Fishery Report prepared by Dennis Halligan, Natural Resource Management Corporation, Humboldt County, California.

Prepared pursuant to the Mad River PEIR and Army Corps LOP

Also see the documentation submitted to the County Supervisors supporting a request for increased extraction volume.

FINAL REPORT

1998 FISHERIES MONITORING PROGRAM

FOR GRAVEL EXTRACTION OPERATIONS

ON THE

MAD, EEL, VAN DUZEN, AND TRINITY RIVERS

Prepared by:

Dennis Halligan

Fisheries Biologist

Natural Resources Management Corporation

1434 Third Street, Eureka, CA 95501

707-442-1735

January 6, 1999

The gravel operators that contributed to this monitoring program included:

Mad River Sand and Gravel

Eureka Sand and Gravel

Redwood Empire Aggregates

Arcata Readimix

Hansen Trucking

Mercer-Fraser Company

Drake Materials

County of Humboldt

Tom Bess

Jack Noble

Leland Rock

Fort Seward Ranch

Randall Sand and Gravel

INTRODUCTION

Many northern California rivers draining areas underlain by the Franciscan formation geology contain low gradient depositional reaches that are highly aggraded with cobble, gravel, and sand. The lower reaches of several of these rivers are currently being utilized to provide gravel-based products, such as concrete and asphalt, for a variety of public and private construction projects. Several companies operate within the Eel, Van Duzen, and Mad Rivers. These operations provide a valuable commodity necessary for the construction and maintenance of communities and infrastructure. Commercial gravel removal operations have occurred on the depositional reaches of rivers and creeks in this area since at least the 1950's. Extraction generally occurs on gravel deposits that have been annually replenished during the winter run-off. Due to the fact that fish species utilize the waterways and that gravel is extracted from exposed bar surfaces, there is an expressed concern about the potential impacts these operations may have on the fishery resources. This is especially true given the Endangered Species Act (ESA) listing for coho salmon (*Oncorhynchus kisutch*) and the candidate status given to steelhead (*Oncorhynchus mykiss*).

Some of the Humboldt County gravel operators determined it was in the best interest of the public, the environment, the County, and themselves to undertake a physical and biological monitoring program that would address a range of concerns regarding the potential effects extraction operations have on the riverine processes, aquatic habitats, fish, wildlife, and botanical species. A series of meetings were conducted between the operators, their consultants, U.S. Army Corps of Engineers (COE), California Department of Fish and Game (CDF&G), National Marine Fisheries Service (NMFS), and the County of Humboldt. These meetings produced a set of monitoring guidelines and requirements that formed the basis for the Humboldt County Interim Monitoring Program (IMP) and the COE Letter of Permission (LOP). The information gathered from the monitoring program was intended to help the County of Humboldt Extraction Review Team (CHERT), the COE, and other agencies review gravel extraction

proposals to predict their effects on the riparian and aquatic environment. It was contemplated that some of this information also be used to help in the development of the Humboldt County Eel River management plan and the upcoming Mad River Programmatic Environmental Impact Report (PEIR).

Humboldt County rivers support a number of different fish species. These include anadromous fish such as the steelhead (*Oncorhynchus mykiss*), chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*Oncorhynchus kisutch*), coastal cutthroat trout (*Oncorhynchus clarki clarki*), American shad (*Alosa sapidissima*), Pacific lamprey (*Lampetra pacifica*), white sturgeon (*Acipenser transmontanus*), and green sturgeon (*Acipenser medirostris*). Several resident species such as the prickly sculpin (*Cottus asper*), coast range sculpin (*Cottus aleuticus*), threespine stickleback (*Gasterosteus aculeatus*), and California roach (*Lavinia symmetricus*) are also present. The Sacramento squawfish (*Ptychocheilus grandis*) inhabits the Eel and Van Duzen River drainages.

The purpose of this document is to report the results of the 1998 fisheries monitoring program as required under the LOP.

back to top

MATERIALS AND METHODS

The 1998 fisheries monitoring program was focused on four general subjects: river water temperatures, summer steelhead holding areas, and upstream migration timing and holding patterns for adult salmon and steelhead. Habitat mapping, which is also included in the IMP and LOP protocols, was not conducted due to it being required only once every three years.

Water temperature monitoring was conducted utilizing Hobo-Temp data loggers within the gravel extraction reaches. Twenty monitors were placed in flatwaters and pools of the Mad, Eel, S.F. Eel, and Van Duzen Rivers. The Hobo-Temps were set to record for 120 days, taking temperatures every 1.6 hours. Each monitor received a new battery (good for two years) to insure its continued operation for the entire sampling period. The protocol states that the monitors will be placed at the head of a pool as well at its deepest point for each operator. Due to the loss of 8 Hobo-Temps in 1997 from theft or destruction by the general public, the number of monitors utilized in 1998 was reduced. In some cases this protocol was also modified to adjust for suitable locations being shared by two operators and attrition of dataloggers. Also, based on the results of the 1996 and 1997 temperature monitoring, it was determined that an extra effort should be made to record data in areas where temperature stratification was likely to occur. The Hobo-Temps were installed as soon as the water conditions permitted, generally between June 24 and July 29. No monitors were installed in the Trinity River due to safety concerns resulting from adverse river conditions during much of the summer. The monitors were retrieved during early fall to avoid losses from potential for increased flows due to storm run-off. The data was then downloaded and plotted into graphic form. The resulting profiles were then cropped to reflect the actual start and end dates of monitoring activity (See Appendix 1).

The Hobo-Temps were calibrated in an ice bath prior to deployment. Each monitor was set to record for 6 hours, with a reading taken every 12 seconds. The average of the readings of three handheld thermometers (less than 0.5°C variance from each other) was used to estimate the temperature of the ice bath. The individual monitors varied from 0 to ±0.3°C around the handheld average. The manufacturer reported that these monitors could vary from ±0.7°C around the true temperature.

The summer steelhead survey dives on the Van Duzen, Eel, and Trinity Rivers were conducted during July and August. The Mad River dive occurred at the end of August in coordination with the annual CDF&G summer steelhead survey. All pools within the extraction monitoring reaches were surveyed.

The numbers and origin (natural or hatchery) of adult steelhead were recorded.

The fall adult salmonid migration survey was conducted between September 1 and October 21. The dive surveys ended before the December 1 date specified in the protocol due to poor visibility conditions that coincided with fall rainfall runoff. All habitats within the extraction monitoring reaches were surveyed either visually, as in the case of riffles or shallow runs, or by snorkel diving in deeper runs and all pools. The species, number of individuals, and location were recorded in field books. Holding locations were plotted on the aerial photographs (See Appendix 2).

An adult salmonid spawner survey was conducted simultaneously with the migration dives. Surveyors visually checked pool tails and riffles for spawning fish and redds.

Incidental observations of fish, wildlife, amphibian, and reptilian species were recorded in field books during the course of normal duties.

RESULTS

Temperature Monitoring

Twenty Hobo-Temp temperature monitors were distributed throughout the gravel extraction reaches of the Mad, Eel, S.F. Eel, and Van Duzen Rivers. See Appendix 1 for the water temperature profiles.

Mad River

Five Hobo-Temps were placed in the Mad River; two at the Guynup Bar, one at the Blue Lake Bar, one at the Christie Bar, and one at the O'Neill Bar. One of the Guynup monitors was located upstream of any extraction bar to record water temperatures unaffected by operations. Three were specifically placed in locations that appeared to contain holding habitat for summer steelhead, although none were present at the time of deployment. All locations contained rearing juvenile steelhead.

The daily water temperature fluctuations in the lower Mad River generally ranged from 19°C (66°F) to 24°C (75°F). The maximum sustained water temperatures were in the range of 23-25°C (73-77°F) for several weeks. The highest daily temperature of 25.4°C (78°F) was recorded on July 27 at the REA Blue Lake Bar. The monitor that recorded the overall coolest temperatures in a well-mixed setting was placed in the 6-foot scour pool created by the boulder/log structure at the ARM O'Neill Bar. Temperatures at this location never exceeded 22°C (71.6°F).

Eel River

A total of eight Hobo-Temp temperature monitors were placed in the mainstem Eel River from Fort Seward at River Mile 65 downstream to Fernbridge. The two upstream-most Hobo-Temps were placed at Fort Seward. One Hobo was placed upstream of the Van Duzen River in order to record water

temperatures unaffected by extraction operations in the lower river. Another was installed at the Hansen Bar in an area of mixing. A monitor was placed adjacent to Sandy Prairie in a secondary channel (the main channel in 1997) that had intermittent inflow and outflow. The sixth Hobo was located at the Drake Bar. The seventh monitor was adjacent to the south bank of the river under vegetation opposite of the Worswick Bar. The final gage was placed at the north footing of Fernbridge

The daily water temperatures fluctuations, within the lower Eel River, generally held in the 18-23°C (64-73°F) range for prolonged periods of time. The highest temperature of 25.1°C (77°F) was recorded by the thermograph placed in a flatwater upstream of the mouth of the Van Duzen River. The thermograph that recorded the overall coolest temperatures was placed at the bottom of the secondary channel at Sandy Prairie. The Sandy Prairie station recorded stratified water temperatures that had little daily variation. The temperature profiles indicated that water temperatures reached stressful levels for salmonids in the lower reaches of the Eel River.

Daily water temperatures generally fluctuated between 22°C (71F) and 26°C (79°F) August through mid-September of 1998 at the Satterlee Bar, Fort Seward. The highest water temperature of 27.9°C (81° F) was recorded on August 5, 1998 in a shaded undercut bank at the bottom of a 4-foot deep run. These temperatures represent extremely stressful to lethal conditions for salmonids. No extraction operations took place at Fort Seward in 1998.

South Fork Eel River

Three Hobo-Temps were placed in the South Fork Eel River. One was placed at the Randall Sand and Gravel Bar and two at the Mercer-Fraser Cooks Valley operation.

The upstream Cooks Valley monitor was placed under a bedrock outcrop in a lateral scour pool along the right bank. This pool contained stratified water temperatures throughout the entire summer. The pool was primarily fed by subsurface gravel bar seepage, although a minimal amount of input was contributed by surface flow. The main flow of the river was contained in a higher elevation channel along the left bank. Daily variation in temperatures was approximately 1°C. The monitor recorded water temperatures throughout the season which ranged from 18° (64°F) to 22° (71°F). A juvenile steelhead was observed in the pool during placement and retrieval of the Hobo-Temp.

The second Cooks Valley Hobo was placed in a 4-foot deep mid-channel pool under a pile of large cobbles that would shield it from direct sunlight while maintaining adequate flow for monitoring. This monitor recorded water temperatures that maintained a 6°C daily fluctuation until the end of July. As river flows decreased as the summer went on, the water in the pool stratified as is evident in the thermograph (Appendix 1). This difference between the surface and bottom water was also observed during retrieval of the monitor in early October.

The Randall Hobo-Temp was placed under a boulder undercut at the bottom of a 4-foot deep run. Large cobbles were placed so that it was shielded from direct sunlight. Water temperatures generally ranged from 18°C (64°F) to 26°C (78°F) during the summer. The maximum temperature of 29.8° C (85.5°F) was recorded on July 27, 1998.

Van Duzen River

Four Hobo-Temps were placed in the Van Duzen River. Two monitors were installed at the Bess, one at

the Noble, and one at the Rock operations. The maximum sustained water temperatures, within the lower Van Duzen River, held in the 20-24°C (68-75°F) range for prolonged periods of time. The single highest temperature of 25.9°C (80°F) was recorded July 16, 1998 on the bottom of a 5-foot deep riprap lateral scour pool at the Bess operation. The Hobo-Temp that recorded the overall coolest water was placed on the bottom of a 7' deep lateral scour pool upstream of the Hwy. 101 bridge at the Leland Rock operation

back to top

Summer Steelhead Survey

Mad River

The summer steelhead dive in the lower Mad River was conducted on August 26 and encompassed the reach between the Hatchery to Essex. CDF&G conducted a survey on August 25 from Essex to North Bank Road below the REA plant. These surveys were part of an annual river-wide effort that covered approximately 68 river miles.

A total of 21 summer steelhead (adults and half-pounders) were observed within the extraction reach during the two survey days (Table 1). All the steelhead I observed were holding in pools that contained either large woody debris (LWD) or extensive overhanging and submerged terrestrial vegetation in close proximity to fairly rapidly flowing water. The fish generally held in the densest cover available.

The river-wide summer steelhead survey reported 201 adults and 20 half-pounders.

Table 1. 1998 Mad River Extraction Reach Summer Steelhead Survey Results

Operator	Nat. Spawned	Hatchery	1/2 Pounder	Other
MRS&G	8	0	2	Hundreds of juvenile sth.
REA Emerson Bar	0	0	0	Approx. 100 juvenile sth.
REA Blue Lake Bar	0	0	0	Dozens of juvenile sth.
ES&G Christie Bar	2	0	0	Hundreds of juvenile sth.
Essex to North Bank Road	3	0	6	
Total	13	0	8	

Eel River

A single adult and four half-pounder summer steelhead were observed in the lower Eel River on July 27, 1998. The half-pounders were observed near the mouth of the Van Duzen River (dry at the time) in 4 feet of water with no shade, LWD, or overhead cover. The adult steelhead was observed in a lateral scour pool located adjacent to the Hansen rock plant. This pool had overhanging terrestrial vegetation cover and good flow (Table 2).

Table 2. Eel River Summer Steelhead Survey Results

Operator	Nat. Spawned	Hatchery	1/2 Pounder	Notes
Leland Rock Dwelley Bar	0	0	4	Cool water seep, several juveniles
Hansen	1	0	0	
Total	1	0	4	

Summer steelhead surveys also took place at the Randall Sand and Gravel and Mercer-Fraser Cooks Valley operations on the South Fork Eel River, Satterlee at Fort Seward on the mainstem Eel River, the Tom Bess, Jack Noble and Leland Rock extraction bars on the Van Duzen River, and the Mercer-Fraser Willow Creek Bar on the Trinity River. No summer steelhead were observed at any of these locations. However, two adult chinook salmon were observed at the Mercer-Fraser, Willow Creek operation.

Salmonid Migration Survey

Due to a variety of reasons, migration surveys did not begin until the third week in September. This resulted in a three-week gap between the end of the summer steelhead surveys and the beginning of the migration surveys. Surveys ended in mid-October due to the arrival of early rains that resulted in poor conditions for underwater.

The vast majority of adult fish in all the rivers were observed in pool habitats.

Mad River

The Mad River upstream chinook migration appeared to begin during the end of September or first week in October. This run started a month later and with fewer individuals than the previous two years. They

were not observed during the summer steelhead dive on August 25 and 26 or the migration dive on September 21. The migrating adults tended to occupy habitats that had a combination of three habitat factors; shade, woody debris cover, and good water flow. Adult salmonids were generally not present if any one of these factors were missing. The primary holding areas were located in the pools along the Guynup, Blue Lake, and Christie Bars. See Tables 3 to 7 and Figure 5.

Table 3. Mad River Upstream Salmonid Run Timing (Totals by Date)

	9-21-98	10-2-98	10-12-98
Totals	5 sh 10 – ½ lb.	2 ch, 9 sh 7 – ½ lb.	8 ch, 11 sh 21 – ½ lb. 2 jacks

Abbreviations: ch - chinook, sh - steelhead, jacks - chinook jacks and steelhead half-pounders, coho - coho salmon, un - unidentified species, either chinook, coho, or steelhead, juv - juvenile salmonids.

Figure 5

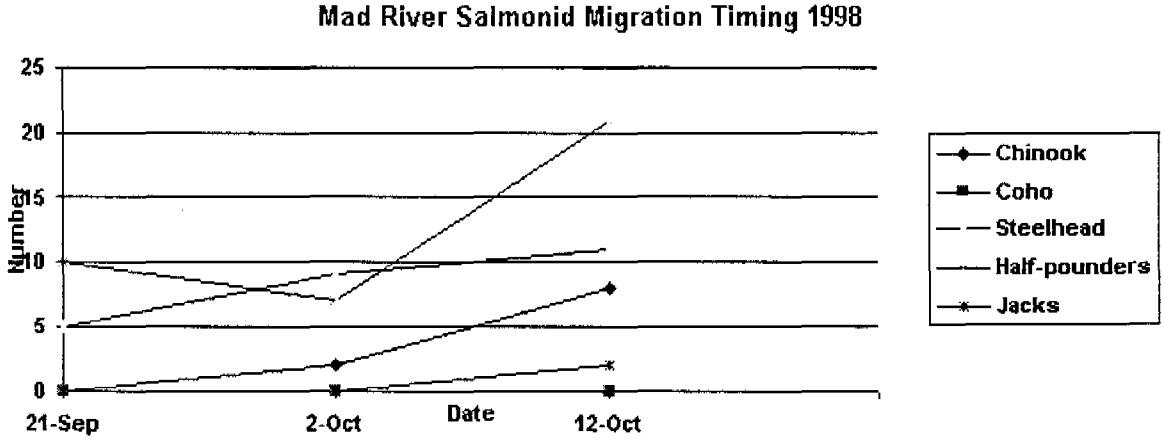


Table 4. Mad River Sand and Gravel - Guynup Bar Upstream Salmonid Migration Run Timing and Holding Locations

Holding	9-21-98	10-2-98	10-12-98

Location			
1st Groin	0	1 – ½ lb.	0
2nd Groin	1 sh	1 ch, 7 sh	4 ch, 8 sh,
Hobo pool	0	0	0
Summer bridge	0	0	0
Total	1 sh	1 ch, 7 sh, 1 – ½ lb.	4 ch, 8 sh

Abbreviations: ch - chinook, sh - steelhead, jacks - chinook jacks, ½ lb. – steelhead half-pounders

Table 5. Redwood Empire Aggregates - Emerson and Blue Lake Bars Upstream Salmonid Migration Run Timing And Holding Locations

Holding Location	9-21-98	10-2-98	10-12-98
Emerson	0	1 chinook	1 chinook
Riprap	0	0	0
LWD pool	0	0	0
2nd pool	0	0	0
3rd Pool	0	0	0
Log pool	0	0	0
Total	0	1 chinook	1 chinook

Table 6. Eureka Sand and Gravel -Christy and Johnson Bars Upstream Salmonid Migration Run Timing and Holding Locations

Holding Location	9-21-98	10-2-98	10-12-98
Upstream	0	0	3 ch, 1 jack

Christie			
Christie Bar	1 sh	1 sh	2 sh
Johnson Bar	0	1 sh, 2 – ½ lb.	0
Total	1 sh	2 sh, 2 – ½ lb.	3 ch, 2 sh, 1 jack

Abbreviations: ch - chinook, sh - steelhead, jacks - chinook jacks, ½ lb. - steelhead half-pounders

Table 7. Arcata Redimix - Spini-Johnson, Graham, and O'Neill Bars Upstream Salmonid Run Timing and Holding Locations

Holding Location	9-21-98	10-2-98	10-12-98
Spini-Johnson	3 sh, 10- ½ lb.	4 – ½ lb.	1 sh, 17 – ½ lb., 1 jack
O'Neill Bar	0	0	0
LWD structure	0	0	4 – ½ lb.
Total	3 sh, 10 – ½ lb.	4 – ½ lb.	1 sh, 21 – ½ lb., 1 jack

Abbreviations: ch - chinook, sh - steelhead, jacks - chinook jacks, ½ lb. - steelhead half-pounders, coho - coho salmon, juv - juvenile salmonids.

Eel River

The Eel River surveys began on September 23. Only one adult steelhead was observed during the surveys. It is believed that this fish was the same summer steelhead observed in this location (Hansen Bar) at the end of August. Chinook salmon were reported holding and being caught in the Cock Robin Island area during the survey period. Surveys ceased after underwater observation conditions degraded following the onset of the fall rains. There were reports of salmon being caught in the river in late October and early November after the surveys ended.

Trinity River

Trinity River chinook and steelhead upstream migration tends to begin a month or more prior to the onset of the migration diving season. For this reason, the LOP and IMP protocols are inadequate for determining the approximate start date for the runs. Therefore, the only need for the migration surveys

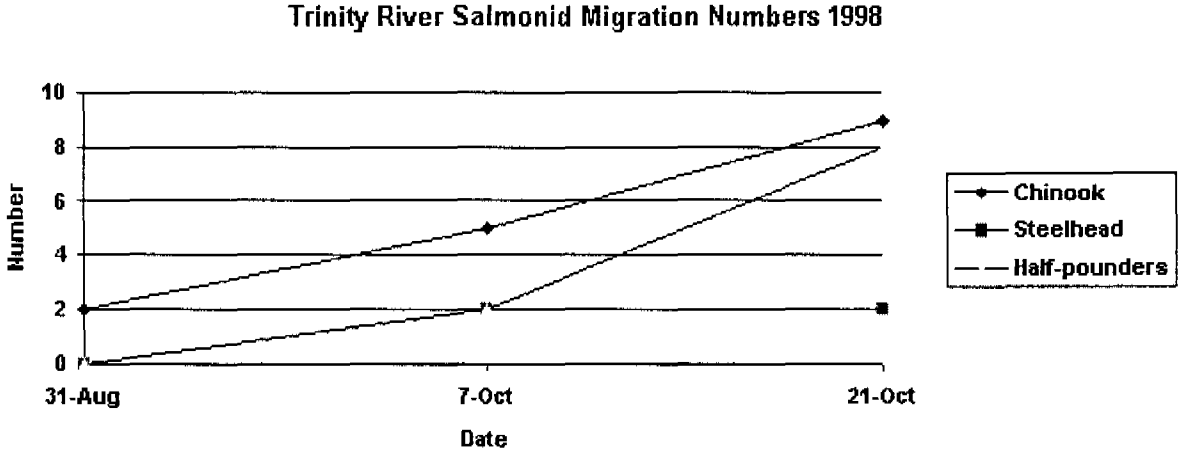
was to record the holding locations of the migrating fish. It was determined that the survey protocols required an inordinate amount of time and expense to accomplish this task. For this reason, and the fact that the weather further shortened the dive season, only two migration dives were conducted.

Table 8. Trinity River (Willow Creek Area) Upstream Salmonid Holding Locations

Holding Location	8-31-98	10-7-98	10-21-98
Big Rock	1 ch	1 ch, 1 – ½ lb.	3 ch, 1 sh
Air Strip	1 ch	1 ch, 2 sh, 1 – ½ lb.	4 ch, 1 sh, 6 – ½ lb.
Trench Run		1 ch	1 – ½ lb.
Big Bend		2 ch	2 ch, 1 – ½ lb.
Total	2 ch	5 ch, 2 sh, 2 – ½ lb.	9 ch, 2 sh, 8 – ½ lb.

Abbreviations: ch - chinook, sh - steelhead, jacks - chinook jacks, ½ lb. - steelhead half-pounders, coho - coho salmon

Figure 2



Van Duzen River

No dives were conducted on the Van Duzen River due to the mouth being impassable to anadromous salmonids from the lack of flow during the survey period. The mouth of the river became passable with

the onset of the fall rains. However, once the rains began the river became too turbid for observations.

Spawning Observations

No spawning activity or redds were observed during surveys either inside or outside the monitoring reaches on any of the rivers.

Incidental Observations

Noise Effects

Andrew Jensen, NRM Fisheries Technician, had an opportunity to observe the effects of heavy equipment noise and vibration on juvenile salmonids on October 12, 1998 in the Mad River. He reported that a school of juvenile steelhead, approximately 150 individuals, did not appear stressed or agitated even though heavy equipment operations were occurring a short distance away. They continued to act normally.

Trenching Turbidity

Turbidity inspections of the gravel bar trench at the Mercer-Fraser Co. Trinity River operation near the town of Willow Creek were conducted in conjunction with the summer steelhead and migration snorkel surveys. Equipment operations were underway during the August survey. The water within the trench was extremely turbid at the time. I inspected the gravel and cobble buffer that separated the trench from the river by both surface and underwater observation. No turbid water was observed escaping from the trench. The buffer strip appeared to functioning as it was intended.

Stranding Observations

Depressions in gravel bars, formed by scour around LWD and receding river levels isolating high flow and secondary channels, were observed on extraction and nonextraction bars in the Mad, Eel, and Van Duzen Rivers prior to extraction operations. Most of these depressions completely dewatered later in the summer as the water table continued to drop. Stickleback and juvenile squawfish were observed in those that were maintained by subsurface flow. No salmonids were observed.

Juvenile Salmonids

Incidental observations of juvenile salmonids were recorded during some of the snorkel surveys. Although accurate counts were not taken, there appeared to be more juvenile steelhead present in 1998 than in 1997. The Mad River held significant numbers of juvenile steelhead in nearly every dive location, sometimes in schools estimated at 150 or more. Several dozen age 2+ and 3+ steelhead were

observed below the mouth of the Van Duzen River and adjacent to the Hauck/Hansen Bar on the lower Eel River. More than 100 juvenile steelhead of all ages were observed at the two temperature monitoring stations at the Bess operation on the Van Duzen River. Steelhead were also rearing throughout the summer at Jack Nobles property. Large numbers of young steelhead were observed throughout the Mercer-Fraser dive reach on the Trinity River.

It appeared as if there was a small steelhead smolting migration in the fall on the Mad River. Several juvenile steelhead in the Age 2+ to 3+ range appeared to have lost their parr marks and were becoming more silvery in color. This same phenomena was observed in the Mad, Eel, and Van Duzen Rivers in 1996 (Halligan 1997).

I did not observe any coastal cutthroat trout in the Mad River although I suspect they are present, albeit in low numbers. They were identified by some of Bill Trush's students between the Annie and Mary Bridge and the Hwy. 299 bridge.

Low Flow Channel Observations

Although I did not take any measurements that would have enabled year-to-year comparisons, it appeared that there was a general loss of pool and run volume between 1997 and 1998. This may have been a result of last winter's sustained high flows and bedload transport. This type of channel filling was observed in every river except the Trinity. Larry Preston (CDF&G) told me that he had also observed general pool filling in the Mad River from the Essex pump station down to the Kadle hole, just upstream of the 101 bridge.

Incidental Fish and Wildlife Observations

Pacific lamprey ammocoetes, beavers, river otters, western toads, foothill yellow-legged frogs, mallards, mergansers, double-crested cormorants, great blue herons, greater yellowlegs, ospreys, and killdeer were observed on the Mad River.

Two western pond turtles, a rough skin newt, western toads, foothill yellow-legged frogs, mergansers, mallards, great blue herons, greater yellow legs, double-crested cormorants, and killdeer River otters, deer, ospreys, cormorants, and yellow-legged frogs were observed on the Van Duzen River.

Yellow-legged frogs, western toads, and crayfish were observed at the Mercer-Fraser site in the Trinity River.

Humboldt State University Student Surveys

I hoped to include a summary of the results of some of the 1998 HSU student surveys in this report, like I did for the 1997 field season. However, through no fault of Dr. Trush, the reports were not available at the time of this writing. It is possible that some of the results will be included in the annual CHERT report.

back to top

DISCUSSION

Water Temperatures

The objectives of the LOP and IMP water temperature monitoring protocol were to "document cold water refugia suitable for anadromous salmonids, document temperature stratification, and locate cold water refugia." In addition to these stated (and redundant) objectives, it was felt that recording the general stream temperature profiles was also important. The monitoring program has met these objectives.

Thermal Refugia

Thermal refugia locations were documented in the Mad, Eel, S.F. Eel, and Van Duzen Rivers during the three-year monitoring period. The relatively high flows in the Trinity River appeared to keep the water column well mixed which tended to retard the development of stratified layers. Adult and juvenile salmonids were observed to be utilizing some stratified areas and not others for some unknown reasons. Salmonids were also seen holding and rearing in warm water locations while nearby thermal refugia was not occupied. The locations and characteristics of these refugia varied both spatially and temporally. It also appeared that the presence or absence of shade had little to do with refugia locations.

Stratified thermal layers were primarily located in habitat units that experienced little or no mixing of bottom waters. These units included main channel, lateral scour, and backwater pools whose location can vary from year to year. These locations tended to exhibit the normal daily temperature variations of the surrounding areas while there was adequate flow to insure mixing of bottom water. As the flows dropped during the later summer, mixing decreases or ceased and thermal layers developed and persisted until the first fall rains. Jack Noble's "A Bar" pool on the Van Duzen (1997) and the Mercer-Fraser Cooks Valley #2 on the S.F. Eel (1998) are typical locations.

Cool water seeps were located where flow trickled out the downstream ends or sides of gravel bars. This was commonly observed where a gravel bar was adjacent to a deep-water pool of some type. For example, a cool seep was consistently located at the downstream end of the Emmerson Bar on the Mad River where the riffle entered the Blue Lake riprap scour pool. Another spot was at the head of the upstream Bess lateral scour pool on the Van Duzen River. Juvenile steelhead reared at these locations during each of the past three years, taking advantage of the cool water along with the high dissolved oxygen and food concentrations.

Cool water upwelling locations were observed at places where physical features, such as bedrock outcrops, buried riprap boulders or large woody debris forced interstitial flow up and out of the substrate. These areas tended to be relatively small in size (a few square meters), quickly mixed into the general flow and as such, fairly difficult to locate. In some cases, several dozen juvenile steelhead were observed hugging the bottom at these spots. One area was located in the Blue Lake riprap scour pool on the Mad River and another along the Hauck Bar in the lower Eel River.

Cool water seeps were found at the dried up mouths of tributaries such as the North Fork Mad and Van Duzen Rivers. These intermittent tributary reaches contributed subsurface flow to their receiving waters. Juvenile steelhead, and occasionally adult summer steelhead, were observed at these locations.

Cool water surface flow was available from perennial tributaries such as Hall (Mill) and Lindsey Creeks on the Mad River and smaller springs.

General Temperature Profiles

The Hobo-Temp data indicates that general water temperatures reach stressful to lethal levels for salmonids in the local rivers. Many of the monitors recorded temperatures that exceeded 22 to 24°C (71-75F°) for extended periods of time. Summer steelhead prefer water temperatures in the 10°C-15°C (50°-59°F) range with a sustained upper limit of 20°C (68°F), but can survive for short periods up to 27°C (81°F) with fluctuating conditions (Moyle et al. 1995). In spite of these high temperatures, juvenile steelhead appeared to be able to rear successfully in the lower mainstems, especially in the Mad River.

Coho juveniles are known to occupy the lower river reaches at least part of the year. They were captured in the lower Mad River during a trapping study in the late spring and early summer of 1998, when water temperatures were relatively cool. However, juvenile coho have not been observed in any of the dive surveys over the last several years rearing in the rivers during the later summer months when water temperatures reach stressful to lethal levels. It is believed that these fish migrated into cool tributaries where they found more favorable conditions for summer rearing.

A general progressive cooling of water temperatures in a downstream direction was observed in the 1997 and 1998 data. Dr. Tim Lewis of the Forest Science Project in 1997 and the Humboldt County Resource Conservation District (1998) also reported this type of cooling. This can be attributed to the increasing influence of coastal weather conditions. Factors such as fog, humidity, wind, and ambient air temperatures play an increasingly greater role in water temperature regulation as the rivers get closer to the coast.

1998 Water Temperatures

Mad River

The daily water temperature fluctuations in the lower Mad River generally ranged from 19°C (66°F) to 24°C (75°F). As observed in 1997, there appeared to be a slight decrease in water temperatures (1 to 2°C) in a downstream direction. The maximum sustained water temperatures were in the range of 23-25° C (73-77°F) for several weeks. Although juvenile steelhead were observed in all the sampling locations, these temperatures exceeded the tolerance levels for coho juveniles. No coho were observed during any of the 1998 dive surveys as well as those conducted in 1996 and 1997 (Halligan 1997, 1998). However, adult summer steelhead were observed holding in the upstream Guynup and Christie pools. Summer steelhead were also observed holding in pools with relatively high water temperatures in 1996 and 1997 (Halligan 1997, 1998).

back to top

Eel River

The Eel River temperature data also showed a distinct cooling trend as the river neared the coast. The warmest location was located at the Randall site in Garberville, where temperatures exceeded 26°C (78°F) for 1.5 months. By contrast, the Worswick monitor recorded temperatures that only occasionally exceeded 22°C (71.6°F) for the same time period. In addition, the lower river exhibited less daily temperature variation than the upriver sites.

The Cooks Valley #2 station exhibited a daily water temperature variation of 4 to 5°C for about the first month of monitoring. As the flows dropped and thermal mixing decreased, the water at this site became stratified. This pool remained stratified throughout the remainder of the summer despite the fact that there was little or no shade canopy for several thousand feet upstream.

The S.F. Eel River thermographs revealed some interesting characteristics regarding water temperatures in this reach of the river. The temperature profiles recorded in the Cooks Valley stratified pools and the Randall station tended to follow the same general weekly/monthly rise and fall patterns. However, the water temperatures in the stratified locations of Cooks Valley were nearly the same as the lowest daily readings at the Randall site.

Van Duzen River

Van Duzen River water temperatures tended to fluctuate in the 18-24°C (64-75°F) range for most of the summer. Water temperatures also cooled by a few degrees in a downstream direction. Each of the pools with Hobo-Temps contained juvenile steelhead the entire summer. Although the overall number of juvenile steelhead was low, there appeared to be more rearing in the river in 1998 than in either 1996 or 1997. They generally positioned themselves at the head of the pool to take advantage of the cool water seeps as well as the increased food and dissolved oxygen production of the upstream riffle.

Summer Steelhead Survey

The 1998 river-wide summer steelhead survey counted 201 adults and 20 half-pounders. The previous year's counts contained a substantial portion of the Mad River hatchery-reared steelhead of the Washougal River (Columbia River basin) strain. The last of these hatchery-reared fish returned in 1997. None were observed in the 1998 survey. A noticeable decline in summer steelhead populations has been observed in the Mad River stock over the past three years (Tables 9 and 10). This decrease may be due to the reduction in ocean productivity resulting from the recent El Niño, freshwater habitat problems, and poaching activities.

Table 9 : CDF&G Mad River Summer Steelhead Survey Results (River-wide)

Year	Natural Adult	Hatchery Adult	Unknown Origin	Natural ½ Pounder	Hatchery ½ Pounder	Unknown ½ Pounder
1996	408	41	71	12	0	14

1997	146	4	134	12	0	0
1998	201			20		

Table 10 : NRM/CDF&G Mad River Summer Steelhead Survey Results (Extraction Reach)

Year	Natural Adult	Hatchery Adult	Unknown Origin	Natural ½ Pounder	Hatchery ½ Pounder	Unknown ½ Pounder
1996	51	29	8	7	0	0
1997	11	51	0	0	0	0
1998	13	0	0	8	0	0

Salmonid Migration Surveys

The LOP states that the migration surveys shall be used "to document adult salmonid upstream migration patterns, use of holding areas, and how fish generally distribute themselves while they are transporting up the rivers." I feel that, based on the past three years of data collection, these objectives have been met.

The migration patterns and timing tend to vary with each river system. The Mad River chinook and steelhead generally begin their migrations around the beginning of September. Coho salmon tend to enter the Mad River around mid-October. The Trinity River runs are underway around mid- to late summer. The Eel River migration tends to begin with steelhead in September and chinook entering around mid-October. The Van Duzen River runs commence when flows are high enough to allow for passage at its confluence with the Eel River.

Adult salmonids were found to generally distributed themselves wherever quality holding habitat was available. These locations tended to be pools that contained large woody debris and were relatively deep. In a few cases salmonids were observed holding in runs that contained woody cover along the banks. It did not appear that the presence or absence of an extraction bar had any bearing on the use of a particular habitat unit by salmonids.

The presence of summer bridges spanning the rivers did not appear to impede upstream migration in any way. For each of the past three years these structures were in place during the migration periods. A steady influx of bright fish, as well as visual tracking of unusually marked chinook, moving through reaches containing bridges indicated uninhibited movement by adults. Adult steelhead and chinook were even observed holding in the deep, well shaded water under summer bridges in the Trinity and lower Eel Rivers in 1997 in spite of the heavy truck traffic overhead.

back to top

Mad River

The upstream migration of adult chinook and steelhead in the Mad River was appeared to begin about a month later than in 1996 and 1997. Even though less surveys were conducted during the 1998 season, the runs appeared to be smaller than in 1996 and 1997. A general decline in the total early run numbers was observed in the past three years (Table 11). However, since the yearly surveys ended so early no conclusions can be drawn regarding the year's run strength.

Bright fish were observed in different monitoring reaches throughout the entire 1998 dive period. Also, the continually changing numbers of fish in the upstream monitoring reach at the Guynup Bar would indicate fish were not holding for long periods of time at any one place. Summer bridges did not appear to be hindering migration through the extraction reach. As observed in 1996 and 1997, adult salmonids preferred holding in pools that contained woody debris cover rather than runs or riffles.

Even though there were fewer surveys conducted in 1998 than in the previous two years, it appeared that half-pounders and jacks were less abundant. It is possible that this was due to a variety of factors in both the freshwater and marine environments. It could be that the low number of surveys just failed to adequately sample the run. The past few years of high flows that accelerated watershed erosional processes may have filled in rearing habitats with sediment that could have affected summer and winter survival of juvenile salmonids. These same high flows may have also resulted in excessive streambed scour which could have destroyed redds. For the past two years salmonid smolts have been entering the ocean during a period of low productivity and high temperatures due to El Niño conditions. These ocean conditions may have significantly affected marine survival.

Table 11: Mad River Adult Salmonid Observations 1996-1998

9-6-96	9-16-96	9-27-96	10-7-96	10-17-96	11-6-96
25 ch, 65 sh 70 jacks 15 un.	8 ch, 9 sh 47 jacks 1 un	57 ch, 18 sh 138 jacks	7 ch, 37 sh 268 jacks	43 ch, 22 sh 1 coho 322 jacks	113 ch 134 sh 15 coho 147 jacks

9-3-97	9-12-97	9-22-97	10-6-97	10-21-97
3 ch, 60 sh 32 jacks	11 ch, 78 sh 68 jacks	6 ch, 62 sh 44 jacks	2 coho 16 ch, 30 sh 12 jacks	7 coho 28 ch, 28 sh 31 jacks

9-21-98	10-2-98	10-12-98
5 sh 10 – ½ lb.	2 ch, 9 sh 7 – ½ lb.	8 ch, 11 sh, 21 – ½ lb. 2 jacks

Note: The "jacks" designation in the 1996 and 1997 surveys included chinook jacks and steelhead half-pounders.

Eel and Van Duzen Rivers

No migrating adults were observed this year in the extraction reaches of the lower Eel River. There did not appear to be any barriers to upstream migration throughout the entire reach. However, fish were reported to be holding downstream in the Cock Robin Island area.

The mouth of the Van Duzen remained impassable for migrating salmonids the entire summer and early fall. It opened after the first large storm of the season and allowed passage. However, the storm flows also eliminated the use of underwater observation.

Table 12: Eel River Adult Salmonid Observations 1996-1998

9-9-96	9-20-96	10-1-96	10-11-96	10-21-96	11-11-96
0	6 jacks	4 jacks	1 ch, 5 jacks	20+ ch 11+ sh 4 jacks 30+ un	1,500+ ch 2 jacks 500+ un

9-9-97	9-19-97	9-30-97	10-27-97
14 sh, 5 jacks	8 sh 13 jacks	2 sh 11 jacks	49 ch, 3sh 12 jacks

9-23-98	10-8-98	10-19-98
1 sh	0	0

Trinity River

Due to the relative stability of the bedrock controlled Trinity River channel, the locations of pools, runs, and riffles have changed very little in the past three years. As in previous years, adult salmonids were observed holding in the same general habitat units. There were no migration surveys in 1997 due to excessive turbidity.

Table 13: Trinity River Adult Salmonid Observations 1996 and 1998

9-11-96	9-26-96	10-4-96	10-14-96	11-8-96
10 un	4 ch, 1 jack	3 ch, 1 jack 11 unk.	13 ch, 7 sh 3 jacks, 4 unk.	22 ch, 6 sh 5 jacks

8-31-98	10-7-98	10-21-98
2 ch	5 ch, 2 sh, 2 – ½ lb.	9 ch, 2 sh, 8 – ½ lb.

Spawning Observations

I did not observe any spawning activity this monitoring season. This may have been due to the early fall rains and runoff allowing fish easier movement upstream. Spawning was observed in the lower Mad River in early November in 1996. It is possible that the late October suspension of the 1998 dive season, due to increased turbidity levels, resulted in missed opportunities to observe spawning in later weeks.

Personal Observations

Throughout the entire 1998 monitoring period, I did not observe any instances of direct impacts to salmonids or any other fish species as a result of extraction operations. It is possible that gravel extraction operations have some indirect impacts on salmonid populations, but it would be very difficult to determine the degree or significance of those impacts given the variety of land uses, recreational activities, and changing ocean and weather conditions that influence fish stocks.

General Comments

There has been much discussion about the usefulness of conducting gravel extraction-related fisheries monitoring in Humboldt County. Personally, I feel that even though the biological monitoring program criteria were not designed around testing hypotheses to answer specific questions regarding the potential impacts of gravel extraction, useful data has been collected. I feel that the data collected to date appears to indicate that, at least for the Humboldt County rivers, gravel extraction does not significantly affect water temperatures, salmonid migration movements, holding patterns with regard to noise impacts, or steelhead rearing locations. It was expected during the development of the LOP and IMP that the first set of monitoring protocols would likely need modification due to some questions being answered, new ones being asked, and deficiencies being identified.

Now that the third year of the LOP and IMP monitoring programs is complete, there is the opportunity to modify them to try to answer specific questions regarding potential impacts. It is my opinion that the CHERT, Operators, and Agency personnel need to sit down and decide exactly what kind of biological monitoring protocol is desired and economically justified for the LOP modification. Whatever form the new program takes, it will end up becoming a part of the new Mad River PEIR and the Eel River Management Plan. The new monitoring protocols need to be built on consensus as well as open and professional communication.

There are opportunities to conduct meaningful work while at the same time keeping costs under control. One way to do this is to develop a cooperative intern program between the gravel companies and HSU. The University has a large pool of students that would likely be very willing to conduct research on the local rivers that could have direct applicability in the Humboldt County area and beyond. I believe that, with proper oversight, there are several graduate theses waiting to be researched and written that could be of value not only to the Operators and the County, but could also be used to further the general knowledge about fisheries biology. Three examples are directed studies of the success of lower river spawning, a comparison of different health indicators (age, length, weight, etc.) between mainstem Mad River juvenile steelhead and those in a relatively pristine system found in Redwood National Park, and the role gravel extraction plays in the development or retardation of riparian succession.

---

back to top

ACKNOWLEDGEMENTS

I would like to thank all of the gravel operators, who provided the financial support for this project, and without whom this monitoring program would not have been possible. Thanks to Teri Branstetter, Bob Brown, and Paul Kraus for providing me with information and aerial photographs. Many thanks to Andrew Jensen, NRM Fisheries Technician, for his assistance with the dive surveys. Finally, thanks to Michael Lamprecht for doing the best he can under sometimes trying circumstances.

REFERENCES

Flosi, Gary, and Forrest Reynolds. 1994. California Salmonid Stream Habitat Restoration Manual.

Second Edition. Inland Fisheries Division, California Department of Fish and Game.

Halligan, D. 1997. Final report on the results of the 1996 fisheries monitoring program on the Trinity and lower Mad, Eel, and Van Duzen Rivers. Natural Resources Management Corporation, Eureka, California.

Halligan, D. 1998. Final report - 1997 fisheries monitoring program for gravel extraction operations on the Mad, Eel, Van Duzen, and Trinity Rivers. Natural Resources Management Corporation, Eureka, California.

Humboldt County Resource Conservation District. 1998. Final Report of the Eel River Water Quality Monitoring Project. Submitted to the California State Water Quality Control Board. 205 (J) Contract # 5-029-250-2.

Lewis, T. 1997. Influences of distance from coast and elevation on maximum weekly average temperatures. Memo from the Forest Science Project. Humboldt State University, Arcata California.

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

Moyle, P.B., R.M. Yoshiyama, J.E. Williams, and E.D. Wikramanayake. 1995. Fish Species of Special Concern in California. California Department of Fish and Game, Sacramento.

PERSONAL COMMUNICATIONS

Larry Preston, CDF&G Fisheries Biologist, Eureka California

back to top

APPENDIX 1
(Not Available - contact Dennis Halligan for Appendix)

WATER TEMPERATURE PROFILES

APPENDIX 2
(Not Available - contact Dennis Halligan for Appendix)

AERIAL PHOTOGRAPHS

THE END OF REPORT