Mattole Salmon Group

Mattole River
Juvenile Salmonid Migrant Monitoring
2005

FINAL REPORT

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Acknowledgements

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Abstract

Monitoring of juvenile salmonid emigration with rotary screw and pipe traps on the Mattole River has been conducted by the Mattole Salmon Group (MSG) since 1985. This report describes monitoring conducted from 13-May 2005 through 01-Aug 2005. Two large and unseasonal storm events occurred during the course of the 2005 trapping season. Due to high flows, trapping was postponed after each event until river flows resumed to levels safe enough to conduct trapping without risking harm to trapped fish and MSG personnel. Catch data for 2005 is presented for juvenile California Coastal Chinook salmon (*Oncorhynchus tshawtscha*), Southern Oregon/Northern California Coastal Coho Salmon (*Onchorhynchus kisutch*), and Northern California Steelhead (*Onchorhynchus mykiss*). Chinook daily catch totals ranged from 0 to 316, with Coho daily catch totals ranging from 0 to 12 and Steelhead daily catch totals ranging from 0 to 86. Temperature and river discharge data are also presented.

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

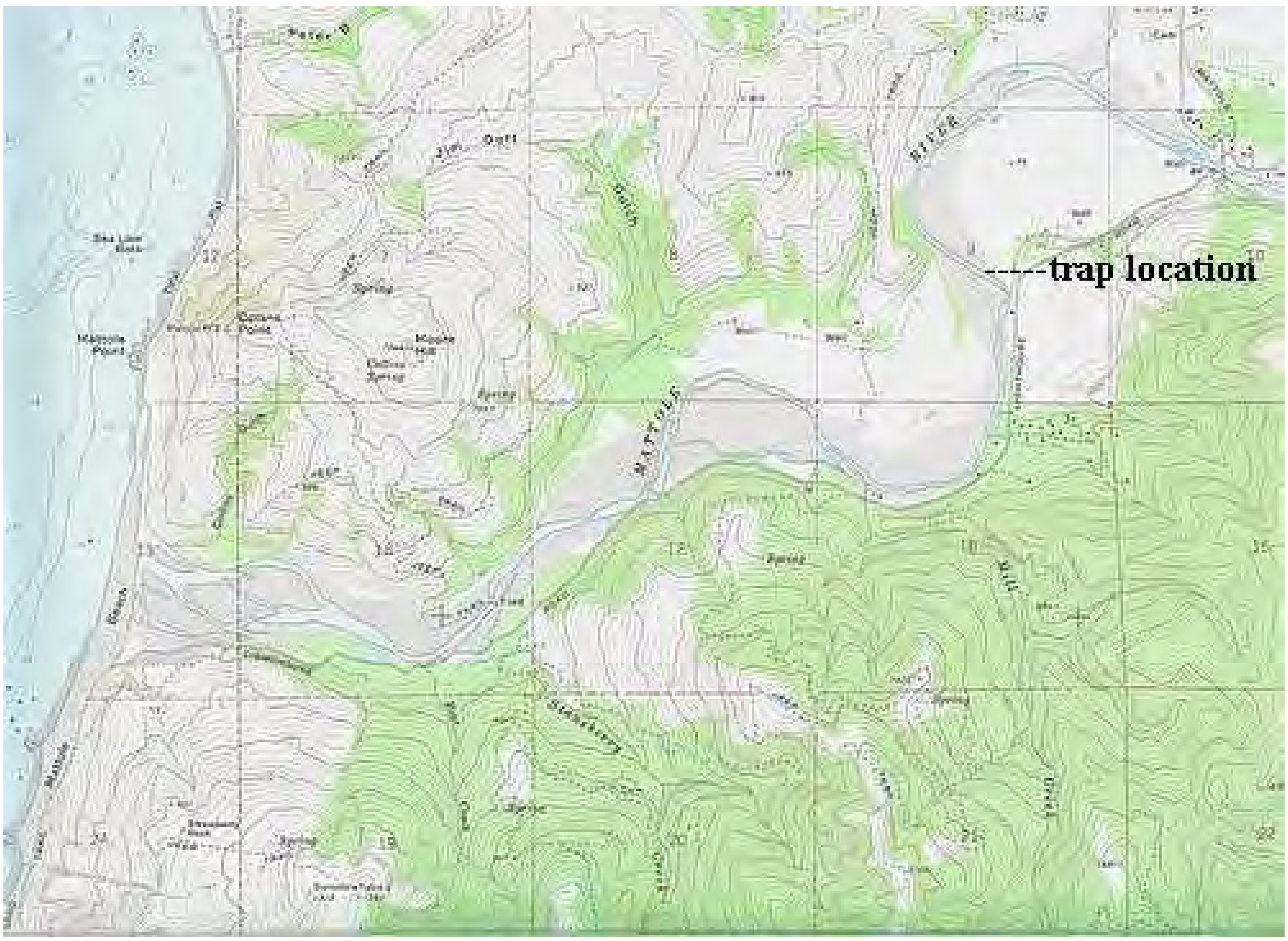
2005 marked the 20th consecutive year of the MSG's Juvenile Salmonid Migrant Monitoring program. The MSG has conducted annual population monitoring of juvenile salmonids (by downstream migrant trapping in spring and early summer) in the lower mainstem Mattole River since 1985 (fyke trap through 1996, 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 2005, due to reduced funding, the MSG decided to focus all of its efforts and funding in 2005 on the lower mainstem, a 1.5 m screw trap on loan from the BLM. 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, in stream 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

A canoe survey was conducted in late April to scout for possible sites to install a 1.5 m screw trap to monitor emigrating salmonids. A suitable site was found and established at river mile (RM) 3.9 (Figure 1). Landowners Dr. Richard Scheinman and Charles Gould permitted the MSG to install and operate the trap on their properties. The 2004 trapping site was not used due to changes in channel morphology, including a much shallower depth, which would have significantly impaired the ability to monitor juvenile salmonid emigration over the full term of natural migrations.

Figure 1 Mattole River and 2005 trap location.



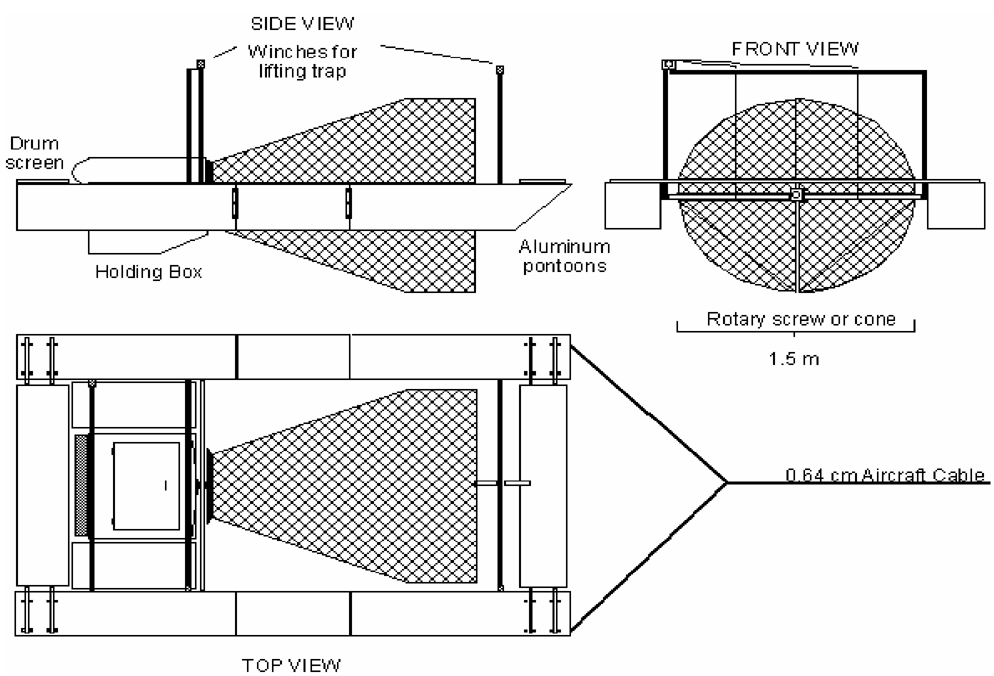
Trap Design and Operation

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 high river discharge, and incrementally moved back into the thalweg as the river discharge decreased. When deployed, the bottom the cone is approximately 1 m 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 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. Due to limited funding, 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 depicting key components and dimensions.



Biological Sampling Procedures

During the 2005 season the rotary screw trap was operated 4 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 25°C, the trap is not operated and will remain non-operational until safe temperature limits recur. This precaution was not necessary during the 2005 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 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 Chinookc, 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 1+, with 1+ fish being much larger in size, silvery, and lacking distinct parr marks. Steelhead were classified as YOY or 1+, the latter of which was determined mainly by size (>90mm) and scale analysis. Scale samples were taken from up to 3 Steelhead, 1+ in age, per day.

Trap efficiencies were estimated for Chinook juveniles using standard mark-recapture techniques. The Mattole has too few Coho to undertake efficiency estimation, and for juvenile steelhead the MSG has found that they don't emigrate promptly after marking and release (McEwan 1996). The mark-recapture protocol for Chinook is as follows: On up to 3 days of each 4-day trapping week, up to 200 juvenile Chinook are 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 Chinook were over 150. Chinook 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 3 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. 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.

Results and Discussion

2005 Rainfall Patterns

The 2005 trapping season began on 05-13-05 and ended on 08-01-05. Days after trapping began, 05-17-05, an unseasonal storm event passed through the Mattole Watershed on. River flows increased from 800 cubic feet per second (cfs) to over 8000 cfs within 24 hours. Trapping was delayed for nine days until river flows reached a level safe enough to ensure no harm to trapped fish or personnel. A second unseasonal storm event occurred in the watershed on 06-17-05. Flows increased to over 9000 cfs from around 500 cfs during the course of this storm. Once again trapping was delayed for 10 days until river flows reached safe levels for trapped fish and personnel.

Trap Efficiencies

Trap efficiency tests were conducted throughout the 2005 season. Using standard mark-recapture techniques (outlined in Biological Sampling Methods), trap efficiencies were formulated using the following equation:

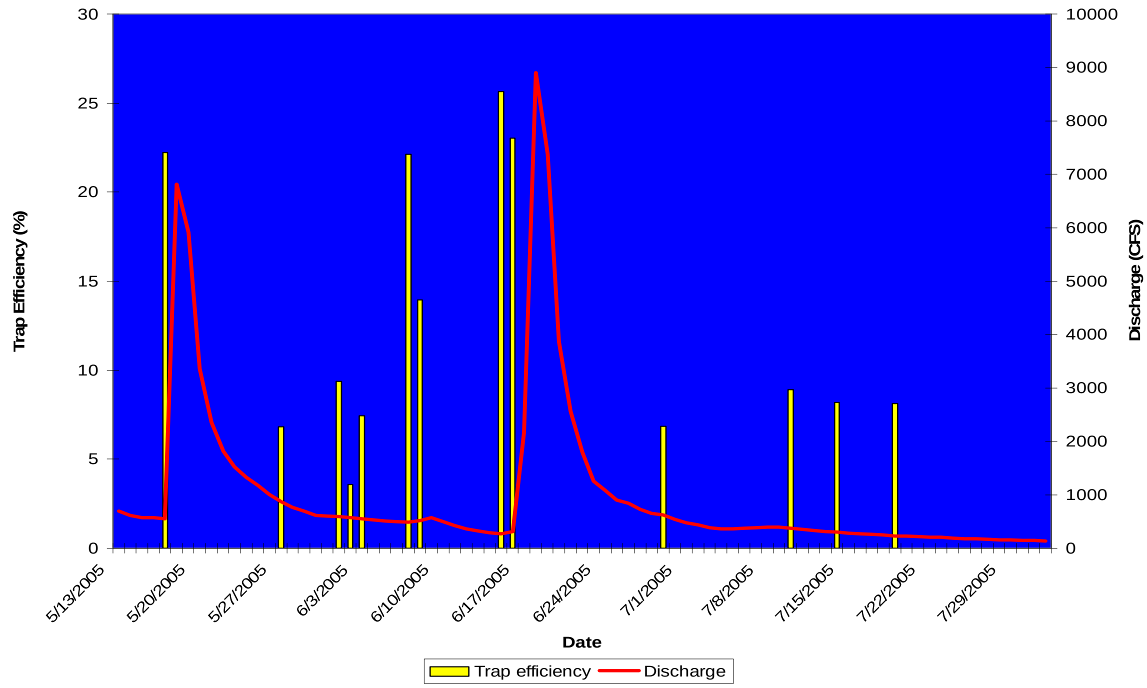
$$E=R/M, \text{ where } R>0$$

where the estimated trap efficiency E, equals the proportion of marked fry recaptured R to the number of marked fry released M. Figure 3 details the trap efficiency test data. Daily trap efficiencies ranged from 3.57 to 25.64 percent. These percentages represent 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. Figure 4 compares trap efficiencies with discharge data for the 2005 season. This figure shows that trap efficiencies were high leading into this years high flow events and then drastically declined as river levels dropped. This could be due, in part, to the gradual easing of the trap back into the thalweg as river flows permitted. Peak trap efficiencies were recorded when river flows were low enough to allow the trap to be entirely within the thalweg.

Figure 3 Trap efficiency estimates for 2005.

Date marked	M	R	Date of recapture	E	Efficiency %
16-May	18	4	17-May	0.222222222	22.22
26-May	44	3	27-May	0.068181818	6.82
31-May	64	6	1-Jun	0.09375	9.38
1-Jun	112	4	2-Jun	0.035714286	3.57
2-Jun	94	7	3-Jun	0.074468085	7.45
6-Jun	122	27	7-Jun	0.221311475	22.13
7-Jun	172	24	8-Jun	0.139534884	13.95
14-Jun	156	40	15-Jun	0.256410256	25.64
15-Jun	139	32	16-Jun	0.230215827	23.02
27-Jun	73	5	28-Jun	0.068493151	6.85
8-Jul	90	8	9-Jul	0.088888889	8.89
12-Jul	110	9	13-Jul	0.081818182	8.18
18-Jul	74	6	19-Jul	0.081081081	8.11

Figure 4 Trap efficiencies and discharge for the 2005 season.



Chinook Monitoring on the Mainstem Mattole

Juvenile salmonid monitoring on the Mattole River occurred for 37 days in 2005, as compared with 24 days in 2004. These dates commenced with trap deployment in May or June and ended in July or August. Start dates are mainly in part due to 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 lower mainstem trap was operational for 46% of the total days possible (start to end date) in 2005. This was in part due to CDFG permitting which only allowed trapping for 4 out of 7 days per week.

Chinook Catch Totals

For the 2005 season, the number of Age 0 Chinook captured was 3229, as compared with 3032 for the 2004 season. The maximum number of Chinook caught occurred on 05-27-05 was 316 (Figure 5) and the minimum number occurred on 07-30-05 with a 0 total. Several days of consecutive 0 totals of Chinook marked the end of the trapping season in 2005.

Figure 6 shows that although Chinook catch totals were comparable for 2004 and 2005, the timing of out migration was quite different. Two large and unseasonal storms produced large amounts of rainfall during the 2005 trapping season. This rainfall raised river levels substantially throughout the entire season. There were no storms that produced significant rainfall in 2004, creating more stressful conditions for Chinook due to low flows and increased temperatures. It is possible that in 2004, the large amount of emigrating fish in a short time period was due to these conditions. It is also possible that the high flows and lower temperatures in 2005 caused a much more gradual emigration for juvenile Chinook.

It is also worth noting that the mouth of the Mattole River closed much later in 2005 than in previous years. The date of mouth closure was well after the trapping season ended. The MSG believes that that the Mattole estuary at one time provided valuable habitat for rearing Chinook through deep pools, and protected slough channels. However, on-going monitoring and recent research performed in the Mattole estuary have documented that water quality conditions reach inhospitable levels for juvenile Chinook. Based on trapping data, late mouth closure and dives by MSG personnel, it is believed that no juvenile Chinook were stranded in the estuary in 2005.

Figure 5 Chinook daily catch for 2005.

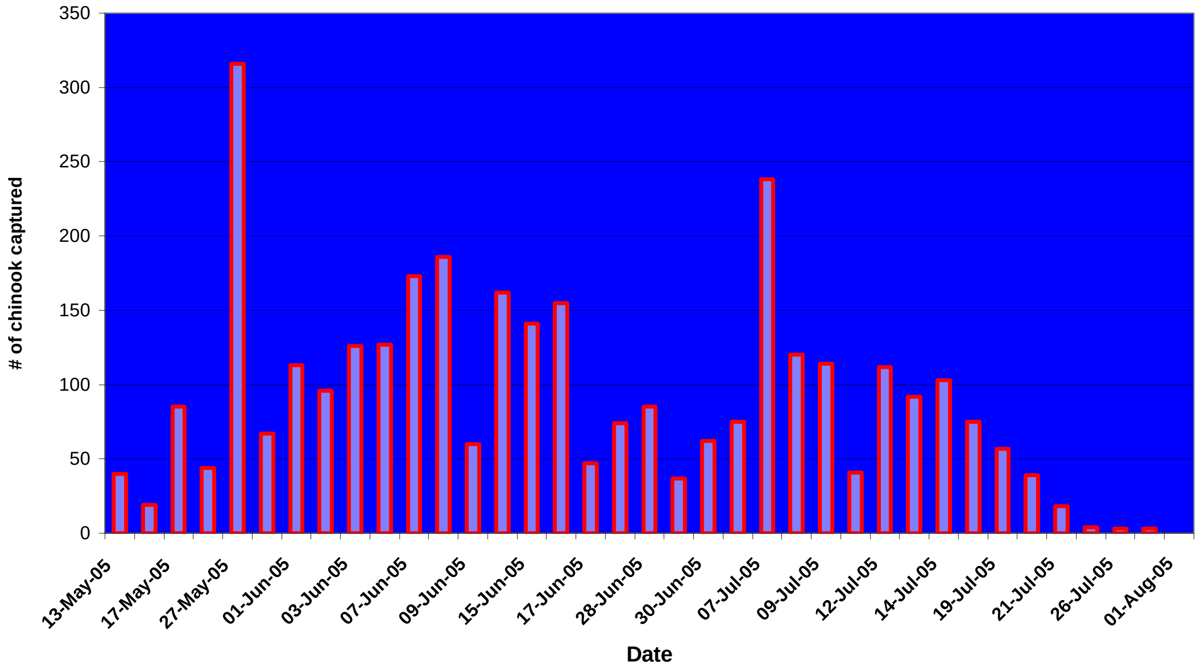
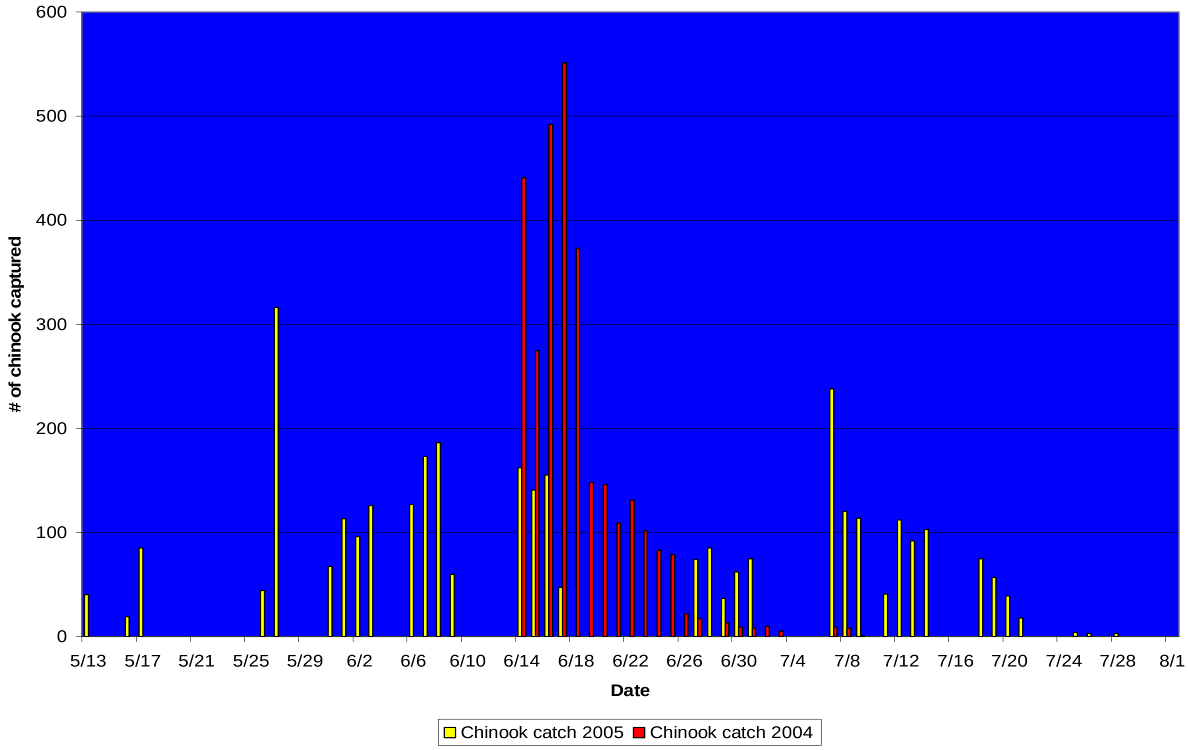


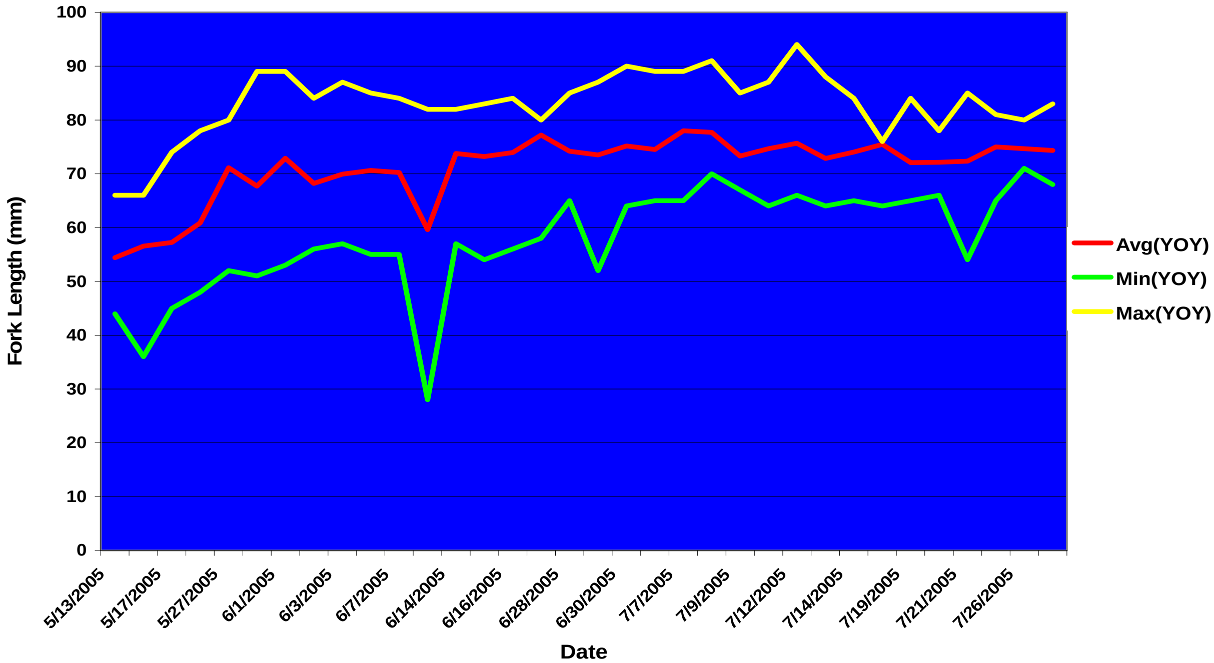
Figure 6 Chinook daily catch 2004 and 2005.



Chinook Fork Lengths

Fork lengths were recorded for 895 Chinook in 2005 (28% of the total 2005 catch). Initial catches of Chinook occurred on 05-13-05 with a daily average fork length of 54.43 mm (sd=5.3, n=30). Average fork lengths increased slowly through the season and on 07-28-05 the daily average fork length measured 74.33 mm (sd=7.77, n=3), with the peak in daily average fork lengths occurring on 07-07-05 at 77.97 mm (sd=5.71, n=30). The maximum fork length measured for a Chinook in 2005 was 94 on 07-12-05 and the minimum fork length for 2005 was 28 mm on 06-14-05. (Figure 7)

Figure 7 Average, Minimum, and Maximum Fork Lengths (mm) for Chinook 2005.

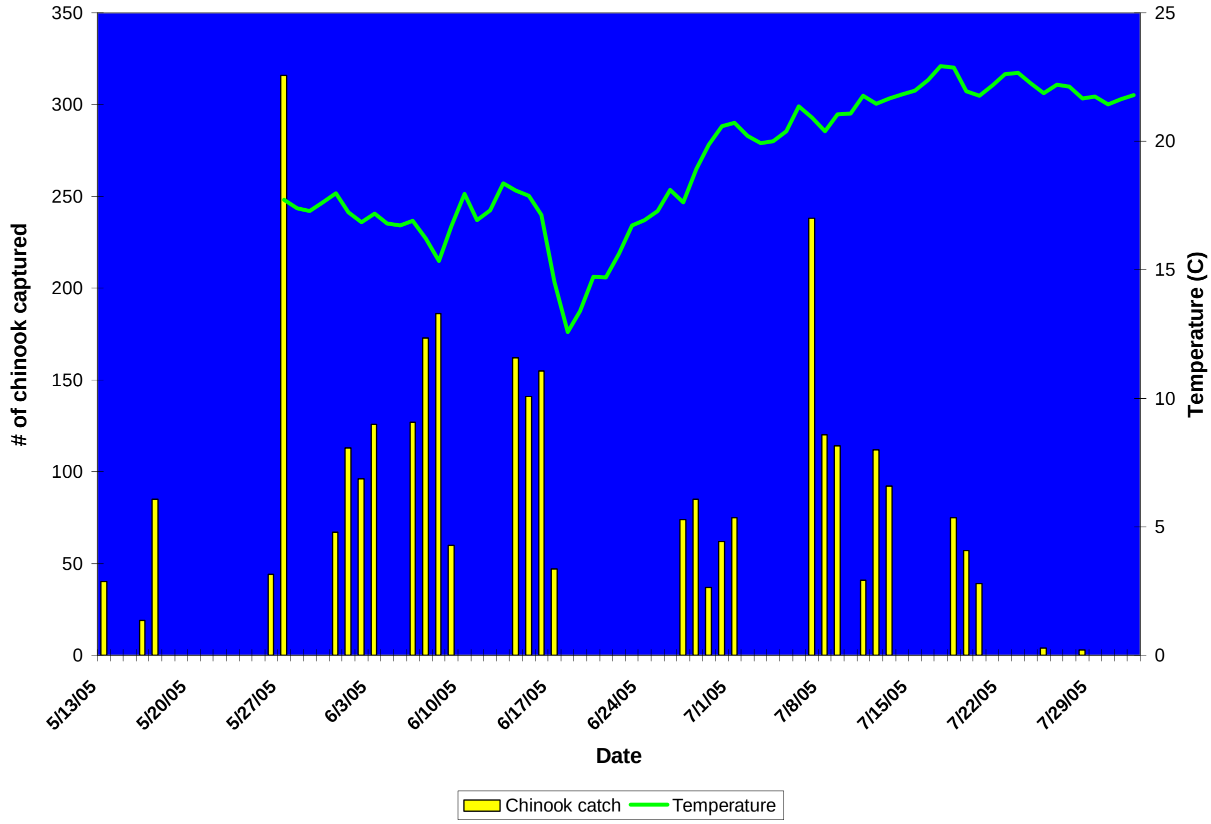


Temperature

Water temperatures were obtained from a *Hobo Water Temp Pro* data logger attached to the rear of the trap at a depth of 2.5 feet. This logger monitored river temperatures from 05-28-05 through 08-01-05. By the end of June daily average temperatures reached 20° C and did not go below this level for the rest the season. Temperatures at or above 20° C are thought to be stressful for salmonids (Bjornn, 1991).

Initial catches of Chinook occurred at temperatures of 15-16° C. These readings were taken with a handheld thermometer prior to the deployment of the data logger. Peaks of the Chinook run occurred at temperatures of 17-18°C and 21-22°C. In contrast to previous seasons, there were no large peaks in daily catches associated with rising temperatures (Figure 8).

Figure 8 Chinook catch and daily average temperature (taken by *Hobo Water Temp Pro* data logger).

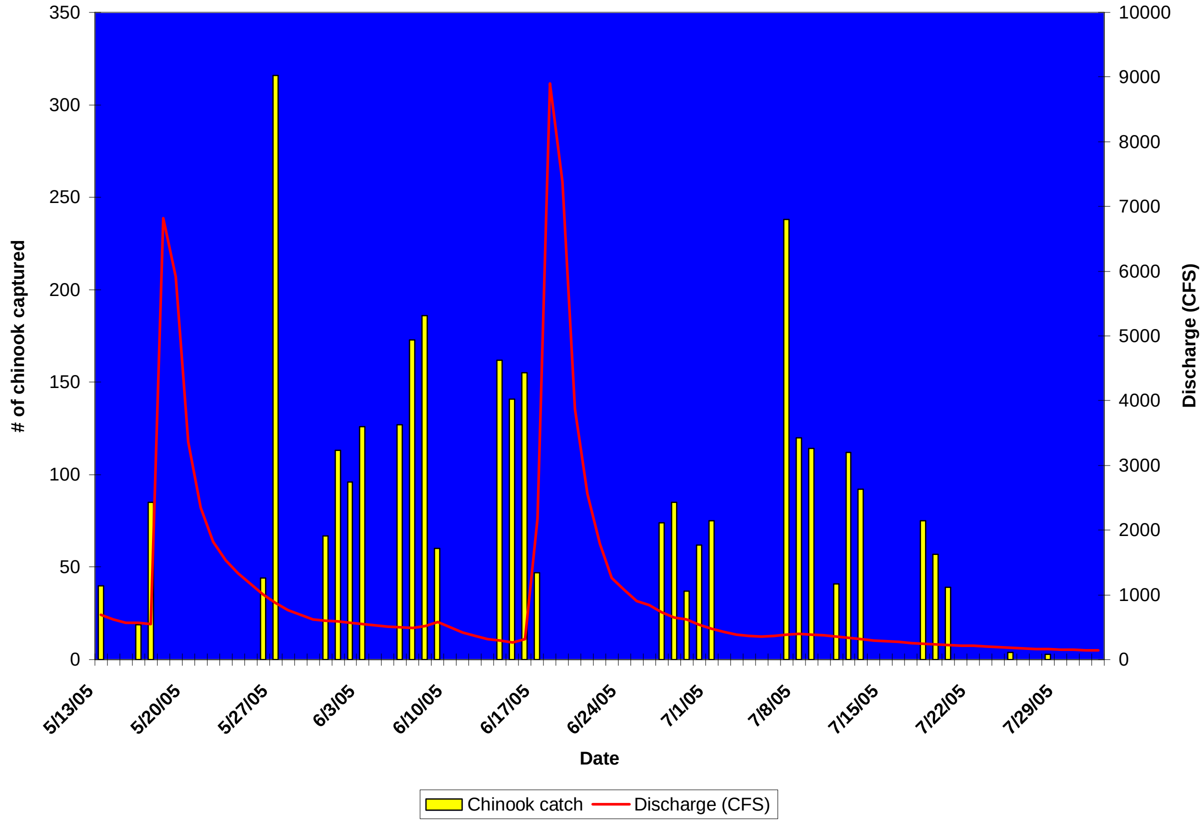


Discharge

Discharge for the Mattole River is measured daily in cubic feet per second (cfs) using the USGS Service monitoring gage # 11469000 at Petrolia, CA. The trap was positioned approximately 2 river miles downstream of this gauge. However, the confluence of the Lower North Fork lies between the gauge and trap site, and it is believed that this tributary can contribute up to 10% of the mainstem flow in high flow situations. As part of the 2006 season, the MSG plans to determine the actual contribution, in cfs, of the Lower North Fork to the mainstem Mattole River.

This season the Chinook run showed a common trend in which larger than average numbers of juvenile Chinook out migrated during the descending limbs of the hydrograph. (Figure 9)

Figure 9 Chinook catch and daily average discharge (Flow rates taken from USGS gauge # 11469000 Mattole River, Petrolia CA).

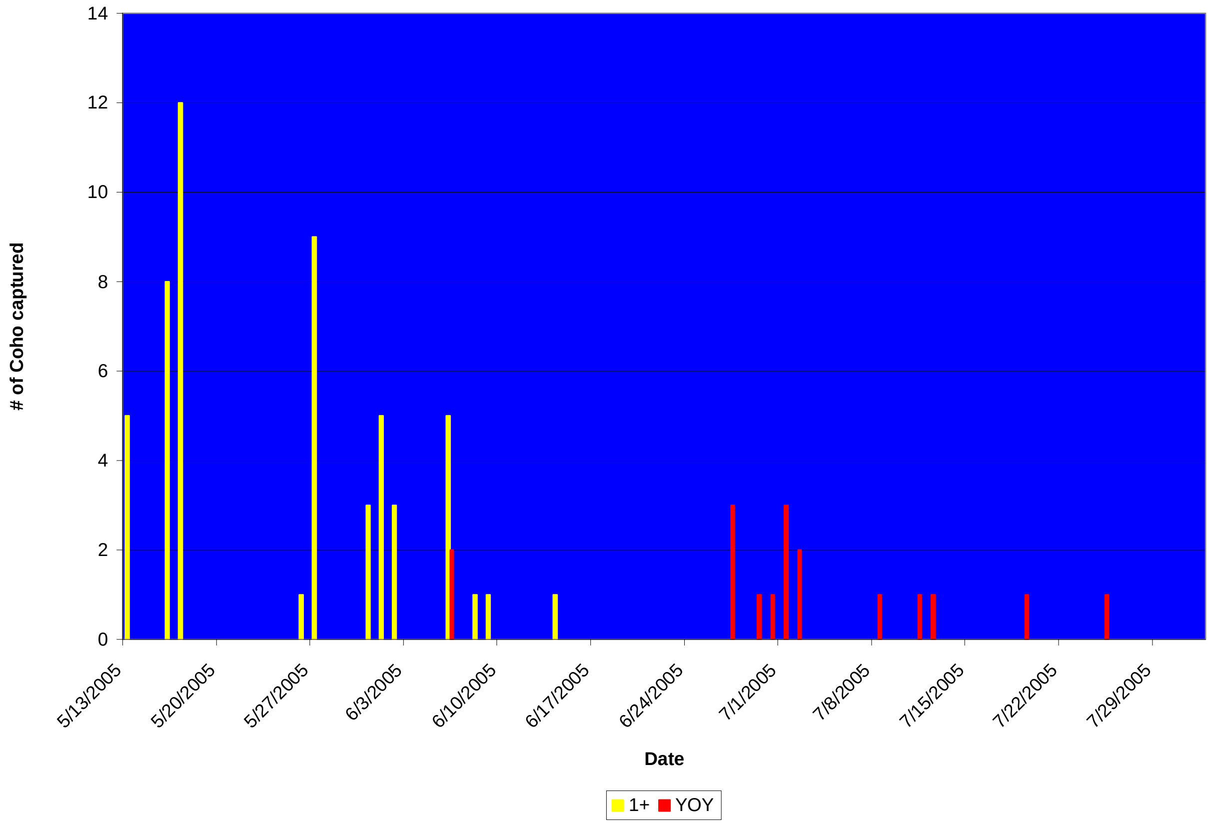


Coho Catch Totals

For the 2005 season a total of 71 coho were captured, compared with 2 for the 2004 season. Fifteen coho that were captured after 06-27-05 and 2 coho that were captured on 06-06-05 were considered young of the year and comprised 24% of this season's total catch of coho. Designation of age was based on size, timing of emigration and physical characteristics. The remaining 54 coho were considered 1+ (older than one year), and comprised 76% of this 'years catch of coho. (Figure 10)

It is believed that catch numbers were higher for 2005 as compared with 2004, in part due to an earlier commencement date for trapping, which was considerably earlier than in previous years. This proved invaluable with larger numbers of 1+ coho being captured than in previous seasons. Also of note, were the 17 young of the year captured in the later part of the season. Regardless of the causes associated with these observations, this data suggests that in certain years, YOY coho do rear in lower river and estuary. This increases the need for habitat restoration in this part of the watershed.

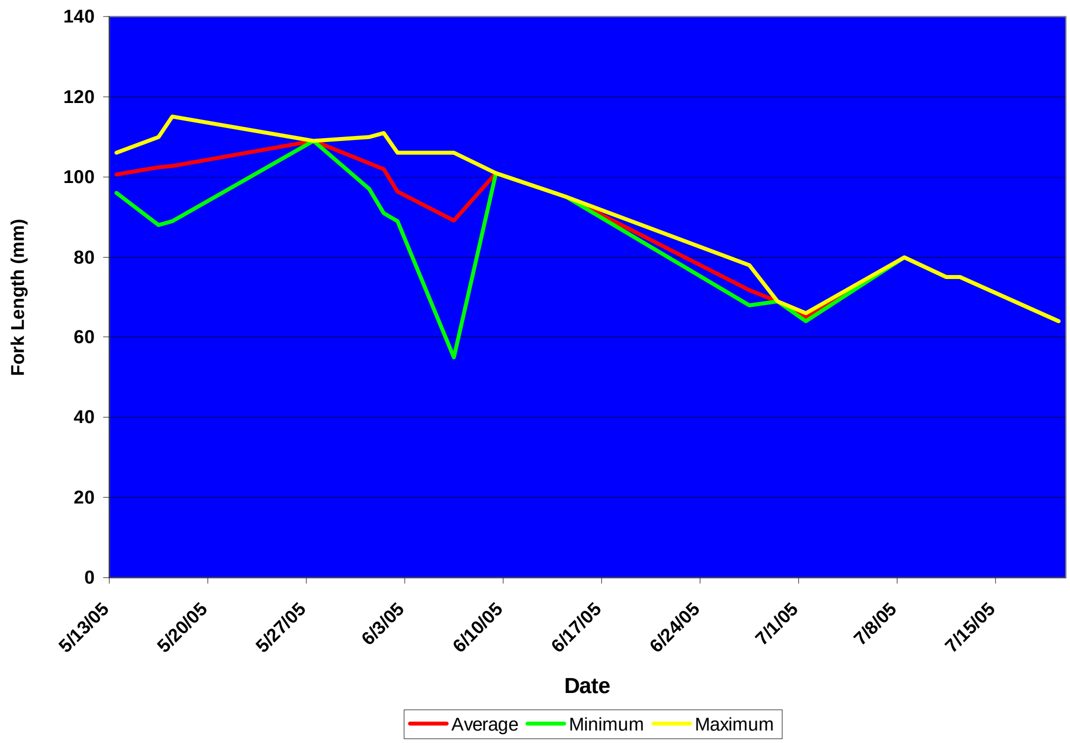
Figure 10 Coho Daily Catch for 2005.



Coho Fork Lengths

Fork lengths were taken from the 71 coho (100 % of the total coho catch) that were captured. Initial catches of 1+ coho occurred on 05-13-05 with a daily average fork length of 100.6 mm (sd=3.71, n=5). Catches on 06-27-05 had a daily average fork length of 71.67 mm (sd=5.51, n=5). Catches on and after 06-27-05 were considered young of the year. A considerable difference can be seen in daily fork length average after this date. Final catches of coho occurred on 07-25-05 with a daily average fork length of 68 mm (sd=0, n=1). (Figure 11)

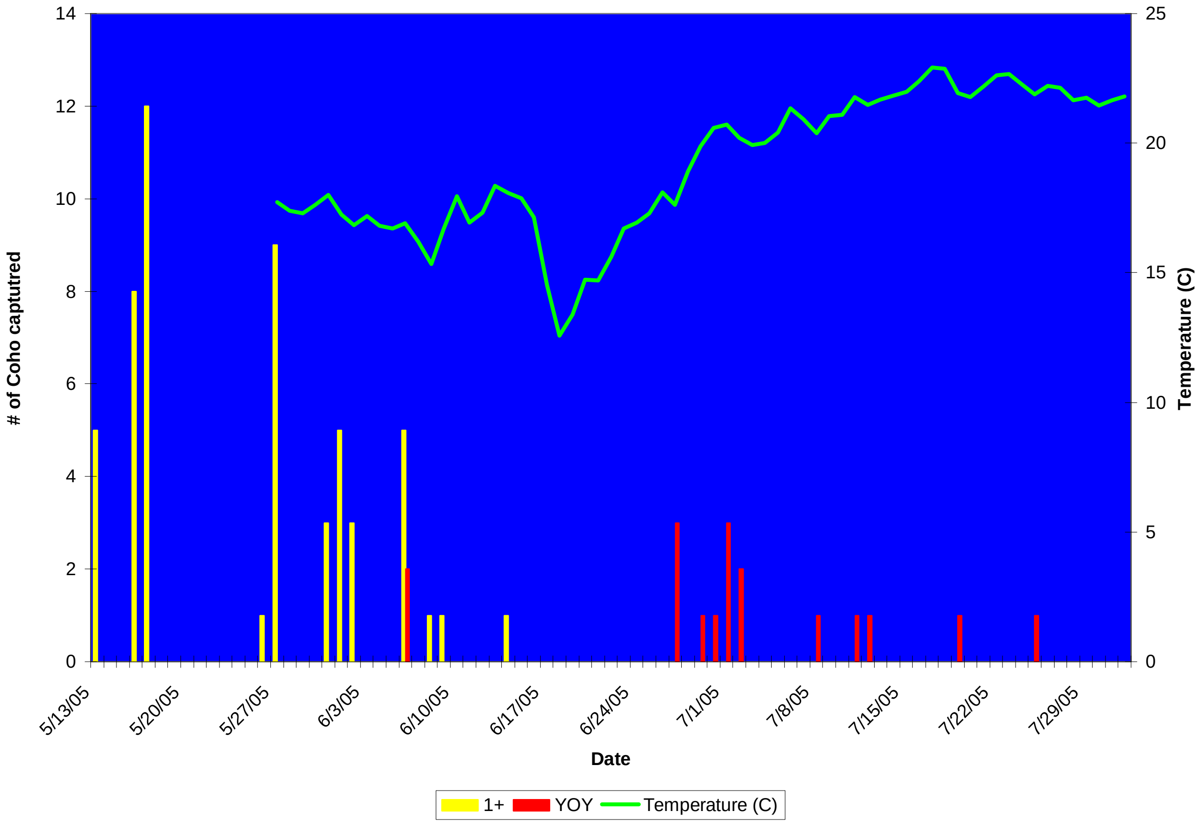
Figure 11 Average, Minimum and Maximum Fork Lengths (mm) for Coho 2005.



Temperature (Coho)

Initial catches of coho occurred at temperatures of 15-16° C. These readings were taken with a handheld thermometer prior to the deployment of the data logger. The first peak of the 1+ coho run occurred on 05-17-05 with temperatures in the 15-16° C range. The second peak of the 1+ coho run occurred on 06-06-05 with temperatures ranging from 16-17° C. Temperatures from 06-27-05 through 08-01-05 ranged from 17-22° C, and all fish captured over these dates were considered young-of-the-year (Figure 12).

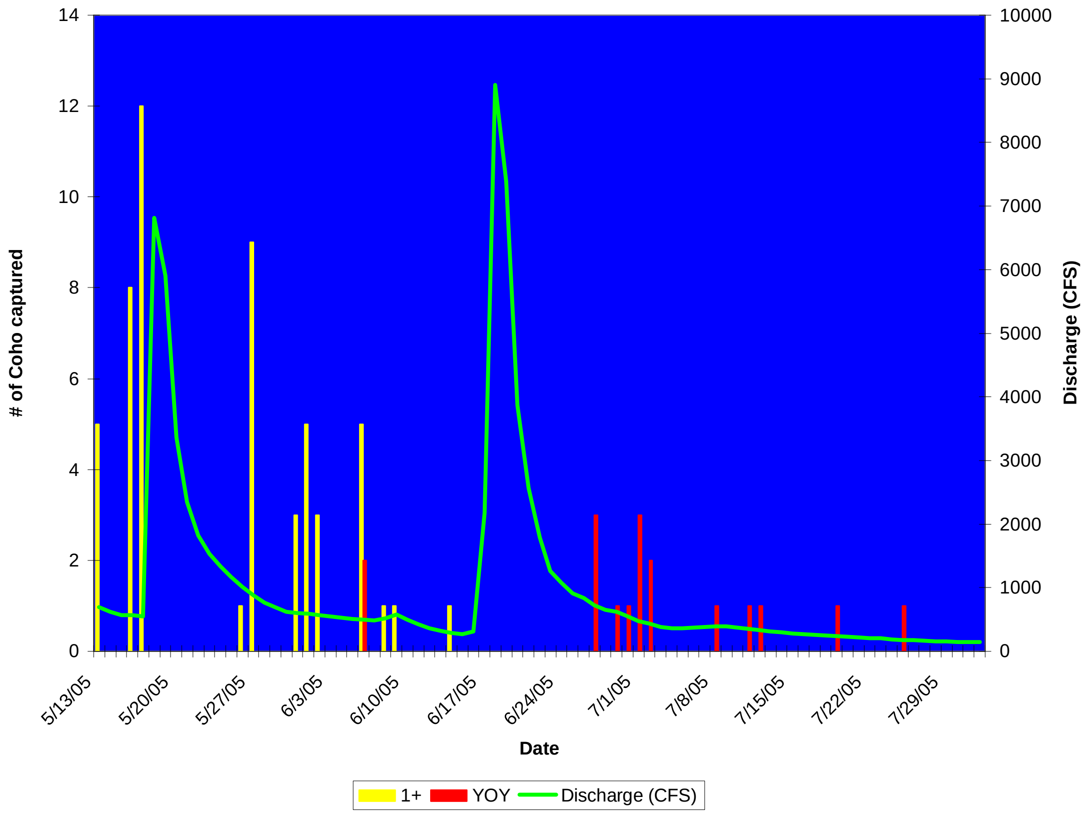
Figure 12 Coho catch and daily average temperature (taken by *Hobo Water Temp Pro* data logger).



Discharge (Coho)

The first and largest pulse of coho occurred on 06-17-05 during the ascending limb of the hydrograph. The second pulse of the coho run occurred on 06-06-05 during the descending limb of the hydrograph. The last pulse of the coho run was comprised of YOY and occurred on 06-27-05 during the descending limb of the hydrograph as well (Figure 13).

Figure 13 Coho catch and daily average discharge (Flow rates taken from USGS gauge # 11469000 Mattole River, Petrolia CA).

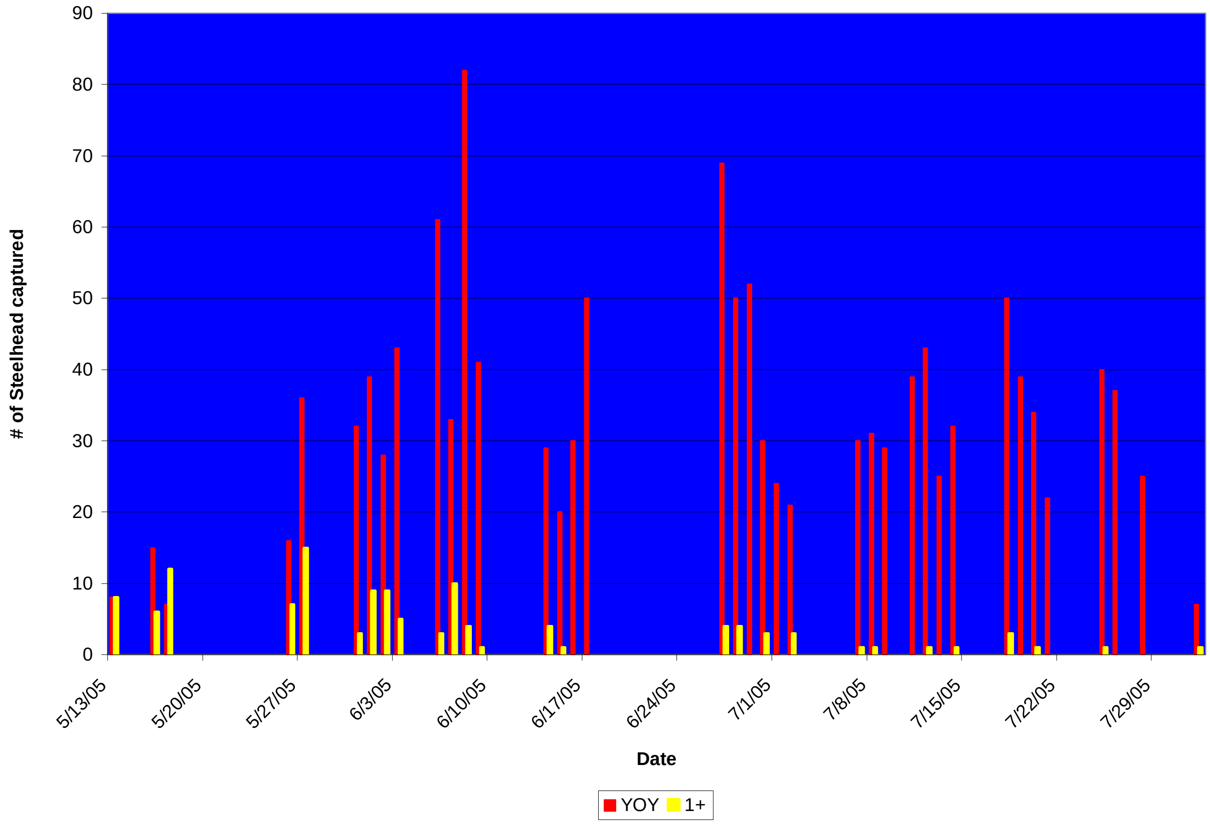


Steelhead Catch Totals

For the 2005 season a total of 1,420 natural steelhead were caught (Figure 14), compared with 26,126 for the 2004 season. Ninety-one percent of this seasons steelhead catch was considered young of the year and 9% were considered age 1+. Designation of age was based on size and physical characteristics. The peak of the run occurred on 6-08-05 with a daily catch of 82 steelhead. The peak of the 2004 run occurred on 06-18-04 with a daily catch total of 2,246 steelhead.

The drastic difference in catch totals from 2004 and 2005 can be partially explained by the difference in river levels of the two years. The 2005 season produced rain events that raised river levels considerably higher than in 2004. This is believed to have delayed emigration for smolting steelhead considerably, possibly due to deeper pools and cooler temperatures throughout the watershed. The MSG Summer Steelhead Dive project confirmed a considerable amount of steelhead rearing throughout the watershed. Numerous dive reaches had schools of steelhead numbering in the thousands (MSG, 2005).

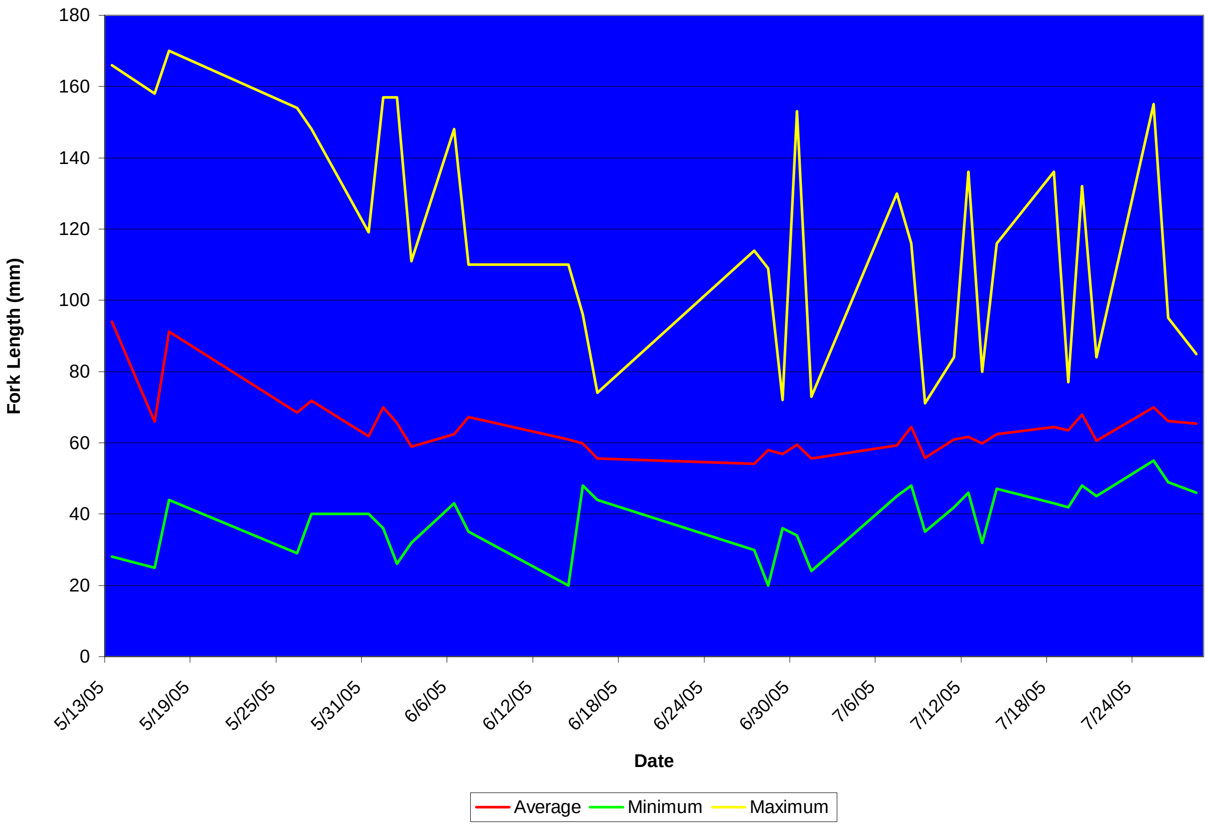
Figure 14 Steelhead catch totals for 2005.



Steelhead Fork Lengths

Fork lengths were taken from 980 out of the 1,420 (69 % of the total catch) steelhead that were captured (Figure 15). Initial catches of steelhead occurred on 05-13-05 with a daily average fork length of 93.93 mm (sd=47.13,n=16). Maximum fork lengths fluctuated drastically after 06-30-05 due to the sporadic capture of larger, 1+ parr and smolts. On 07-28-05 final catches of steelhead recorded a daily average fork length of 65.31 mm (sd=9.65, n=6).

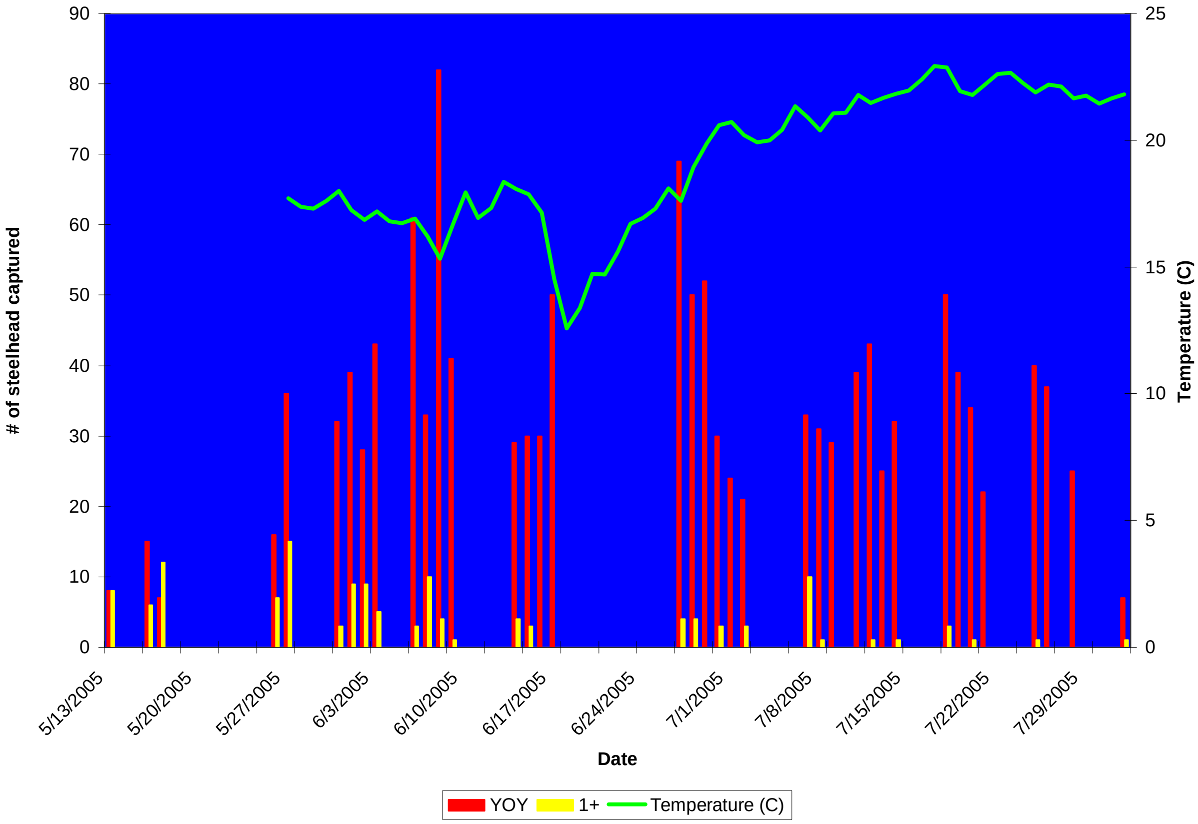
Figure 15 Average, Minimum and Maximum Fork Lengths (mm) for Steelhead 2005.



Temperature (Steelhead)

Initial catches of steelhead occurred at temperatures of 15-16° C. These readings were taken with a handheld thermometer prior to the deployment of the data logger. The peak of the steelhead run occurred with a daily average temperature of 16°C. As daily average temperatures reached 20° C, the steelhead daily catch remained consistent. Large pulses of steelhead that migrate when temperatures reach stressful levels have been seen in previous seasons. There were no such pulses this season. This may be in part due to high river levels, which enabled pools to stay deep and cool, as well as keeping daily average temperatures much lower than in previous years throughout the watershed (Figure 16).

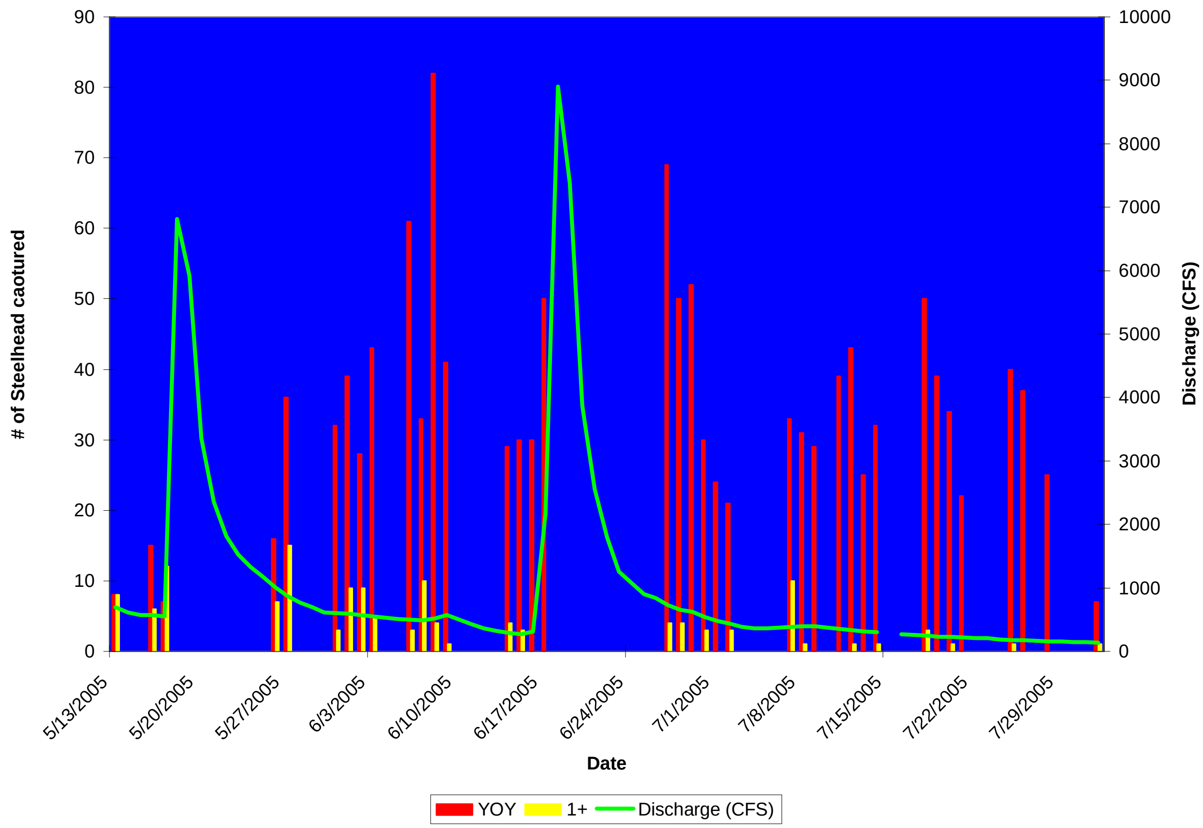
Figure 16 Steelhead catch and daily average temperature (taken by *Hobo Water Temp Pro* data logger).



Discharge (Steelhead)

The steelhead run for 2005 showed a common trend in which large pulses of fish occurred during the descending limb of the hydrograph. This is particularly evident after the second high flow event of the season (Figure 17). The first high flow event of 2005 seems to have occurred prior to the onset of the steelhead YOY emigration.

Figure 17 Steelhead catch and daily average discharge (Flow rates taken from USGS gauge # 11469000 Mattole River, Petrolia CA).



Conclusions and Recommendations

Salmonid runs for 2005 seem to have been successful in comparison to previous years. Two large storm events kept river levels higher than in previous years, as well as keeping temperatures much lower. These two factors likely improved survival of juvenile Mattole salmonids in 2005. As a result, juvenile Chinook were able to migrate at a gradual pace and were not at risk of being stranded in the Mattole estuary, which might have proven fatal. More coho YOY were also documented in the lower mainstem than in previous years. The juvenile steelhead emigration in 2005 also diverged from patterns of previous year. According to observations from both the rotary screw trap and dive surveys it appears that most of the YOY chose either to remain in freshwater for an additional year or to delay out migration until after the trap was removed.

It is possible that large numbers of out migrating salmonids could have emigrated during periods of high flow when the trap was not operated. The MSG will try to foresee these kinds of events in the future and make the proper adjustments to protocol to allow for trapping in higher flows. It is also a goal of the MSG to have an earlier commencement date for trapping in 2006, in order to more completely monitor coho and Chinook emigrations. This will enable the MSG to provide a more scientifically accurate estimate of Mattole juvenile salmonid runs.

Catches vary from year to year due in part to water year type. Although the two unseasonable large storm events presented gaps in data analysis for the 2005 season, it also provided improved conditions for salmonid migration and rearing. Due to these 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.

Other goals for the 2006 season include creating accurate population estimates for target and non-target species based on an abundance index, mark-recapture and trap efficiency data.

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.

McEwan, D. and Jackson, T.A. 1996. *Steelhead Restoration and Management Plan for California*. California Department of Fish and Game. p. 22.

Mattole Salmon Group (MSG). 2005. *Summer Steelhead Dive Final Report.* Petrolia , California

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