State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

ANNUAL REPORT
SHASTA AND SCOTT RIVER
JUVENILE SALMONID OUTMIGRANT STUDY, 2000-2001
PROJECT 2a1

by

William R. Chesney
Northern California, North Coast Region

Steelhead Research and Monitoring Program
January 2002

Table of Contents

List of Charts

Charts – Shasta River

List of Charts (cont.)

Acknowledgements

The Steelhead Research and Monitoring Program (S-RAMP) would like to acknowledge the people who contributed their efforts to a successful field season;

Elizabeth Beckett
Tristan Behm
Diana Bellotti
Ron Boatner
Jim Chesney
Caroline Cloudas
Sarah Davis
Larry Della Bitta
Andrew Eller
Dan Espinoza
Laura Finley
Cliff Finley
Don Flickenger
Dawn Fogel
Ron Foss
Jon Gerken
Errol Giles
Jerry Guse
Barbara Hagedorn
Jack Herr
Kathleen Hitt
Rose Horn
Jody Inselman
Virginia Jimenez
Kristi Jones
Nubez Jordan
Jim Kilgore
Heather Lamson
Don Lucas
Sue Maurer
Jennifer Plank
Danielle Quigley
Mike Reber
Bruce Rideout
Bethanie Rizzardo
Larry Super
Jim Whelan
Erich Yokel

Thanks to Bruce Rideout and Erich Yokel for their outstanding maintenance of the traps and management of the databases

Additional Thanks to:
Jim Kilgore, U.S.F.S –Scott River Ranger Dist., for all his cooperation on the Scott River trap
Amricorps – Watershed Stewards Project
California Deptartment of Fish and Game – Klamath River Project
Shasta River Coordinated Resources Management and Planning Committee

Shasta River Rotary Screw Trap Summary

Background

2001 was the second consecutive year of rotary trapping on the Shasta and Scott Rivers. The objectives of the trapping in 2001 were to:

- Determine emigration abundance and timing for juvenile salmonids.
- Estimate rotary trap efficiencies for chinook and steelhead and produce production estimates if possible.
- Measure fork lengths and determine life stage from a sub-sample of the salmonids collected.
- Collect scale samples from a sub-sample of the trapped steelhead for age analysis.
- Collect tissue for genetic analysis.
- Investigate the relationships between environmental conditions and emigration pattern of salmonids

Methods

We sampled the Shasta River with a five-foot rotary screw trap manufactured by EG Solutions, Corvallis, Oregon. The trap was operated in the same location and manner as it was in 2000 (Chesney , 2000). We fished 6 days per week, Sunday PM through Saturday AM just downstream of the Shasta River Fish Counting Facility. The trap catch was processed two times a day, at approximately 2200 and 0600 hours. It was necessary to check the trap at 1600 hours daily to remove algae and debris between trap processings. 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. All vertebrates collected in the trap were identified and counted. During julian weeks 11 through 13, large numbers of emerging chinook fry were collected in the trap. In order to reduce the handling stress and processing time, we determined the number of fish per gram and then weighed the total catch of chinook fry to obtain an estimate of the number trapped. Scales were collected from a sub-sample of the steelhead trapped. In order to determine whether we were trapping the same fish more than once, all trapped steelhead received an upper margin caudal clip before they were released. Salmonids collected in the trap were classified by life stage: sac fry, fry, parr, silvery parr, smolt and adult.

<u>Trap Efficiency Determinations</u>

Weekly estimates of the trap catch efficiency were calculated for chinook, steelhead smolts and silvery parr. A known number of chinook and steelhead were taken from the trap, marked and released upstream during julian weeks 9 through 20. Chinook were marked in a solution of Bismark Brown dye. 0.4 grams of Bismark brown were mixed into 10 gallons of water. The steelhead smolts and silvery parr were marked with a unique fin margin clip each week. The fish were marked during the morning processing and held in live cars until approximately one hour before sunset.

By recording the number of marked fish that we recaptured, we were able produce a Petersen Estimate of the total number of steelhead and chinook outmigrants moving downstream during the week.

Results

The Shasta River rotary trap began sampling one day per week on 1/11/01. This weekly sampling continued until 2/25/01, when we began trapping six days per week. Trapping ended on 7/7/01 due to low flows. The trap was fished for a total of 2,489.4 hours. A total of 2,874 steelhead, 357 coho and 262,555 chinook were trapped. Table 1 shows the total catch for all species.

Table 1.

Sum of Fish Species Trapped, Shasta River

Species	**Count**
Steelhead *Onchorhynchus mykiss irideus*	2,874
Chinook Salmon *Onchorhynchus tschawytscha*	262,555
Coho Salmon *Onchorhynchus kisutch*	357
Pacific Lamprey *Lampetra tridentata*	24,862
Sculpin *Cottus spp.*	127
Speckled Dace *Rhinichthys osculus*	1085
Klamath Smallscale Sucker *Catostomus rimiculus*	687
Brown Bullhead *Ictalurus nebulosus*	581
Green Sunfish *Lepomis cyanellua*	7
Japanese Pond Smelt *Hypomesus transpacificus*	27
Largemouth Bass *Micropterus salmoides*	2

Steelhead

The largest weekly total of steelhead smolts and silvery parr were trapped during julian week 19 (week ending 5/20/01, Chart 1). The largest weekly total of parr were trapped during week 25 (week ending 6/24/01, Chart 2).

The fork lengths of 1,399 steelhead fry, parr, silvery parr and smolts were measured. The fork length frequency for the trap catch is shown by month in Charts 3a-d. The largest mean size for the steelhead catch was observed during weeks 14-17 at 187.12 mm (Chart 3b). Age 0+ steelhead fry and parr first appeared in the catch during weeks 18-21. 380 scale samples were collected from a sub-sample the measured fish. They will be read during the winter of 2002 in order to determine the age/length relationship of the steelhead that were trapped.

Chart 1

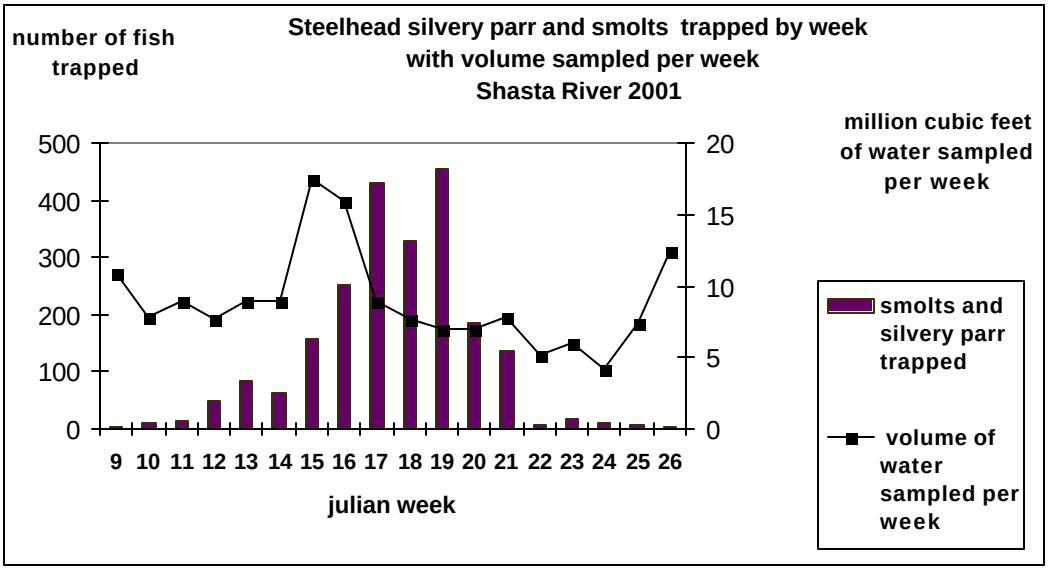


Chart 2

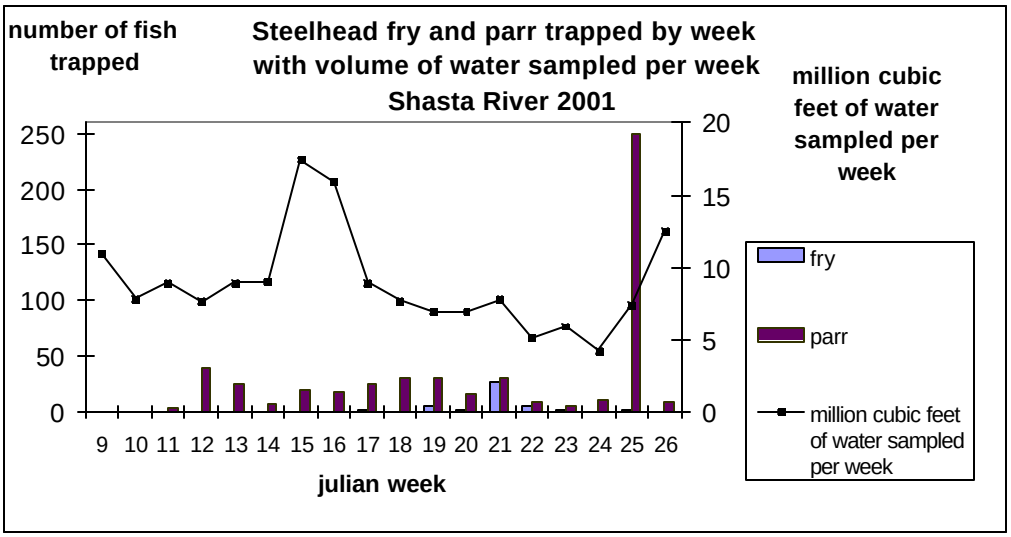
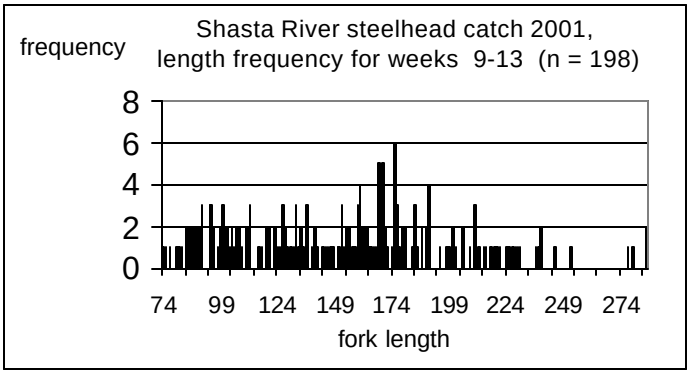


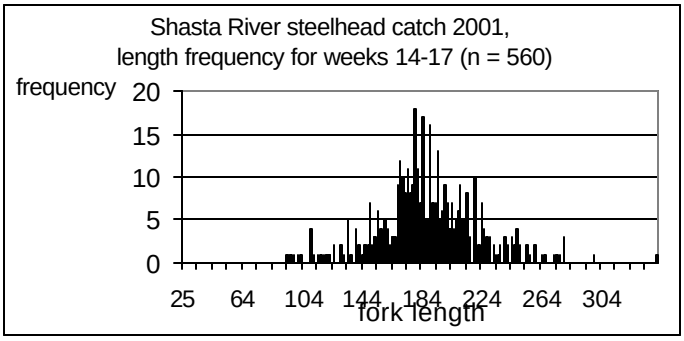
Chart 3a-d; Shasta River steelhead fork length by month

Chart 3a



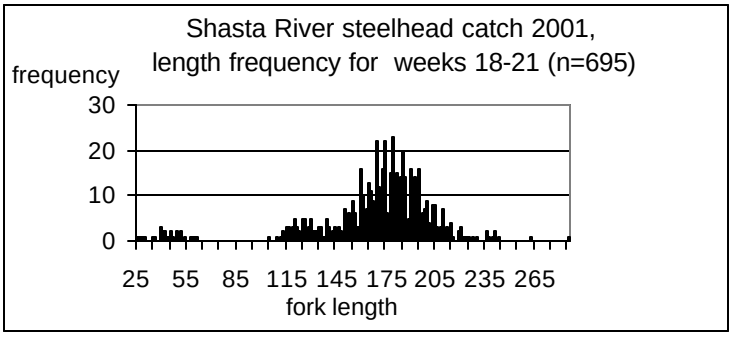
mean length = 152.51 mm, std. dev.= 56.97

Chart 3b



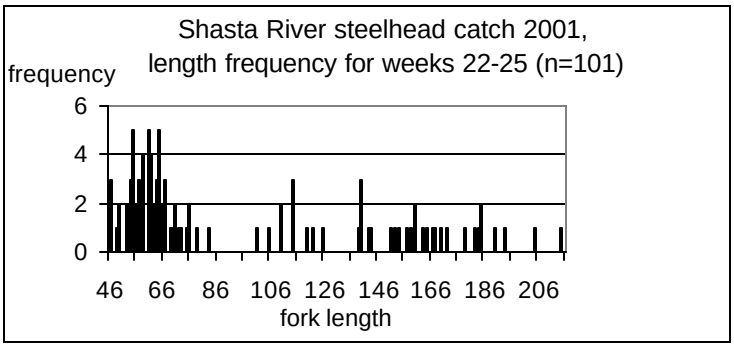
mean length = 187.12 mm, std. dev.= 33.85

Chart 3c



mean length = 168.57, std.dev. = 36.76

Chart 3d



mean length = 95.67 mm, std.dev. = 48.47

Trap Efficiency for Steelhead

The highest trap efficiency for steelhead smolts as determined by Petersen mark and recapture estimates occurred during week15, 11.6% (Chart 4). The greatest density of smolts trapped per unit volume fished occurred during week 19 with 65.4 smolts trapped per million cubic feet of water sampled (Chart 5). The estimates for the number of steelhead smolts outmigrating for weeks 9 through 20 are listed in Table 2.

Table 2.

Trap efficiency and estimated number of steelhead smolts outmigrating by julian week

Julian week	Estimated trap efficiency	Estimated number of smolts	95% Confidence Interval	
			upper	lower
13	4.48%	1,870	3,257	559
14	4.18%	1,528	2,661	457
15	11.60%	1,360	2,429	729
16	5.10%	4,914	8,560	1,469
17	4.03%	10,692	21,384	4,346
18	2.20%	14,760	25,711	4,411
19	1.30%	7,828	15,059	3,692
20	0%	unknown	-----	-----

Chart 4

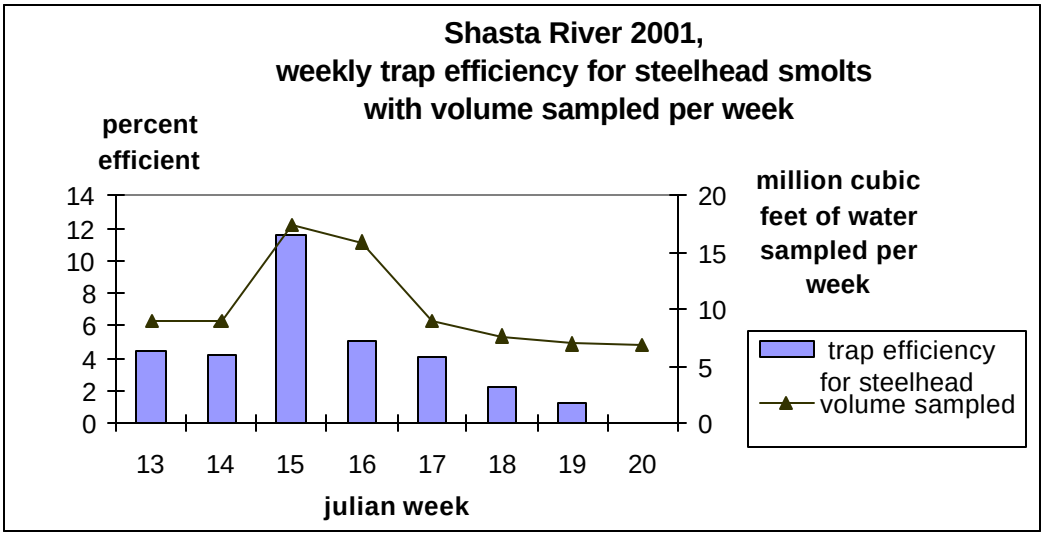
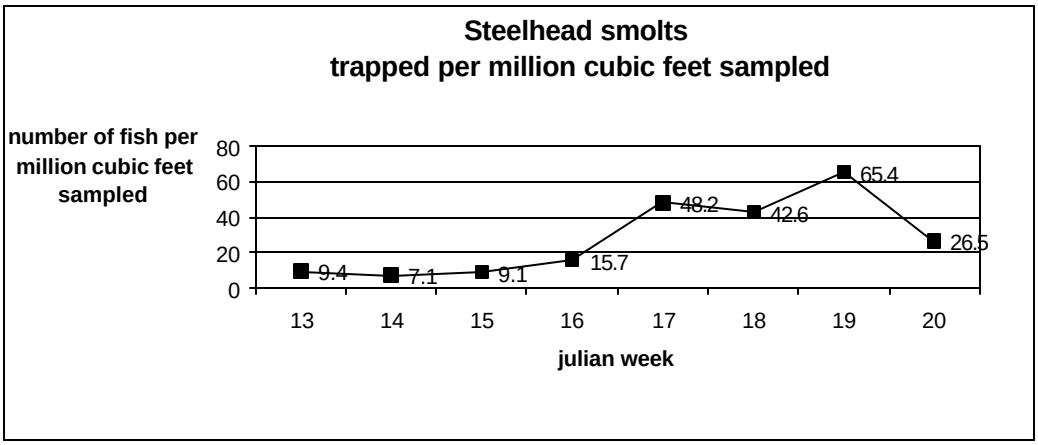


Chart 5



Coho

The largest weekly total of coho smolts and silvery parr were trapped during julian week 16 (week ending 4/22/01, Chart 6). The largest weekly total of parr were trapped during julian week 25 (week ending 6/24/01, Chart 7). The largest weekly total of fry were trapped during julian week 17 (week ending 4/29/01, Chart 7).

The fork lengths of a total of 253 coho fry, parr and smolts were measured. The fork length frequencies for the coho trapped are shown by month in Charts 8a-d. We were unable to determine the trap efficiency for coho due to the low number collected.

Chart 6

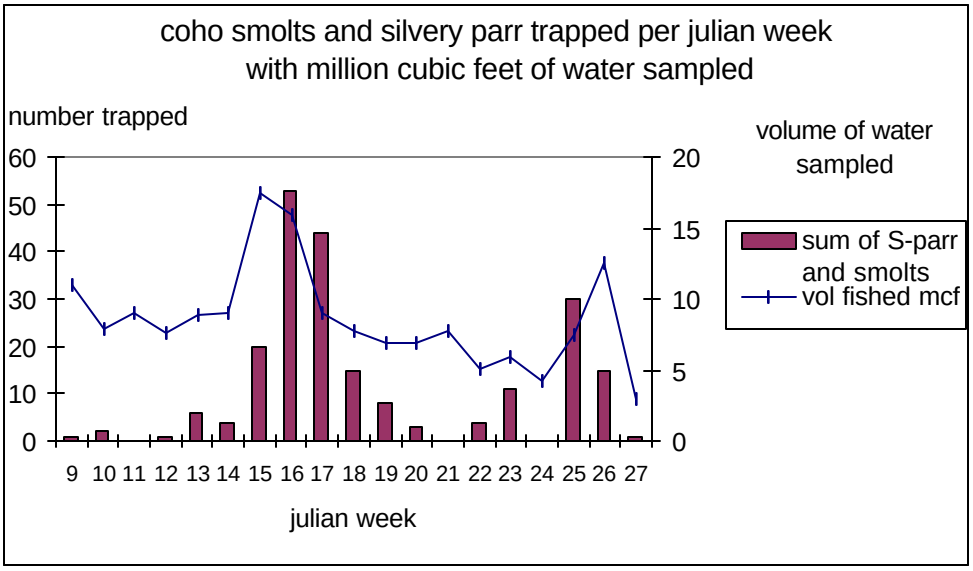


Chart 7

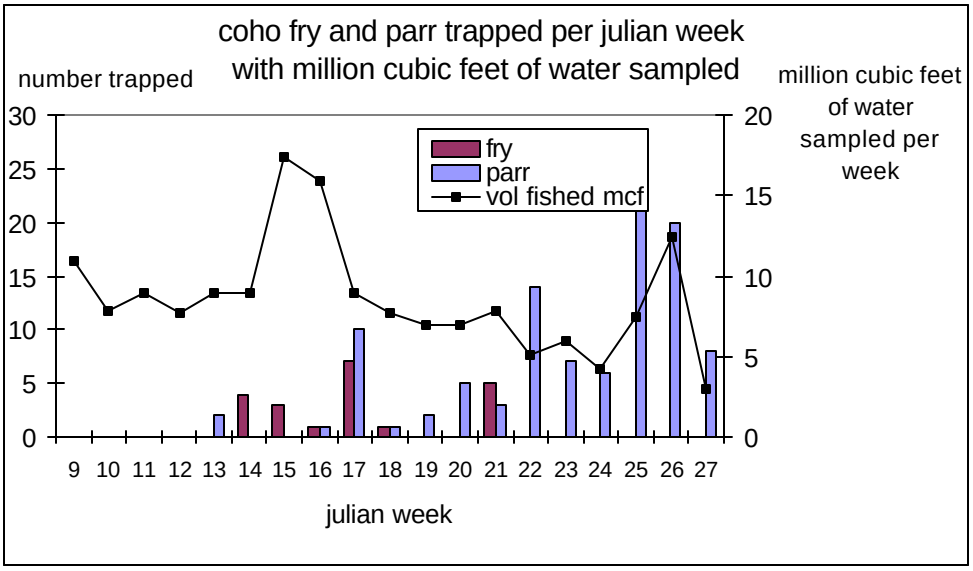
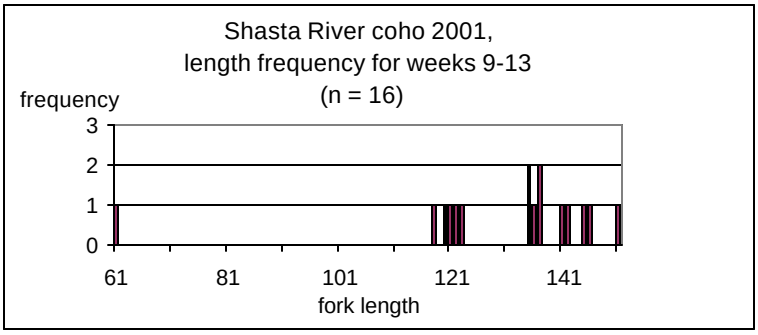


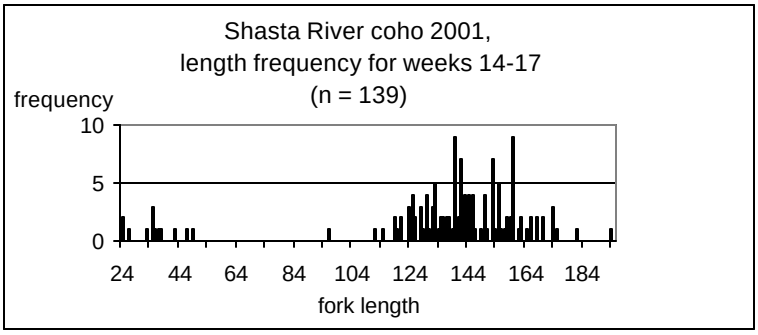
Chart 8a-d; Shasta River coho length frequency by month

8a



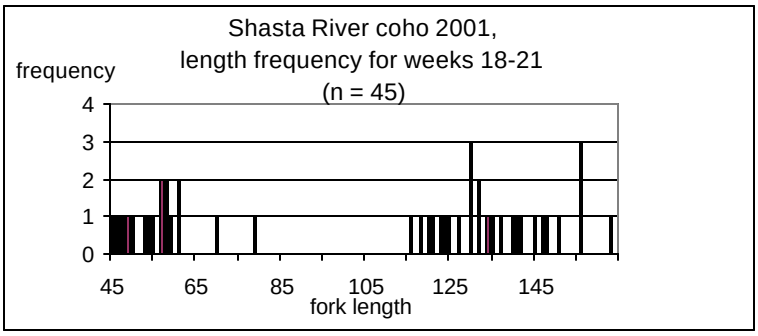
mean length = 129.37mm, std dev = 20.91

8b



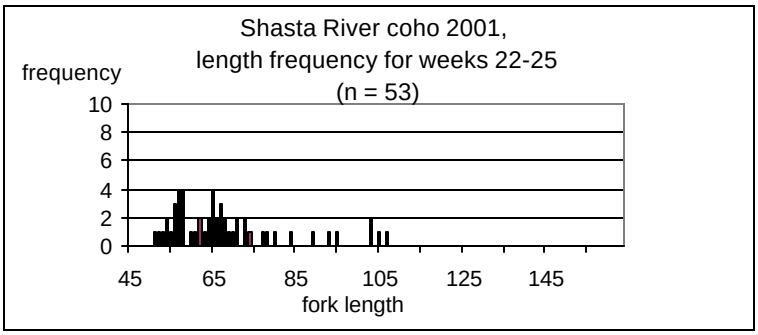
mean length = 133.56mm, std. dev. = 36.5

8c



mean length = 104.31mm, std. dev. = 41.38

8d



mean length = 68.43 mm, std. dev.= 14.37

Chinook

The largest weekly total of chinook were trapped during julian week 12 (week ending 3/25/01) A total of 89,736 fry were trapped during six consecutive days at a density of

11,676 chinook per million cubic feet of water sampled (Chart 9). The fork lengths of a total of 3,115 chinook fry, parr and smolts were measured. The fork length frequencies for the measured sub-sample are shown by month in Charts 11 a-d. The mean length for the samples and the standard deviations are shown. The highest trap efficiency for chinook occurred during week 16, at 35.6% (Chart 12).
No estimates were made for week 19 due to large amounts of filamentous algae, which interfered with the operation of the trap. Table 3 shows the estimated number of chinook outmigrating from the Shasta River during weeks 9- 20.

Chart 9

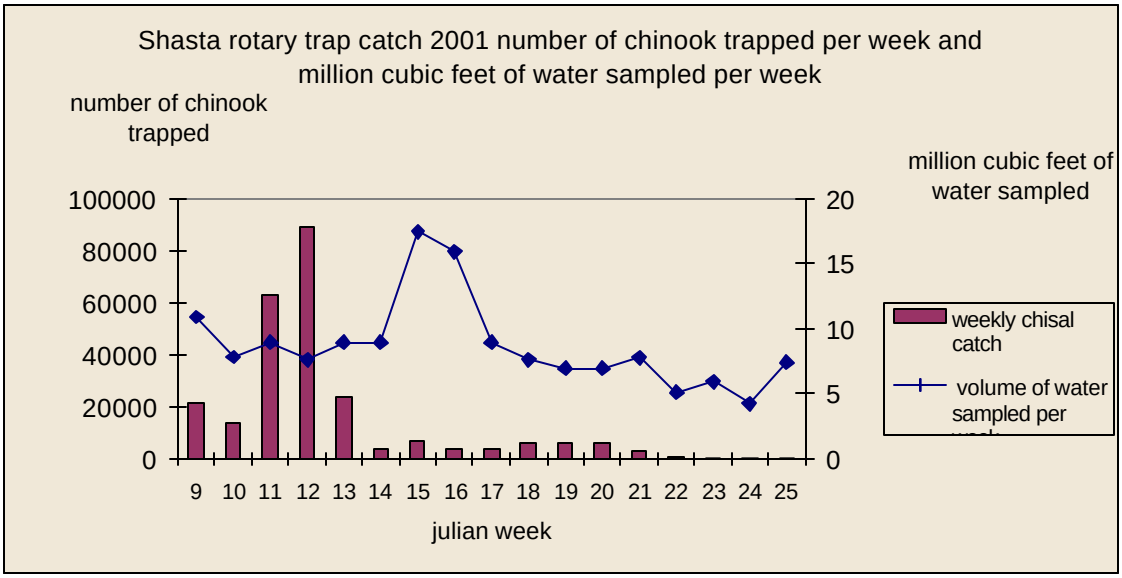


Chart 10

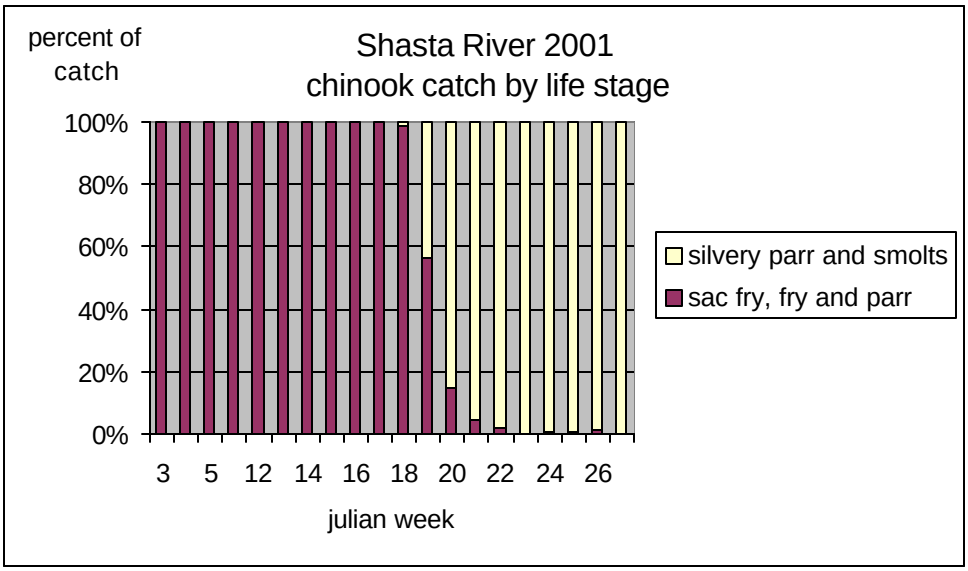
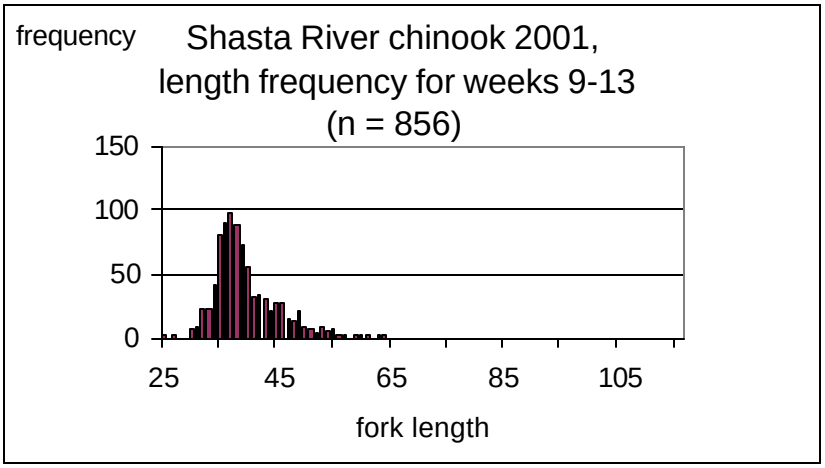


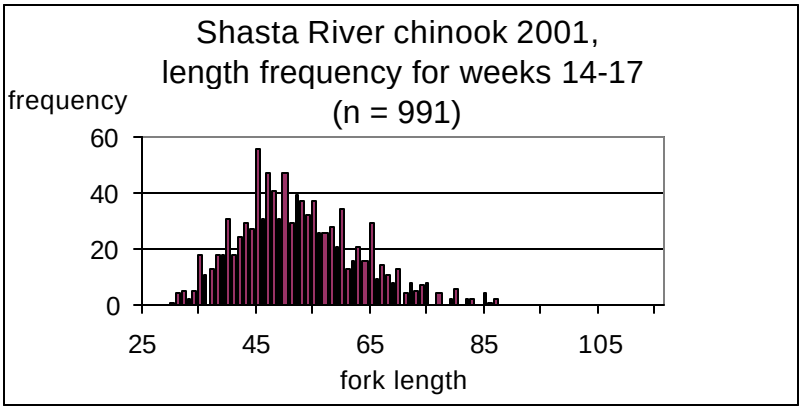
Chart 11 a-d; chinook length frequency by month

Chart 11a



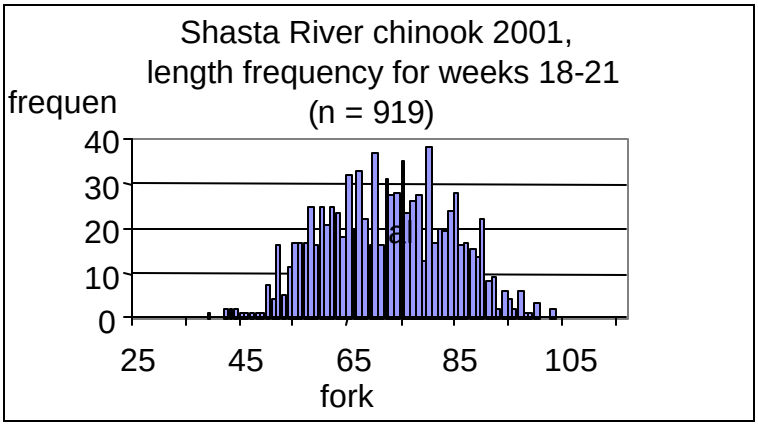
mean length = 39.49mm, std. dev.= 5.48

Chart 11b



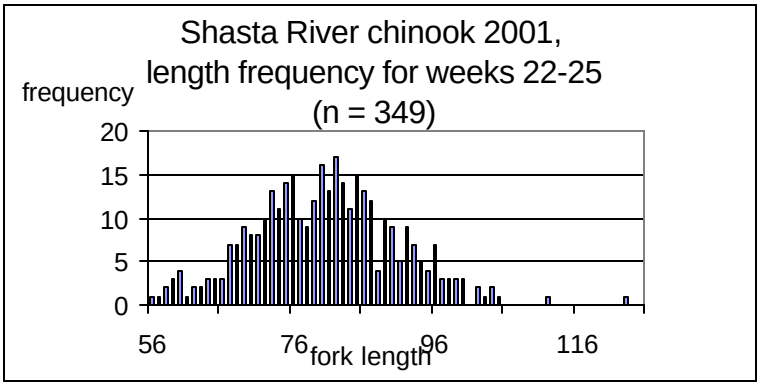
mean length = 52.37mm, std. dev. 10.56

Chart 11c



mean length = 72.11mm, std. dev. = 11.74

Chart 11d



mean length = 80.58mm, std. dev. 10.23

Chart 12

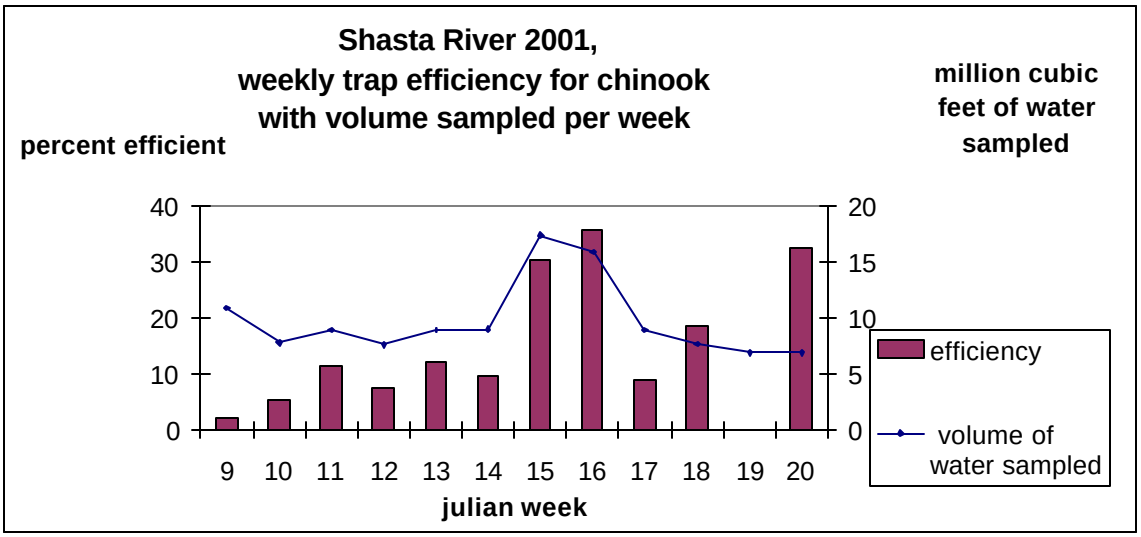


Chart 13

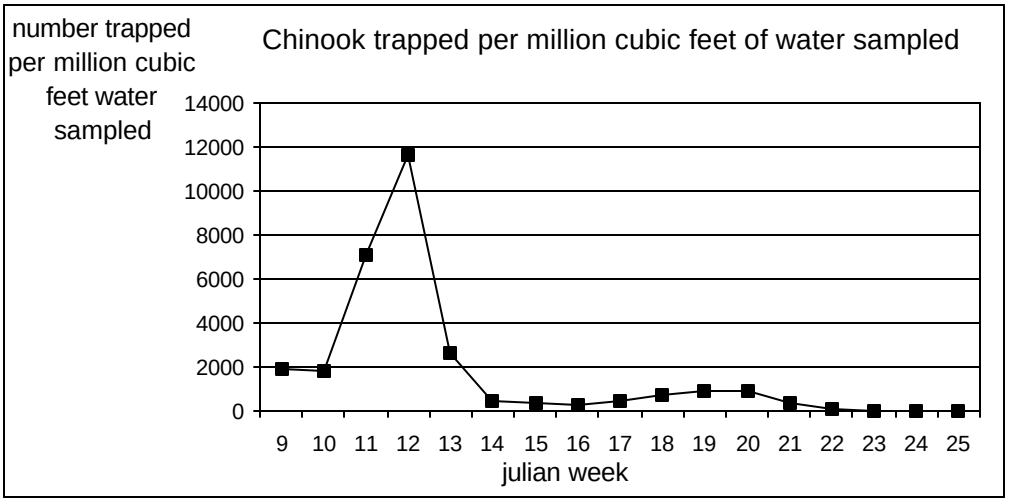


Table 3.
Shasta River 2001: estimated outmigration of chinook, weeks 9-20. Estimates are only for the six days per week that the trap was operated.

julian week	Estimated trap efficiency, %	Weekly expanded estimate of the number of chinook outmigrating from the Shasta River
9	2.2	953,494
10	5.4	260,156
11	11.6	546,269
12	7.5	1,199,412
13	12.1	197,376
14	9.5	43,747
15	15.2	22,560
16	17.8	12,188
17	9.0	40,234
18	18.5	31,580
19	N/A	N/A
20	32.4	19,658
		Total 3,326,674

Discussion

Trap Operation

The trap operated in flows ranging from 317 cfs in week 12, to 11 cfs in in week 25 As flows decreased in week 20 to 21 cfs, we used dam boards and sand bags to increase flow through the trap. In 2000, we equipped the rotary trap with a video camera in order to eliminate holding fish during periods of low flow and high water temperatures. With this method, we were able to identify most video taped fish to species but we were unable to determine their life stage. In 2001, we were interested in positively identifying the life stage of fish outmigrating late in the season. We continued to operate the trap in the conventional way but we increased the frequency of trap checks.

As in 2000, we had the option of releasing half the volume of water and catch directly back into the river. The "half cone" was utilized during the chinook fry emergence and when we were collecting large quantities of algae. This enabled us to operate the trap under most conditions with three trap checks per day and minimal mortality.

Trap Efficiency

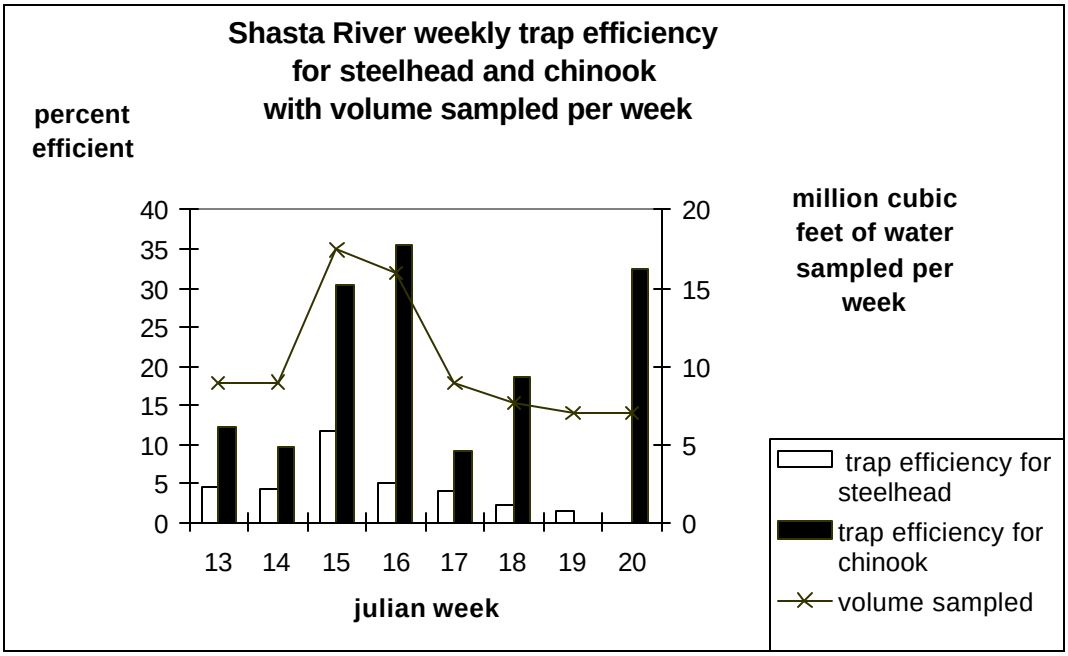
We marked and released steelhead smolts and silvery parr upstream of the trap over an eight-week period, week 13 through week 20. Before week 13, the number of steelhead trapped were insufficient to determine trap efficiency. After week 20 the water temperatures were too warm to hold and mark fish. Chinook were marked from week 9 through week 20. No chinook were marked during week 19 due to high water temperatures.

A total of 584 steelhead smolts and silvery parr were marked with fin margin clips. 21 of these fish (3.59%) were recovered.

A total of 6,102 chinook were marked with Bismark Brown dye and released upstream of the trap. Of the 688 of the marked chinook, (11.27%) were recovered. Chart 14 shows the decreasing trap efficiency for steelhead during periods of low flow and slower water

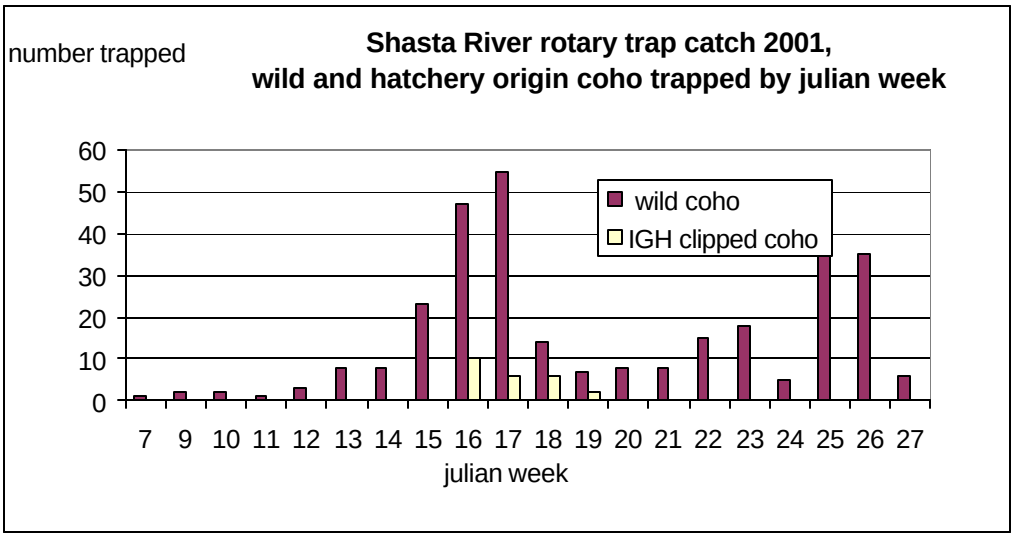
velocities, and increasing efficiencies for chinook during the same period. Although the trap efficiency for steelhead is low during week 19 and 20, the density or number of steelhead trapped per million cubic feet of water sampled is the highest for the season during week 19 (Chart 5). Apparently steelhead smolts are capable of avoiding the trap especially during periods of low flow and slower water velocities. Similar observations were made at the S-RAMP rotary traps on the Bear and the Mad Rivers in 2001 (S. Ricker personal communication).

Chart 14



On 3/29/01, Iron Gate Hatchery released 46,254 yearling coho. All of these fish had received a left maxillary clip prior to release. Between 4/16/01 and 5/08/01, a total of 24 of these fish were collected in the Shasta River rotary trap (Chart 15).

Chart 15



The operation of the rotary trap on the Shasta River enabled us to determine the outmigration timing of various steelhead, chinook and coho life stages. Conditions in the river that affect outmigrant success, such as flow and temperature, were also recorded.

We observed a trend of reduced flows and increasing water temperatures with the onset of the irrigation season on 4/1/01 (Charts 14, 15). Similar observations have been reported by Coots (1953), Skinner (1959) and CDFG (1997).

The impacts of reduced flows and returning irrigation water on rearing and outmigration are discussed in the Long Range Plan for the Klamath River Basin Conservation Area Fishery Restoration Program, 1991. “Rearing habitat requires sufficient shelter, food, and water temperature. Reduced flows shrink the amount of shelter in pools as well as the quantity of streambed invertebrates available for food from riffle areas. Lack of shelter also exposes the fish more to potential predators, such as heron and otter. All of these factors lower the number of fish the river can support” (CDFG 1980, Bottom etal.1985). The outmigration of steelhead, coho and chinook smolts (Charts 1, 6 and10) had just begun when the irrigation season and its effects were first observed on April 1 (Charts 16 and 17).

Juvenile coho and steelhead parr typically require one and two years, respectively, of rearing in fresh water prior to outmigration as smolts (Moyle 1976, Hopelain 1998). During week 25, when daily maximum water temperatures reached 82 degrees, we recorded the highest catch of coho and steelhead parr. We believe that with water temperatures in the lethal range, these fish were exiting the Shasta River in search of more suitable rearing habitat.

Chart 16

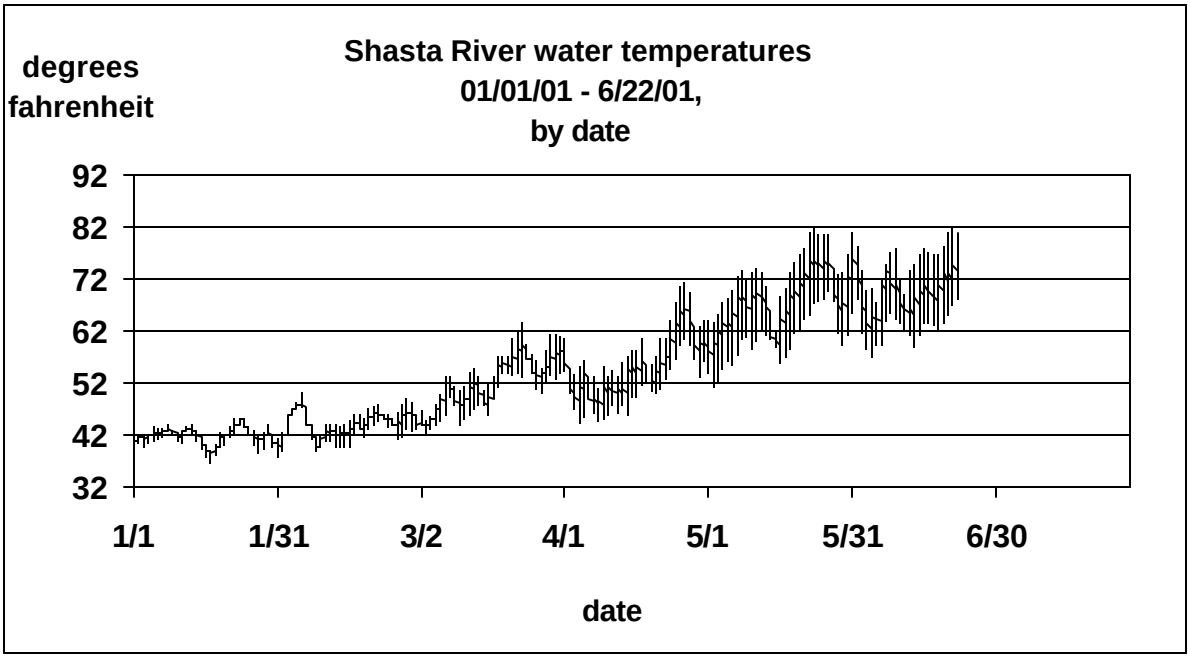


Chart 17

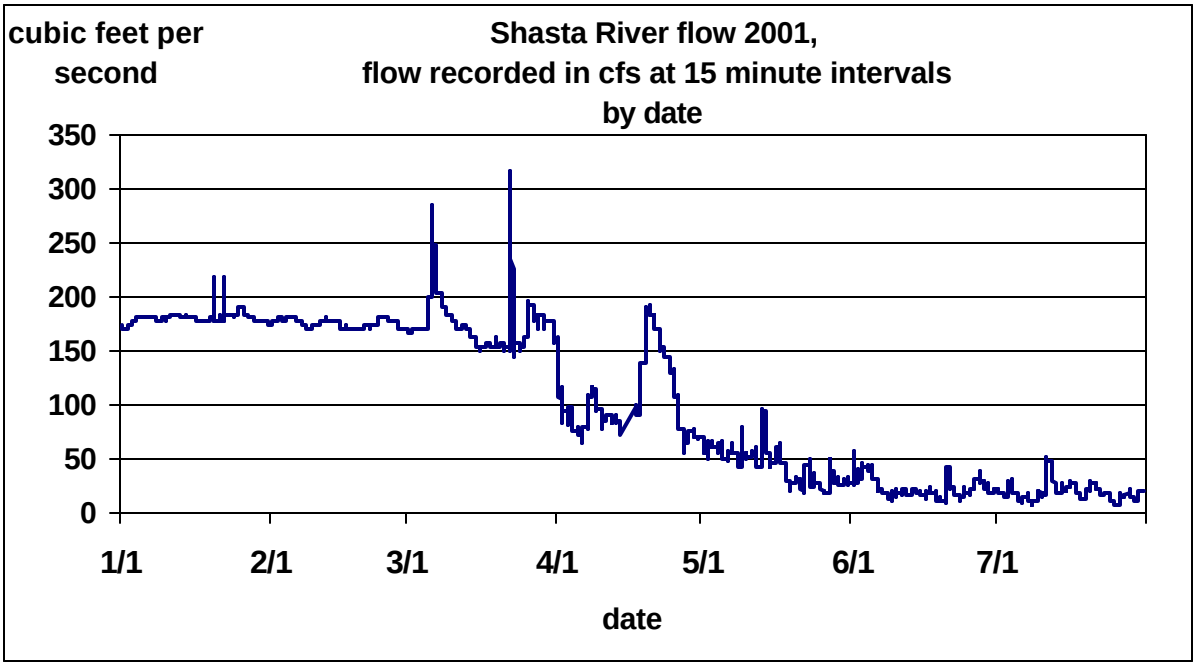


Chart 18

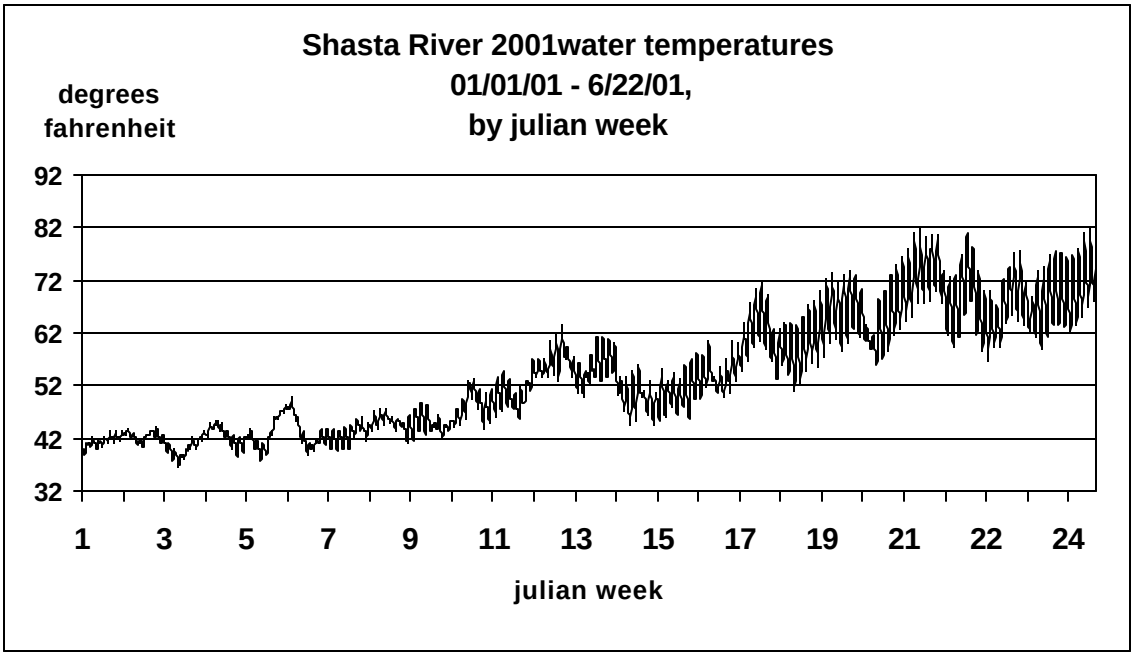
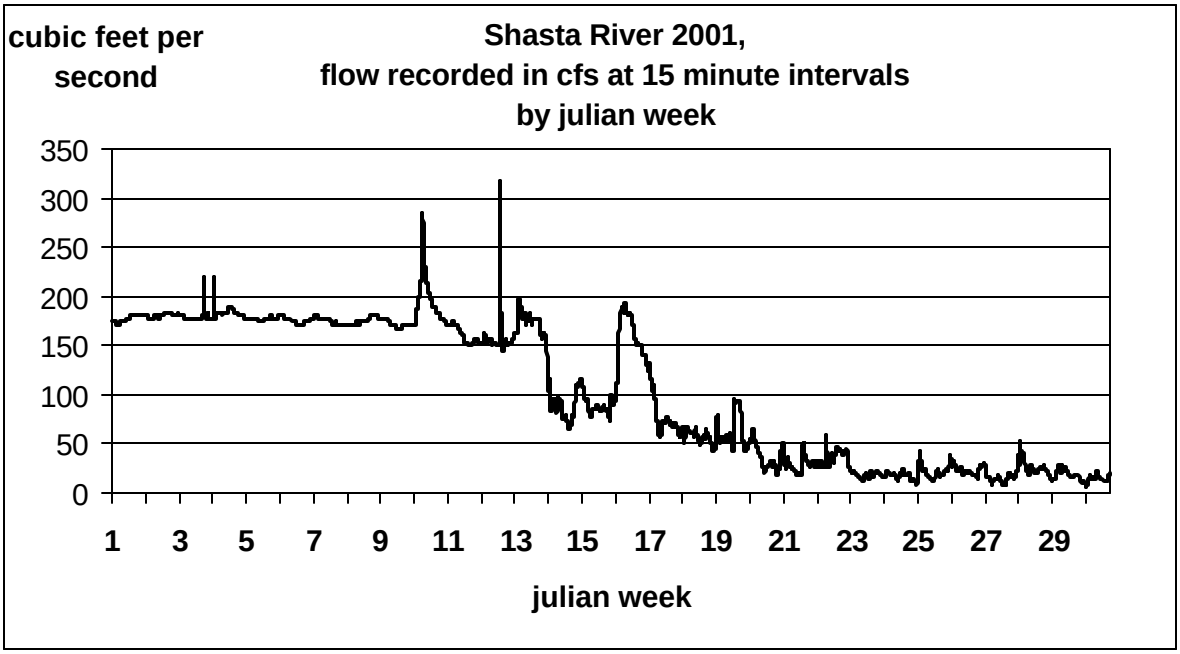


Chart 19



Recommendations

- We recommend that as many steelhead smolts as possible be marked and released upstream during trap efficiency estimates. Marking more fish should help to improve the confidence intervals of the smolt production estimates. The number of fish trapped, water temperatures, holding capacity of live cars and time will limit the extent that this can be done.

- Investigate the use of lighting near the trap to increase the catch of steelhead smolts. This technique has been used successfully to trap Atlantic salmon, *Salmo salar* in Maine (B. Rideout, personal communication).

- Modify Figure 5 in A Biological Needs Assessment for Anadromous Fish in the Shasta River, Siskiyou County, CA. (CDFG, 1997) as it appears in the Shasta Watershed Restoration Plan, (Shasta River Coordinated Resources Management and Planning Committee). This table shows the temporal distribution of spawning, egg incubation, and migration periods of anadromous fish for the Shasta River. It presently shows the outmigration of coho being completed by the end of May. This time period needs to be extended into July, as we trapped coho parr leaving the Shasta River on our final day of operation on 7/06/01 (see Figure 2 on page 22).

- We recommend that the above mentioned Figure 5 also be modified to include information on the time period when 0+ coho and 0+ and 1+ steelhead are present and rearing in the river.

Figure 2.

Life history overview of Shasta River coho salmon and steelhead

Shasta River Coho

Life History Stage	Source	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Upstream Migration	CDFG, 1997												
Spawning Period	CDFG, 1997												
Egg incubation	CDFG, 1997												
Downstream Migration of juveniles	CDFG, 1997												
Downstream Migration of smolts	CDFG 2001								?	?	?	?	?
Downstream Migration of fry and parr	CDFG 2001								?	?	?	?	?
Rearing Fry and Parr	CDFG 2001	Exact location of rearing in the Shasta unknown, however based on 2001 trapping, age 0+ coho were collected until trap operations were ended on 7/6/01.											

Shasta River Steelhead

Life History Stage	Source	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Upstream Migration	CDFG, 1997												
Spawning Period	CDFG, 1997												
Egg incubation	CDFG, 1997												
Downstream Migration of juveniles	CDFG, 1997												
Downstream Migration of smolts	CDFG 2001								?	?	?	?	?
Downstream Migration of fry and parr	CDFG 2001								?	?	?	?	?
Rearing Fry and Parr	CDFG 2001	Steelhead present in the system year-round, however exact locations of rearing and instream movements throughout the river system unknown.											

Legend	
Life stage periodicity as reported in CDFG 1997	
Life stage periodicity as observed in 2001	

Scott River Rotary Screw Trap Summary

Methods

We sampled the Scott River with an eight-foot rotary trap from weeks 9 through 12, and a five-foot rotary trap from weeks 13 through 23. As in 2000, we operated the trap at the Cabin Hole located 4.75 miles upstream of the mouth of the Scott River. From weeks 9 through 14, the trap was fished from Sunday PM through Saturday AM. During weeks 15 through 23 the trap was fished from Sunday PM through Friday AM. The catch was processed at approximately 0800 and at 1600 daily. Hourly water temperatures were recorded at the site with an Onset Optic StowAway temperature logger. If sufficient numbers were present in the catch, a random sample of twenty-five fish of every salmonid species was measured and classified by life stage. All vertebrates collected in the trap were identified and counted. Trap efficiency determinations were conducted as described for the Shasta River rotary trap beginning in week 11.

Results

The Scott River trap began sampling as described above on 2/26/01 and ended on 6/07/01 due to low flows. The trap was fished for a total of 1,599.7 hours. Table 4 shows the total unexpanded catch for all species trapped.

Table 4.

Sum of Fish Species Trapped, Scott River 2001

Species	Count
Steelhead Trout *Onchorhynchus mykiss irideus*	4,378
Coho Salmon *Onchorhynchus kisutch*	183
Chinook Salmon *Onchorhynchus tschawytscha*	33,967
Brown Trout *Salmo trutta*	1
Pacific Lamprey *Lampera tridentata*	10,695
Klamath Small-scaled Sucker *Catosomus rimiculus*	9,122
Sculpin spp. *Cottus spp.*	2
Speckled Dace *Rhinichthys osculus*	313
Three Spine Stickleback *Gasterosteus aculeatus*	13

Steelhead

The largest weekly total steelhead were trapped during week 12: 2,179 (Chart 20, Table 4). The fork lengths of 1,489 steelhead were measured. The fork length frequency of measured sub-sample is shown by month in Charts 23a-d. Age 0+ steelhead fry and parr first appear in the catch during weeks 18-21. 416 scale samples were collected from a sub-sample of the measured fish.

Trap efficiency for Steelhead

The highest trap efficiency for steelhead smolts and silvery parr as determined by Petersen mark and recapture estimates occurred during week 16, 19.8% (Chart 24). The greatest number of steelhead trapped per unit volume sampled occurred during week 12, with 92.68 fish trapped per million cubic feet sampled (Chart 21). The estimates for the total number of juvenile steelhead moving past the trap between weeks 11-21 are

shown in Table 5. The largest weekly estimate occurred during week 12 with13,516 steelhead for the period sampled.

Chart 20

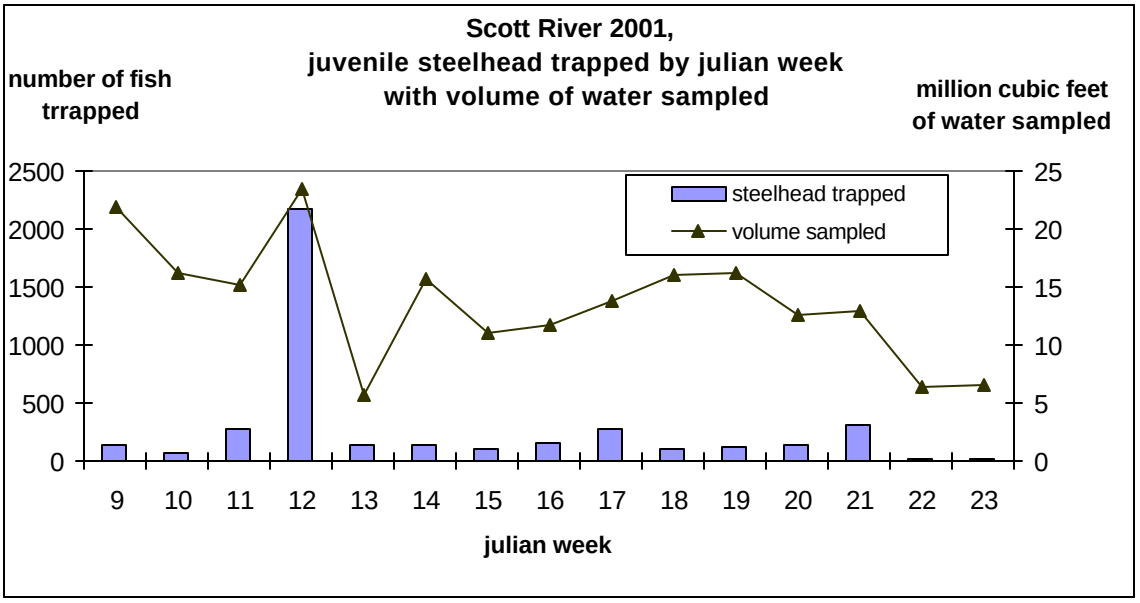


Chart 21

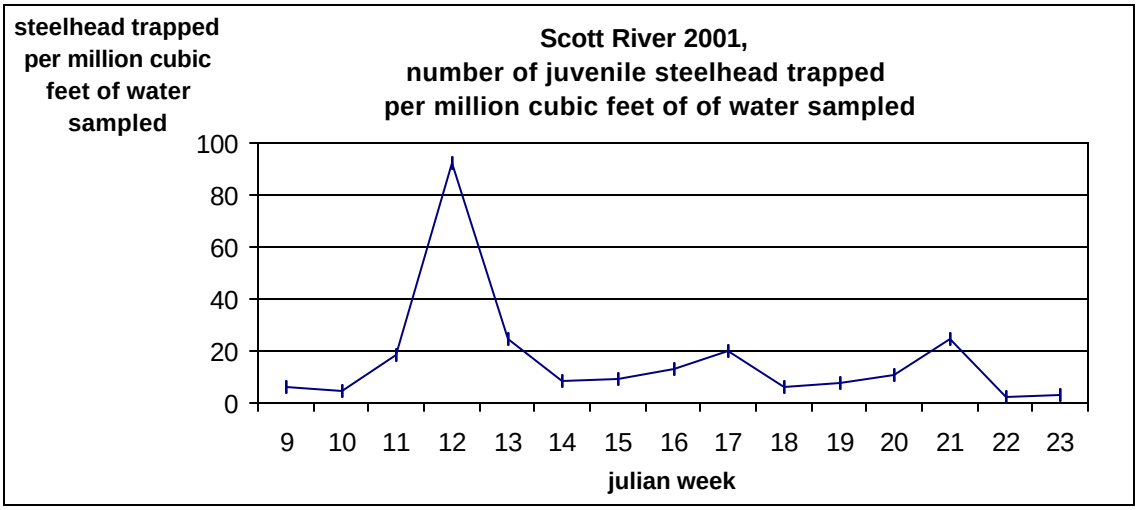


Chart 22

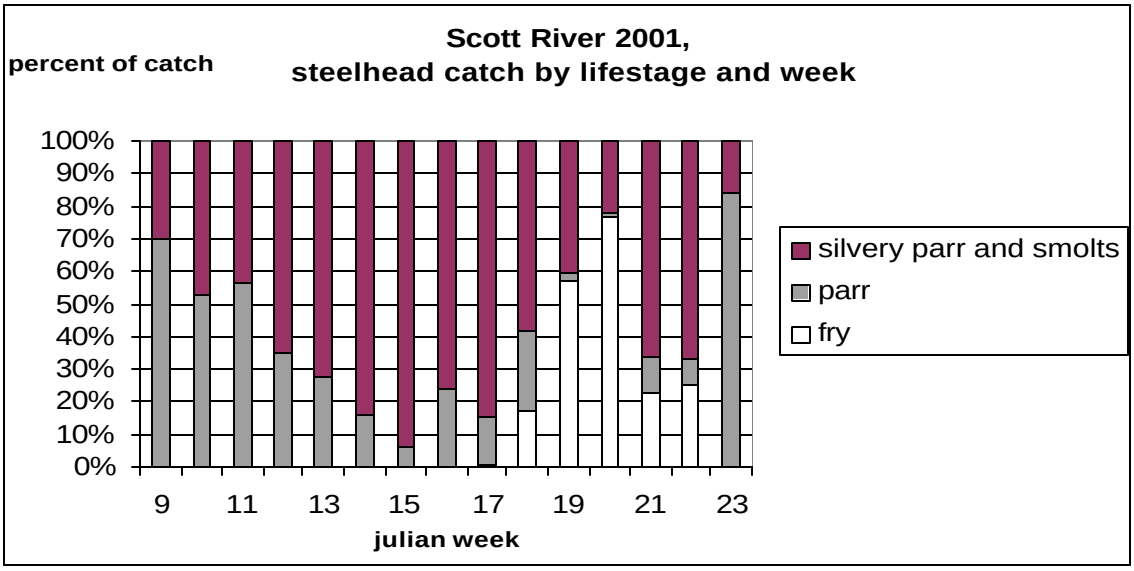
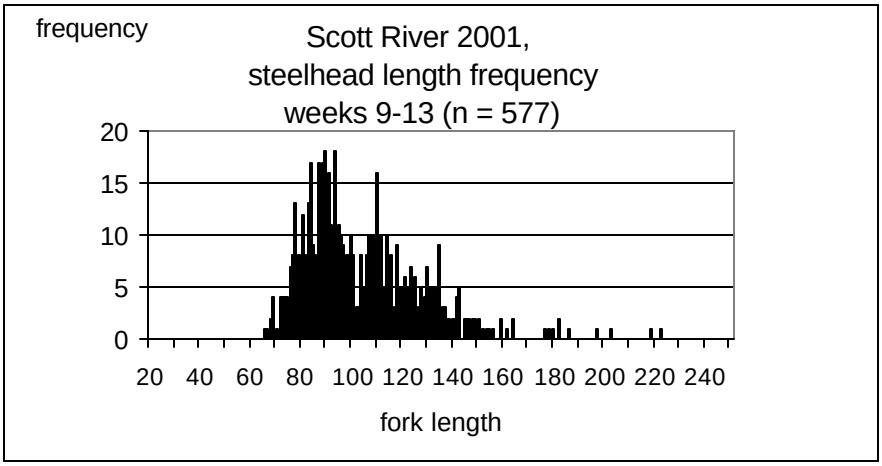


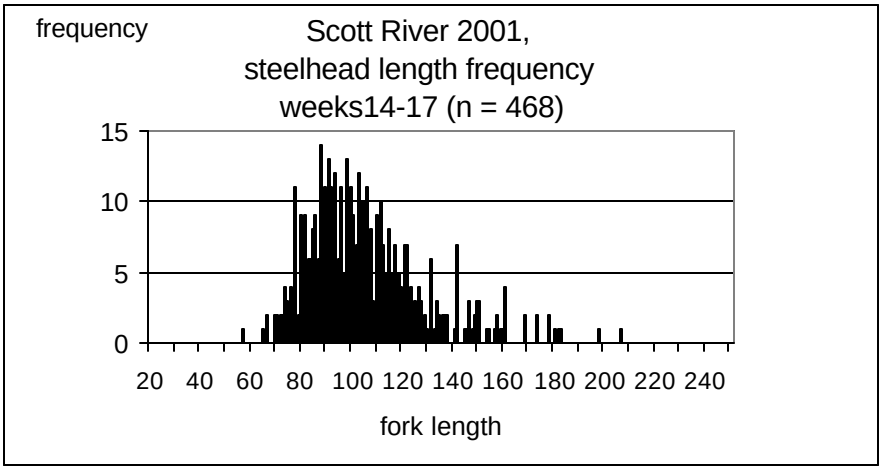
Chart 23 a-d Scott River steelhead length frequency by month

Chart 23a



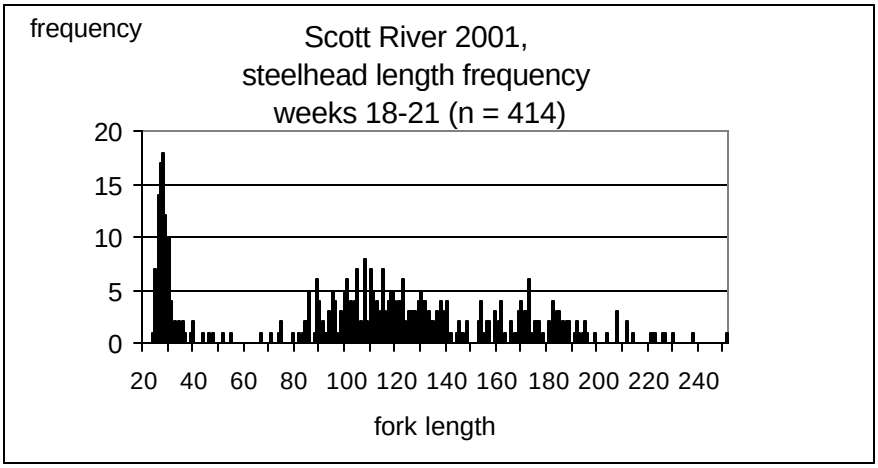
mean =104.57 mm, std. dev.= 23.73

Chart 23b



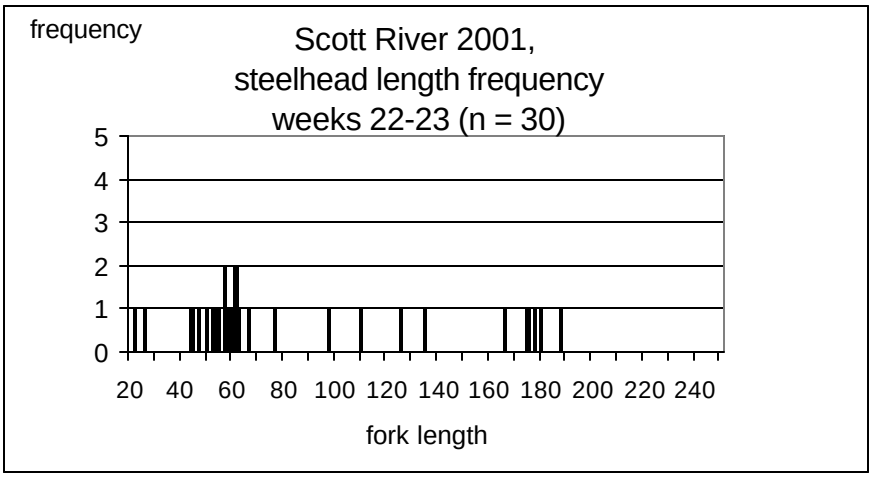
mean length = 105.57mm, std. dev.= 24.45

Chart 23c



mean length = 108.44mm, std. dev. 56.05

Chart 23d



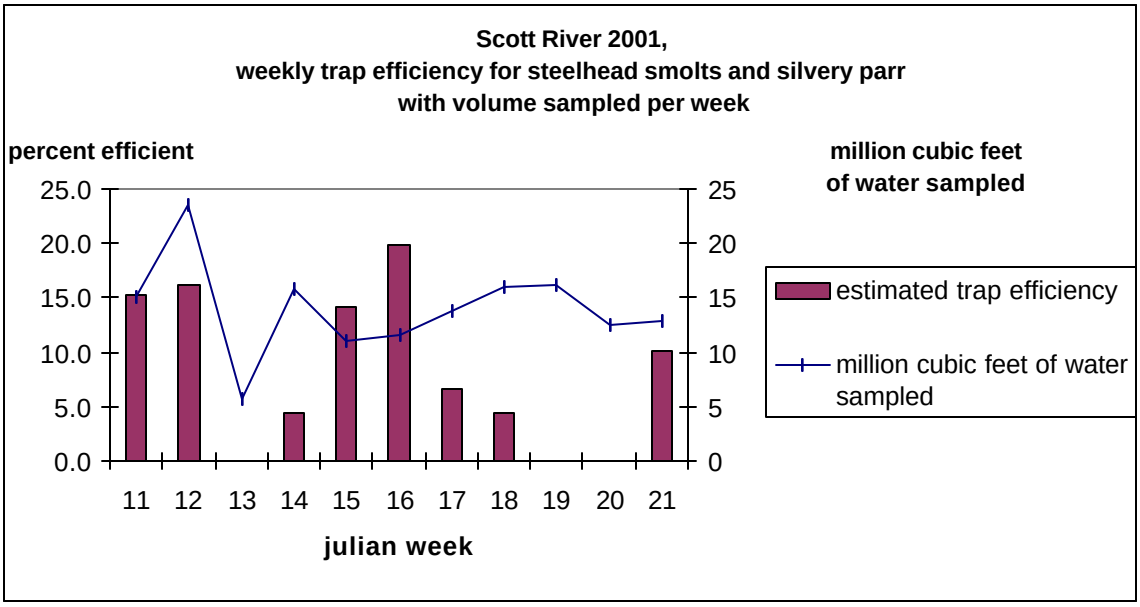
mean length = 87.13 mm, std. dev.= 51.96

Table 5.

Trap efficiency and estimated number of juvenile steelhead outmigrating by julian week

Julian week	Number of steelhead trapped	Estimated trap efficiency	Estimated number of steelhead	95 % confidence interval	
				Upper	Lower
11	282	15.3%	1,840	3,204	550
12	2179	16.1%	13,516	21,732	8,271
13	140	NA	NA	NA	NA
14	116	4.4%	2,633	4,586	787
15	85	14.1%	602	1,049	180
16	115	19.8%	580	1,014	320
17	169	6.7%	2,522	4,851	1,189
18	78	4.5%	1,699	2,959	508
19	120	NA	NA	NA	NA
20	137	NA	NA	NA	NA
21	217	10.1	2,136	4,210	945

Chart 24



Coho

A total of 183 juvenile coho were collected in the trap. Catch by life stage and week is shown in Charts 25 and 26. The fork lengths of 89 of these fish were measured and their length frequencies by month are shown in Charts 27 a-c. To minimize handling stress, we did not collect scale samples from coho. We were unable to determine the trap efficiency for coho due to the low number collected.

Chart 25

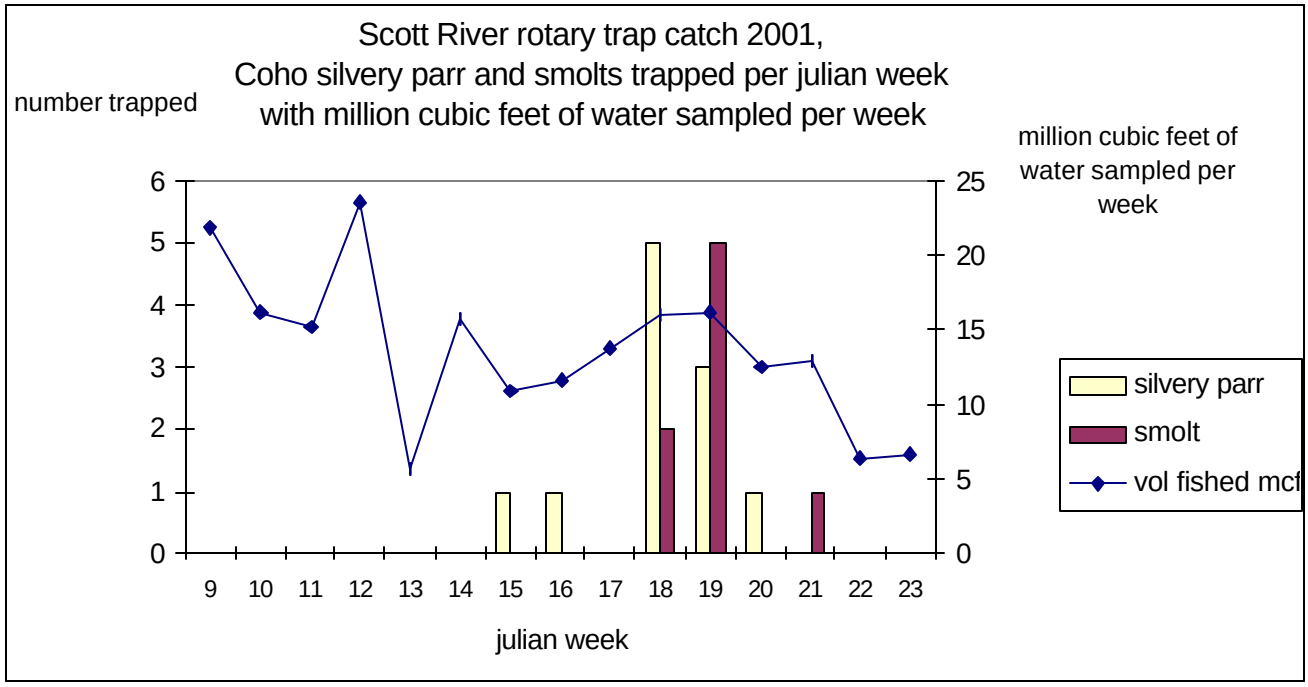


Chart 26

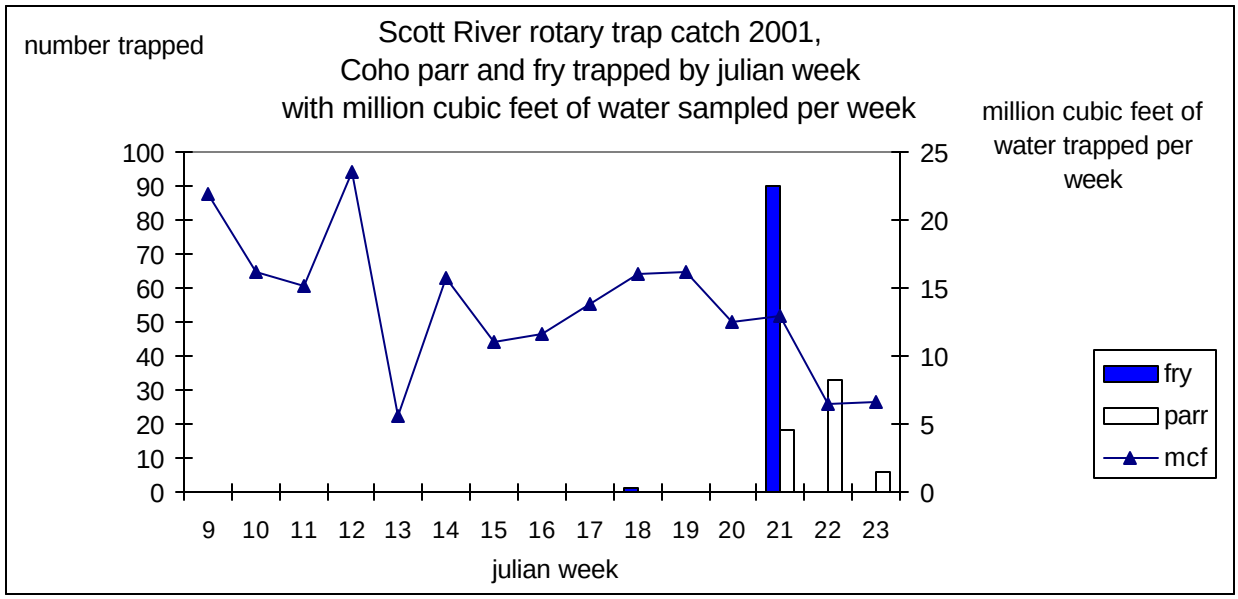
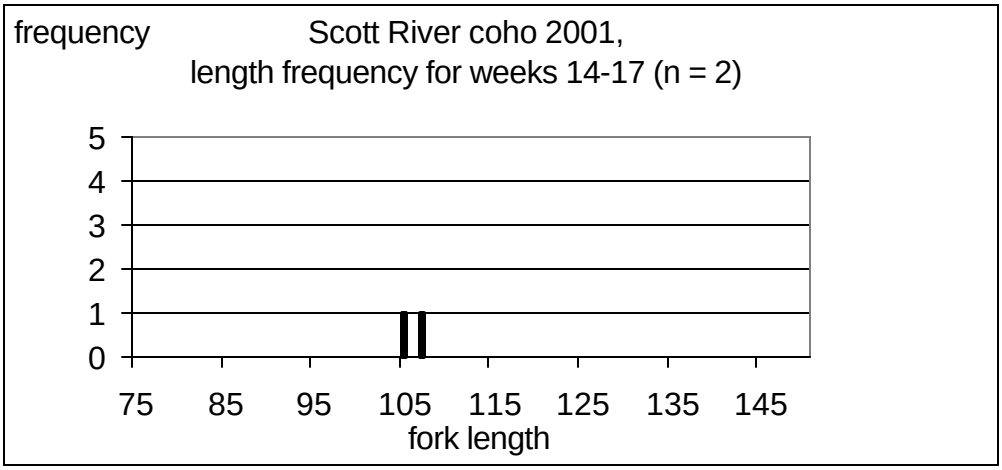


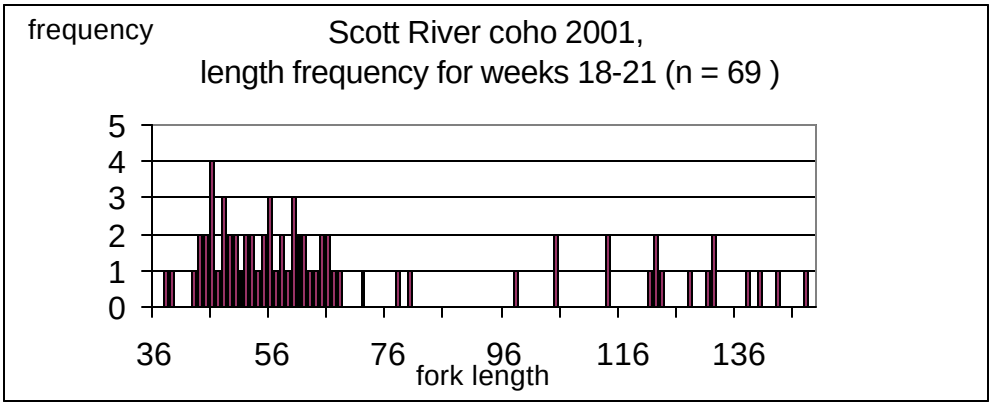
Chart 27 a-c Scott River coho length frequency by month

Chart 27a



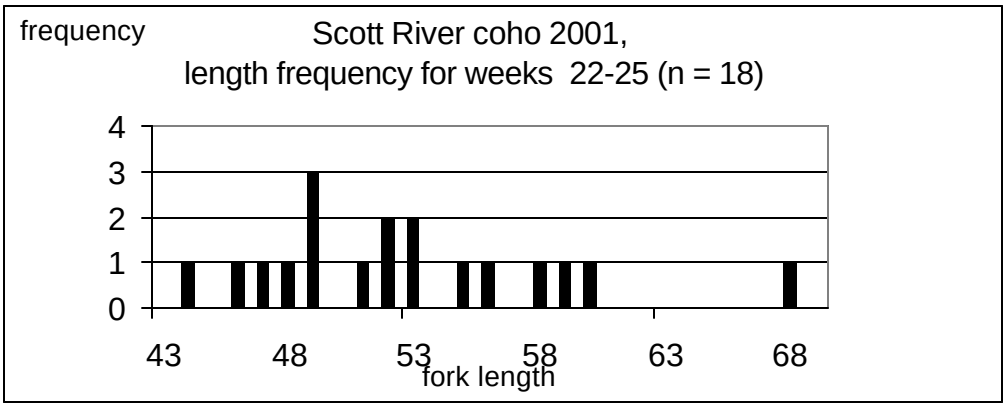
mean length = 106 mm, std. dev. = 1.41

Chart 27b



mean length = 72.34 mm, std. dev. 31.92

Chart 27c



mean length = 52.72 mm, std. dev. 5.89

Chinook

A total of 33,967 chinook were collected in the trap. The catch per week is shown in Chart 28. The largest weekly catch of chinook occurred during week 21 (6,918). The greatest catch density occurred during week 16 with 593.55 chinook trapped per million cubic feet of water sampled (Chart 29, Table). The fork lengths of 1,537 chinook were measured. The fork length frequencies of the measured sub-sample are shown by month in Charts 30 a-d. The highest trap efficiency for chinook occurred during week 12 at 12.1% (Chart 31). Table 6 shows the estimated number of chinook moving downstream of the trap during the period when efficiency estimates were made.

Chart 28

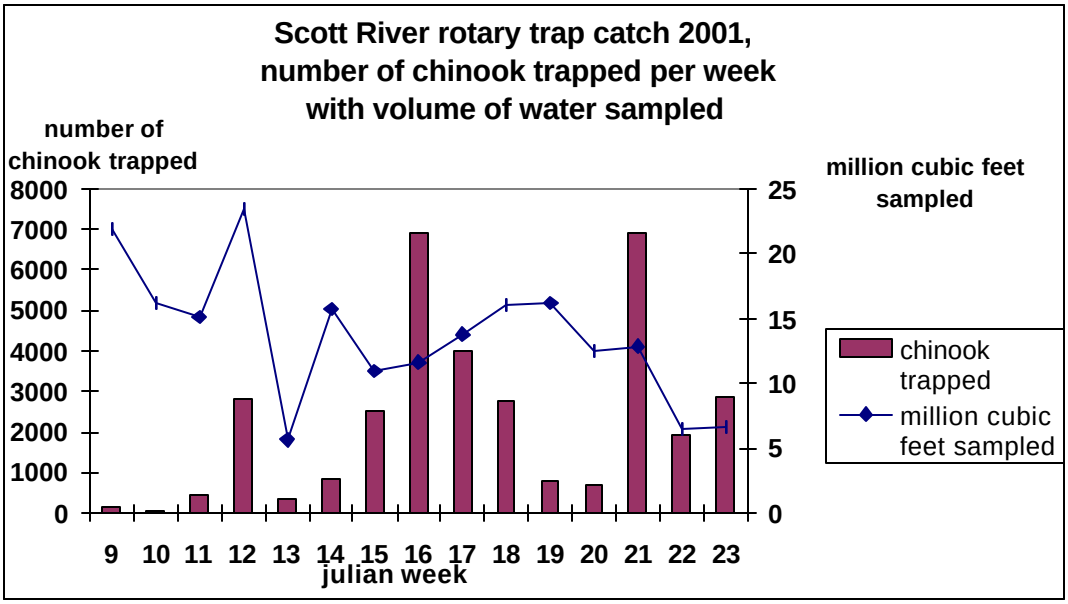
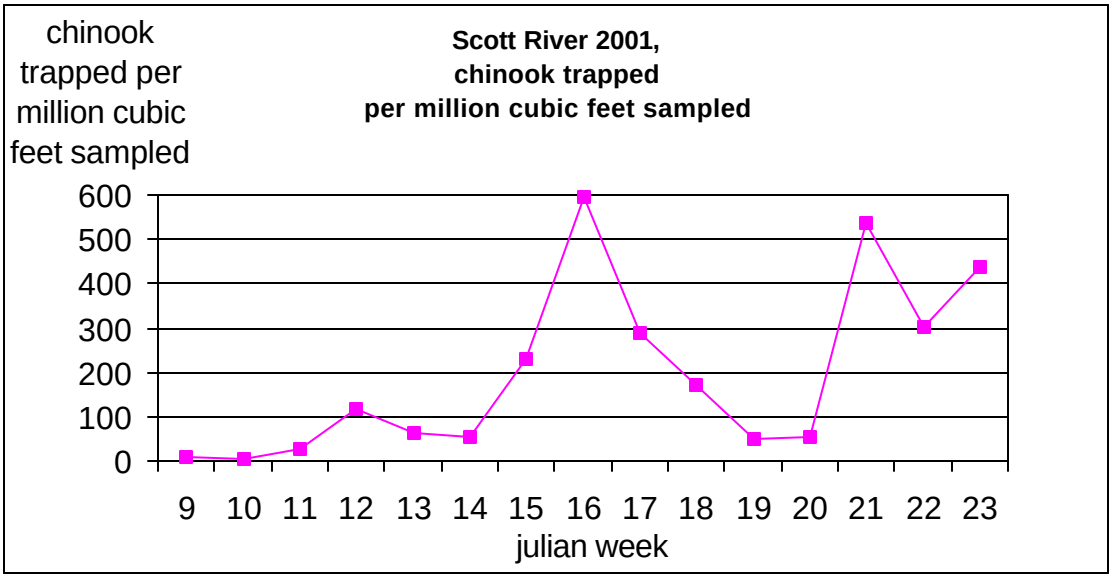
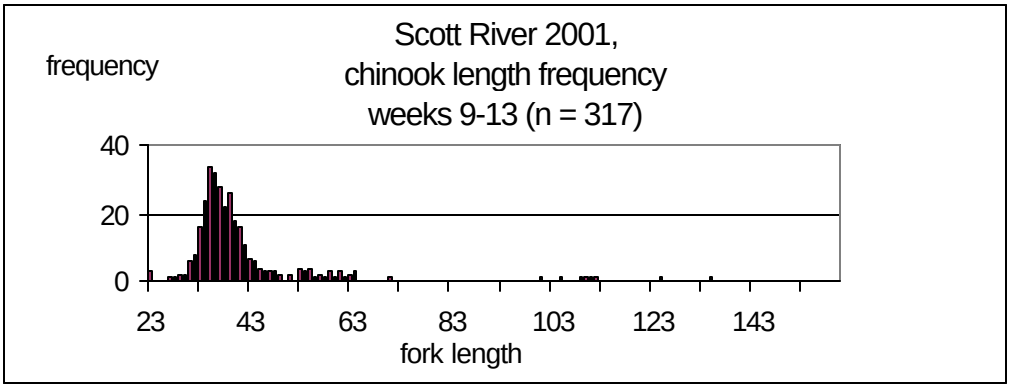


Chart 29



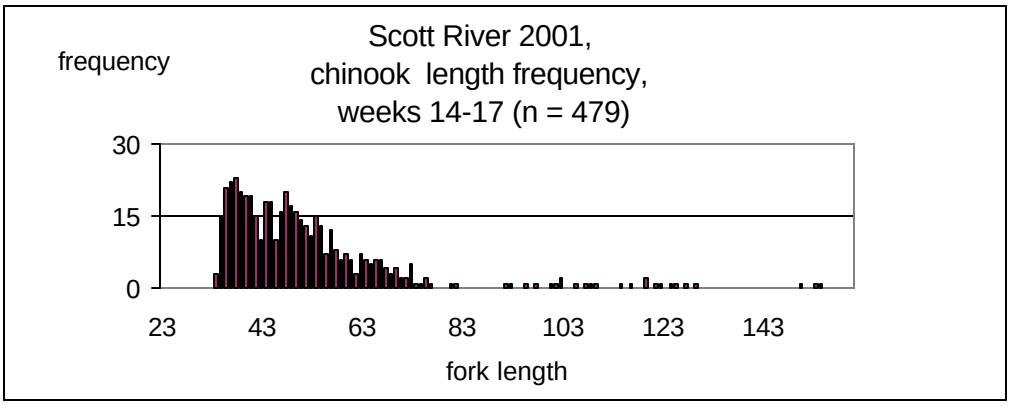
Charts 30 a-d chinook length frequency by month

Chart 30a



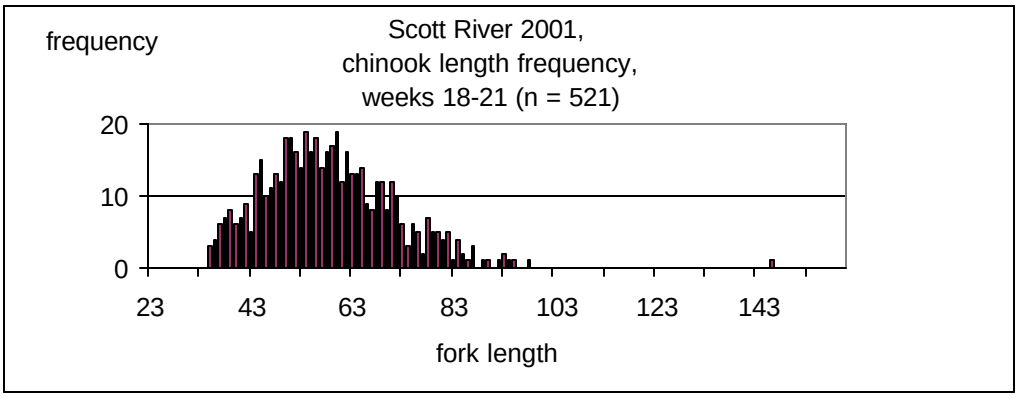
mean length = 41.20 mm, std dev 13.91

Chart 30b



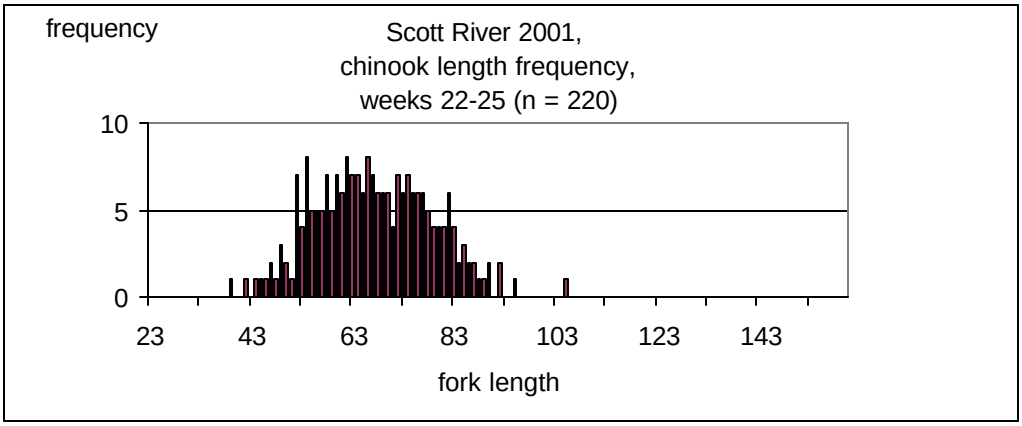
mean length = 52.24mm, std. dev.= 18.52

Chart 30c



mean length = 58.57mm, std. dev. 13.0

Chart 30d



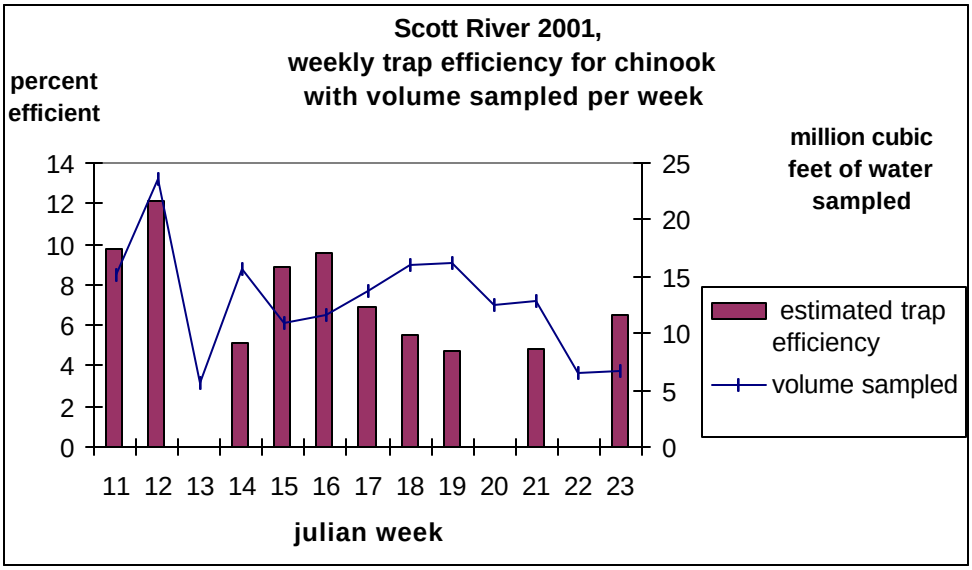
mean length = 67.27mm, std. dev. 11.52

Table 6.

Trap efficiency and estimated number of juvenile chinook outmigrating by julian week

Julian week	Estimated trap efficiency	Estimated number of chinook outmigrating during the period sampled each week	Volume of water sampled during the week	Minutes sampled per week	Chinook Trapped per million cubic feet sampled
9	NA	NA	21.89	5564	7.44
10	NA	NA	16.25	6375	3.38
11	9.8%	4,428	15.60	8135	28.62
12	12.1%	23,123	23.51	5500	119.01
13	NA	NA	5.66	6360	62.36
14	5.1%	16,490	15.75	7290	53.39
15	8.9%	28,235	11.00	6775	228.45
16	9.6%	71,968	11.64	6755	593.55
17	6.9%	57,985	13.82	6740	289.50
18	5.5%	50,000	16.06	7106	171.23
19	4.7%	16,957	16.17	6836	49.28
20	NA	NA	12.54	5232	54.78
21	4.8%	144,125	12.88	6640	537.11
22	NA	NA	6.44	5345	300.15
23	6.5%	44,430	6.62	5330	436.25

Chart 31



Discussion

Trap Operation

We started sampling in week 9 with an eight-foot rotary trap manufactured by E.G. Solutions. We used this larger trap in order to increase our trapping efficiency and improve our estimates of salmonid production. Flows in the Scott River ranged from 1,060 to 98 cubic feet per second during the sampling period. The wide range of flows is typical for the Scott River due to snowmelt. Initially we found it difficult to position the trap and maintain the necessary cone speed. Rapid increases in flow due to rain and snowmelt during week 12 (Chart 33) increased the catch of both fish and debris. The trap collected so much debris that it became inoperable. After experimenting with a variety of setups, it was determined that rigging a five-foot trap as shown in Figure 1 gave us the greatest flexibility to trap at a variety of flows. Don Lucas, Jack Herr and Erich Yokel devised system to position the trap by means of two hand-operated winches on the bank. With this arrangement, one person could safely retrieve the trap even with the cone in the water.

On 06/07/01, flows dropped to a point that we were unable to operate the trap. We observed many salmonids in the canyon upstream of the trap location that had either not yet out-migrated or were going to rear over the summer if conditions were suitable.

Recommendations

- As with the Shasta rotary trap, we recommend as many steelhead smolts as possible be marked and released upstream during trap efficiency estimates. Marking more fish should help to improve the confidence intervals of the smolt production estimates.
- Determine the feasibility of locating the trap further downstream to capture chinook production from the lower 4.75 miles of river and to locate a trap site with more water velocity.

Figure 1. Scott River rotary trap 2001, trap rigging diagram

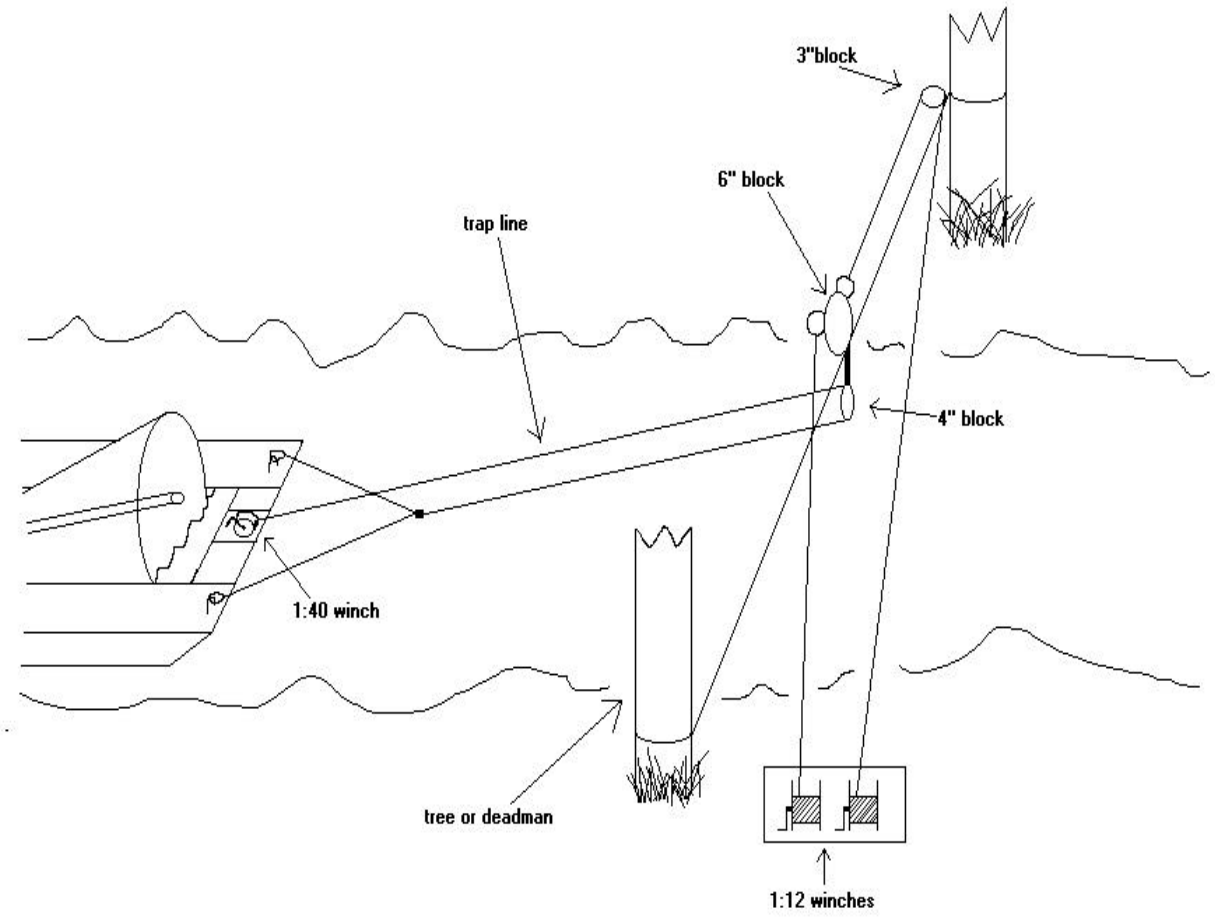


Chart 32

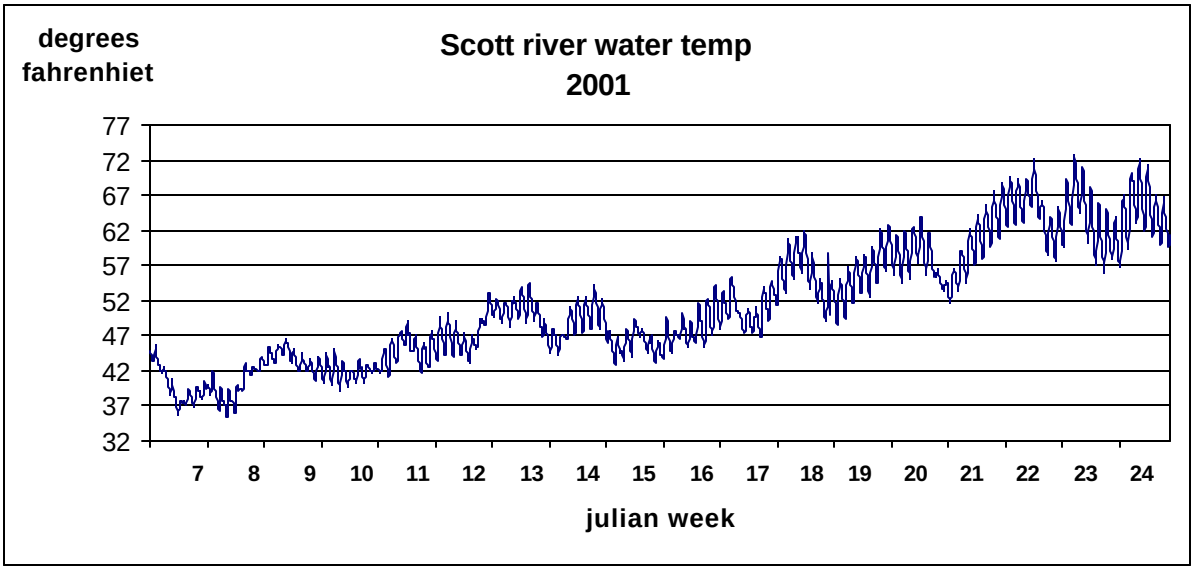
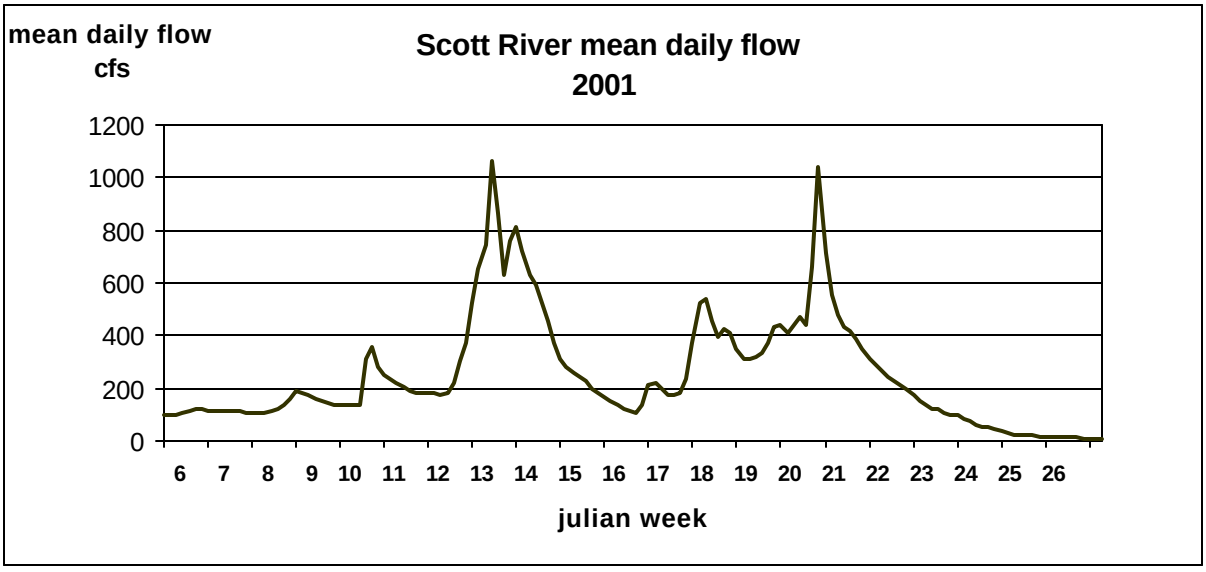


Chart 33



References

Bottom, D.L, P.J. Howell, and J.D. Rodgers. 1985. The effects of stream alterations on salmon and trout habitat in Oregon, Oregon Dept. of Fish and Wildlife, Portland. 70p.

California Department of Fish and Game. 1997. A biological needs assessment for anadromous fish in the Shasta River, Siskiyou County, California. Northern California-North Coast Region, Redding, CA. 29p.

California Department of Fish and Game. 1980. Scott River waterway management plan. State of California Resources Agency, pp. 44-57

Chesney, W.R. 2000. Annual Report, Study 3a1, Shasta and Scott River juvenile steelhead trapping, 2000. California Dept. of Fish and Game, Steelhead Research and Monitoring Program, Yreka, CA. 36p

Coots, M. 1953. Creel Census, May 2, 1953. Shasta River, Siskiyou County. Inland Fisheries Division, California Department of Fish and Game files, Yreka, CA.

Hopelain, J.S. 1998. Age growth and life history of Klamath River Basin steelhead trout (*Oncorhynchus mykiss irideus*) as determined from scale analysis. Inland Fisheries Division. Administrative Report No. 98-3. 19p.

Klamath River Basin Fisheries Task Force. 1991. Long range plan for the Klamath River Basin Conservation Area fishery restoration program. pp. 2-89

Moyle, P.B. 1976. Inland Fishes of California. University of California Press. 379p.

Skinner, J.E. 1959. Preliminary Report of the Fish and Wildlife in relation to plans for water development in Shasta Valley. California Department of Water Resources; Shasta Valley Investigation, Bulletin No. 87, Appendix B, 50 pages.

Personal Communications

Rideout, Bruce California Department of Fish and Game, scientific aid, Yreka, California.

Ricker, Seth. California Dept. of Fish and Game, fisheries biologist, Arcata, California.

Appendix A. 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**

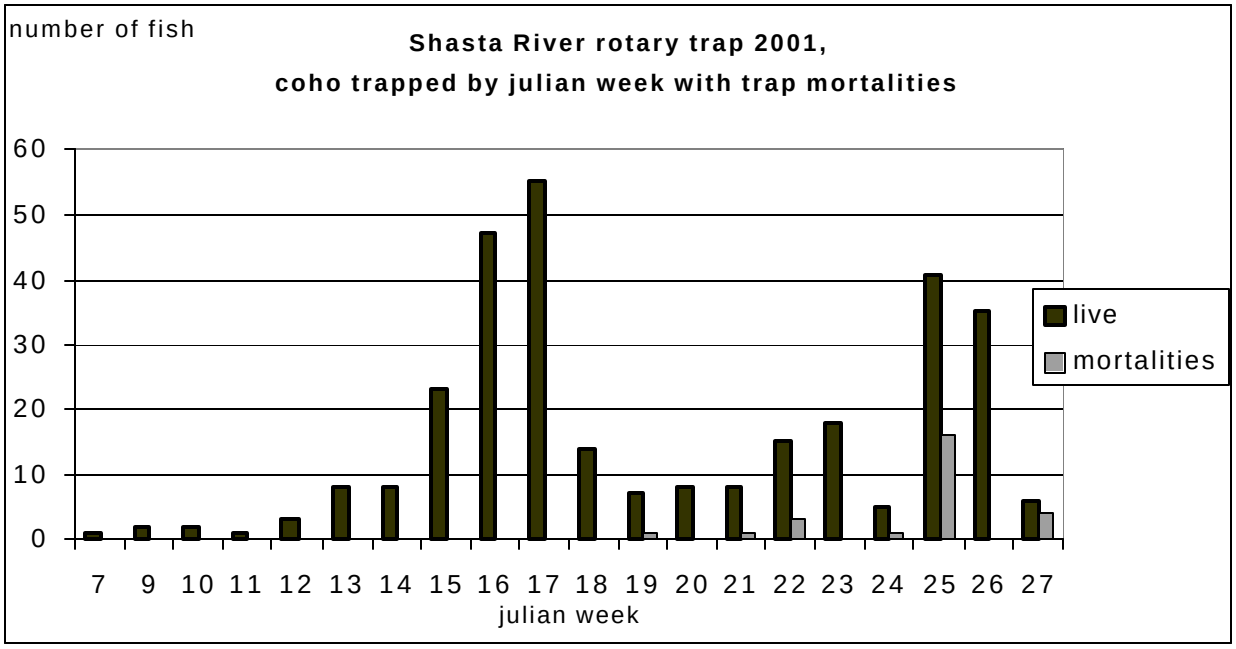
Appendix B. Trapping Mortalities

Scott River RST 2001

	Number Trapped	Mortalities	% Mortality
Steelhead	4,378	26	.59
Coho	183	0	0
Chinook	33,967	318	.93

Shasta River RST 2001

	Number Trapped	Mortalities	% Mortality
Steelhead	2,874	23	0.80
Coho	357	26*	7.28*
Chinook	262,555	3742	1.42



* Maximum daily water temperatures reached 82 degrees Fahrenheit during week 21. 25 of the 26 coho mortalities were observed in week 21or later. Based on the loss of scales and decomposition, some of the coho appeared to have died prior to entering the trap.