types of sampling equipment.

From March 2000 to July 2000, SRAMP operated a rotary screw trap (RST), 1/4 mile above the mouth of the Shasta River. The primary purpose of this work was to determine if an RST would be an effective sampling tool for studying the steelhead outmigration from the Shasta River. Further objectives of the sampling were to:

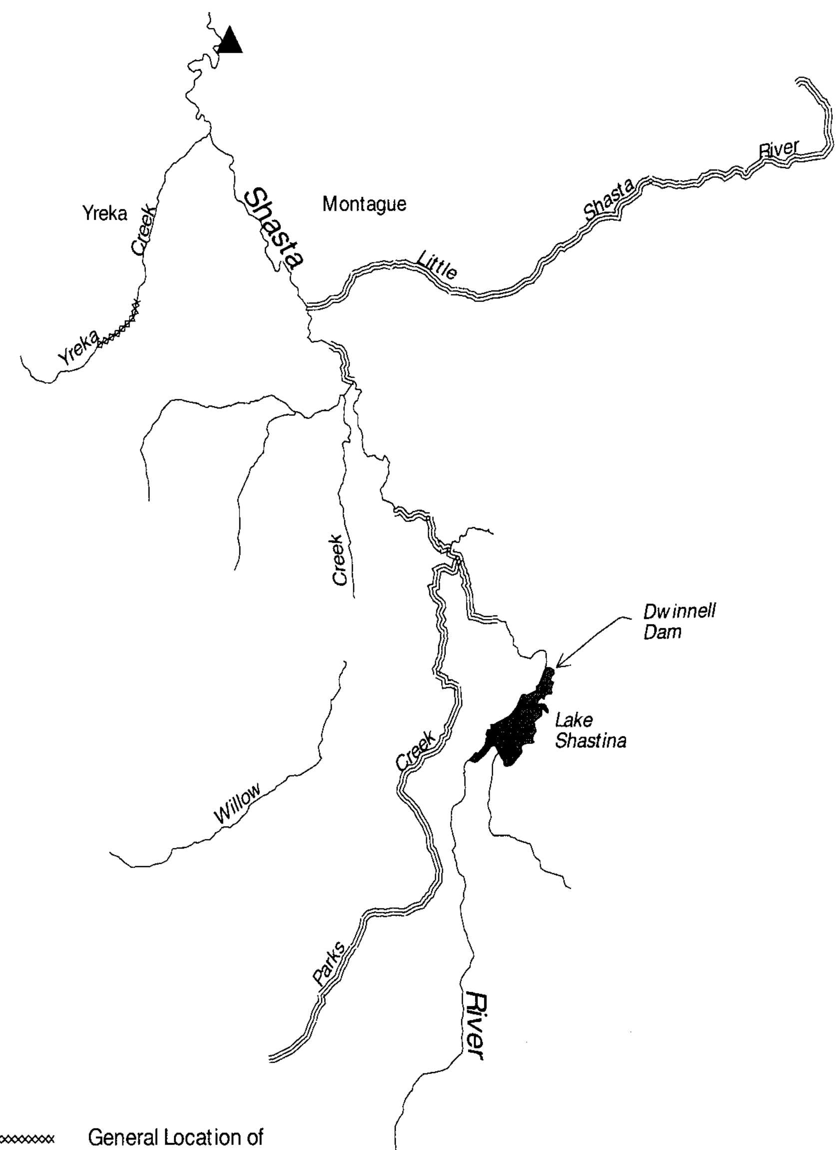
< Determine emigration abundance and timing for juvenile salmonids.
< Estimate rotary screw trap collection efficiencies.
< Measure fork lengths from a sub-sample of the salmonids collected.
< Collect scale samples from a sub-sample of the trapped steelhead for age analysis.
< Determine the feasibility of a time lapse video system for recording the "catch" as it passes through a modified rotary screw trap.

The following report summarizes the results and lessons learned from operating the rotary screw trap on the Shasta River during the year 2000.

Figure 1


CALIFORNIA
DEPARTMENT
FISH&GAME
Klamath River Basin Overview
Steelhead Research & Monitoring Program
Irongate Dam to Salmon River/Klamath River Confluence
Oregon
California
Mid Klamath
Shasta
Scott
Salmon
Pacific
Ocean
Portland
Klamath
Basin
Klamath
Falls
Crescent City
Yreka
San
Francisco
30
0.0
30
Miles
Scale: 1 Inch = 30 Miles
December 2000
California Dept. of Fish & Game, SRAMP, Yreka CA

Shasta River Subbasin



General Location of Index Reach 2000

Proposed Index Reach

Rotary Screw Trap Location

Calif. Dept. of Fish & Game
Steelhead Research
& Monitoring Program
Yreka, CA

5 0.0 5 Miles

November 27, 2000

Scale: 1 Inch = 5 Miles

Figure 2

Scott River Subbasin

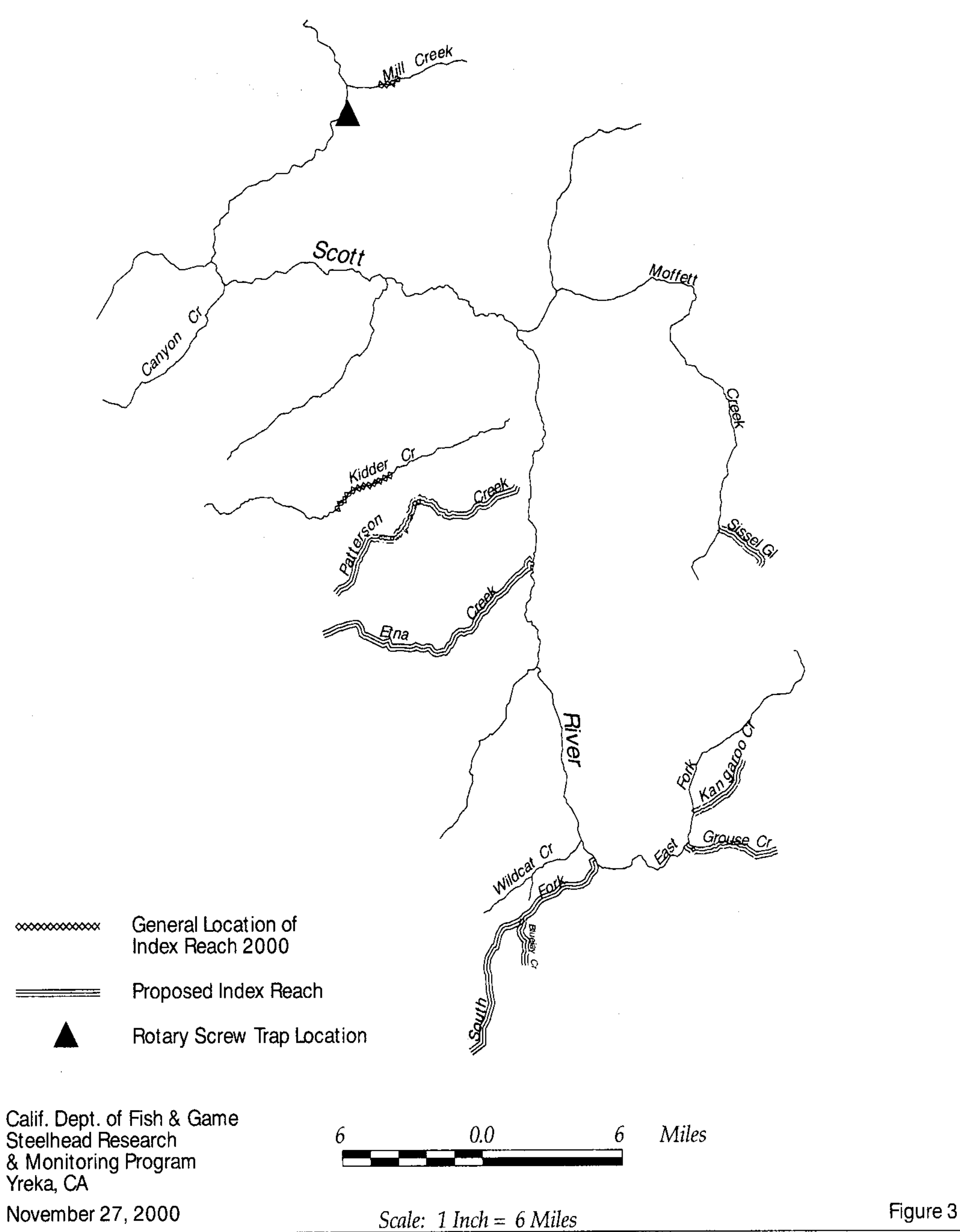


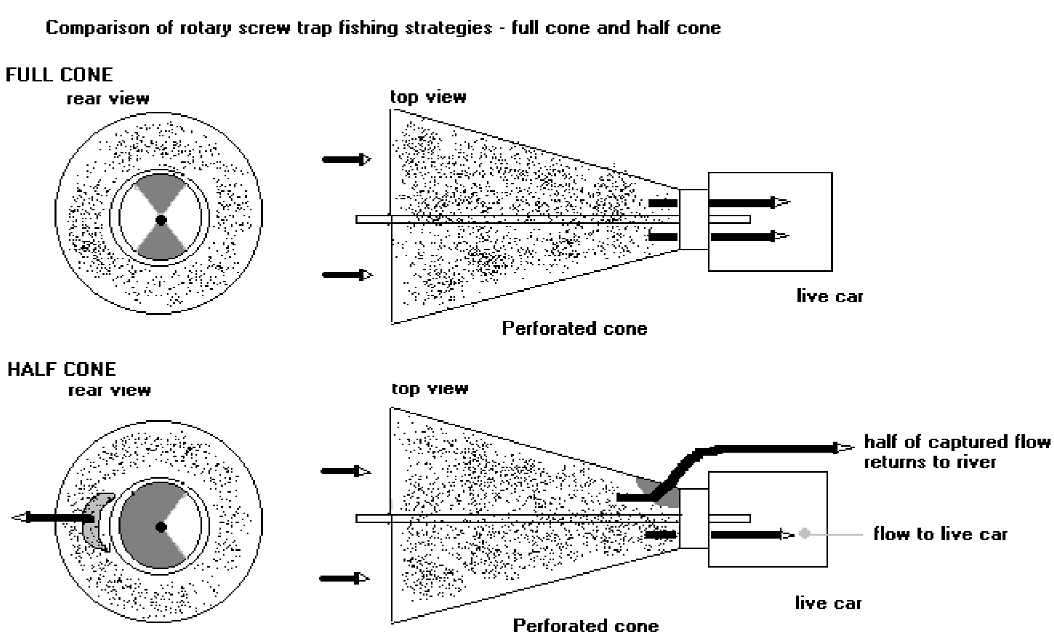
Figure 3

Methods

Site selection:
The rotary screw trap was fished directly downstream of the Shasta River weir site (Figure 2). This site was chosen because it met many of the conditions needed to successfully operate a rotary screw trap. The channel morphology at this location confines the stream to a distinct thalweg which is easily trapped at most flows. The site is close to the mouth of the system, enabling us to sample downstream of almost all of the spawning and rearing habitat in the Shasta River, and the site is accessible by vehicle year round. Additional benefits of the site include a USGS gauging station approximately one mile upstream, the property is owned by the State of California, and electric power is available.

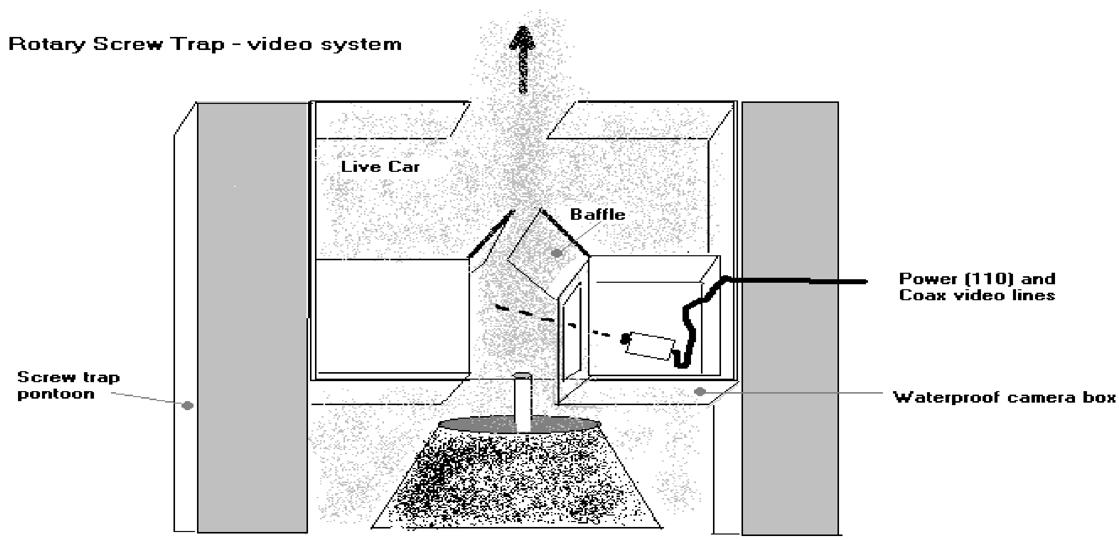
Trapping gear:
We used a five-foot rotary screw trap manufactured by EG Solutions, Corvallis Oregon. The trap was equipped with twenty-two foot pontoons for extra flotation and an extended live car to accommodate the large numbers of fish and filamentous algae we expected to collect. As the catch of fish and algae increased, it was necessary to further modify the trap to avoid trapping too many fish in the live car. The cone on a rotary trap is divided in two by an internal wall that spirals its way down the length of the cone (Illustration1). By blocking the exit of half of the cone and venting it to the river we reduced the volume of water sampled by one half. This reduced the catch and enabled us to fish the trap for as long as seven hours between trap checks. .

Illustration 1.



During the late season trapping, we removed the rear screen from the trap and we placed a video camera inside the trap to record in time lapse the catch as it passed downstream (Illustration 2). This equipment used included a Panasonic AG 6740 VCR, and a WV-CP150 camera equipped with a Computar 3.5 - 8mm f 1.4 lens. The use of this equipment eliminated the handling and holding stress that occur with the use of a conventional trap.

Illustration 2



Trap Monitoring

The trap was fished six days per week, Sunday PM through Saturday AM. The trap catch was processed two times a day, at approximately 2200 and at 0600. It was necessary to check the trap at 1600 daily to remove algae and debris between trap processing. Flow into the trap was measured at the beginning and end of each set using a General Oceanics digital flow meter, model 2030R. This enabled us to calculate the total volume of water fished during the set. Hourly water temperatures were recorded with an Onset Optic StowAway temp logger attached to the downstream end of the trap. Water conductivity and turbidity were measured and recorded daily. All vertebrates collected in the trap were identified and counted and a sub-sample of all fish species were measured for fork length. Scales were collected from a sub-sample of the steelhead collected. In order to determine whether we were trapping the same fish more than once, all trapped steelhead received an upper margin caudal fin clip before they were released. Salmonids collected in the trap were classified by life stage: sac fry, fry, parr, silvery parr, smolt and adult.

Fish Health Evaluation

In January of 2000 we learned that the CA-NV Fish Health Center was participating in the National Fish Health Survey and that it would be possible to assess the health of salmonids emigrating from the Shasta River by contributing data to the National Wild Fish Health Survey. Throughout the spring, a small sample of the chinook collected in the trap were processed and sent to the CA-NV Fish Health Center for examination.

Trap Efficiency Determinations:

Weekly estimates of the trap efficiency were conducted from 4/06/00 through 5/22/00. A known number of steelhead and chinook were marked with an Alcian Blue stain and released each week one half mile upstream of the trap. The number of marked and unmarked fish recaptured were used to produce an estimate of trap efficiency for steelhead and chinook.

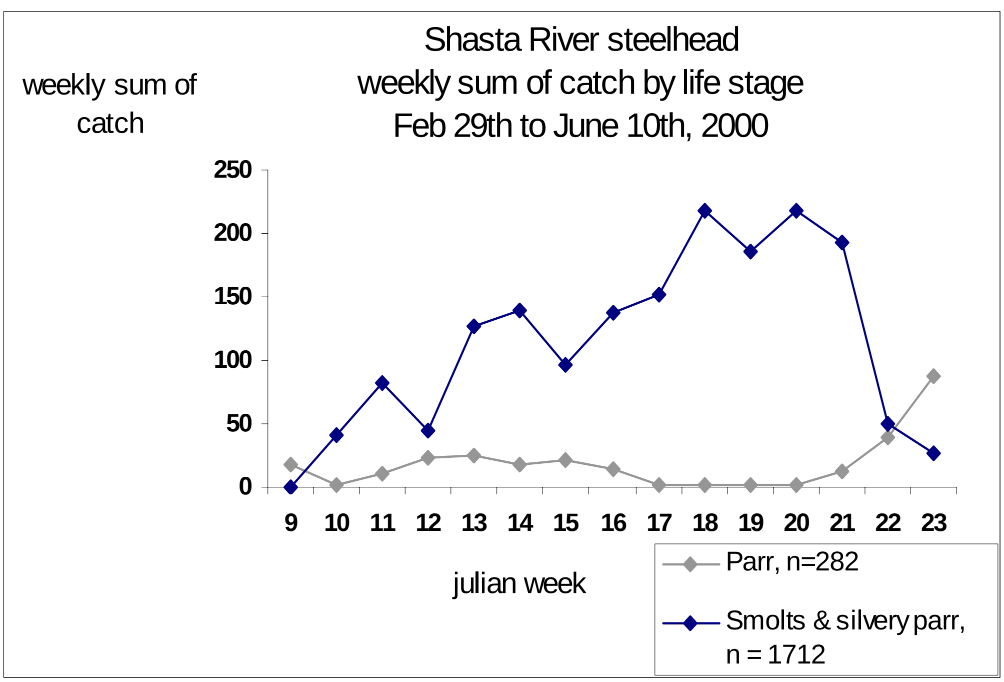
Results

The Shasta River rotary screw trap began operating on 2/26/00 and completed the sampling season on 7/16/00. During this period the trap was fished for a total of 2,384.6 hours. A total of 4,631 steelhead, 212 coho and 32,409 chinook were trapped.. Table 1 shows the total catch for all species trapped. The largest weekly total of steelhead smolts were trapped during julian week18 (week ending 5/6/00 Chart 1). The largest weekly total catch of age zero plus were recorded during julian week 26 (week ending 7/8/00 Chart 2). This coincided with the greatest daily density of steelhead trapped (Chart 3).

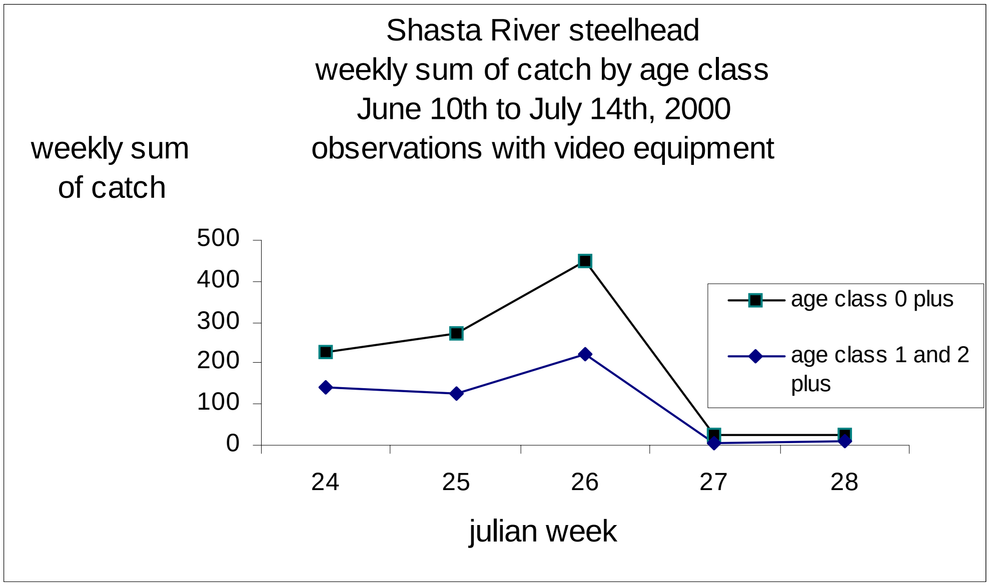
Table 1
Sum of Fish Species, Shasta River

Species	Count
Chinook Salmon *Onchorhynchus tschawytscha*	**32,409**
Coho Salmon *Onchorhynchus kisutch*	**212**
Steelhead Trout *Onchorhynchus mykiss irideus*	**4, 631**
Pacific Lamprey *Lampera tridentata*	**17,560**
Sculpin spp. *Cottus spp.*	**182**
Speckled Dace *Rhinichthys osculus*	**738**
Klamath Small-scaled Sucker	**859**
Brown Bullhead *Ictalurus nebulosus*	**29**
Golden Shiner *Notemigonus crysoleucas*	**13**
Green Sunfish *Lepomis cyanellus*	**17**
Japanese Pond Smelt *Hypomesus transpacificus nipponensis*	**4**

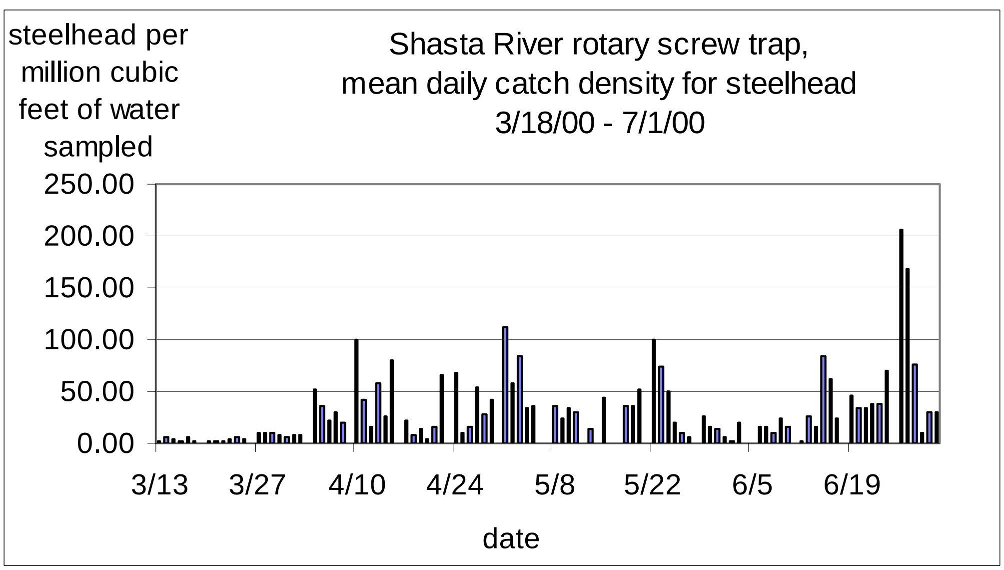
Chart 1



<u>Chart 2</u>

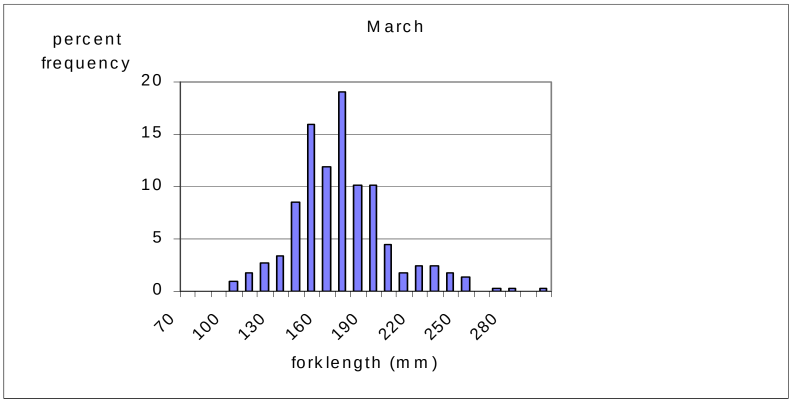


<u>Chart 3</u>



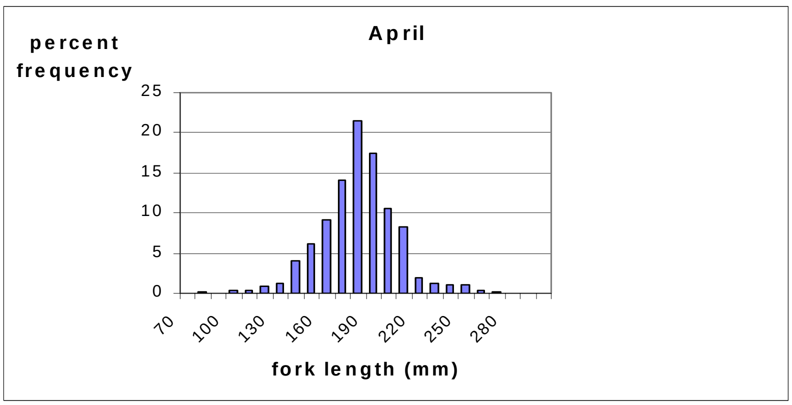
<u>Steelhead Size</u>
The fork length of 1,720 steelhead smolts were measured. The percent frequency per fork length is shown for each complete month sampled in Chart 4 a-d. Analysis of the 532 scales samples collected is scheduled to determine the age / length relationship of the smolts sampled.

Chart 4: Shasta River Steelhead smolt, fork length / percent frequencies by month



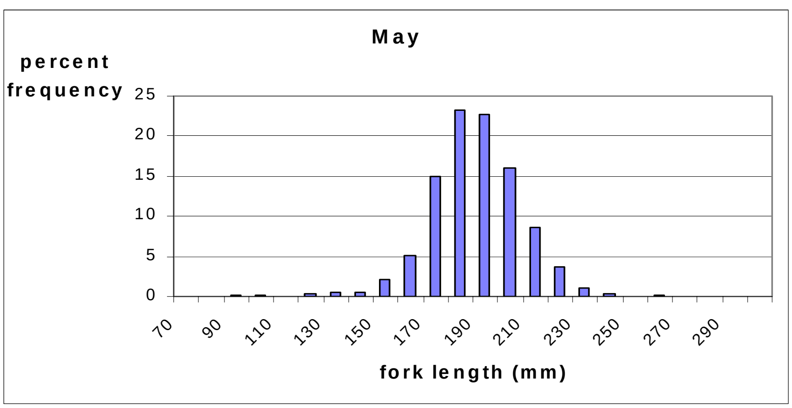
4a
March 5 - April 1.

n = 295
mean = 170
s.d. = 33.7



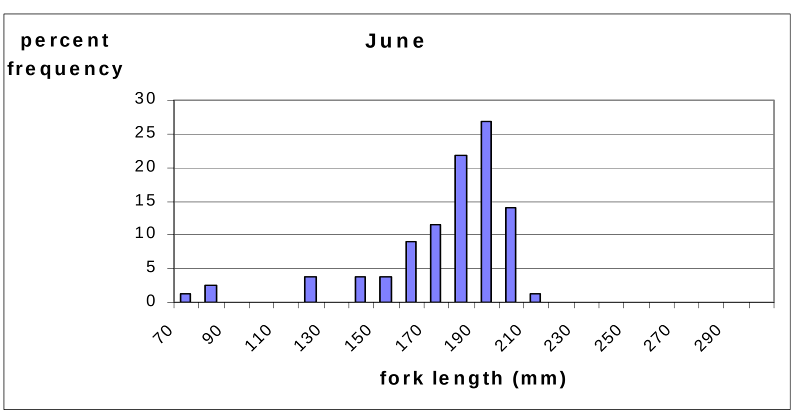
4b
April 2 - April 29

n = 526
mean = 181.7
s.d. = 28.2



4c
April 30 - May 27

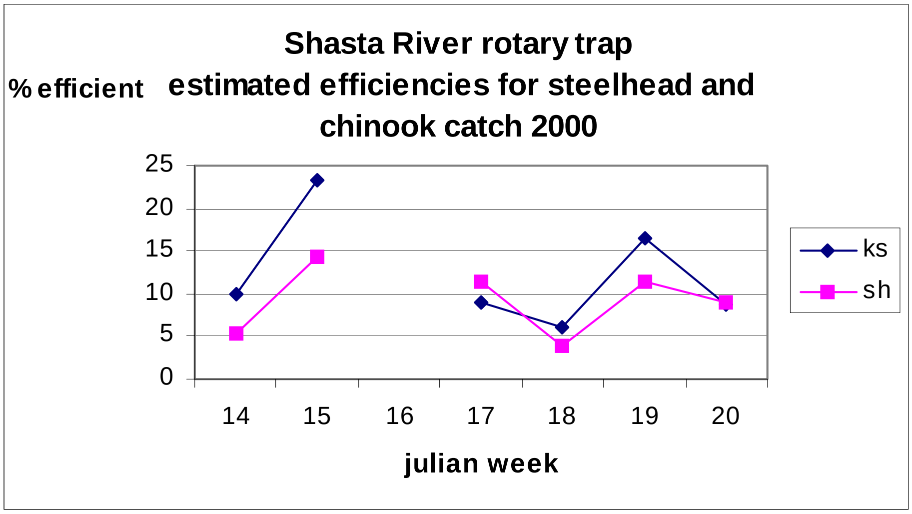
n = 821
mean = 186.7
s.d. = 23.0



4d
May 28 - June 17

n = 78
mean =174.7
s.d. = 30.3

Chart 5



Trap Efficiency
The highest trap efficiency was observed during julian week 15 (the week ending April 15th) 14.2% for steelhead and 23.3% for chinook salmon (Chart 5). We were unable to estimate the efficiency of the trap during julian week 16 (week ending 4/22) due to large amounts of algae in the catch.

Video Operation
From 6/12/00 to 7/16/00 a total of 1,556 steelhead were recorded moving downstream through the trap. The staff reviewing the tape found that it was difficult to interpret the life stage of the recorded fish, but that it was possible to sort the steelhead into two age categories, zero plus and one and two plus years of age.

Fish Health Assessment
After examining 98 juvenile chinook salmon collected in the trap from March 28th to May 25th, the California Nevada Fish Health Center concluded that "juvenile chinook outmigrating from the Shasta River in the Spring of 2000 were healthy". "The two major fish pathogens of the Klamath River, *Flavobacterium columnare* and *Ceratomyxa shasta*, were not observed in any of the samples taken from the Shasta River" (Faulkner, 2000).

Discussion

Trap Operation
The rotary screw trap was an effective tool for monitoring salmonids out migrating from the Shasta River. The trap operated during flows that ranged from 50 to 400 cfs. Modifications to the cone and live car along with frequent trap checks enabled us to sample with minimal mortality despite large amounts of algae in the catch. Mortality was also reduced by placing a one by three foot rectangular laundry basket inside the live car. We believe the basket provided cover for the smaller fish in the live car. By equipping the trap with time lapse video cameras we were able to operate the trap late in the season when the concerns of handling fish in warm water would have limited the use of a conventional trap.

Trap Efficiencies

The trap efficiencies for the steelhead and chinook showed similar trends from julian week 14 through julian week 20 (Chart 4). Because the only mark applied was an Alcian Blue stain to the caudal fin, it's possible that some of the fish were recovered in a week other than the one in which they were marked. The table below shows that of the 65 chinook that were recaptured, 64 of them were trapped within 48 hours of a release date. For steelhead, 3 of the 6 weeks marked fish were recovered on day 4 of the week and in one week a recovery was made on day 5. In future efforts to estimate trap efficiencies, we will assign a unique mark to the steelhead that are marked and released for recapture each week.

Table 2: Trap efficiency mark and recapture results

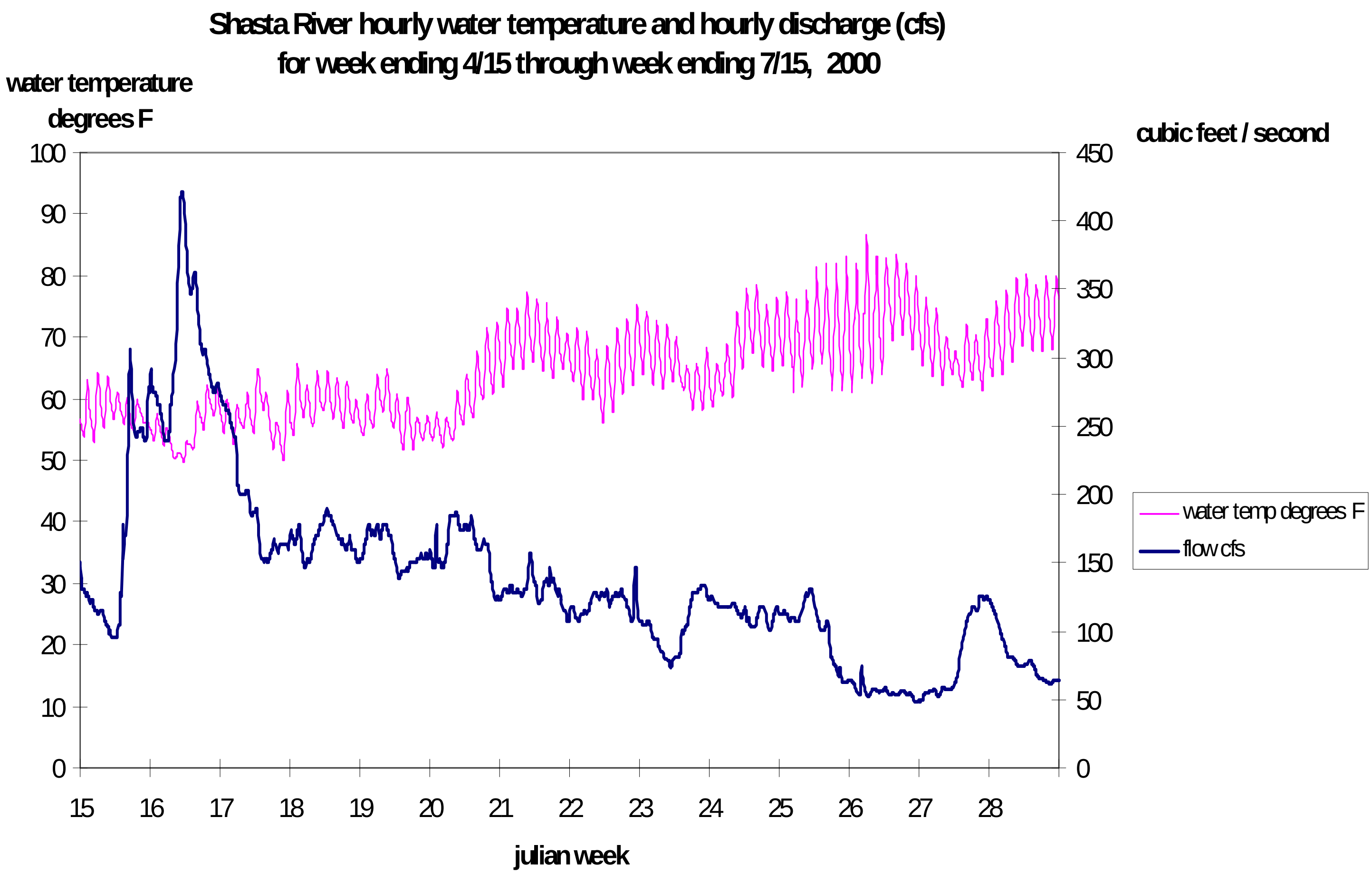
#FISH MARKED			**#FISH RECAPTURED**											
			DAY 1		DAY 2		DAY 3		DAY 4		DAY 5		DAY 6	
DATE	CH	SH	CH	SH	CH	SH	CH	SH	CH	SH	CH	SH	CH	SH
4/6/00	99	35	8	1	1	0	0	0	0	0	0	0	0	0
4/10/00	93	41	7	1	14	3	0	0	0	1	0	0	0	0
4/24/00	100	25	5	0	3	0	0	1	0	1	0	0	0	0
5/1/00	80	72	0	1	4	0	0	0	0	0	0	1	0	0
5/8/00	95	25	7	0	7	1	0	1	0	0	0	0	0	0
5/15/00	100	32	4	0	4	1	1	0	0	1	0	0	0	0

Table 3: Summary table of mark and recapture

Week Ending 2	**STEELHEAD**		**CHINOOK**	
	# MARKED	#RECAPTURED	# MARKED	#RECAPTURED
4/8/00	35	1	99	9
4/15/00	41	5	93	21
4/29/00	25	2	100	8
5/6/00	72	2	80	4
5/13/00	25	2	95	15
5/20/00	32	2	100	8

Water temperatures greater than 72 degrees Fahrenheit limited our ability to handle and mark salmonids after week ending 5/20/00.

Chart 6



Outmigration

The largest estimate for outmigrating steelhead smolts 2,750, occurred from 5/1/00 to 5/3/00. The largest number of age 0 fish were trapped during julian week 27, (the week ending 7/8/00, Chart 2). This sudden increase in parr exiting the system is most likely a response to water temperatures that have been determined to be lethal to steelhead (Danbacher, J.,1991; Reiser et al., 1979)

Trap operation

A unique mark needs to applied to the fish for each week that trap efficiencies are estimated. Recent experiments with flourescent tempera paint have shown it to be an effective mark with 96% of the marked fish retaining their mark for 98 days (Ricker in press). We plan to use tempera paint along with Alcian Blue to have sufficient unique marks.

The video system enabled us to count and to distinguish between zero plus and one and two plus steelhead. We are refining the video system with the goal of being able to identify the life stage of the steelhead as well.

Scott River Trap

Background

In the fall 1999, the USFS Scott River Ranger District (Jim Kilgore fisheries biologist) received funding from the Klamath Basin Fisheries Task Force to operate a rotary screw trap on the Scott River. The purpose of the trapping was to study the outmigration of salmonids from the Scott River basin. The Steelhead Research and Monitoring Program (SRAMP) Study Plan 3a1 also called for a rotary screw trap to be operated on the Scott River during the same period. The USFS and SRAMP staff determined that it would be beneficial to operate the trap cooperatively. By combining our resources we were able to increase the sample period from what either SRAMP or the USFS could afford alone.

Methods

Site Selection

Site selection in the lower Scott River canyon was difficult due to limited access. We looked at a number of locations and determined that the Cabin Hole located at River Mile 4.75 upstream of the mouth was the best overall location for the trap. Flow data were collected at the U.S. Geological Survey (U.S.G.S.) gage located at River Mile 21. Kelsey, Tompkins and Canyon Creeks enter the Scott River between the trap and the gage so the flows plotted (Chart 11) are not complete. However we feel the U.S.G.S. data represents the trend of the Scott River seasonal flow change.

Trapping Gear

The U.S.F.S. arranged to use an 8 foot rotary screw trap which belonged to the U.S. Fish and Wildlife, Arcata Field Office.

Trap Monitoring

The trap was fished five days per week, Sunday p.m. through Friday a.m.. The catch was processed twice a day at approximately 0830 and at 1600. The flow into the trap was measured for the duration of the set with a General Oceanics digital flow meter. Water temperatures were recorded with a hand held thermometer at each processing. Scales were collected from a sub-sample of the steelhead collected.

Fish Health Evaluation

The California-Nevada Fish Health Center examined a small sample of chinook juveniles collected in the trap. The data collected were used to evaluate the condition of the outmigrating chinook.

Trap Efficiency Determinations

Weekly estimated of trap efficiency were conducted for 8 weeks: steelhead from April 3rd through June 6th and chinook from May 16th through June 29th. After June 6th, insufficient steelhead were trapped to conduct an efficiency estimate. The fish were marked with an Alcian Blue stain and released .5 mile upstream of the trap. The number of marked and unmarked fish recaptured were used to produce and estimate of trap efficiency for the week. To improve the chance of recapturing some of the marked fish, we planned to mark at least 50 steelhead and 100 chinook for each weekly release group. This was difficult because of the small number of steelhead caught per day. We began holding the steelhead catch from two days effort in order to have more fish to mark and release, but the high mortality observed on these fish caused us to abandon this practice.

Results

The Scott River rotary screw trap began sampling on March 19t h and was ended on July 18th. During this period the trap was fished a total of 1254.2 hours. A total of 2325 steelhead. 873 coho and 10,238 chinook were trapped. Table 4 shows the total catch for all species trapped. The largest weekly total of steelhead smolts (Chart 7) were trapped during julian week 18 (April 30th to May 6th). The largest total catch of parr recorded during julian week 26 (June 25th to July 1st).

Table 4 Sum of species, Scott River

Species	**Count**
Chinook salmon *Onchorhynchus tschawytscha*	**10,238**
Coho salmon *Onchorhynchus kisutch*	**873**
Steelhead Trout *Onchorhynchus mykiss irideus*	**2325**
Pacific Lamprey *Lampera tridentata*	**893**
Sculpin spp. *Cottus spp.*	**8**
Speckled Dace *Rhinichthys osculus*	**1119**
Klamath Small-scaled Sucker *Catosomus rimiculus*	**3388**
Brown Bullhead *Ictalurus nebulosus*	**1**
Three Spine Stickleback *Gasterosteus aculeatus*	**1**
Bullfrog tadpole *Rana catesbeiana*	**437**

Chart 7

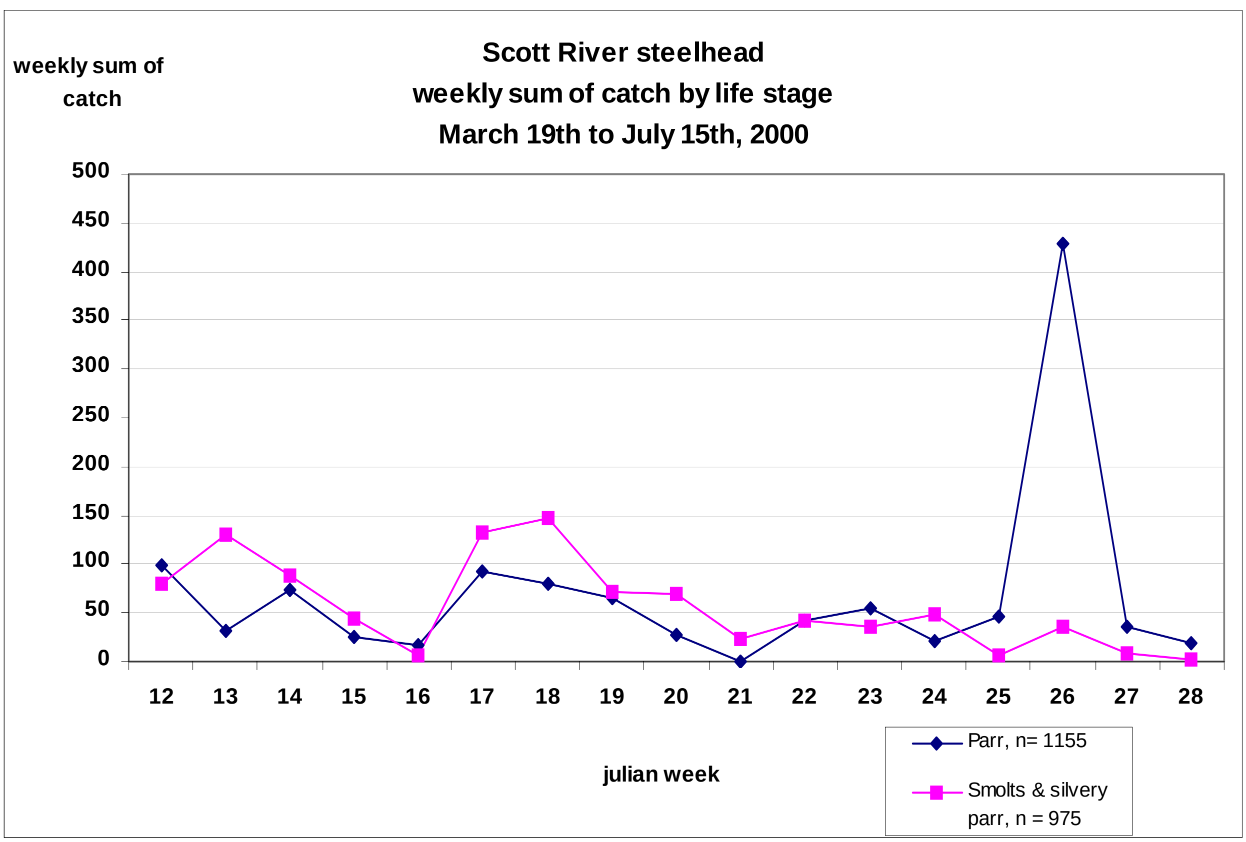
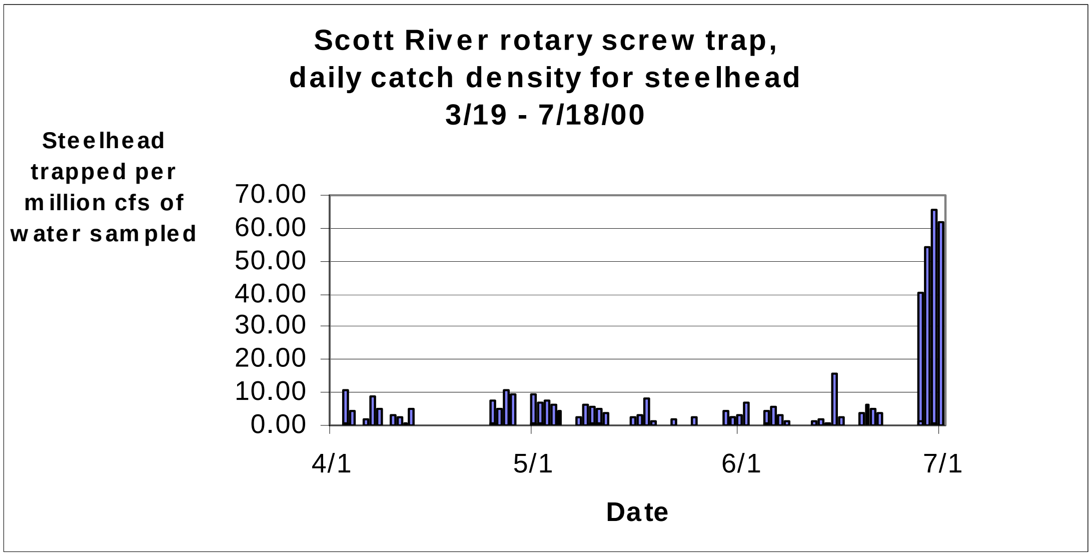
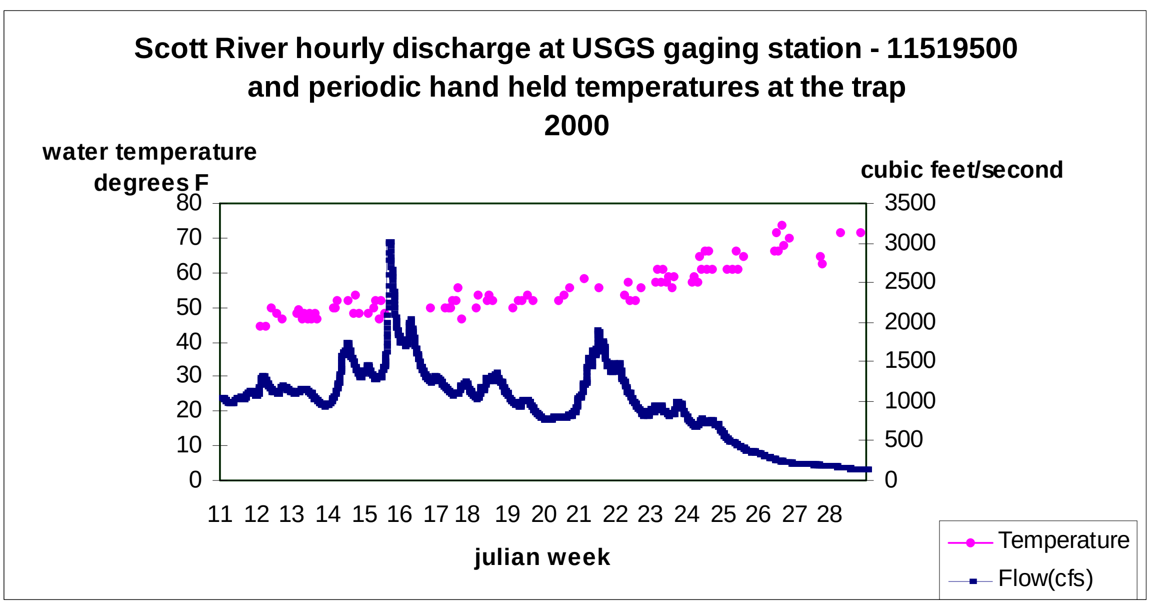


Chart 8



The density of steelhead caught (the number of steelhead per million cubic feet of water sampled) is illustrated in Chart 8.

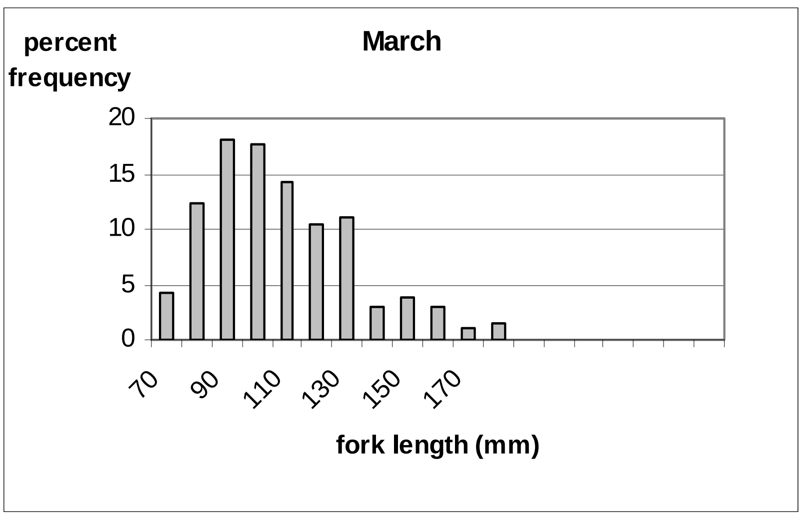
Chart 9



High flows and debris accumulation halted trapping during julian week 15 and 16 (Chart 9). Snowmelt peaked during julian week 21 and 22 and again trapping was halted due to debris accumulation in the trap. In julian week 25 and 26, flows decreased as snowmelt decreased and upstream water use increased.

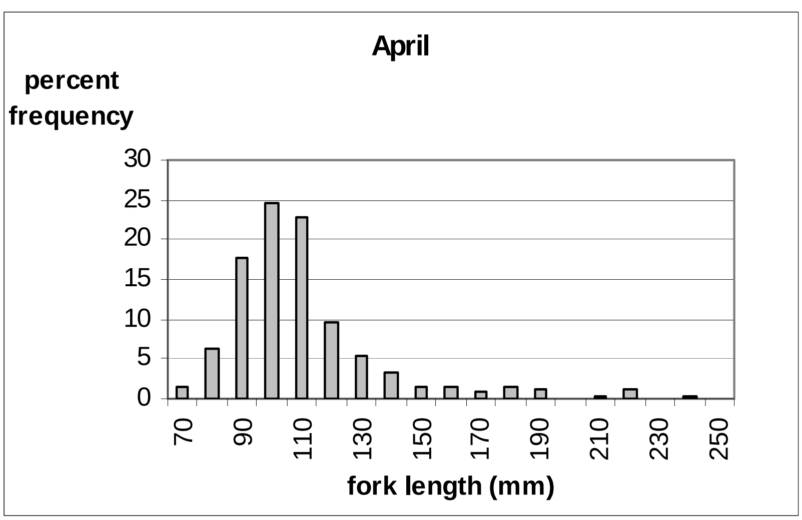
Steelhead Size
The fork length if 952 steelhead smolts were measured. The percent frequency per fork length is shown for each month that sampling occurred (Chart 10). Analysis of the scale samples is scheduled to determine the age/length relationship of the smolts sampled.

Chart 10: Scott River steelhead smolt, fork length/ percent frequencies by month



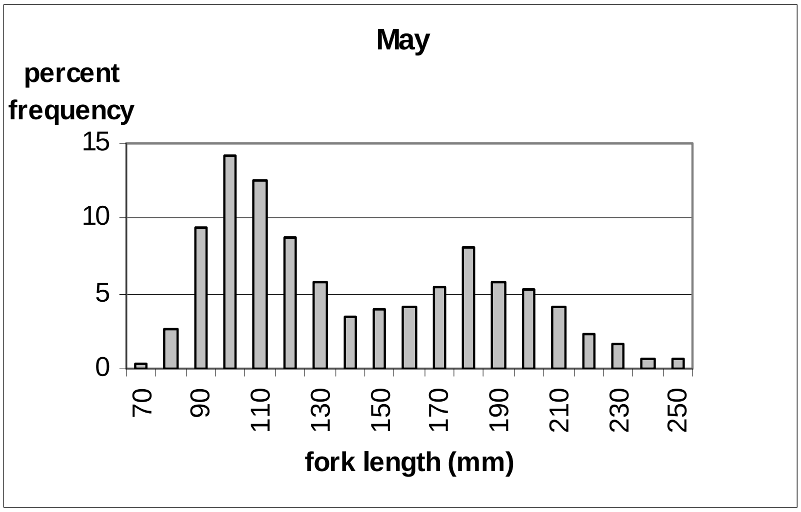
10a
March 19 - April 1

n = 209
mean = 109.4
s.d. = 30.7



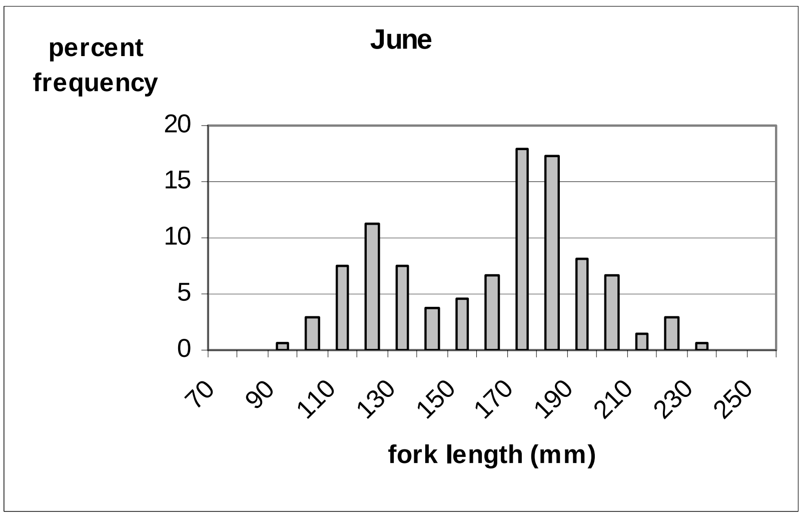
10b
April 2 - April 29

n = 272
mean = 112.2
s.d. = 35.3



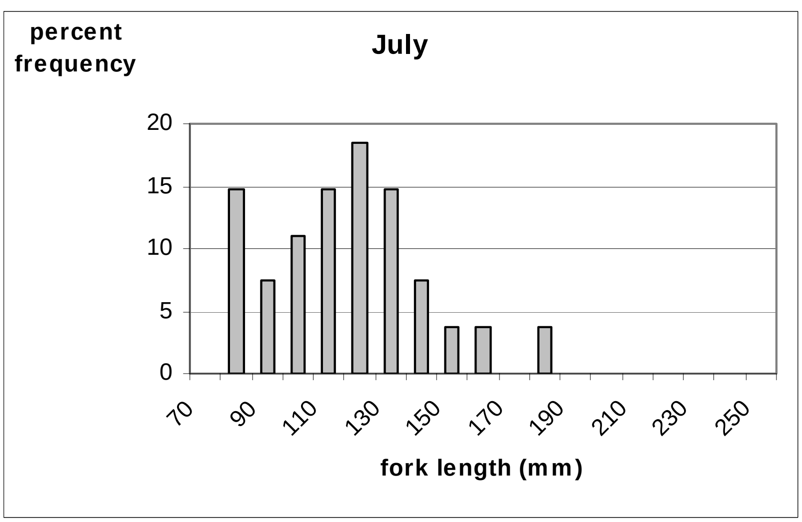
10c
April 30 - May 27

n = 310
mean = 143.7
s.d. = 46



10d
May 28 - June 24

n = 134
mean = 160.5
s.d. = 33.3



10e
June 25 - July 15

n = 27
mean = 114.1
s.d. = 28.0

Fish Health Evaluation
According to the CA-NV Fish Health Center staff (pers. comm. J. Faulkner, 2000) the chinook that were examined from the Scott River were in good condition with no sign of the two major fish pathogens occuring in the Klamath River, *Flavobacterium columnare* and *Ceratomyxa shasta*, (Faulkner, 2000).

Trap efficiency
Of the eight weeks in which steelhead were marked only three weeks saw recaptured fish (Table 5). The efficiency calculations for those three weeks ranged from 5.3% to 9.1% (Chart 11). Of the six weeks chinook were marked, four weeks contained recaptures (Table 5). 33 to103 chinook were marked weekly, with 5 weeks having greater than 50 fish marked.. The trap efficiencies for chinook varied from 3.1% to 8.7%, similar to the efficiencies calculated for steelhead (Chart 11).

Table 5 - Scott River -rotary screw trap mark and recapture results, spring 2000

	#FISH MARKED			#FISH RECAPTURED					
				DAY 1		DAY 2		DAY 3	
J week	DATE	Chinook	Steelhead	CH	SH	CH	SH	CH	SH
14	4/3/00	0*	50	0	0	0	0	0	0
15	4/10/0	0*	21	0	1	0	0	0	0
17	4/25/0	0*	52	0	4	0	0	0	0
18	5/2/00	0*	40	0	0	0	0	0	0
19	5/9/00	0*	36	0	1	0	0	0	0
20	5/16/0	33	16	1	0	1	0	0	0
22	5/31/0	103	18	4	0	0	0	0	0
23	6/6/00	54	32	0	0	0	0	0	0
24	6/15/0	94	0**	0	0	0	0	0	0
25	6/20/0	63	0**	1	0	0	0	0	0
26	6/29/0	101	0**	4	0	0	0	0	0

*Not marked due to small size
**Not marked due to small numbers

Chart 11

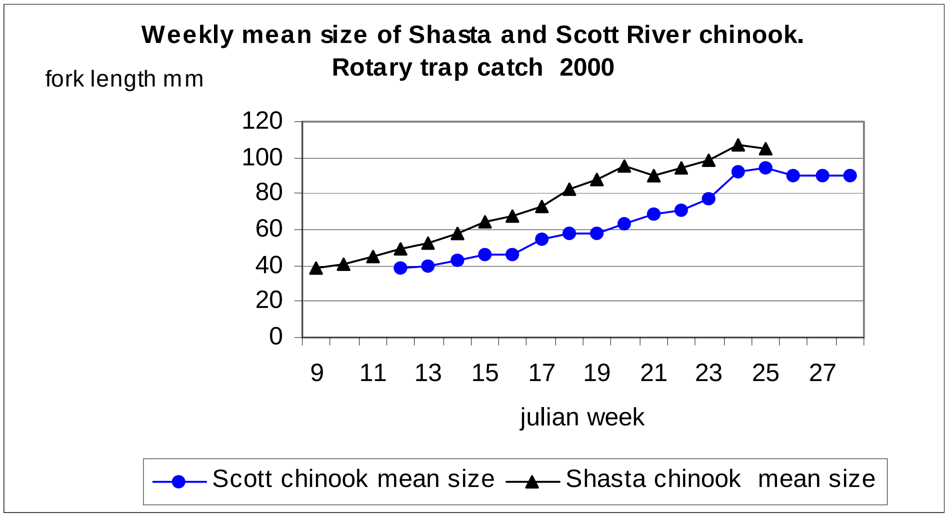


Chart 12

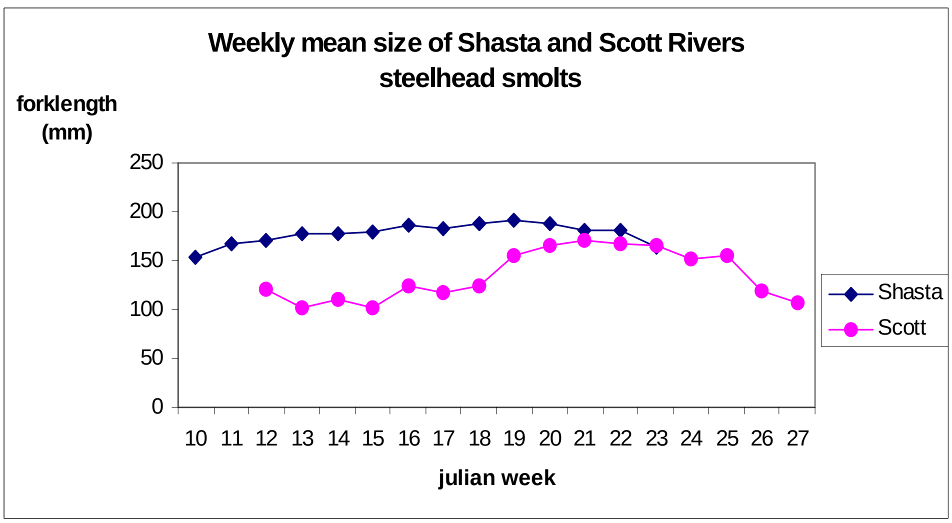
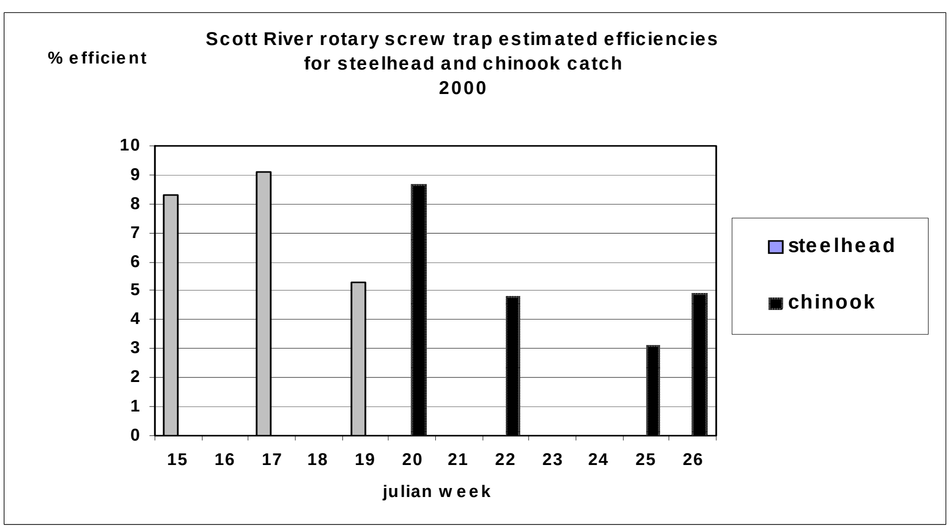


Chart 13



Discussion

Scott River Trap Operation

During julian weeks 16 and 22, the flow of the Scott River increased due to snow melt coming from high elevation. High flows during these weeks increased the amount of debris collected in the live car and made it difficult to operate the trap. In 2001, we will be using a trap manufactured by EG Solutions with a live car approximately three times the size of the one used during the 2000 season. This larger live car should enable us to operate longer before debris becomes a problem. The trap will also be equipped with a crowder enabling us to process the fish faster with less stress.

Trap Efficiency and Smolt Production Estimates

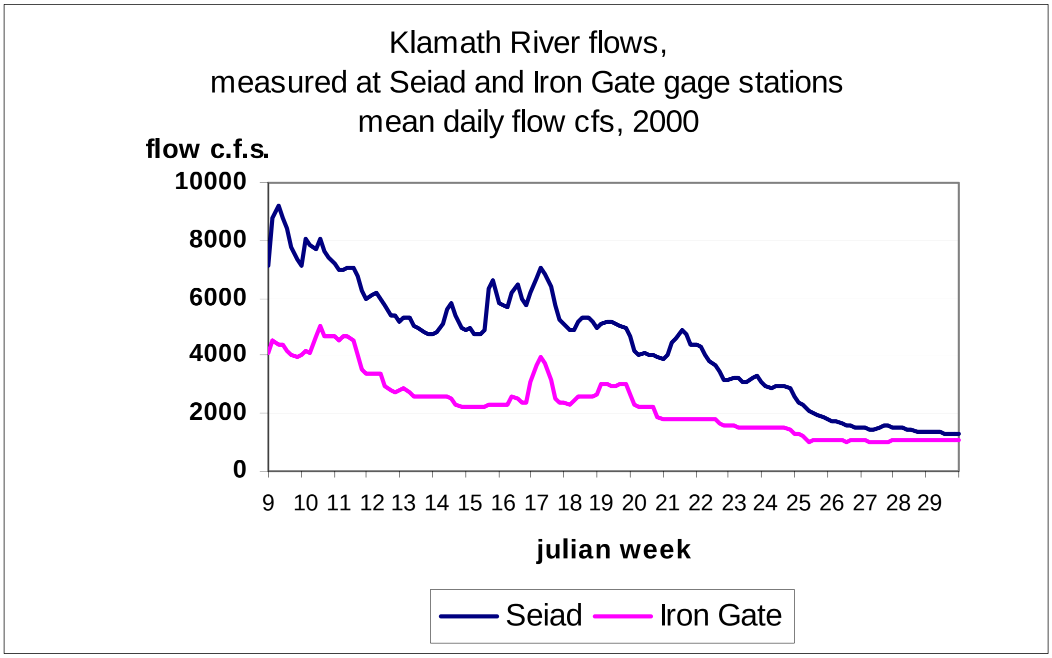
Carlson et. al (1998) present parameters for running an effective mark and recapture estimation. Based on their study ~4000 salmon smolts would need to be marked pe season if trap efficiency is estimated at 10% and relative error of 10% is desired. If the trap efficiency is at 20% and a relative error of 10% is desired then ~2000 salmon smolts would need to be marked per season. This approach appears to work for sockeye salmon because of the direct emigration behavior. Steelhead tend to hold for variable periods and not emigrate directly making the process of calculating smolt abundance more challenging. We want to pursue the feasibility of generating steelhead smolt abundance estimates by marking steelhead smolts for multiple days within a sampling week (Carlson et. al. 1998).

Comparison of Shasta River and Scott River catches

We observed surprising differences in size of the outmigrants and outmigration timing of salmonids emigrating from the Shasta and Scott Rivers. During the sampling period, Shasta River chinook appear to have outmigrated earlier (Appendix B and E) and at a larger size than the Scott River chinook (Chart 12). Steelhead smolt and parr outmigrations showed similar peaks for both systems (Appendix A and D), but the weekly mean size of steelhead smolts were consistently larger in the Shasta River than those outmigrating from the Scott River (Chart 13).

Due to spring inflow, the Shasta River is warmer than then the Scott River during the winter. The largest of these springs make up Big Springs Creek, which enter the Shasta River at river mile 30.5. Wales estimated the combined winter time flow of these springs to be 125 cfs with the water temperature between 52 and 53 degrees Fahrenheit (Wales J. H. 1951). Mean daily water temperatures for the Shasta and Scott Rivers on March 15, 2000 were 51.3 and 47.0 . This four to five degree difference is seen throughout the winter and could partially explain why Shasta River outmigrants are larger.

Chart 14



Time of outmigration from the tributaries may play a role in salmonid survival in the mainstem KlamathRiver. Chart 14 shows the flow of the Klamath River at Iron Gate Dam and Seiad during the sampling period. The outmigration of Shasta River chinook peaked during week 21 when the Klamath River flows were ~2000 c.f.s. at Iron Gate and ~4900 c.f.s. at Seiad, while the Scott River chinook outmigration peaked during julian week 26 when the Klamath River flows were ~1000 c.f.s. at Iron Gate and ~1800 c.f.s at Seiad. Because of these differences in flow, less habitat was available for outmigrants entering the Klamath River later in the season. The fish kill observed in the mainstem Klamath during this same time period is an indication of the conditions late season outmigrants encounter in the Klamath River (CDFG Report on Documentation of the Klamath River Fish Kill, June 2000).

During julian week 26 a large catch of steelhead parr (not smolts) were trapped in both the Shasta and Scott Rivers. This sudden increase in parr exiting the tributaries is most likely a response to high water temperatures recorded during this period (Danbacher, J.,1991; Reiser et al., 1979). On 6/29/00 temperature recorders at two different locations on the lower Shasta River recorded daily high water temperatures of 83 degrees F. The high water temperature for the same day at the Scott river trap was 72.4 degrees. By julian week 26, Klamath River flows were reduced considerably (Chart 14), resulting in the reduction of available rearing habitat for parr entering the mainstem river.

Recommendations

To get a better understanding of steelhead production within the Shasta and Scott Rivers additional information is needed. Suggested areas of study include:

< Spatial and temporal distribution of steelhead spawning.
< Habitat preference for each steelhead life stage and locations of these habitats.
< Learn more about seasonal migration of parr into over summering habitat and where that habitat exists.
< Factors that limit parr to smolt survival in the tributaries and mainstem Klamath.
< Continue to monitor outmigration timing to determine if patterns observed in 2000 are typical.
< Monitor seasonal flow and temperature conditions in the Klamath River and its tributaries to better understand their relationship to juvenile rearing and survival

Although the Shasta and Scott Rivers are adjacent sub-basins, we observed considerable variation in smolt size and outmigration timing. By taking these variations into consideration, flow managers may be able to provide adequate flows at critical times for rearing and outmigrating salmonids.

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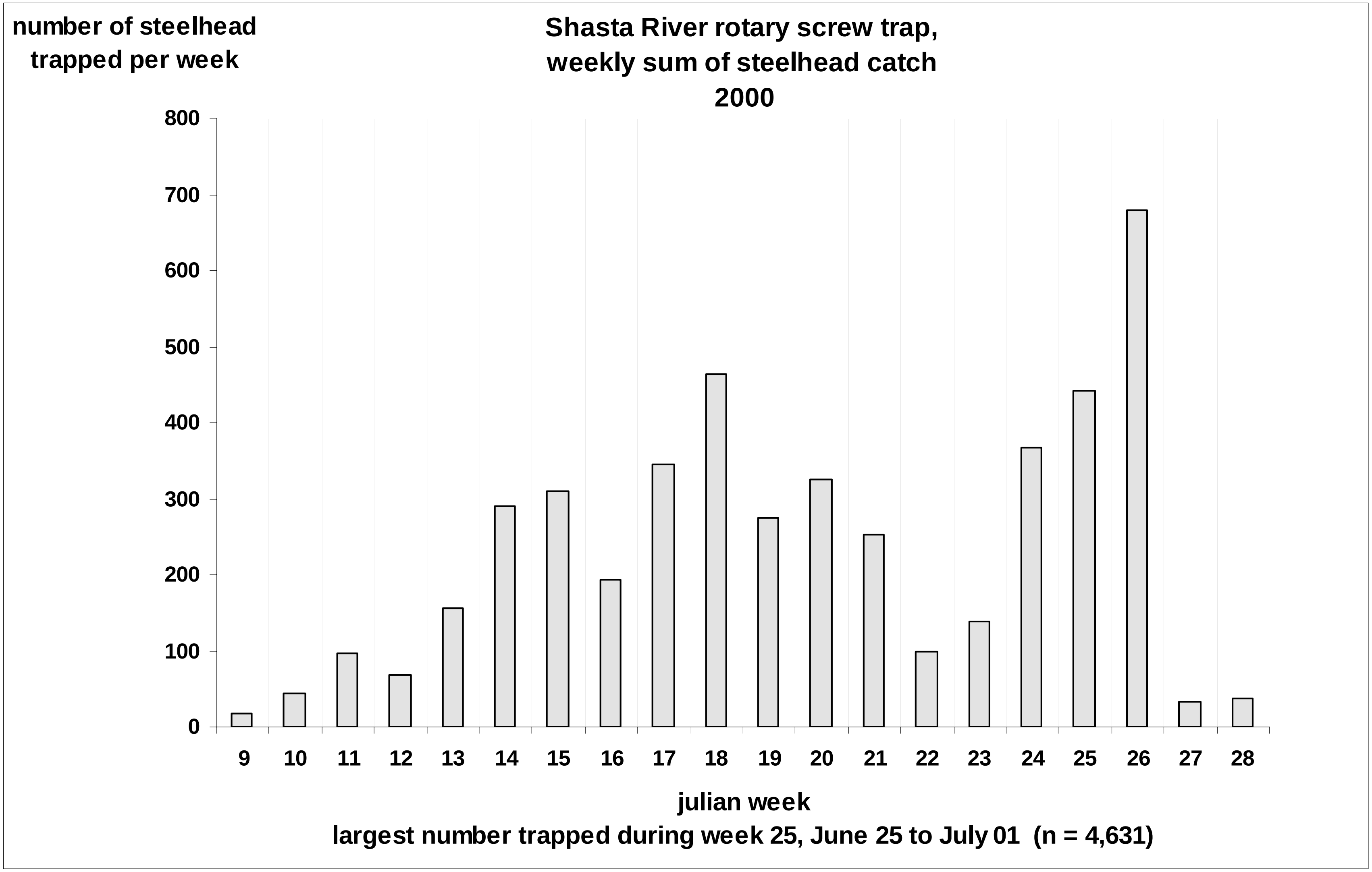
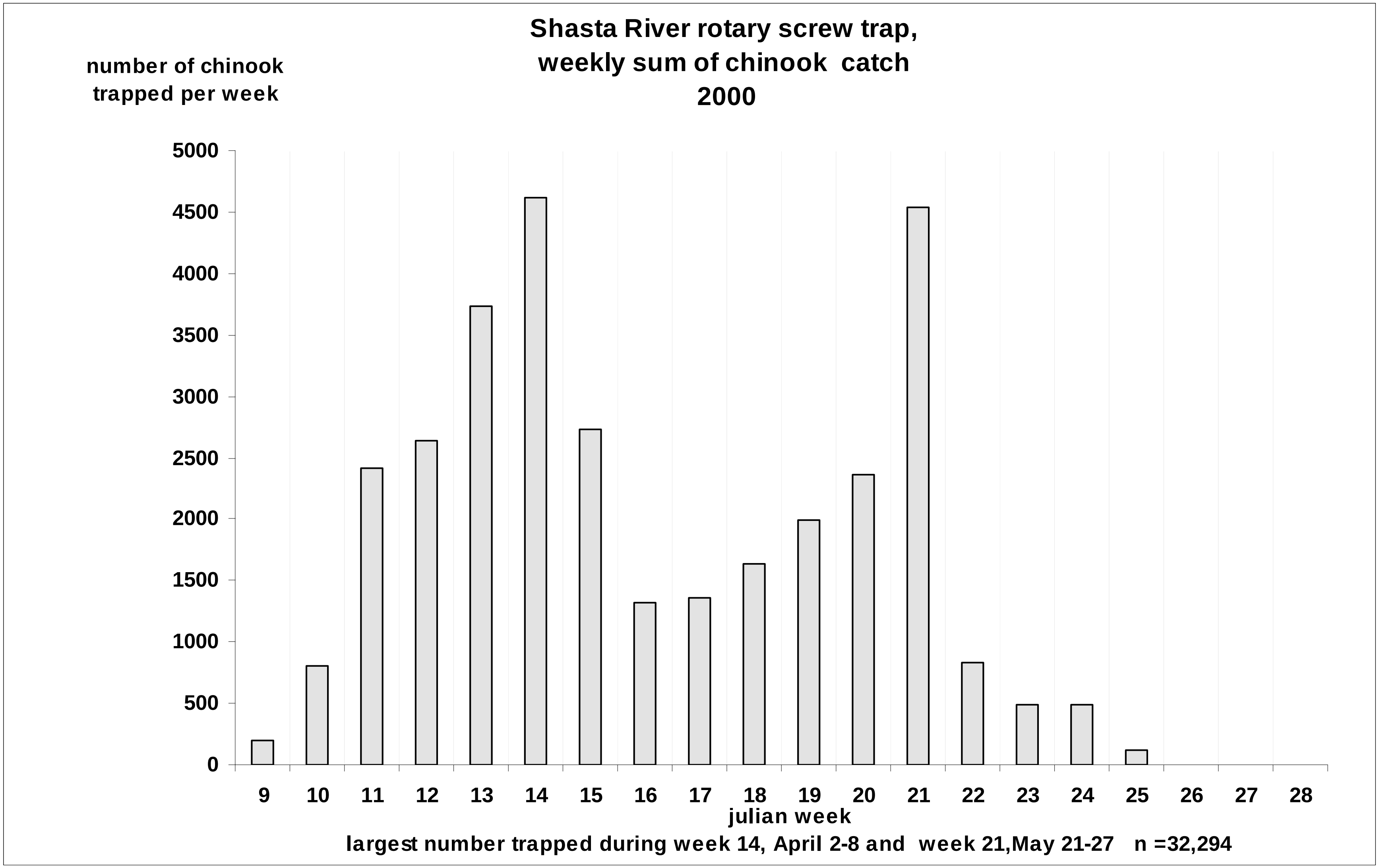
APPENDICIES

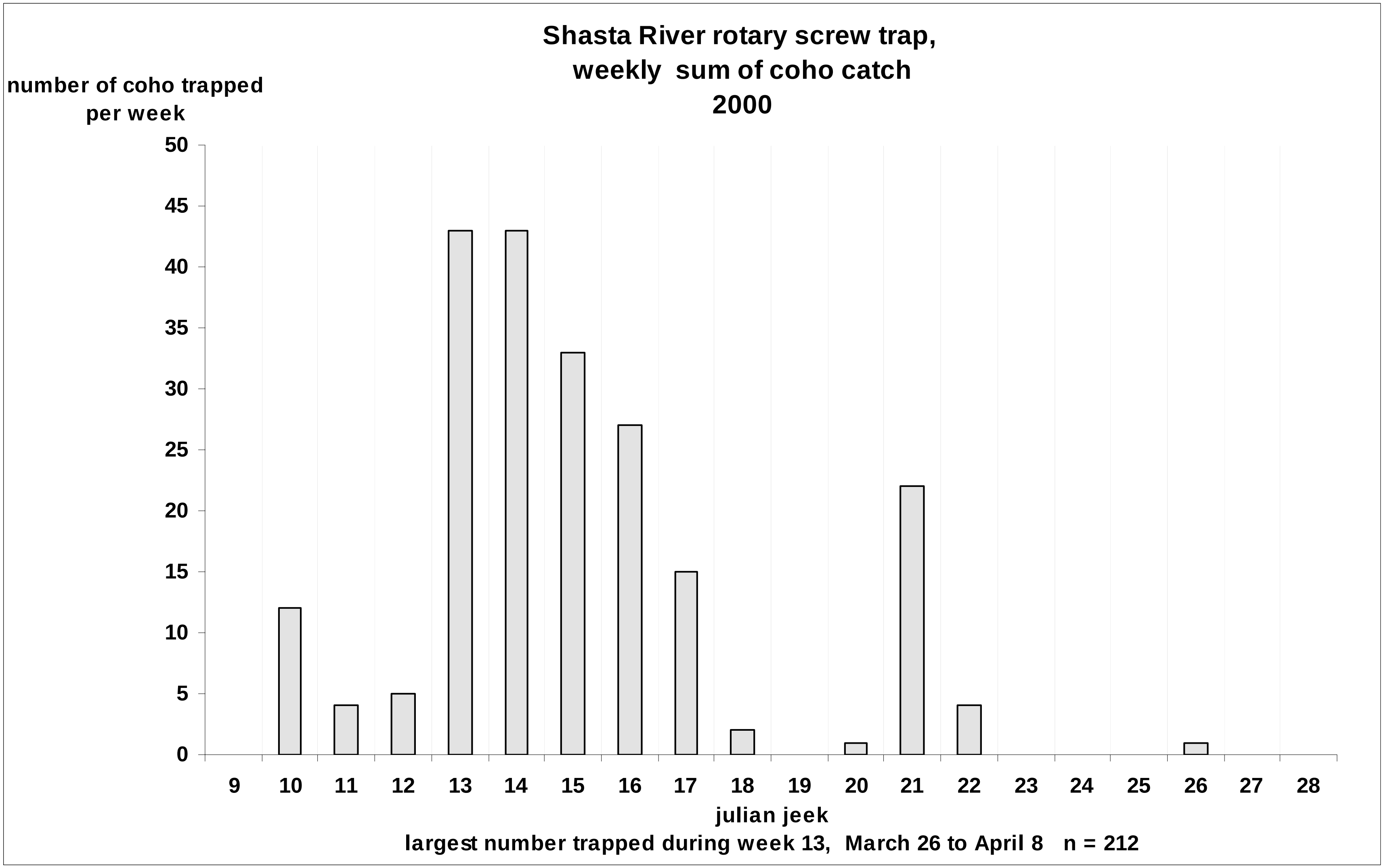
Appendix A. Shasta River steelhead catch by julian week



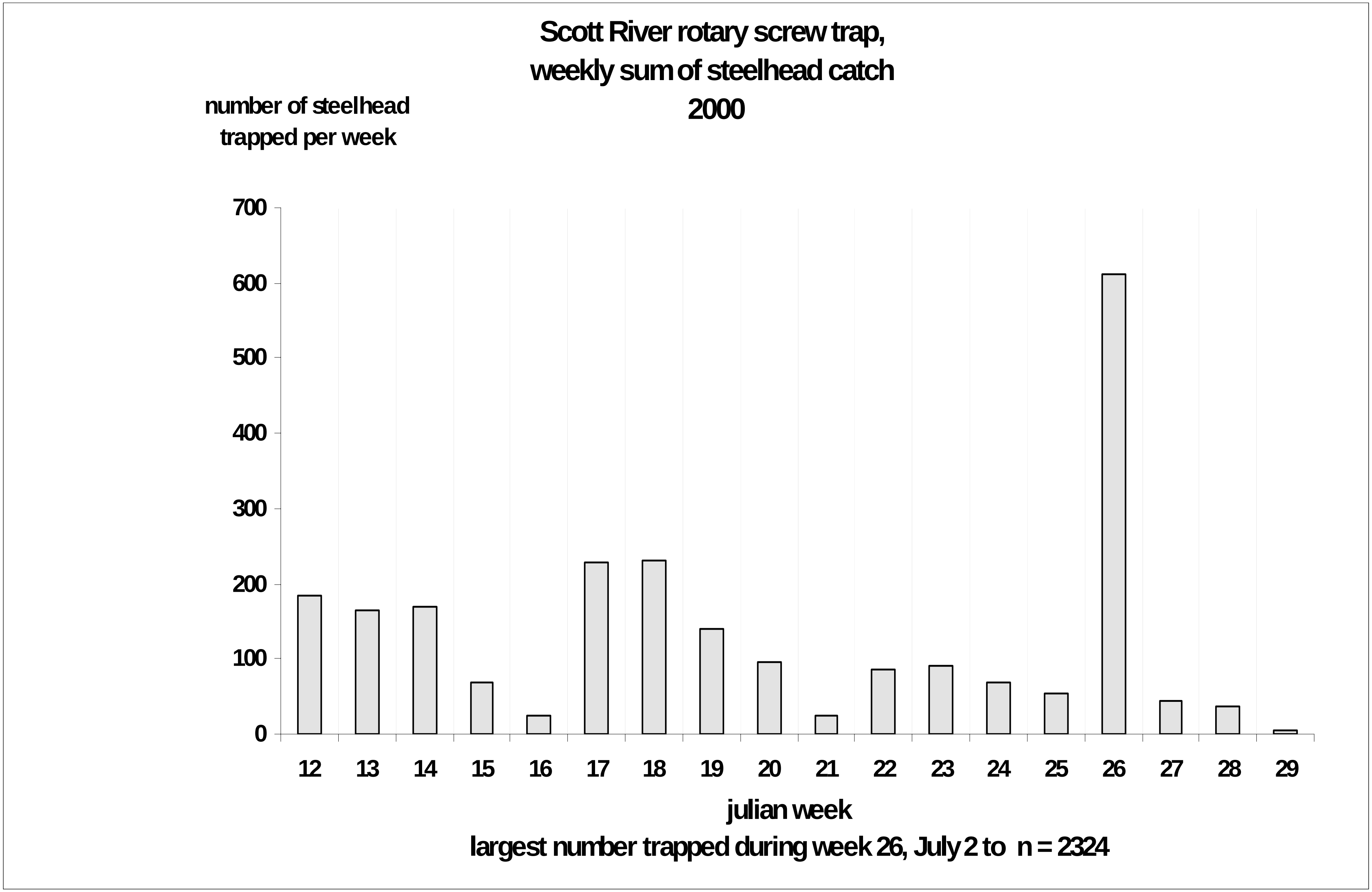
Appendix B. Shasta River chinook catch by julian week



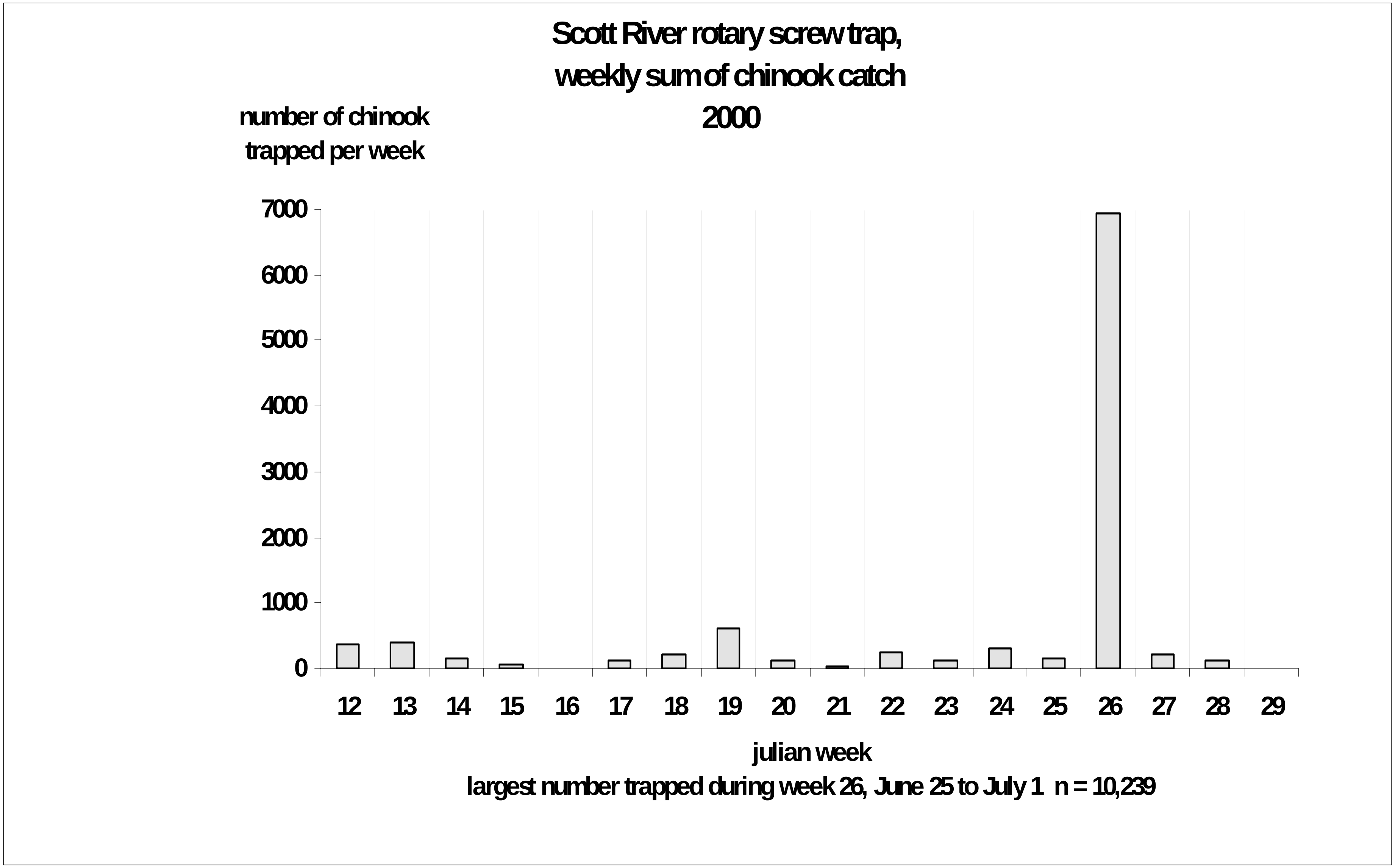
Appendix C. Shasta River coho catch by julian week



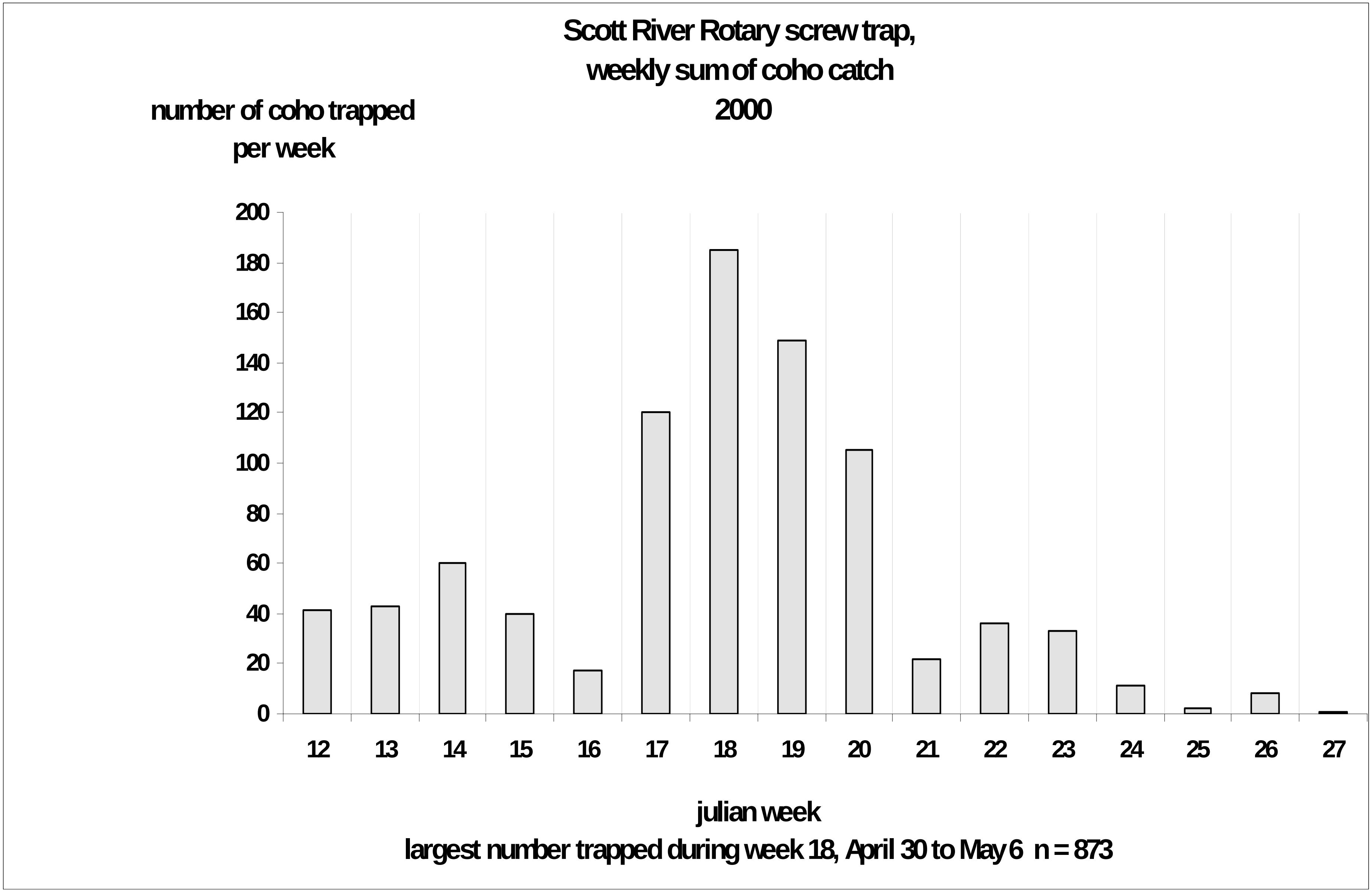
Appendix D. Scott River steelhead catch by julian week



Appendix E. Scott River chinook by julian week



Appendix F. Scott River coho catch by julian week



Appendix G. Mortality of all species on the Shasta River and Scott River

Species	Shasta River Total Mortality	Scott River Total Mortality
Chinook salmon	231	138
Coho salmon	0	3
Steelhead	20	27
Pacific Lamprey - amoecete	9	15
Brown Bullhead	4	0
Bullfrog tadpole	2	92
Klamath Small Scale Sucker	16	208
Sculpin	4	3
Speckled Dace	10	57

Appendix H. List of julian weeks and calendar equivalents

Julian Week #	Inclusive Dates
1	1/1 - 1/7
2	1/8 - 1/14
3	1/15 - 1/21
4	1/22 - 1/28
5	1/29 - 2/4
6	2/5 - 2/11
7	2/12 - 2/18
8	2/19 - 2/25
9	2/26 - 3/4*
10	3/5 - 3/11
11	3/12 - 3/18
12	3/19 - 3/25
13	3/26 - 4/1
14	4/2 - 4/8
15	4/9 - 4/15
16	4/16 - 4/22
17	4/23 - 4/29
18	4/30 - 5/6
19	5/7 - 5/13
20	5/14 - 5/20
21	5/21 - 5/27
22	5/28 - 6/3
23	6/4 - 6/10
24	6/11 - 6/17
25	6/18 - 6/24
26	6/25 - 7/1

Julian Week #	Inclusive Dates
27	7/2 - 7/8
28	7/9 - 7/15
29	7/16 - 7/22
30	7/23 - 7/29
31	7/30 - 8/5
32	8/6 - 8/12
33	8/13 - 8/19
34	8/20 - 8/26
35	8/27 - 9/2
36	9/3 - 9/9
37	9/10 - 9/16
38	9/17 - 9/23
39	9/24 - 9/30
40	10/1 - 10/7
41	10/8 - 10/14
42	10/15 - 10/21
43	10/22 - 10/28
44	10/29 - 11/4
45	11/5 - 11/11
46	11/12 - 11/18
47	11/19 - 11/25
48	11/26 - 12/02
49	12/03 - 12/09
50	12/10 - 12/16
51	12/17 - 12/23
52	12/24 - 12/31**

*** = eight days only during leap years**
**** = eight day julian week**