Mattole Salmon Group

Juvenile Salmonid Monitoring on the Mainstem Mattole River at Petrolia, CA 2006

FINAL REPORT
CADFG Fisheries Restoration Grant Program
Grant # P0510525

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Acknowledgements

The MSG would like to acknowledge the following persons and agencies integral to the efforts of the 2006 Downstream Migrant Trapping season:

David Fuller, US Bureau of Land Management, for technical guidance and continued financial support of fisheries monitoring efforts in the Mattole River Watershed.

California Department of Fish and Game, for continued support of the Mattole Salmon Group year after year.

Bill Pinnix, US Fish and Wildlife Service, for technical guidance and data analysis assistance.

David Gaylor, Ph.D., for conducting statistical analyses of trap efficiency data.

Tom Campbell, for providing valuable new insights and ideas to the MSG DSMT program, supervision, leadership, and editing.

Jillian Grbavac, Americorps Intern, for invaluable field work and data entry.

Natalie Arroyo, Americorps Intern, for invaluable field work and data entry.

Kali Lovett, Nicks Interns Program, for expressing interest in Mattole fisheries and providing hours of invaluable field work.

Dr. Dick Scheinman, landowner, for granting the MSG permission to conduct trapping operations on private property.

Background

The Mattole Salmon Group (MSG) has been assessing salmonid populations and their limiting factors for over 25 years on the Mattole River as part of a watershed approach to native salmonid and aquatic habitat enhancement. One of the primary goals of the MSG is the recovery of native salmon and steelhead stocks to robust, self-perpetuating population levels. Due to the considerable effort and expense devoted to the rehabilitations and recovery of natural systems, including native salmon and steelhead and their habitat, an integral component of watershed restoration is appropriate monitoring activities. The MSG has conducted downstream migrant trapping annually since 1985, in cooperation with Humboldt State University (HSU), the US Bureau of Land Management (BLM), the US Fish and Wildlife Service (USFWS), and the California Department of Fish and Game (DFG). Due to high levels of natural variability, monitoring population trends among the three resident salmonid species of the Mattole requires a long-term approach. The MSG intends to continue to conduct its current monitoring programs in partnership with state and federal agencies.

Introduction

2006 marked the 21st consecutive year of the MSG's Juvenile Salmonid Migrant Monitoring program. The MSG has conducted annual population monitoring of juvenile salmonids (by downstream migrant trapping in spring and early summer) in the lower mainstem Mattole River since 1985 (fyke trap through 1996, and a 1.5 m screw trap thereafter), in lower Bear Creek since 1997 (pipe trap) and in the middle mainstem Mattole near Ettersburg beginning in 2001 (pipe trap). For 2006, the MSG conducted juvenile salmonid monitoring on the lower mainstem Mattole River using a 1.5 m screw trap on loan from the BLM, as well as in Squaw Creek using a pipe trap. 2006 marked the first year of juvenile monitoring in Squaw Creek, one of the five largest tributaries to the Mattole (see appendix). Data collected provides valuable information and insights on the timing of down-migration, relative abundance, as well as the age and size of emigrating juvenile salmonids. Data also serve as an indicator of adult escapement, reproductive conditions, instream habitat quality and future recruitment to adult populations. To assess such factors, downstream migrant trapping needs to be conducted over many consecutive years, particularly for trend analysis purposes.

Techniques and Methods

Trap Site

The 1.5m screw trap was installed at river mile (RM) 3.9 on the lower mainstem Mattole River (Figure 1). Landowners Dr. Richard Scheinman and Charles Gould permitted the MSG to install and operate the trap on their properties. 2006 was the second consecutive year that the MSG conducted juvenile monitoring at this location. Due to having one of the steepest riffles in the lower river, the site continues to be a valuable location for the placement of a screw trap.

Figure 1 Mattole River and 2006 trap location.

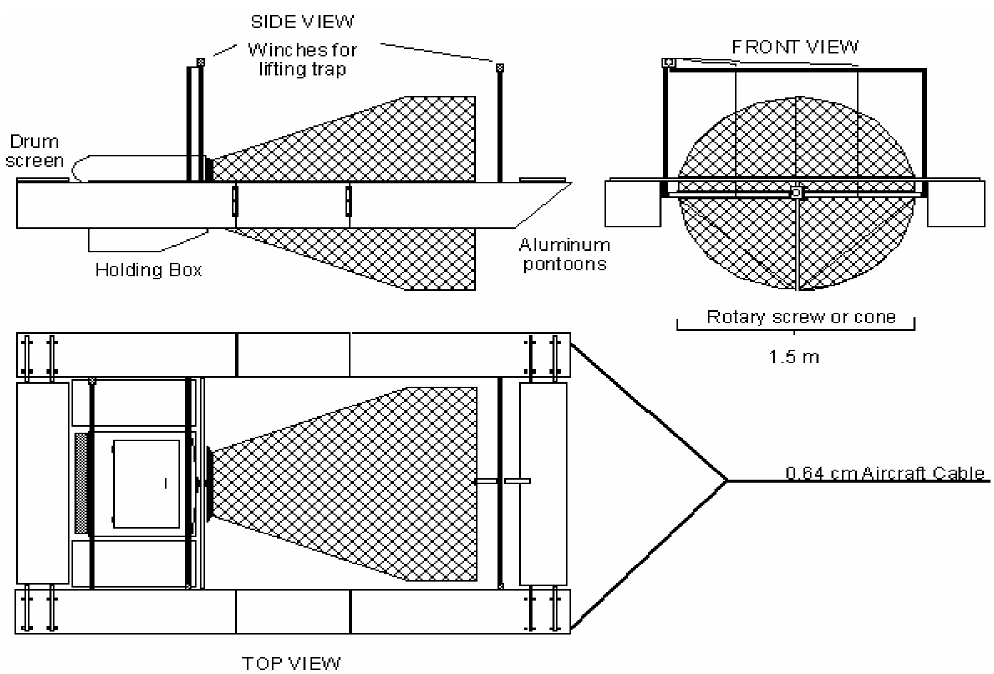
Trap Design and Operation

A rotary screw trap with a 1.5 m diameter cone was used for downstream migrant trapping (Figure 2). The trap was anchored with 0.64 cm diameter aircraft cable to a series of steel fence posts and large trees just upstream. A Z-rig anchor system was used to allow the trap to be positioned in the thalweg (or on the edge depending on river flows), as well as to pull it ashore for analyzing daily catches. Cone revolutions (revs) were used to determine where and when the trap could be operated without imparting unnecessary risk to trapped fish. Ideal cone revolutions for downstream migrant trapping range from a minimum of 10 revs/180 seconds to a maximum of 37 revs/180 seconds.

The trap was operated on the edge of the thalweg during higher river discharge, and incrementally moved back into the thalweg as the river discharge decreased. When deployed, the bottom the cone is approximately 1m or less from the stream bottom. A sampling day was defined as the time period between the setting of the trap one day, and the removal of captured fish approximately 24 hours later. This period encompassed all night hours, when the majority of juvenile salmonids emigrate (Steel, 1999). Trap checks occurred each morning around 0900 hours.

River conditions ultimately determined when the trap was operated. An effort was made to install the rotary screw trap as early as possible in order to record as much of the Chinook salmon juvenile emigration as possible. This was done in order to get the most accurate data on emigration patterns and relative abundances of Chinook salmon, as well as coho salmon and steelhead. The MSG focused its efforts around the juvenile Chinook salmon run while collecting as much data as possible on the coho and steelhead runs.

Figure 2 Rotary screw trap design.



Biological Sampling Procedures

During the 2006 season the rotary screw trap was operated 7 days a week, unless high stream flows or excessive water temperatures posed a risk to the survival of captured fish. According to the MSG's DFG-approved Downstream Migrant Monitoring QAQC, during periods when water temperatures are consistently over 68°F, the trap is not operated and will remain non-operational until safe temperature limits recur. This precaution proved necessary during the 2006 season.

The trap was not operated when high flows may have caused water velocities within the live box to exceed the swimming capabilities of the smallest fish, which may have resulted in mortalities greater than 5%. Live boxes were checked and cleared of debris more than once a day during periods of high flow and/or in very windy conditions. Traps and live boxes were inspected daily during operation to check for any damage. All dip nets were inspected prior to each daily use to check for rips in the mesh. Fish holding buckets were inspected weekly for leaks, cracks and sharp protrusions. Fish safety was paramount, and information gathering was considered secondary.

The trap was checked in the early morning when water temperatures were typically low. All fish measured for the biosample were anesthetized with tricaine methanesulfonate (MS-222) prior to processing. Up to 30 individuals of each species and developmental stage were randomly sub sampled from the daily catch. Biosampled salmonids were measured to the nearest mm for fork length (FL) and examined for developmental stage, recapture marks, health and physical irregularities. All captured salmonids that were not biosampled were tallied according to species, developmental stage, and/or age and examined for recapture marks. Fish other than Chinook, coho, and steelhead were considered non-target species. Non-target fishes captured were identified to species and tallied.

Juvenile Chinook were classified as young of the year (YOY). Coho were classified as either YOY or smolt, the latter of which were much larger in size, silvery, and lacked distinct parr marks. Steelhead were classified as YOY (<=75 mm), parr, or smolts. Again, delineation of parr and smolts was subjective and based primarily on the degree of silvery coloration and distinctness of the parr marks. Occasionally, steelhead <65 mm were classified as parr if captured very early in the season.

Trap efficiencies were estimated for Chinook and coho salmon juveniles using standard mark-recapture techniques. The mark-recapture protocol is as follows: 2 days out of each 7-day trapping week, up to 200 juvenile Chinook salmon and 50 coho salmon smolts were marked by either snipping a thin vertical slice from the tip of the caudal fin, alternating between the upper and lower caudal lobes on successive days, or using the dye, Bismark Brown, for marking. Bismark Brown was used when numbers of fish to be marked were over 150. Chinook and coho salmon marked for trap efficiency trials are held in a live box to assess mortality from handling and marking, and then are released about 300 yards upstream from the trap (ideal release time is at dusk to reduce predation). Recaptures of marked Chinook occur over the ensuing 2 days.

Quality Assurance/Control Procedures

Prior to the initiation of trapping, a training session is required for all trap personnel. Training was given by experienced MSG staff and covers fish identification, trap operation, fish measurement (fork lengths of juvenile salmonids), data recording, trap efficiency estimation, safety, and QA/QC procedures. Trained trap operators counted the total number of fish trapped, and were able to accurately identify the species of each individual fish. On at least one trapping day every two weeks, the Principal Investigator (or designee) verified identification and re-measured a 20% sample of captured salmonids. If greater than 1% error in identification or 10% error in measurement was found, the trap operator received additional review in identification and/or measurement techniques.

All trapping operations were conducted in close coordination and communication with DFG personnel stationed in Eureka and Fortuna. When in operation, traps are monitored and cleaned at least once a day, and more often when debris loading or increased fish numbers caused increased mortality. If mortalities were to exceed 5 percent on any single day, trapping would be suspended immediately and DFG personnel notified within 24 hours. Resumption of trapping would occur only after DFG concurrence that corrective action had been implemented to eliminate mortalities. Fortunately, this was not required this year due to low mortality rates throughout the season.

Data Analysis

Abundance Index

Daily velocity measurements were taken directly in front of the cone as follows: the submerged portion of the cone was divided into three cells (right, center, left); within each cell, velocity was measured at 0.2 and 0.8 of the cone operating depth for 60 seconds using a General Oceanics® digital flowmeter (Model 2030). A mean water velocity was calculated for each cell. Each cell area (m^2) was calculated, then multiplied by its corresponding mean water velocity (m/s). The values for each cell were summed, yielding an estimate of volume of river discharge sampled (Q_s) in cubic meters per second (m^3/s). Discharge data from the U.S. Geological Survey Water Resource gauge station at Petrolia (#11469000) was combined with discharge data that was taken from the Lower North Fork Mattole River using a Global Water® data logger (Model WL16). This combined data was used as a surrogate measure of mean daily river discharge (Q) at the trap site. There was a significant difference between river discharge at the USGS gauging station and the respective trap location due to the Lower North Fork Mattole River, just downstream of the gauge. 2006 marked the first year of flow sampling in the LNF Mattole River, enabling the use of the Abundance Index for trend analysis purposes.

Daily catch data were recorded and evaluated for each sample day. Trends in emigration were analyzed on a daily basis using daily abundance indices, adjusting for the days not sampled due to high flows. Daily abundance indices ($Index_d$) for each species and development stage were calculated by the following equation:

Equation 1

$$Index_d = Catch_d / (Q_s/Q).$$

Where: $Catch_d$ = daily catch of a species

Q_s = volume of water sampled (cfs)

Q = mean daily river discharge (cfs)

The usefulness of this index as an estimator of abundance is contingent upon the assumptions that catch rates are directly proportional to the percentage of river flow sampled, and that individuals from a given species and life stage are equally susceptible to capture. The abundance index is not intended to represent a population estimate but is used to compare relative abundance between weeks during the trapping season, between trapping seasons, and between years.

Trap Efficiency Estimates

Trap efficiency tests were conducted throughout the 2006 season. Using standard mark-recapture techniques (outlined above), trap efficiencies were formulated using the following equation:

Equation 2

$$E=R/M, \text{ where } R>0$$

where the estimated trap efficiency E, equals the proportion of marked juveniles recaptured R to the number of marked juveniles released M. This data represents an estimate of the number of fish captured, compared to the total number of fish emigrating past the trap in a particular 24-hour period. Throughout the season, trap positioning was adjusted in order to optimize trapping efficiency. At higher flows the trap was positioned in order to prevent injury or death of fish due to high water velocities within the live box. Peak trap efficiencies were recorded when river flows were low enough to allow the trap to be entirely within the thalweg.

All trap efficiency data analyses were conducted on a volunteer basis by statistician David Gaylor, Ph.D..

2006 Results

Juvenile salmonid monitoring on the Mattole River occurred for 58 days in 2006, as compared with 37 days in 2005. This was in part due to an amendment to the MSG's MOU allowing for 7 days of trapping per week. The trap was deployed in late April, with a start date of 05.3.06. Start dates coincide with river flows reaching levels safe enough for trap installation. End dates are in part due to the water-year type, timing and duration of sustained high water temperatures, catch levels and the accumulation of algal drift. The end date for 2006 was 07.02.06, after numerous days of sustained high water temperatures and low Chinook catch totals.

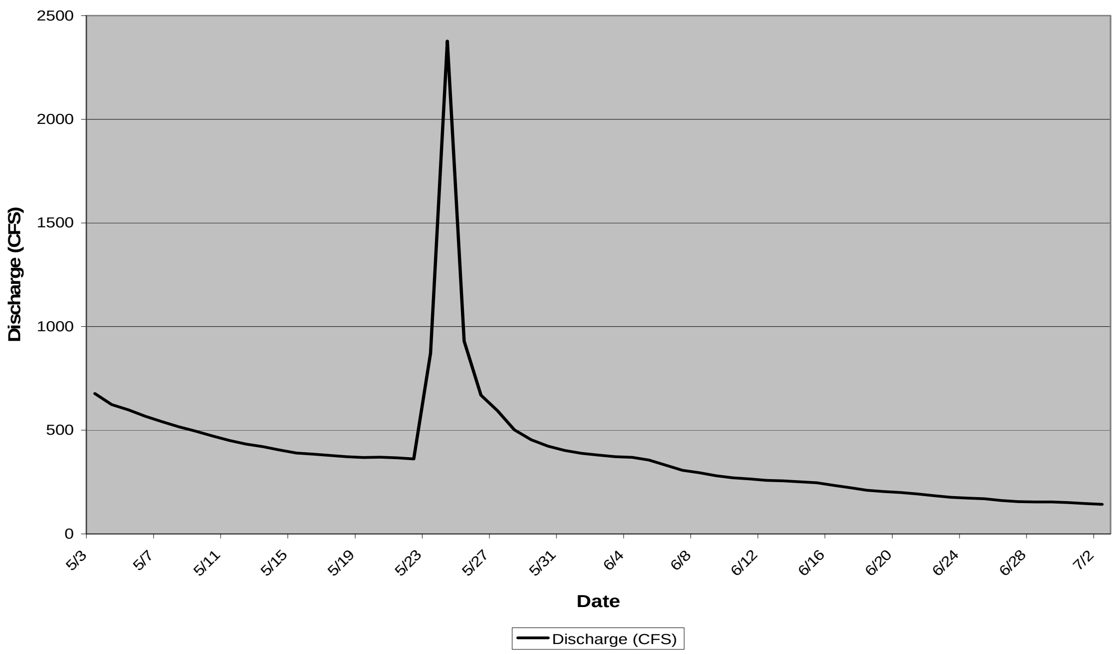
Physical Environment

Discharge

The 2006 season began when river flows reached levels safe enough for MSG personnel to install the 1.5m screw trap. On the first day of trapping, 05.3.06, the flow of the Mattole River was 677 cfs at the trapsite. This flow was calculated by using the USGS flow data for Petrolia, CA along with flow data collected from the Lower North Fork Mattole River (which is downstream of the USGS gauge in Petrolia). A water level recorder was installed in the LNF Mattole River for this purpose. Data from this recorder was analyzed by Bill Pinnix, USFWS.

Flow data for the 2006 season is presented in figure 3. One high flow event occurred on 05.23.06. This event delayed trapping for approximately 3 days. Trapping was resumed on 5.27.06, however, the trap was placed on the edge of the thalweg in order to prevent the higher flows from causing any mortalities to trapped fish. The trap was eased back into the thalweg as river flows decreased.

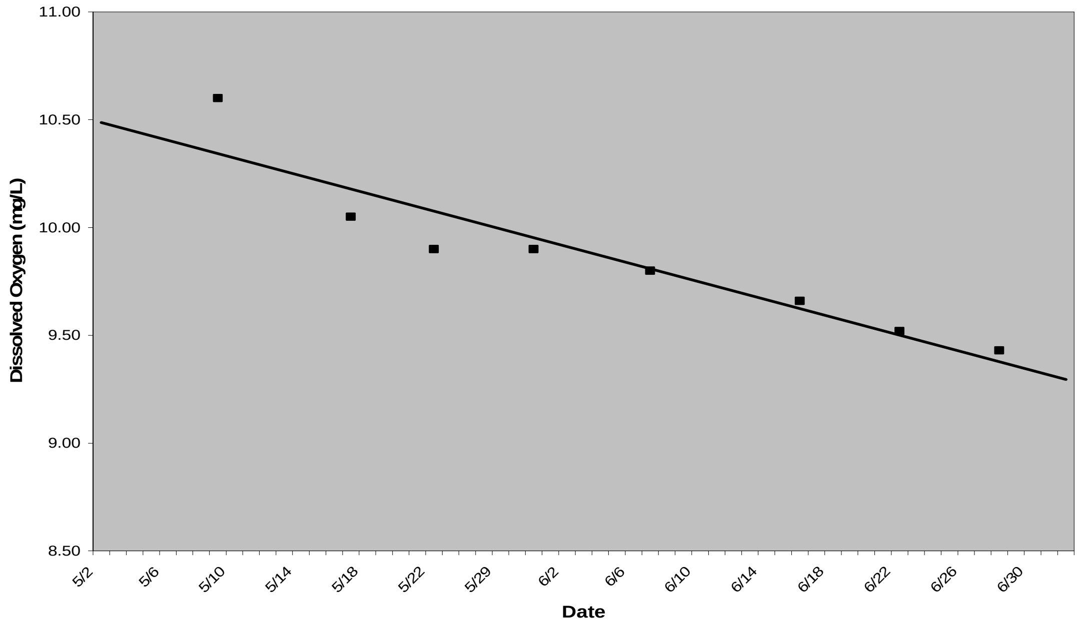
Figure 3 Flow data for the 2006 season.



Dissolved Oxygen

Dissolved oxygen (DO) levels for the 2006 season are presented in Figure 4. DO readings were obtained using a YSI Dissolved Oxygen meter, on loan from the USFWS. Readings were taken inside the livebox of the trap. DO levels for the 2006 season never fell below 9.0 mg/L, ensuring a that a high amount of DO was present at all times within the livebox.

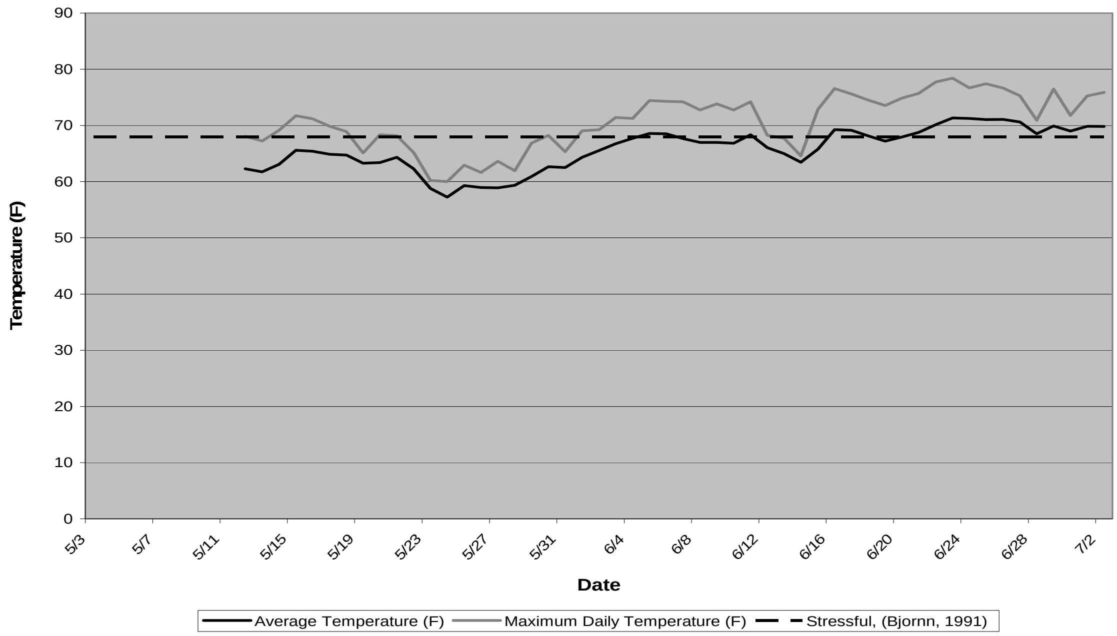
Figure 4 Dissolved oxygen data for the 2006 season, Mattole River.



Water Temperatures

Water temperature data for the 2006 season was obtained using Hobo Temperature Loggers and is presented in Figure 5. A temperature logger was placed on the outside of trap on the first day of trapping, but was lost with the high flow event of 05.23.06. A second logger was placed on the trap on 06.01.06. All data from 05.12.06 to 06.01.06 was obtained from a temperature logger placed at Stansbury Creek, approximately 2 river miles downstream of the trapsite. Temperatures at or above 68º F are thought to be stressful for salmonids (Bjornn, 1991).

Figure 5 Water temperature data for the 2006 season, Mattole River.



Chinook salmon Monitoring

Chinook salmon catch totals

For the 2006 season a total of 8008 Chinook were captured, as compared with 3309 for the 2005. The Chinook abundance index for 2006 was 57,131. (Figures 6 and 7)

Figure 6 Chinook salmon catch totals for the 2005 and 2006 seasons.

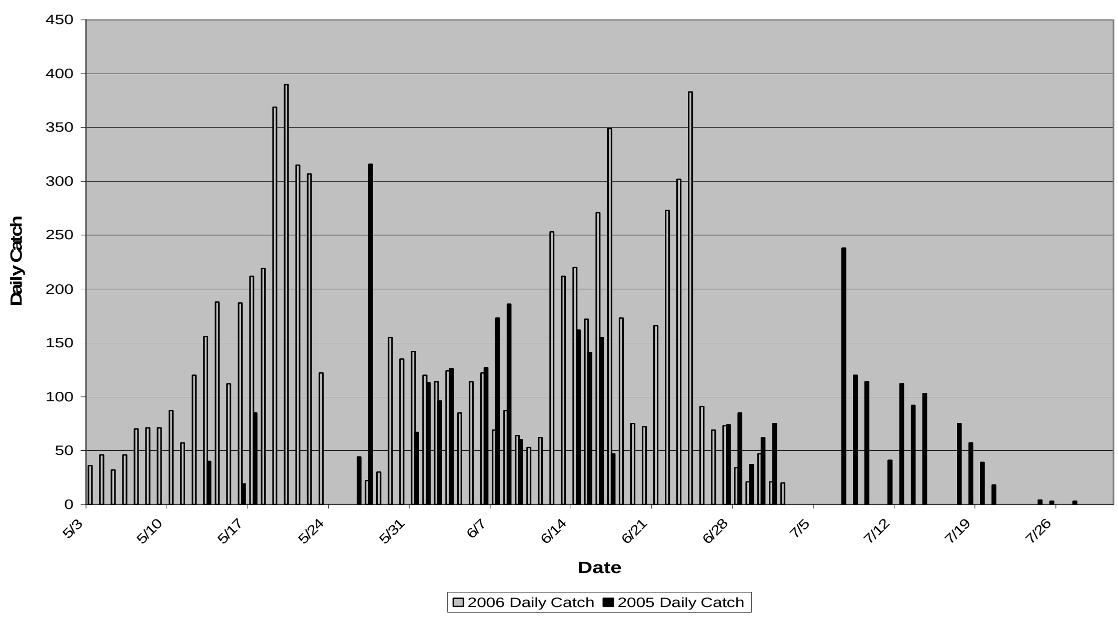
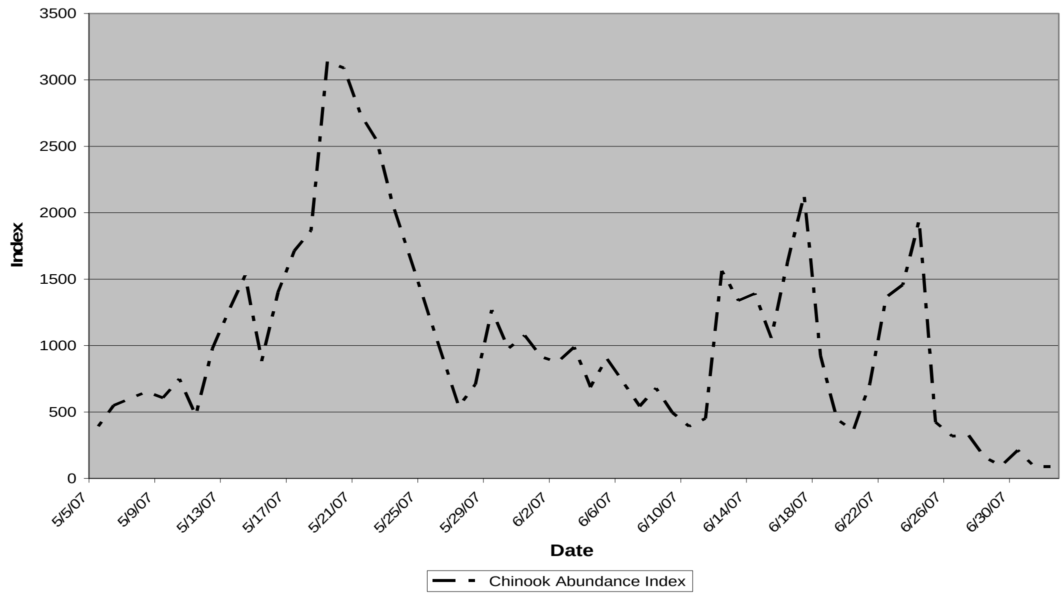


Figure 7 Chinook salmon abundance index for 2006.



Chinook trap efficiency estimates

According to a plot of trap counts for the early days of the trapping season (prepared by David Gaylor), perhaps only about 60 to 180 fish may have been missed prior to the commencement of trapping, a negligible amount compared to the 8008 Chinook salmon trapped during the 2006 season. Similarly, a plot of trap counts at the end of the season revealed that only about 20 to 60 fish were missed by not conducting the trapping season longer.

Hence, starting the trapping season earlier and extending it longer might have detected an additional 80 to 240 fish, which represents only about an additional 1 to 3% of the annual trap count. If the midpoint estimate of 2% (160 fish) is added to the annual trap count of approximately 8000 fish, this adjustment for potential earlier and later migration not captured during the trapping season does not contribute significantly to the uncertainty of the total Chinook migration for 2006.

Trap counts were not obtainable during the high flow rates experienced on 05.24.06 through 05.26.06. Based on the low counts observed immediately before and after the surge, perhaps only about 80 fish were missed in the 3-day period when trapping did not occur. On the other hand, perhaps there was a correspondingly large surge of fish representing a few percent of the total annual migration. In the absence of any additional information, it will be assumed that 160 fish (representing 2% of the total annual trap count) or 800 fish (representing about 10% of the total annual trap count) were missed during this period. These numbers can be readily changed in the calculation for the estimation of the total 2006 Chinook migration presented in the next section.

Total 2006 Chinook Migration

Only a fraction of the migration is captured in the trap. This fraction is called the trap efficiency. The migration is estimated by the trap count divided by the efficiency. For example, if one-eight of the fish are trapped (efficiency of 1/8 = 0.125), the migration count is the (trap count) / (efficiency) = (trap count / 0.125) = 8 x (trap count).

The average trap efficiency for 2006 was 0.120 (Figure 8). A similar average value of 0.128 was obtained for the 2005 season. The two estimates were combined to get an improved average estimate of 0.124, approximately 1/8th, for the trap efficiency. Hence, on the average, the migratory count is approximately 8 times the trap count.

Approximately 8000 Chinook were trapped during the 2006 migratory season. If an additional 160 fish (approximately 2% of the total count) are added to account for additional migration before and after the trapping period and an additional 160 fish are added for the discharge flow surge period of May 24-26, when trapping was not conducted, the total approximate trap count for the season would have been 8320 Chinook. Hence, the total Chinook migration for 2006 would be estimated to be approximately 8 x 8320 = 67,000.

Although there is considerable variation in daily trap counts, this variation is effectively averaged out over the trapping season. The major uncertainty in the calculation of the total annual migration is the trap efficiency. Estimates of efficiency during the 2006 season ranged from 0.012 to 0.338. Using the pooled estimates of trap efficiencies for the 2005 and 2006 seasons, 95% confidence limits for the average trap efficiency are 0.124 ± 0.033, that is, 0.091 to 0.157.

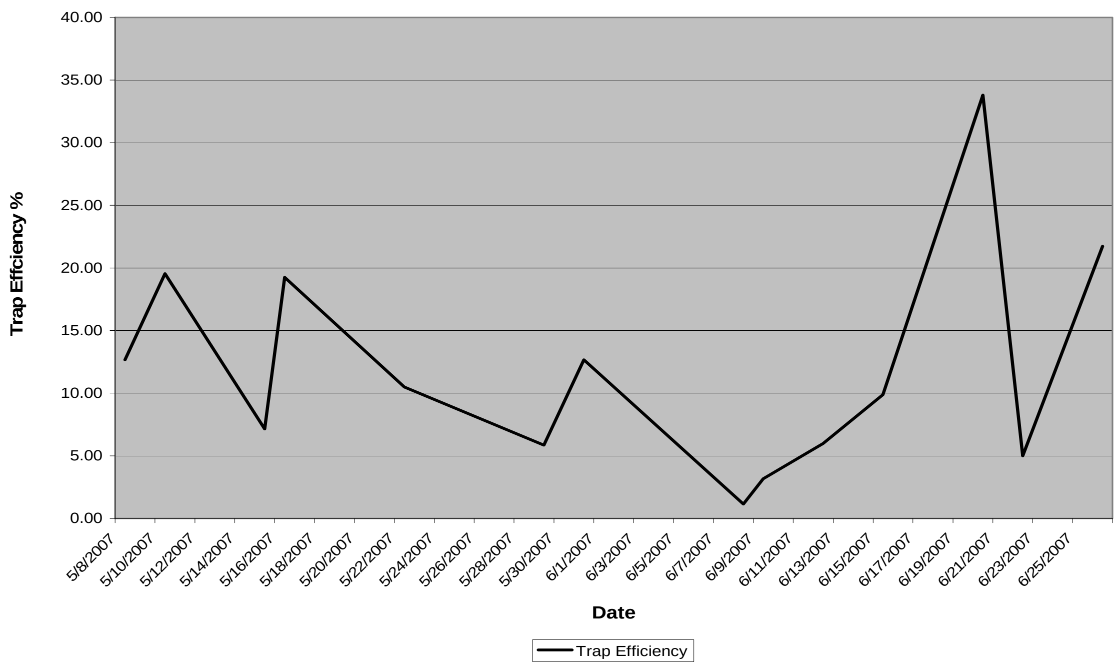
Hence, 95% confidence limits on the total annual 2006 Chinook migration are 8320 / 0.157 = 6.4 x 8320 = 53,000 to 8320 / 0.091 = 11 x 8320 = 92,000. The best estimate of the total 2006 Chinook migration is 67,000 with approximately 95% confidence that the true count lies somewhere between 53,000 and 92,000 fish.

If 800 fish were missed when the trap was not functional during the May 24-26 discharge flow surge, the total approximate trap count for the season would have been: 8000 + 160 + 800 = 8960 Chinook. Then, the total Chinook migration for 2006 would be estimated to be 8 x 8960 = 72,000, with 95% confidence limits of 6.4 x 8960 = 57,000 to 11 x 8960 = 99,000.

Comparison with 2005 Season

During the 2005 season, 3309 Chinook salmon were captured on 37 trapping days, giving an average trap count of 3309 / 37 = 89.4 fish per day. The Chinook migratory season ran from May 13 through July 21, a total of 69 days. Hence, it is estimated that the total trap count for the whole season would have been 89.4 x 69 = 6169 fish. Dividing by the average trap efficiency provides an estimate of the total migration during the 2005 season of 8 x 6169 = 49,000 fish. For the 2006 season, the total Chinook salmon migration estimates of 67,000 or 72,000 indicate considerable improvement of 37 % to 47 % over the estimated 2005 migration of 49,000.

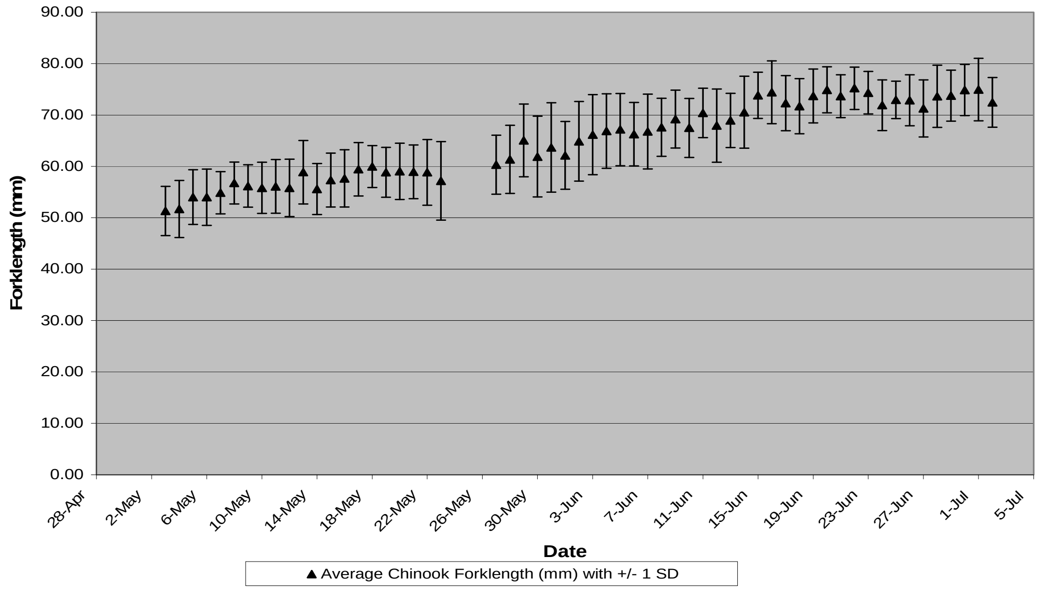
Figure 8 Chinook salmon trap efficiency data for the 2006 season.



Chinook salmon forklengths

Forklengths from 1740 Chinook salmon were measured, accounting for 22% of the total catch, Figure 9. Initial catches of Chinook salmon resulted in an average forklength of 51.33 mm (sd = 4.78, n =30). Final catches revealed an average forklength of 72.44 mm (sd =4.85, n =18). This is an increase of over 21mm throughout the season.

Figure 9 Average Chinook salmon forklengths, 2006.

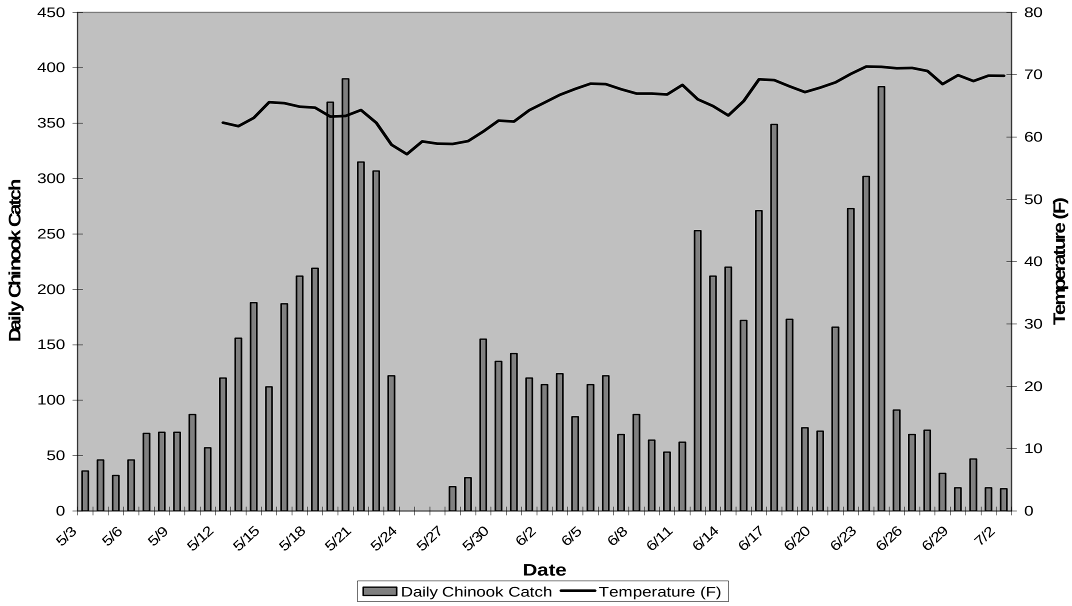


Chinook salmon catches and water temperatures

Water temperatures were obtained from *Hobo Water Temp Pro* data loggers attached to the rear of the trap at a depth of 2.5 feet and one placed at the confluence of Stansbury Creek, app. 2 miles downstream. These loggers monitored river temperatures from 05.12.06 through 07-02-06. By the end of June daily average temperatures reached 68° F and did not go below this level for the rest the season. Temperatures at or above 68° F are thought to be stressful for salmonids (Bjornn, 1991).

Initial catches of Chinook salmon occurred at temperatures around 60° F. These readings were taken with a handheld thermometer. Peaks of the Chinook salmon run occurred at temperatures of 63-64° F. In contrast to the 2005 season, there were several large peaks in daily catches associated with rising temperatures around mid to late June, Figure 10. Temperatures over the stressful level 68º F occurred on 06.22.06 and continued until the trap was pulled on 07.02.06. Stressful levels of temperature were the main factor in ending the season prior to the end of the Chinook salmon run.

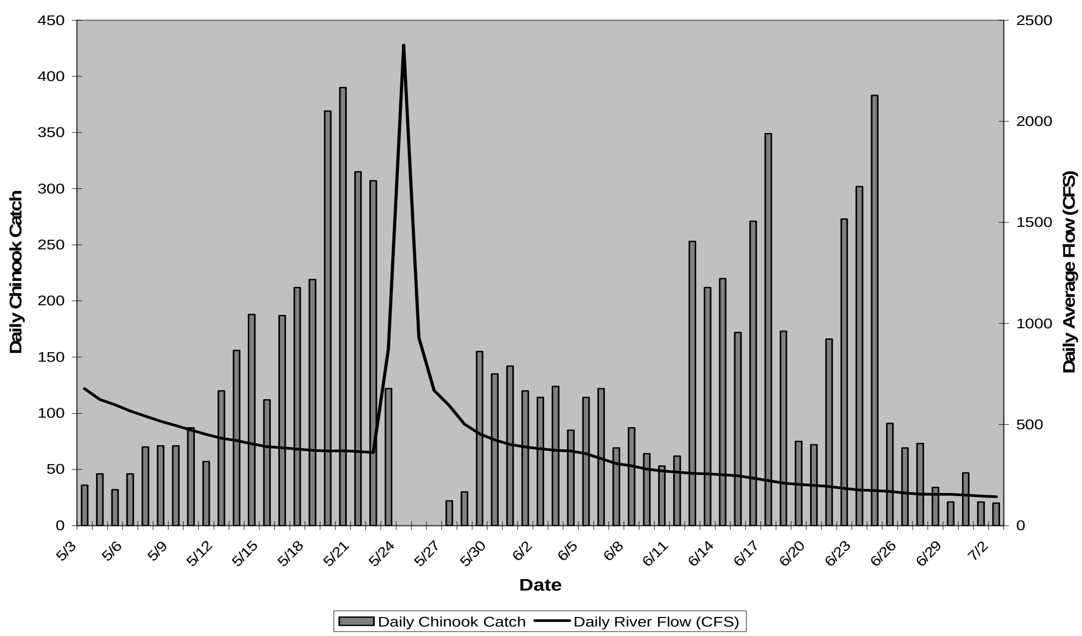
Figure 10 Chinook salmon catch and water temperature (daily average), Mattole River 2006.



Chinook salmon catches and discharge

During the 2006 season, the Chinook salmon run showed a common trend in which juveniles outmigrated during the descending limb of the hydrograph. There was significant outmigration just prior to the 2006 seasons high flow event, Figure 11.

Figure 11 Daily Chinook salmon catch and discharge, Mattole River, 2006.



Coho salmon monitoring

Coho Catch Totals

During the 2006 season, a total of 450 coho salmon smolts and 2 young-of-the-year (YOY) were captured (Figure 12), as compared with 54 smolts and 17 YOY during the 2005 season. Approximately 99.6% of the 2006 total catch was comprised of smolts. The abundance index for 2006 was 3,275 (Figure 13).

Figure 12 Coho salmon catch totals, 2006.

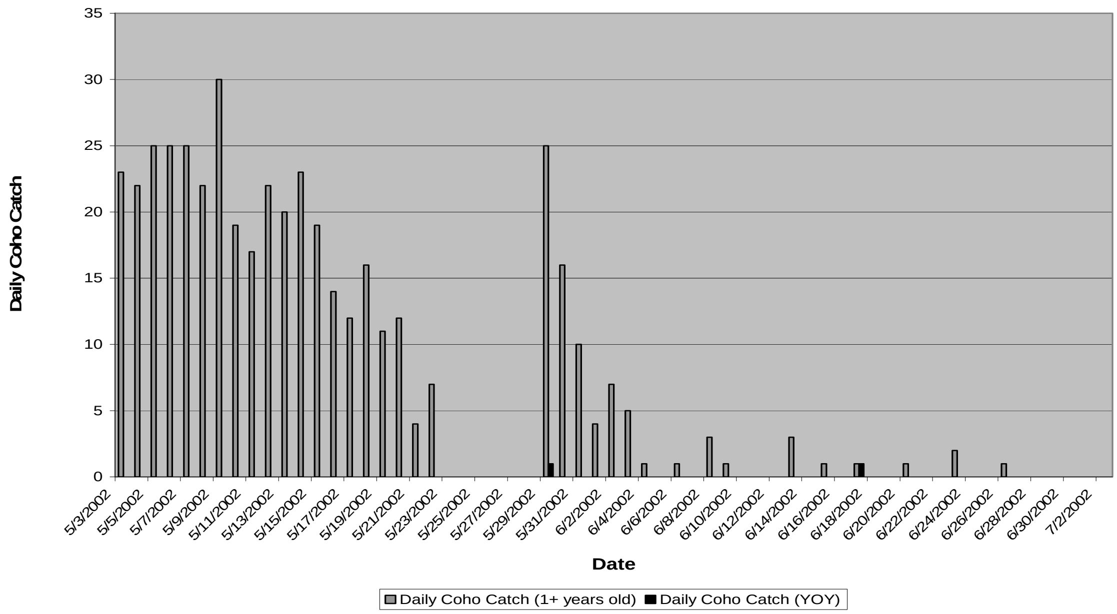
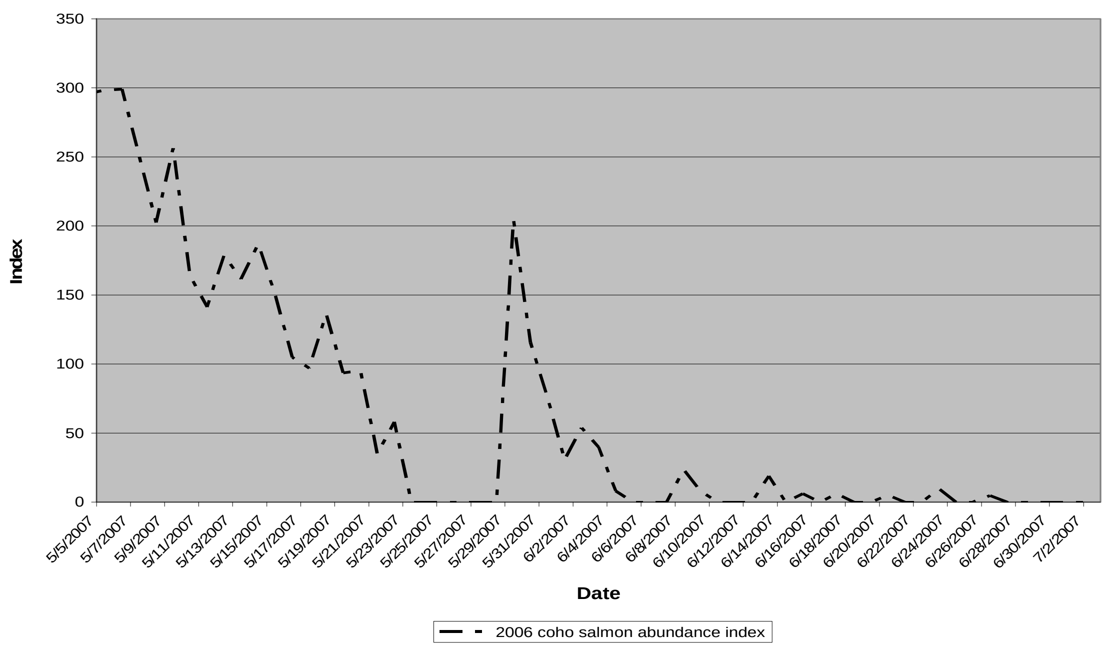


Figure 13 Coho salmon abundance index, 2006.



Coho salmon trap efficiency estimates

A total of three trap efficiency tests were conducted for coho salmon smolts in 2006. The combined average for the three tests was 0.093, which falls within the limits of Gaylor's pooled trap efficiency for 2005 and 2006. Due to the diminishing numbers of coho smolts as the season progressed, trap efficiency tests for coho smolts were concluded early in the season.

A total of 450 coho salmon smolts were trapped during the 2006 season. If the seasonal trap efficiency of 0.124 were apply for coho salmon smolts, a total of 8 x 450 = 3600 fish are estimated to have migrated during days the trap was operated. Based on the consistently high counts during the initial days of trapping, the coho salmon smolt run apparently started before trapping was started. Also, counts were not obtained during the discharge flow surge that peaked on May 24. Hence, additional coho salmon smolts migrated that were not trapped and counted. If only 50 additional fish might have been counted with extended trapping, the estimated 2006 migration would be 8 x (450 + 50) = 8 x 500 = 4000 fish.

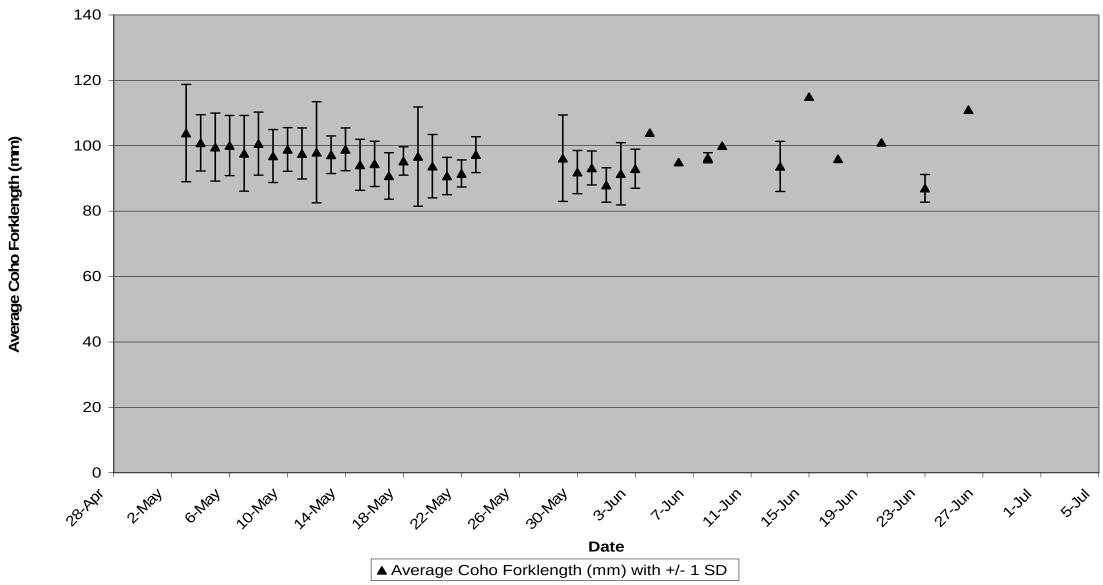
During the 2005 season, a total of 54 Coho salmon smolts were counted on 16 trapping days, an average of 54 / 16 = 3.4 fish per day. The 2005 coho salmon smolt migration appeared to be about 36 days. Hence, a total of 36 x 3.4 = 122 smolts are estimated to have been counted if trapping occurred on every day throughout the season. Applying the trap efficiency factor, it is estimated that about 8 x 122 = 1000 Coho salmon smolts migrated during 2005. It is estimated that over 4000 coho salmon smolts migrated in 2006, over four times more than the estimated migration for 2005.

Only 2 Coho YOY were trapped during the 2006 season. During the 2005 season, 17 Coho YOY were counted from 16 days of trapping, averaging about one per day. Since the 2005 season lasted over one month, the total 2005 Coho YOY count is estimated to be over 30, which is significantly more than only two trapped during the 2006 season.

Coho salmon forklengths

Forklengths from 480 coho salmon were measured (Figure 14), this accounted for 98% of the total catch. Initial coho salmon smolt catches resulted in a daily average forklength of 103.87 mm (sd=14.9, n=30).

Figure 14 Coho salmon smolt daily average forklengths, 2006.



Coho salmon catches and water temperatures

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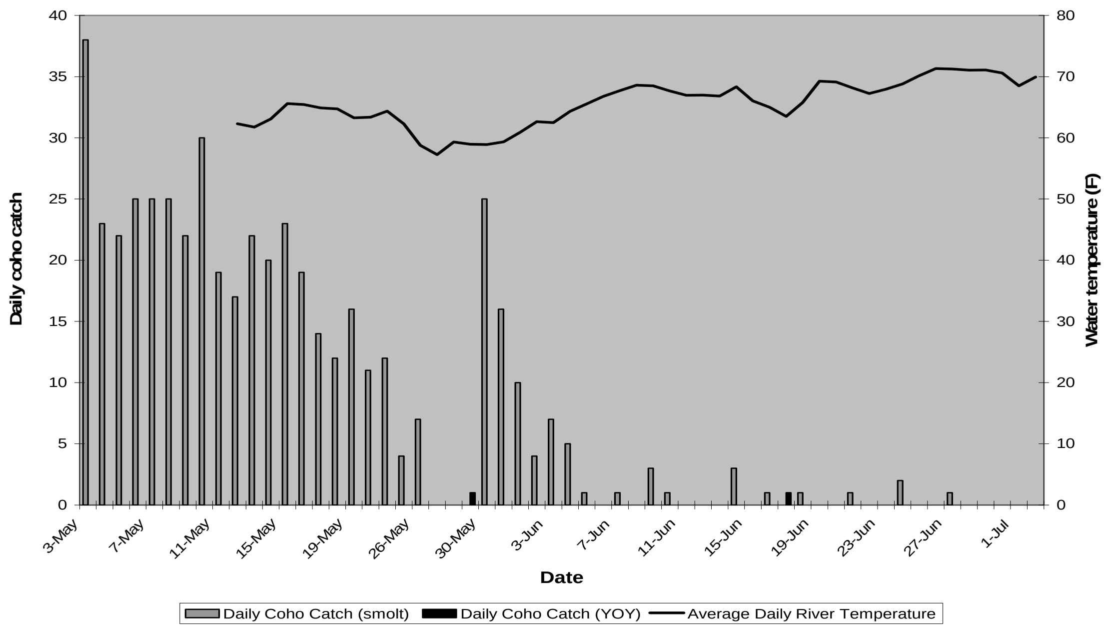
Initial catches of coho salmon occurred at temperatures around 60° F. These readings were taken with a handheld thermometer. The peak of the coho salmon run occurred at temperatures slightly above 60° F. Temperatures over the stressful level 68º F occurred on 06.22.06 and continued until the trap was pulled on 07.02.06. Stressful levels of temperature were the main factor in ending the season, although most of the coho had already migrated past the trap by this time (Figure 15).

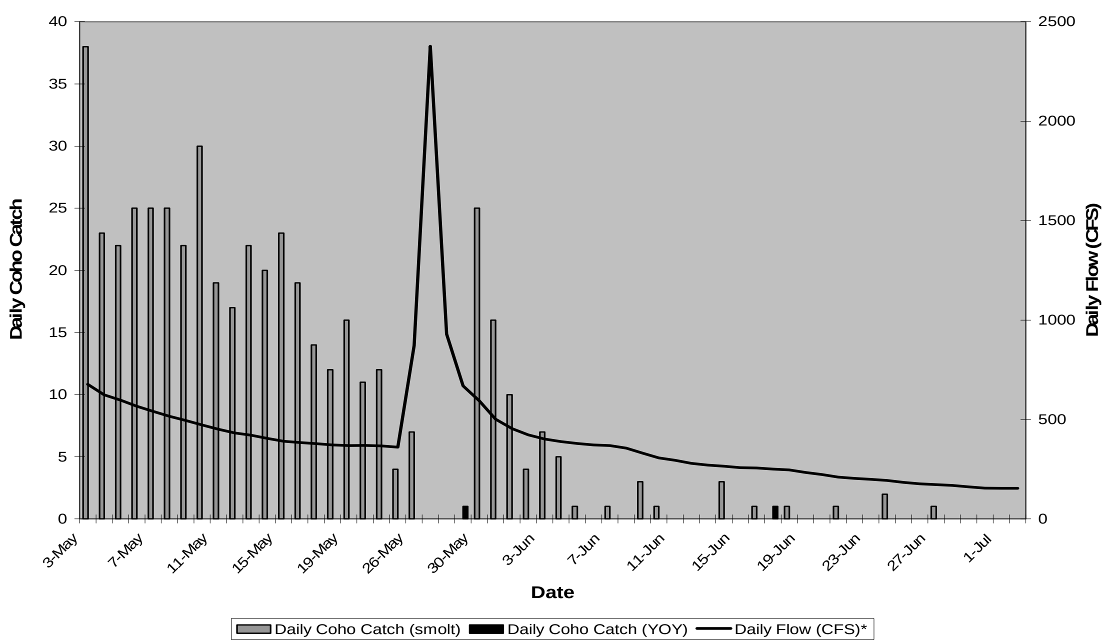
Figure 15 Coho daily catches and water temperature (daily average), Mattole River, 2006.



Coho salmon catches and discharge

The first and largest pulse of coho salmon occurred on 05.03.06 during the first descending limb of the hydrograph. The several succeeding pulses of the coho salmon run occurred during the second descending limb of the hydrograph (Figure 16).

Figure 16 Daily coho catch and discharge, Mattole River, 2006.



Steelhead Monitoring

Steelhead catch totals

During the 2006 season, 15,461 YOY, 712 parr, and 189 smolts were captured (Figures 17 and 18). Abundance indices for steelhead are 83,027 YOY, 5,179 parr, and 1,630 smolts (Figures 19 and 20). Comparisons with 2005 data are not made due to drastic differences in catch totals (see Discussion).

Figure 17 Steelhead parr and smolt daily catches, 2006.

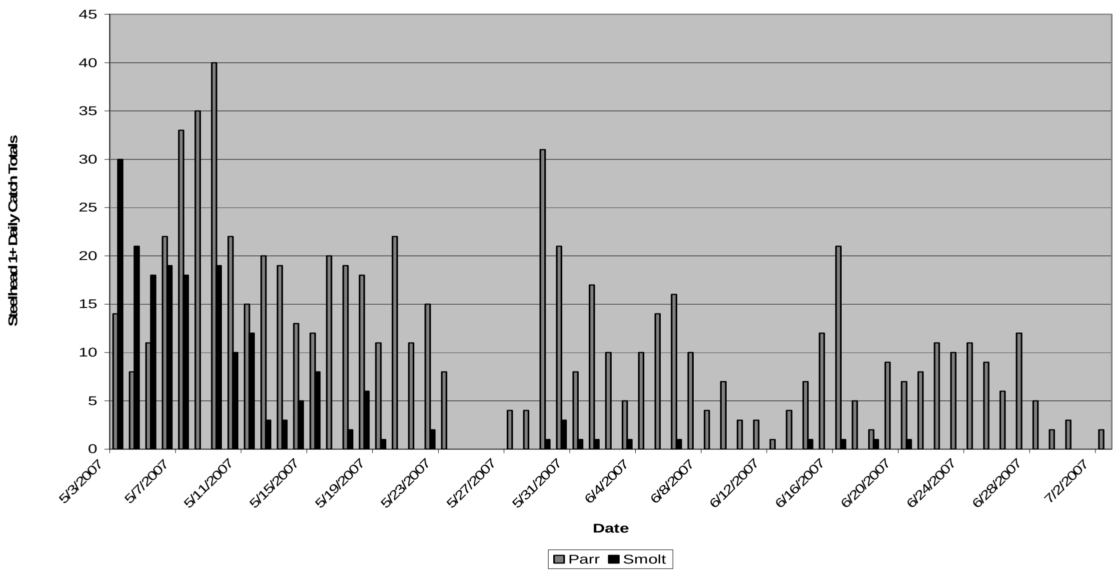


Figure 18 Steelhead YOY daily catch totals 2006.

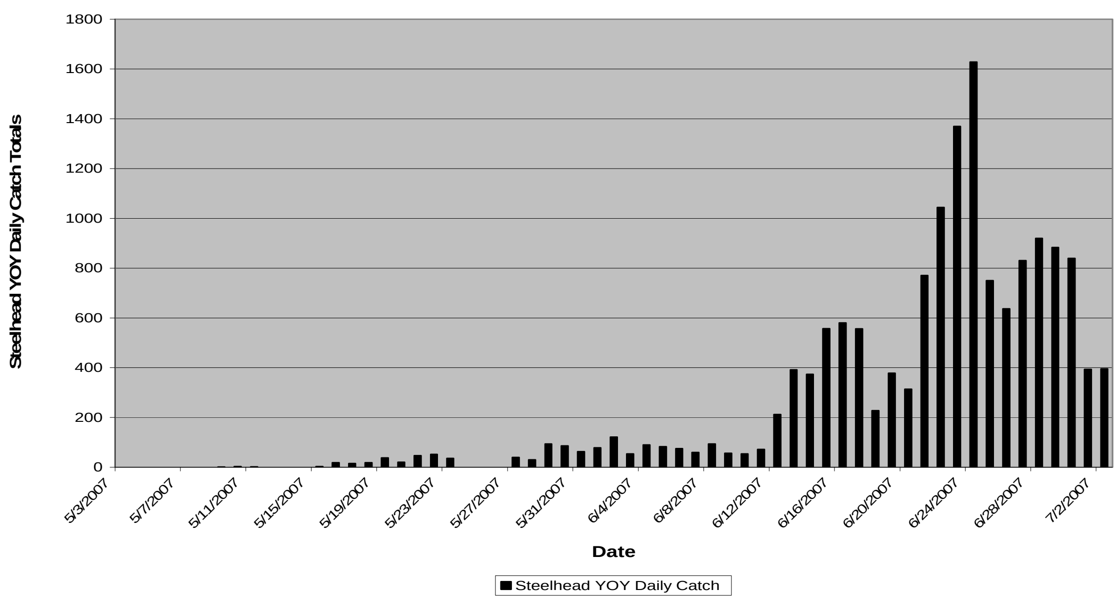


Figure 19 Abundance indices for Steelhead parr and smolts, 2006.

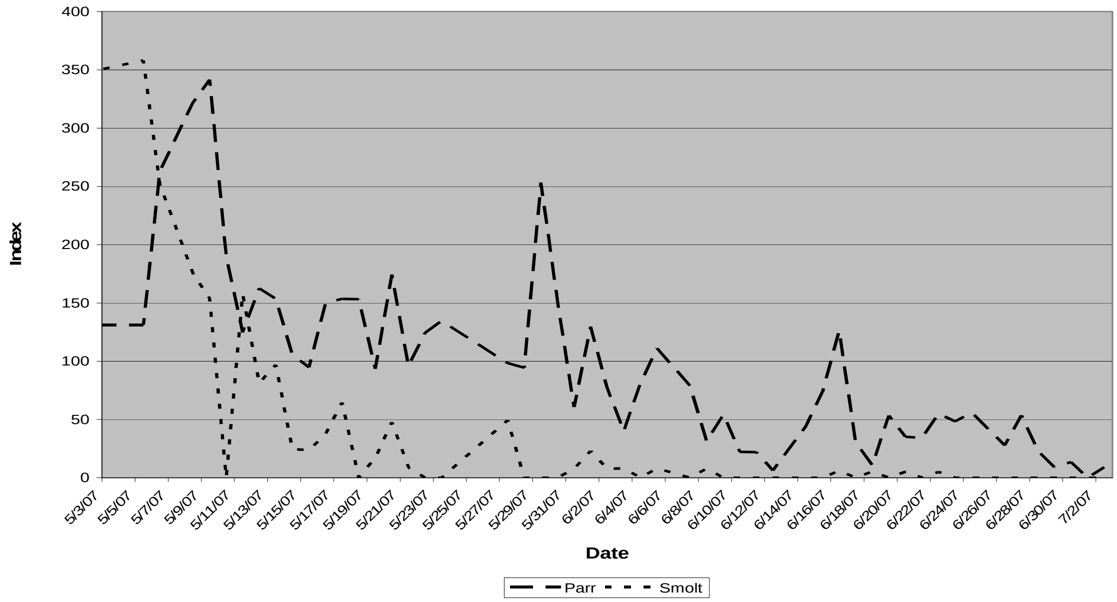
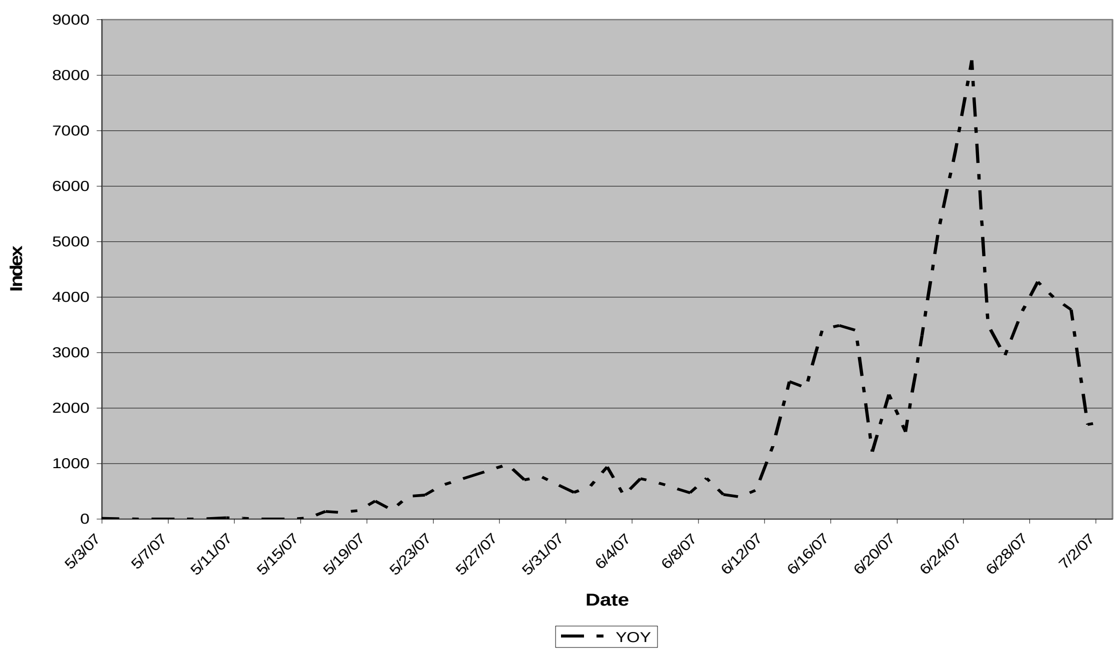


Figure 20 Abundance index for steelhead YOY, 2006.



Steelhead trap efficiency estimates

Steelhead YOY (young of year)

During the 2006 season, 15,461 steelhead YOY were trapped and counted. Approximately 400 steelhead YOY were still being counted per day when trapping ceased after July 2. Had the trapping continued, clearly a few to several hundred more steelhead YOY would have been trapped and counted.

During the 2005 season, 1292 steelhead YOY were counted on 38 trapping days giving an average count of 1292 / 38 = 34 fish per day. The 2005 season lasted approximately from May 13 through August 2, a total of 82 days. Hence, with daily trapping the annual total trap count for 2005 is estimated to be approximately 82 x 34 = 2800 steelhead YOY. The 2006 total count of well over 15,000 shows a significant increase over the estimated 2005 total steelhead YOY trap count of 2800. Note that these are total annual trap counts. Since it is not clear if the trap efficiency of 0.124 applies to Steelhead, this factor was not applied to estimate the total seasonal migration.

Steelhead P+S (Parr plus Smolt)

During the 2006 season, 891 steelhead P+S were counted. It appears that the steelhead P+S season started before trapping began on May 3. Had the trapping started before May 3, it is likely that a few dozen more steelhead P+S would have been trapped and counted.

During the 2005 season, 128 steelhead P+S were counted on 38 trapping days giving an average count of 128 / 38 = 3.4 fish per day. Since the 2005 season lasted about 82 days, the estimated total annual trap count is approximately 82 x 3.4 = 280 steelhead P+S. The estimated 2006 total trap count of well over 900 Steelhead P+S shows a significant increase over the estimated 2005 total annual trap count of 280. Note that these are total annual trap counts. Since it is not clear if the trap efficiency of 0.124 applies to steelhead, this adjustment was not applied to estimate the total seasonal migration.

Steelhead forklengths

Steelhead forklength data for 2006 is presented in figures 21-23. A total of 1250 steelhead YOY were measured (8% of the total catch), with 712 parr (100%), and 189 smolts (100%). Average forklengths for YOY and parr both increased over the course of the season, as average smolt forklengths decreased.

Figure 21 Daily average forklengths for steelhead parr, 2006.

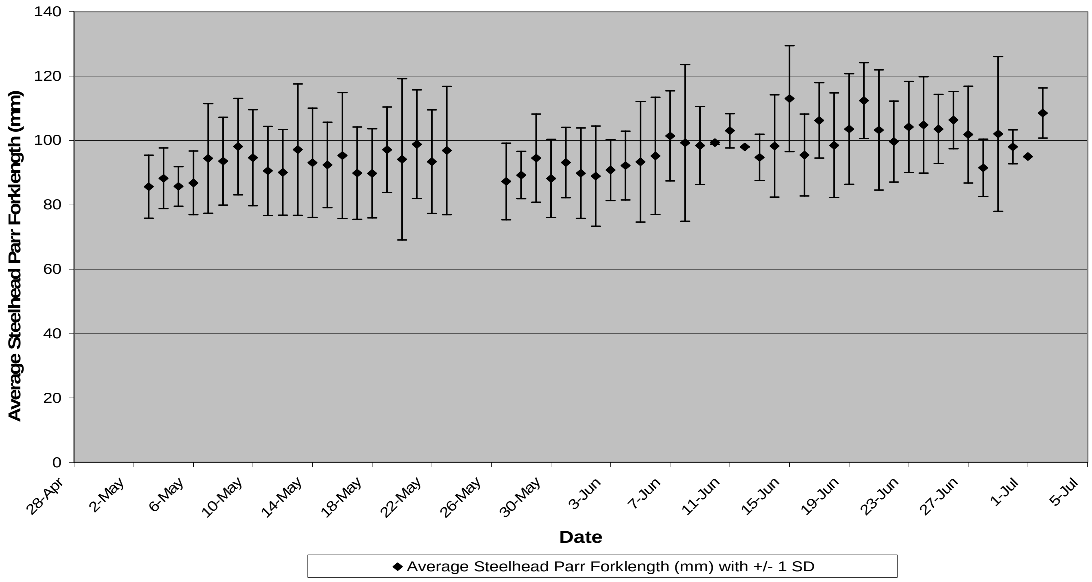


Figure 22 Daily average forklengths for steelhead smolts, 2006.

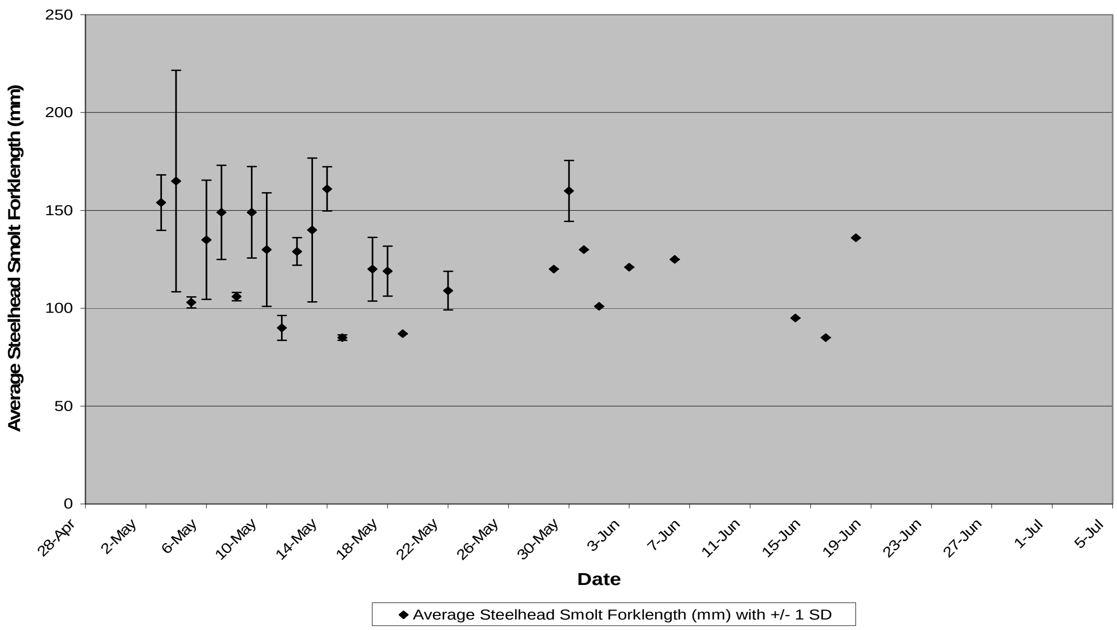
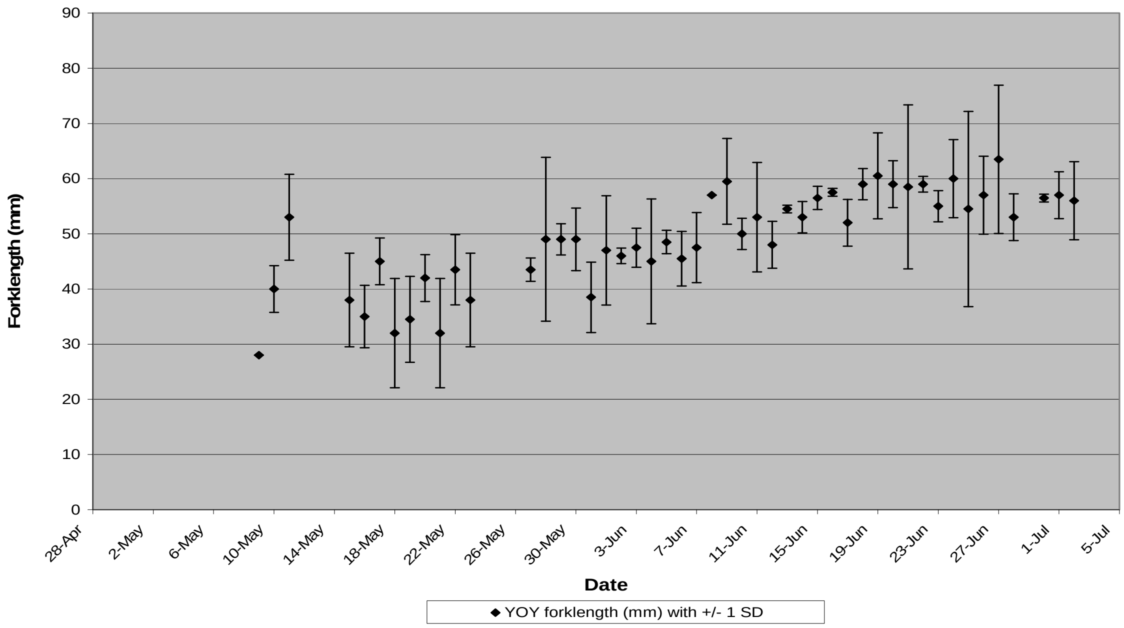


Figure 23 Daily average forklengths for steelhead YOY, 2006.



Steelhead catches and water temperature

Water temperatures were obtained from *Hobo Water Temp Pro* data loggers attached to the rear of the trap at a depth of 2.5 feet and one placed at the confluence of Stansbury Creek, app. 2 miles downstream. These loggers monitored river temperatures from 05.12.06 through 07-02-06. By the end of June daily average temperatures reached 68° F and did not go below this level for the rest the season. Temperatures at or above 68° F are thought to be stressful for salmonids (Bjornn, 1991).

Initial catches of steelhead par and smolts occurred at temperatures around 60° F. These readings were taken with a handheld thermometer. Initial catches of YOY occurred at temperatures of around 64° F. The peak of the smolt run occurred at temperatures at or slightly below 60° F with the YOY run peaking at a daily average temperature of 69° F (figures 24 and 25).

Figure 24 Steelhead parr/smolt catch and water temperature (daily average), 2006.

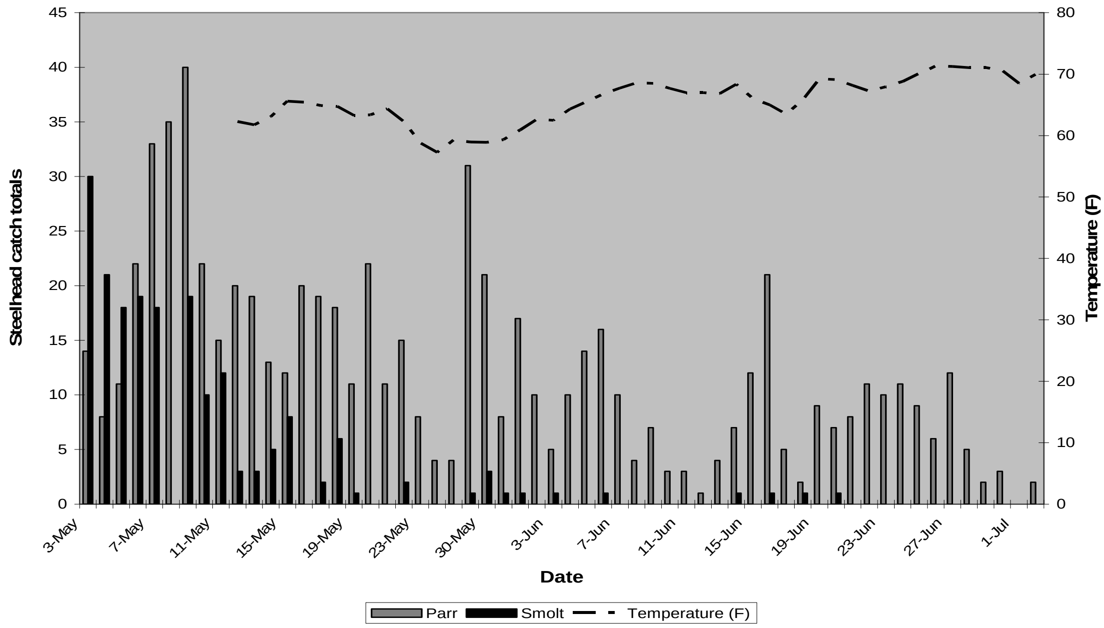
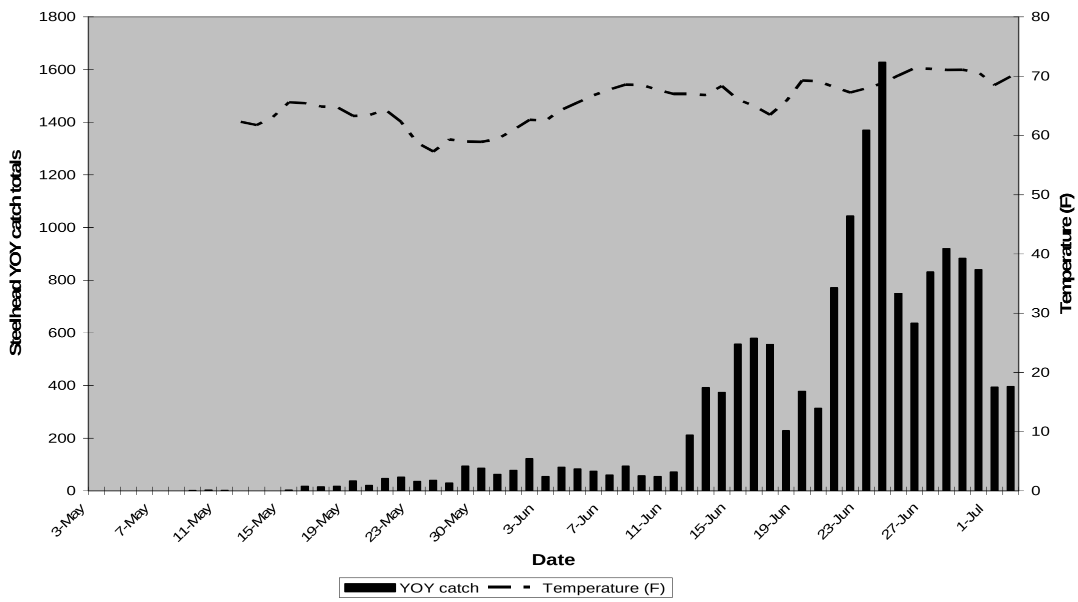


Figure 25 Steelhead YOY catch and water temperature (daily average) 2006.



Steelhead catches and discharge

During the 2006 season, the Steelhead runs showed a common trend in which juveniles outmigrated during the descending limb of the hydrograph (Figures 26 and 27).

Figure 26 Steelhead Parr/Smolt catches and discharge, Mattole River, 2006.

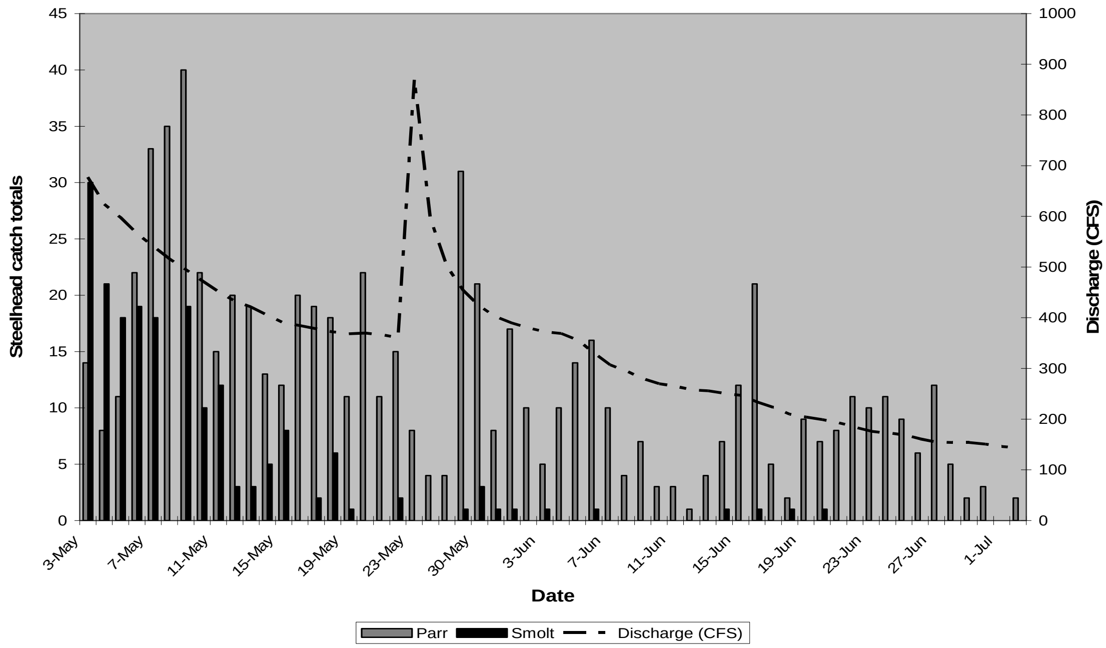
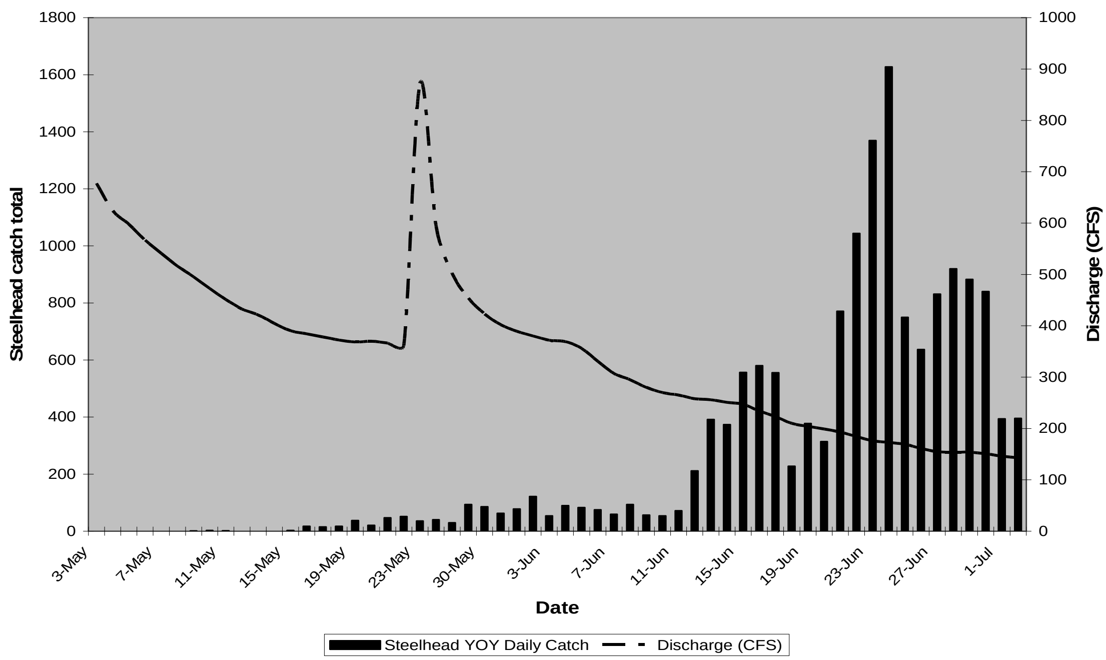


Figure 27 Steelhead YOY catch and discharge, Mattole River, 2006.



Discussion

Catches vary from year to year due in part to water year type and trapping rates. Compared to the cooler temperatures and higher flows that persisted throughout the 2005 season, the 2006 season showed trends of a more typical water year in which river flows dropped and temperatures increased by early July. These two factors have great influence on the yearly trends of salmonid runs on the Mattole River. This was clearly evident in the analysis of the 2006 data.

The 2006 Chinook salmon run showed large pulses of fish corresponding to dropping river flows and rising water temperatures. The seasons highest daily catch totals were around 400 Chinook salmon a day. Comparatively, the 2005 run showed no large pulses, but a steady out-migration throughout the season, with a single daily catch over 300 fish. The end date for 2005 was a month later than the end date for 2006, the more favorable conditions of 2005 allowing the fish a prolonged stay in freshwater prior to emigration to the ocean. The mouth of the Mattole River eventually closed on 07.23.06, well after the larger pulses of Chinook were captured.

The 2006 season marked the first year of continuous trapping throughout the season (barring the 3 days missed during high flows). This caused a great discrepancy between catch totals of 2006 and 2005 (in which the trap was only operated 4 days per week). Based on estimates made by David Gaylor, Ph.D., a larger number of Chinook salmon migrated in 2006 compared to the 2005 season, an increase of 37 - 47%. This estimate coincides with the high number of Chinook spawners observed over the winter of 2005-2006 (MSG, 2006).

The start date 05.03.06 was one of the earliest days of trap commencement on record. This was very evident in the early season catch totals of coho, as well as steelhead smolts. It is thought that the bulk of these runs occur prior to trap deployment in early May. Based on catch totals for the 2006 season, it seems that a higher percentage of these runs were captured than in previous years.

Taking into account the additional days of trapping per week, coho salmon smolt catch totals for the 2006 season were very high in comparison to previous years. Daily catch totals in the early part of the season were averaging in the 20’s and 30’s, whereas the highest daily catch total for the 2005 season was 12. This shows that a much larger portion of the run was captured in 2006 and is a possible indicator of a larger overall coho salmon run.

Steelhead catch totals for the 2006 season were markedly different from those in 2005. During the 2005 season, very low numbers of steelhead captures were recorded. This is thought to be because of the higher flows and cooler temperatures that were predominant throughout the season. It is believed that the bulk of the steelhead remained in the more favorable habitat above the location of the trap in the lower river. This however, was not the case in 2006. Extremely large pulses of steelhead YOY were captured towards the end of the season when flows receded and temperatures climbed, this being a common trend for steelhead in the Mattole River.

Conclusions

Overall, the 2006 monitoring season showed relatively high numbers for each of the three species of juvenile salmonids that migrate on the Mattole River.

The stressful river conditions of high water temperatures and low flows ended the trapping season prior to the end of the Chinook run. Normally, several days of zero Chinook captures marks the end of the season. For the 2006 season however, daily water temperatures of over 75° F were sufficient reason to cease trapping operations. The MSG continues to hold fish health and safety as paramount to any data collection.

Thanks to the assistance of David Gaylor and Bill Pinnix, the MSG was able to make actual estimates of salmonid migration totals for the 2006 season. This data will prove extremely valuable for trend analysis purposes in future years.

The MSG will continue to strive for the earliest commencement date possible each year, in an effort to learn more about the endangered coho salmon runs on the Mattole River.

For the 2007 season, the MSG would like to conduct trap efficiency trials at least three times per week in an effort to achieve more consistent results, which will increase the accuracy of future estimates.

Photographs 2006

Figure 28 The 1.5m screw trap in lower Mattole River (note: incorrect date).

Figure 29 Juvenile salmonids being anaesthetized prior to handling.

Literature Cited

Bjornn, T.C., and Reiser. 1991. *Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats; Habitat Requirements of Salmonids in Streams*. American Fisheries Society Special Publication 19. 4: 83-85.

Mattole Salmon Group (MSG). 2006. *2005-2006 Spawner Survey Final Report.* Petrolia , California.

Steel, E. Ashley. 1999. *In-Steam Factors Affecting Juvenile Salmonid Migration*. University of Washington.

Appendix A Juvenile Salmonid Monitoring in Squaw Creek

Background

During the spring of 2006, a pipe trap was used to collect information on juvenile salmonids in Squaw Creek, one of the Mattole Rivers five largest tributaries. Trapping was conducted in order to collect baseline data of juvenile salmonid presence prior to the construction of 4 large woody debris structures in the fall of 2006. These structures were constructed at the confluence with the Mattole River and just upstream. Trapping will be conducted in 2007, for post project monitoring purposes.

Summary

Trapping was conducted for 25 days, starting on 04.27.06 and ending on 05.22.06. Data was collected using a standard pipe trap consisting of two 40’ x 6” pipes connected to a series of two liveboxes. Data collected is presented in figure 30. Of note were the 136 Chinook salmon and 5 coho salmon smolts that were captured. Mark/recapture estimates were not conducted due to various factors including low daily catch totals and lack of access to the land upstream of the trap location.

Figure 30 DSMT Squaw Creek Data Table

	Chinook salmon	Coho salmon		Steelhead trout			Other fish (non-salmonids)					Amphibians & reptiles					Fish Mortalities	
Date (mo/day)	total Chinook catch	coho young-of-the-year	coho smolt	steelhead young-of-the-year (* = estimated)	steelhead parr	steelhead smolt	Pacific lamprey adult	Pacific lamprey ammocoete	(* = estimated)	prickly sculpin	coastrange sculpin	yellow-legged frog tadpole (* = estimated)	rough-skinned newt	western toad	western pond turtle		Old Mortalities (not related to trap operation)	Fresh Mortalities (related to trapping and/or handling)
4/27				146														1 SH
4/28	1			128	1													5 SH
4/29	2			251		3											1 SH	
4/30				228	2						2						8 SH	1 SH
5/1	4			115	9												1 SH	3 SH
5/2	7			85	7			1			4							
5/3	11			134	18						1						1 CH, 9 SH	2 SH
5/4	6			31	20					1	3						2 SH	4 SH
5/5	6			37	15													
5/6	2			8	1	11												1 SH
5/7	10			19	11						1						2 SH	
5/8	4		1	13	11	7												1 SH
5/9	9			7	22	8												
5/10	6		1	12	30	2					2							
5/11	5			7	44	2			1		6							
5/12	3			5	21	1		1			2							
5/13	6			6	29	1					1							
5/14	5		1	6	24	4												
5/15	8		1	10	15						5						1 SH	1 SH
5/16	9			25	34	5					2						1 CH	
5/17	13			8	28	11					4							7 SH
5/18	7		1	57	48	4			5		2						7 SH	5 SH
5/20	5			96	50	2			9		8						6 SH	4 SH
5/21	6			127	67						13						20 SH	1 SH
5/22	1			44	46	1					10						42 SH	
TOTALS	**136**	**0 , 5**		**1605, 553, 62**			**0, 2**		**15**	**1**	**66**						**2 CH, 100 SH**	**36 SH**