Mattole Salmon Group

Juvenile Salmonid Monitoring on the Mainstem Mattole River at Petrolia, CA 2007

FINAL REPORT
CADFG Fisheries Restoration Grant Program

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Mattole River Smolt Production Estimate 2007-2008

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Background

The Mattole Salmon Group (MSG) has been assessing salmonid populations and their limiting factors for over 26 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. Considerable effort and expense has been devoted to the rehabilitation 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

The 2007 season marked the 22nd 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 (using a fyke trap through 1996, and a 1.5 m rotary screw trap thereafter), in lower Bear Creek from 1997-2003 (pipe trap) and in the middle mainstem Mattole near Ettersburg from 2001-2003 (pipe trap), and lower Squaw Creek in 2006 (pipe trap). During 2007, the MSG conducted juvenile salmonid monitoring on the lower mainstem Mattole River using a 1.5 m rotary screw trap on loan from the BLM. Data collected provides valuable information and insights on the timing of emigration, 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 multiple consecutive years, particularly for trend analysis purposes.

Materials and Methods

Trap Site

The 1.5m rotary screw trap was installed at river mile (RM) 3.9 on the lower mainstem Mattole River (Figure 1) during the 2007 sampling season. Landowners Dr. Richard Scheinman and Charles Gould permitted the MSG to install and operate the trap on their properties. The 2007 season was the third consecutive year that the MSG conducted juvenile monitoring at this particular 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 2007 downstream migrant 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 3.3 revolutions per minute to a maximum of 12 revolutions per minute.

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 Mattole Salmon Group, Juvenile Salmonid Monitoring on the Mainstem Mattole River at Petrolia, 2007.
bottom of the cone is approximately 1 m 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 0800 hours.

River conditions ultimately determined what dates 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 (*Oncorhynchus tshawytscha*) 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 (*Oncorhynchus kisutch*) and steelhead (*Oncorhynchus mykiss*). The MSG focused its efforts around the juvenile Chinook salmon run while collecting as much data as possible on the coho salmon and steelhead runs.

Figure 2. Rotary screw trap design.

**Biological Sampling Procedures**

During the 2007 season the rotary screw trap was operated 6 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 Plan, fish were not handled when morning water temperatures were over 68°F, the trap was not operated and remained non-operational until safe temperature limits recurred.

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 result 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 daily 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.

Fish handling occurred 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 Chinook salmon, coho salmon, and steelhead were considered non-target species. Non-target fishes captured were only identified to species and tallied.

Juvenile Chinook salmon were classified as young of the year (YOY). Coho salmon 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.

**Mark/Recapture Sampling**

When capture numbers were high enough to provide an adequate sample, an intensive mark-recapture sampling technique was employed to generate population estimates for Chinook salmon and coho salmon. Population estimates were not generated for steelhead, the MSG has found that steelhead don't emigrate promptly after marking and release (McEwan, 1996). Population estimates were generated using the modified 1-site version of the Rawson model as described by Carlson *et al.* (1998), stratified on a weekly basis. The proposed method for calculating smolt abundance, DARR 2.0, was not used due to technical difficulties with the program.

Population estimates were conducted for Chinook salmon and coho salmon juveniles using standard mark-recapture techniques. The mark-recapture protocol is as follows: 2 days out of each 6-day trapping week, up to 200 juvenile Chinook salmon and 25 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. Chinook salmon and coho salmon marked for trap efficiency trials were held in a live box to assess mortality from handling and marking, and then were released about 200 meters upstream from the trap. Fish were released at dusk in order to reduce predation. Recaptures of marked Chinook salmon and coho salmon occurred over the ensuing 2 days.

**Quality Assurance/ Quality 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.

Results

The rotary screw trap was deployed in early April, with a start date of April 9, 2007. Start dates coincide with river flows reaching levels safe enough for trap installation. The 2007 start date was one of the earliest start dates on record in the Mattole River. The MSG strives to seek the earliest start date possible for each given season. 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 2007 was July 3, after numerous days of sustained high water temperatures and low Chinook salmon catch totals. Juvenile salmonid monitoring on the Mattole River occurred for 63 days in 2007, as compared with 58 days in 2006 and 37 days in 2005.

Physical Environment

Discharge

The 2007 season began when river flows reached levels safe enough for MSG personnel to install the 1.5m rotary screw trap. On the first day of trapping, April 9, 2007, the flow of the Mattole River was 329 cubic feet per second (cfs).

Flow data for the 2007 season is presented in Figure 3. One high flow event occurred on April 22, 2007. This event delayed trapping for several days. Trapping was resumed on April 24, 2007; however, the trap was placed on the edge of the thalweg in order to prevent the higher flows from causing any mortality to trapped fish. The trap was eased back into the thalweg as river flows decreased.
Figure 3. Discharge at USGS gauging station #11469000 (Petrolia, CA) 2007.

Water Temperatures

Water temperature data for the 2007 season (Figure 4) was obtained using an *Onset Tidbit* Temperature Logger. The temperature logger was connected to a chain and weighted down to a depth of 1 meter below the water surface. Average water temperatures at the DSMT trap site for the 2007 season were at or above the stressful level for 46 out of the 63 days that trapping occurred. Temperatures at or above 68º F are thought to be stressful for salmonids (Bjornn, 1991).
Dissolved Oxygen

Dissolved oxygen (DO) levels for the 2007 season (Figure 5) 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 2007 season never fell below 8.49 mg/L, ensuring a high amount of DO was present at all times within the livebox.
Figure 5. Dissolved Oxygen Data 2007

Chinook Salmon Monitoring

Chinook salmon catch totals and population estimate

For the 2007 season, a total of 10,953 Chinook salmon were captured, as compared with 8,008 for the 2006 season. The majority of these fish migrated during the mid to late part of May (Figure 6). Based on the modified 1-site version of the Rawson model as described by Carlson et al. (1998), the population estimate for Chinook salmon in 2007 was 151,404 with a 95% confidence limit of 118,844 to 183,964.
Chinook Salmon Fork Lengths

Fork lengths from 1,795 Chinook salmon were measured, or 16% of the total catch (Figure 7). Initial catches of Chinook salmon resulted in an average fork length of 46.7 mm (sd = 3.02, n =30). Final catches revealed an average fork length of 77.14 mm (sd =3.53, n =7). This is an increase of over 29 mm throughout the season.
Chinook Salmon Catches and Discharge

During the 2007 season, the Chinook salmon run showed a common tendency in which juveniles emigrated during the descending limb of the hydrograph. There was no significant emigration prior to the 2007 season high flow event which occurred on April 22, 2007 (Figure 8).
Chinook salmon catches and water temperatures

Water temperatures were obtained from an *Onset Tidbit* data logger attached to the rear of the trap at a depth of 1 meter. This logger monitored river temperatures from April 11, 2007 through July 3, 2007. By the middle of May daily average temperatures reached 68° F and did not go below this level for the rest of 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 62° F (Figure 9). Peaks of the Chinook salmon run occurred when temperatures approached the stressful level of 68° F. Temperatures over the stressful level 68° F occurred on May 14, 2007 and continued until the trap was pulled on July 3, 2007. Stressful levels of temperature were the main factor in ending the season prior to the end of the Chinook salmon run.
Coho salmon monitoring

Coho Catch Totals and Population Estimates

During the 2007 season, a total of 222 coho salmon smolts were captured, as compared with 450 smolts during the 2006 season (Figure 10). Approximately 100% of the 2007 total catch was comprised of smolts. Due to extremely low levels of recaptures (4 recaptures out 76 fish marked and released), the modified 1-site version of the Rawson model as described by Carlson et al. (1998) was not used and no population estimate was calculated for coho salmon in 2007.
Coho salmon fork lengths

Fork lengths from 222 coho salmon were measured (Figure 11), or 100% of the total catch. Initial coho salmon smolt catches resulted in a daily average fork length of 106.6 mm (sd=28.2, n=9).
Coho Salmon Catch and Discharge

The largest pulse of coho salmon occurred on May 9, 2007, with the majority of coho salmon smolts emigrating throughout the descending limb of the hydrograph (Figure 12).
Coho salmon catches and water temperatures

Water temperatures were obtained from an Onset Tidbit data logger attached to the rear of the trap at a depth of 1 meter. This logger monitored river temperatures from April 11, 2007 through July 3, 2007. By the middle of May daily average temperatures reached 68° F and did not go below this level for the rest of the season. Temperatures at or above 68° F are thought to be stressful for salmonids (Björn, 1991).

Initial catches of coho salmon occurred at temperatures around 62° F (Figure 13). The peak of the coho salmon run occurred when temperatures approached the stressful level of 68° F, although catch totals remained fairly constant when coho salmon were present. Temperatures over the stressful level 68° F occurred on May 14, 2007 and continued until the trap was pulled on July 3, 2007. Stressful levels of temperature were the main factor in ending the season prior to the end of the coho salmon run, although most of the coho salmon migration had occurred prior to this time.
Steelhead Monitoring

Steelhead catch totals

During the 2007 season, 35,847 YOY, 1,834 parr, and 309 smolts were captured (Figures 14-16), as compared with 15,461 YOY, 712 parr, and 189 smolts for the 2006 season.
Figure 14. Steelhead YOY catch totals.

Figure 15. Steelhead parr daily catch.

Figure 16. Steelhead smolt daily catch.

Steelhead Fork Lengths

Steelhead fork length data for 2007 is presented in Figures 17-19. A total of 1,517 steelhead YOY were measured, or 4.2% of the total catch, with 795 parr, or 56.6% of the total catch, and 115 smolts, or 60.8% of the total catch. Average fork lengths for YOY and parr both increased over the course of the season, as average smolt fork lengths decreased.
Figure 17. Daily average forklengths for Steelhead YOY.

Figure 18. Daily average forklengths for steelhead Parr.

Figure 19. Daily average forklengths for steelhead smolts.

Steelhead catches and discharge

During the 2006 season, the Steelhead runs showed a common trend in which juveniles emigrated during the descending limb of the hydrograph (Figures 20-22).

Figure 20. Steelhead YOY catch and discharge.

Figure 21. Steelhead parr catch and discharge.

Figure 22. Steelhead smolt catch and discharge.
**Steelhead catches and water temperature**

Water temperatures were obtained from an *Onset Tidbit* data logger attached to the rear of the trap at a depth of 1 meter. This logger monitored river temperatures from April 11, 2007 through July 3, 2007. By the middle of May daily average temperatures reached 68° F and did not go below this level for the rest of 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 62° F. Initial catches of YOY occurred at temperatures of around 64° F. Steelhead YOY catch totals increased as temperatures reached the stressful level of 68° F. The majority of the parr and smolt run occurred before temperatures reached 68° F. (Figures 23-25).

![Figure 23. Daily steelhead YOY catch and temperature.](image)

Figure 24. Daily steelhead parr catch and temperature.

![Graph showing daily steelhead parr catch and temperature]

Figure 25. Daily steelhead smolt catch and temperature.

![Graph showing daily steelhead smolt catch and temperature]

Discussion

Catches vary from year to year due in part to water year type and trapping rates. The 2007 season showed trends of a typical water year with low river flow and temperatures that increased to stressful levels by mid-May. Temperatures were peaking around 80° F and averaging over 70° F, towards the end of the season. River flows were below 70 cfs by early July. These two factors appear to have great influence on the yearly trends of salmonid runs 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 salmon emigration. Normally, several days of zero Chinook salmon captures marks the end of the season. For the 2007 season however, daily water temperatures of over 70° F were sufficient reason to cease trapping operations. The MSG continues to hold fish health and safety paramount to any data collection.

The start date of April 9, 2007 was one of the earliest days of trap commencement on record, allowing for an early season catch of very small Chinook salmon, averaging less than 50mm. Overall, Chinook salmon catch totals for 2007 were higher than in previous years, with a total of 10,953 Chinook salmon captured in 2007, as compared with 8,008 for the 2006 season. The majority of the Chinook salmon run migrated when temperatures increased and river flows decreased. The seasons highest daily catch totals were over 650 Chinook salmon a day, compared with a season high of 400 fish per day in 2006.

Coho salmon smolt catch totals were considerably lower in 2007 than in 2006, although trapping commenced a full month earlier. A total of 222 coho salmon smolts were captured in 2007, as compared with 450 smolts during the 2006 season. No coho salmon young of the year were captured in 2007.

Steelhead YOY catch totals were similar to previous years, with large pulses of YOY captured towards the end of the season when flows receded and temperatures climbed. This appears to be a common trend for steelhead in the Mattole River. Steelhead parr and smolt catch totals were lower in 2007 than in 2006.
2007 Photographs

Trap positioned in thalweg, 4-1-07.

MSG crew capturing fish out the livebox, 4-9-07.

Otter Anderson, the 2007 Nick’s Intern for the MSG, releases fish after handling, 4-9-07.
Literature Cited


