SONOMA COUNTY WATER AGENCY'S MIRABEL RUBBER DAM/WOHLER POOL FISH SAMPLING PROTOCOL

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Prepared by

Shawn Chase
Ron Benkert
David Manning
Sean White

Sonoma County Water Agency
P. O. Box 11628
Santa Rosa, CA 95406

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1.0 INTRODUCTION

The Russian River provides habitat for several special status fish species, including three that are protected under the Endangered Species Act (ESA). On October 31, 1996, the National Marine Fisheries Service (NMFS) listed coho salmon as threatened under the ESA within the Central California Coast Evolutionarily Significant Unit (ESU), which includes the Russian River. On August 10, 1997, NMFS listed steelhead as threatened under the ESA within the Central California Coast ESU, which includes the Russian River. On 16 September, 1999, NMFS listed chinook salmon as threatened under the ESA within the California coastal ESU, which also includes the Russian River.

In accordance with Section 7(a)(2) of the ESA, federal agencies must consult with either the USFWS and/or the NMFS to "insure that any action authorized, funded, or carried out by such an agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat..." In the present case, the endangered species are anadromous salmonids, which are managed by the NMFS. The U.S. Army Corp. of Engineers, as the federal sponsor, and the Sonoma County Water Agency (Agency), as the local sponsor, entered into a Memorandum Of Understanding (MOU) with the NMFS to begin the consultation process in December 1997. The MOU covers the Agency's flood control and water supply projects throughout the Russian River Basin.

The Agency is preparing a Biological Assessment of its operations and facilities to assess potential impacts to ESA protected species. The scope of this study is limited to assessing the potential for the Agency's Mirabel and Wohler diversion facility to adversely impact coho and chinook salmon and steelhead. Results from this study will be incorporated into the Agency's Biological Assessment.

1.1 BACKGROUND

The Agency diverts water from the Russian River to meet residential, and municipal demands. The Agency's water diversion is located near Mirabel and Wohler Road (Figure 1). The Agency operates five Ranney collector wells (large groundwater pumps) adjacent to the Russian River near Wohler Road and Mirabel which extract water from the aquifer beneath the streambed. The ability of the Russian River aquifer to produce water is generally limited by the rate of recharge to the aquifer through the streambed. To augment this rate of recharge, the Agency has constructed several infiltration ponds. An inflatable dam (Mirabel Rubber Dam, referred to as the "Rubber Dam" in this report), located in the Mirabel area, raises the water level and submerges the intakes to three diversion pumps. The water is pumped through a dike into a system of canals that supply water to four infiltration ponds. Water is also diverted through two screened control gates that feed two additional infiltration ponds at the Wohler facility. The backwater created by the Rubber Dam also raises the upstream water level and submerges a larger streambed area along the river. This increased depth and enlargement of the submerged area significantly increases infiltration to the aquifer.

The Rubber Dam is generally inflated between April and June and is deflated by between late-September and mid November of most years. The actual timing varies annually depending on a number of factors including, demand, air temperature, precipitation, river flow. The Rubber Dam creates an impoundment that is approximately two miles in length (Wohler Pool). Within the impounded reach, water depth is increased and current velocity is decreased, compared to unimpaired conditions. These changes in the natural hydrology of the river have the potential to alter species composition, distribution, and abundance within the affected reach.

Figure 1 Map of study area

There are several uncertainties regarding the potential for the Mirabel and Wohler facilities to adversely affect coho and chinook salmon and steelhead. In light of these uncertainties, the Agency proposes to conduct a five year study to assess the potential impacts associated with the facilities, and to develop mitigation measures as appropriate. Several sampling techniques are available to monitor fish communities in relatively large river systems such as the Russian. Each technique has its own set of advantages and disadvantages, as well as their own set of sampling biases. Prior to adopting specific sampling methodologies, a reconnaissance sampling program was conducted to determine methodologies that would best assess the fish community and water quality in and around the Mirabel and Wohler facilities.

In 1999, the Agency (in cooperation with NMFS and CDFG) prepared a study plan entitled "Sonoma County Water Agency's Mirabel Rubber Dam/Wohler Pool Reconnaissance Fish Sampling Program" (Chase et al. 1999). This document was approved by the resource agencies, and the study plan was instituted in 1999. The results of that study form the basis for the following five year study plan.

1.2 STUDY AREA

The study area encompasses the Russian River from approximately two river miles (RM) downstream of the Rubber Dam to approximately four RM upstream of the dam (Figure 1). During the initial year of the five year study (2000), each sampling location will be plotted on a base map using GPS coordinates. The following are landmarks and geographical names used throughout this study, and the type of sampling stations that are proposed for each location. River mile (RM) designations were taken from the aerial photographs taken for the County of Sonoma Aggregate Resources Hydrology Monitoring program.

1) Steelhead Beach County Park: Located at RM 21.75
   - Boat electrofishing station
   - Continuous water temperature monitoring station
   - Water quality station

2) Rubber Dam: Located at RM 22.75
   - Boat electrofishing station
   - Continuous water temperature monitoring station
   - Water quality station

3) Wohler Pool: Impoundment formed behind Rubber Dam. Stretches from RM 22.75 to RM 24.75

4) Wohler Bend: Located at RM 23.75
   - Boat electrofishing station
   - Water quality station

5) Benoist Bend: Located at RM 24.50
   - Continuous water temperature monitoring station
   - Water quality station

6) Benoist Pool (downstream end): Located at RM 24.75
   - Boat electrofishing station

7) Diversion Pump Pool: Located at RM 25.65
   - Continuous water temperature monitoring station
   - Water quality station

8) Riverine Reach (downstream end): Located at RM 25.75
   - Boat electrofishing station

Water temperature is a crucial factor affecting all aquatic life. Water temperature directly affects an organisms ability to survive, grow, and reproduce. Salmonids prefer cool, well oxygenated water. As the temperature of water increases, the solubility of oxygen decreases (i.e., warmer water holds less dissolved oxygen). Also, as water temperature increases, a fishes metabolism increases, driving up the demand for both oxygen and food. For example, within a species specific temperature tolerance range, as water temperature increases, its growth rate and swimming performance will increase. Water temperatures above this range will result in an increased susceptibility to disease, a reduction in swimming performance, and a reduction in growth. Ultimately, excessively high temperatures can result in direct mortality. Optimal and lethal water temperatures also vary by life stage (e.g., embryos are less tolerant of high temperatures than juveniles).

Temperature tolerance is species specific. For example, juvenile steelhead prefer water temperatures around 10 to 15°C (50 to 59°F), while smallmouth bass prefer warmer temperatures ranging from 20 to 32°C (68 to 90°F). Thus, as water temperature warms during the summer, conditions become less favorable for salmonids and more favorable for predators such as smallmouth bass.

As rivers flow from their headwaters to the ocean, water temperature increases naturally, depending on meteorological conditions. The impoundment formed by the Rubber Dam may degrade water quality, primarily by increasing the rate at which water temperature increases. Impoundment's such as Wohler Pool slow the flow of water through the basin. The longer the residence time, the greater the opportunity for water to be warmed through solar radiation. Therefore, the key consideration is to determine to what degree, if any, the impoundment increases water temperature compared to free flowing riverine conditions.

2.1 Continuous Water Temperature Monitoring Stations

Four continuously recording water temperature monitoring stations will be installed throughout the study area (Figure 2). Water temperature data will be collected using a Hobo H8 2K data logger (Onset Computers, Inc.). At each station, two data loggers will be placed in the water column such that one will be approximately 0.5 meters deep, and the second will be placed in approximately 3.0 meters, depending on available depths. Data loggers will be programmed to record temperature on an hourly basis, 24 hours a day. The temperature monitors will be deployed just after the Rubber Dam is inflated, and will be operated as long as the dam is up. Data will be downloaded to a portable PC every two to four weeks to prevent the significant loss of data in the advent of equipment failure. Each time the data is downloaded, the data loggers will be calibrated against a mercury thermometer. If the data loggers do not calibrate to the mercury thermometer, they will be brought back to the lab, serviced as needed, and recalibrated prior to being reinstalled. During calibration and servicing, a calibrated data logger will be installed to provide continuous data collection.

Figure 2 Proposed water quality sampling stations

2.2 WATER QUALITY MONITORING (PROFILE) STATIONS:

Water quality (water temperature, dissolved oxygen, and conductivity) will also be monitored at five stations ranging from approximately 6.5 km (4 RM) upstream of the Rubber Dam to Steelhead Beach, approximately 1.6 km (1 RM) downstream of the dam (Figure 2). Water quality parameters will be collected over the deepest section of each sampling station, and water quality profiles will be taken from the surface to the bottom at 0.5 meter intervals. Water quality profiles will be collected on a biweekly schedule. Water quality data will be collected using a Yellow Springs, Inc., (YSI) 85 Portable Temperature/ DO/Conductivity meter.

2.3 DATA ANALYSIS

The rate of water temperature increase above, within, and below the Wohler Pool will be extrapolated to a rate of increase (degrees °C) per kilometer (km) of stream. The temperature data collected at each location will also be evaluated in light of published thermal requirements for salmonids and potential predatory fish.

Data collected in the Water Quality Monitoring sites provide a general description of water temperature and dissolved oxygen levels throughout the study area. However, since these data are collected during the day, this information will not represent daily minimums or maximums. Profile data will augment information generated by the permanent data loggers.

3.0 GRAVEL BAR GRADING OPERATIONS

The Agency annually conducts gravel bar grading activities in the vicinity of the Wohler Pool, both upstream and downstream of the Rubber Dam. Gravel bar grading upstream of the dam consists of contouring the shoreline such that large gravel deposits are spread out to facilitate infiltration. Gravel is not removed from the area, and all work is conducted within the shoreline area that is inundated when the dam is inflated. Downstream of the dam, gravel is removed from one gravel bar that forms the Mirabel Gravel Bar Pond (described below).

In general, gravel bar grading operations have the potential to adversely affect aquatic resources by increasing turbidity, removing spawning gravel and disrupting spawning habitat, stranding of juvenile fish, burial of benthic macroinvertebrates, and mechanical injury resulting from the operation of heavy equipment in the active channel.

Increasing turbidity can adversely impact aquatic organisms by reducing water clarity. Many species, including salmonids, are "sight feeders." A reduction in water clarity can decrease feeding success, and over the long run, can ultimately result in a decrease in growth and survival of aquatic organisms. An increase in turbidity can also decrease light penetration, resulting in a decrease in aquatic plant production. Aquatic plants provide habitat for invertebrates that are utilized as food by other aquatic organisms, and rearing habitat for a variety of juvenile fish. Extremely high turbidity levels can directly injure fish (e.g., eroding and/or clogging of gills). Over an extended period of time, this can result in a decrease in growth and an increase in mortality.

Increased sediment input into the river can fill in the interstitial areas in spawning gravel, and result in decreased survival of developing embryos (however, little, if any spawning habitat is available in the project area. Excessive sediment input can fill in the interstitial areas around cobble substrate, decreasing their suitability as rearing habitat for juvenile fish. Excessive sedimentation can also bury benthic organisms that provide food for fish and other aquatic organisms.

Improper contouring of streambanks following bar grading can result in conditions that are conducive to stranding of juvenile fish. Juvenile fish typically inhabit the nearshore area of rivers. Conditions conducive to stranding include large, flat, shallow areas along the stream margin that are inundated at high flow (or when the temporary dam is in operation) and large depressions along the stream margin that become dewatered at low flow. Juvenile fish that take refuge in these areas during high water conditions can be stranded as the water level drops, and are thus vulnerable to desiccation and predation.

Potential impacts associated with gravel bar grading operations upstream of the Rubber Dam are essentially confined to potential increases in turbidity and sediment input into the river. The gravel bar downstream of the Rubber Dam is graded to an elevation below the low flow water surface elevation of the river. Water is diverted across the bar, forming the "Mirabel gravel bar pond" (Infiltration Pond) next to the river. The Infiltration Pond is connected to the river on the downstream end that allows water flowing through the pond to be released back in to the river. Potential impacts associated with this operation include entrapment of emigrating smolts and an increase in water temperature as the water flows through the shallow pool and reenters the river.

3.1 GRAVEL BAR GRADING OPERATIONS BEST MANAGEMENT PRACTICES (BMPS)

Monitoring of gravel bar grading operations will include the following BMPs:

- Biological oversight will be provided by qualified biologists.
- Permanent vegetation will not be removed.
- Sediment fences will be employed to prevent the input of sediment into the river.
- Operation of heavy equipment in the active stream channel will be limited to moving equipment to and from the mid-channel gravel bars, and will be very short in duration.
- Gravel will not be removed from shoreline areas located above the Rubber Dam. Gravel in these areas will be spread out to facilitate infiltration, only.
- After gravel bar grading operations are completed, gravel bars will be contoured to a 2 percent grade to reduce the potential for stranding.
- Install continuously recording turbidity meters upstream and downstream of gravel bar grading operations.
- Remove as much of the sand forming downstream berm as possible prior to breaching.
- Breaching of the lower berm should be conducted late in the evening or early in the morning to reduce visual impacts to recreational visitors to Steelhead Beach.
- All BMPs will be implemented prior to grading operations commencing.

3.2 TURBIDITY MONITORING

The potential increase in turbidity resulting from gravel bar maintenance operations is covered under the California Regional Water Quality Control Board North Coast Region Order No. 81-73 Waste Discharge Requirements for Sonoma County Water Agency that states:

> "The construction of stream crossings, diversion facilities, protective dikes, and other water quality control facilities can result in turbidity and is considered a non-point source waste discharge.
>
> These activities are normally of short duration and any resulting turbidity will not adversely affect beneficial uses if the discharge is properly controlled. Any activity of this nature shall not increase the turbidity of the affected waters by more than the following:
>
> a. Within the area of immediate influence*:

Background Turbidity Upstream of the Operation	Allowable Increases
0- 30 NTU	5 NTU
Greater than 30 NTU	10 NTU

> b. Outside area of immediate influence there shall be no increase above background turbidity.
>
> *The area of immediate influence is the area between the point of discharge and a point 500 feet downstream from the discharge.

Turbidity levels will be monitored continuously at two sites to determine project related impacts associated with excessive turbidity levels. The actual location of the downstream sites will vary slightly, depending on the location of grading operations. For all gravel bar grading operations, the upstream control site will be located at water quality sampling site #3 (Figure 2). The downstream turbidity monitoring station will be placed approximately 60 m downstream of the dam site (smolt monitoring trap location). For the gravel bar grading operations conducted at the Infiltration Pond, the downstream monitoring site will be located opposite of steelhead beach (150 meters (500 feet)) downstream of gravel bar grading operations).

All mitigation measures (e.g., siltation exclusion fencing) will be in place prior to the commencement of construction related activities.

3.3 Fish Sampling

The presence or absence of salmonid smolts in the infiltration pond will be determined through beach seining. All fish collected during beach seine sampling will be released into the river downstream of Infiltration Pond. Seining operations in the Infiltration Pond will begin one week after the pond is filled, and will continue for one month, or until smolts have not been observed in the pond for at least two consecutive sampling efforts (whichever is longer).

3.4 Water Temperature Monitoring

A continuously recording water temperature data logger will be deployed at the upstream and downstream ends of the Infiltration Pond. The methodology will follow that described above in Section 2.1, except that only one logger at a depth of approximately 0.5 meters depth will be deployed at each station (due to the lack of depths greater than this).

3.5 Data Analysis

Turbidity levels before, during, and after gravel bar grading operations are conducted will be compared to evaluate the potential impacts of increased turbidity on salmonids. This information will be evaluated in light of published information on the effects of turbidity on salmonids.

Water temperature data will be evaluated to determine if water flowing through the relatively shallow Infiltration Pond increases in temperature. This information will also be evaluated in light of published information regarding thermal requirements of salmonids and predatory fish present in the Russian River.

Fish data collected will be evaluated in terms of species composition in the Infiltration Pond including the number of salmonids observed and/or captured. If salmonids are captured in the pond, then a mark-recapture study will be conducted in following years to determine the length of time that salmonids spend in the pond (i.e., do salmonids pass through the pond quickly, or do they become trapped in the pond for an extended period of time.

4.0 SMOLT EMIGRATION

The impoundment formed by the Rubber Dam can potentially impact juvenile salmonids as they emigrate to the ocean. When in place, the Rubber Dam impounds water upstream approximately three km (two River Miles). Salmonid smolts drift downstream with the current during emigration. The impoundment decreases current velocities which may delay emigrating smolts. Smolts have a seasonal "window of opportunity" to complete the physiological process (smoltification) necessary to survive in the marine environment. A substantial delay in migration may result in smolts reverting back to a "resident form," thus spending an additional year in freshwater. Depending on summertime conditions, this may greatly increase mortality of smolts failing to successfully emigrate to the ocean.

The objective of this study is to measure the length of time required for steelhead smolts to emigrate through the impounded reach of the river just before and after the inflation of the Rubber Dam. Steelhead smolts bearing distinguishing marks will be released at the upstream end of the impounded reach and recaptured in a rotary screw trap (described below) downstream of the dam. The amount of time elapsing between release and recapture of the smolts will be recorded.

Two sampling strategies will be employed to assess the rate of smolt emigration through the Wohler Impoundment: mark-recapture and radio telemetry.

4.1 MARK-RECAPTURE

The mark-recapture study consists of releasing marked hatchery reared steelhead smolts into the river, and measuring the length of time required for them to migrated through the Wohler Pool. The marked smolts are recaptured using a rotary screw trap (described below) (Figure 3). Information collected with the rotary screw trap will also provided additional information on the timing of wild steelhead and chinook salmon smolt emigration period, size, and age at emigration.

4.1.1 Fish Marking

All steelhead released from the Warm Springs Fish Hatchery are "marked" with an adipose fin clip, including those released for this study. In this study plan, the term "marked" refers to fish that received a mark in addition to the adipose fin clip as described below. All smolts used in the study will be reared at the CDFG's Warm Springs Fish Hatchery. Prior to marking, fish will be anesthetized in water containing MS-222 (tricaine methanesulfonate). Anesthetized fish are placed on a ceramic plate submerged in water. A commercially available Pow'r-ject marker (NewWest Technologies) will be used to inject a biological stain (Alcian Blue) into the fin rays of each fish marked. The dye remains visible to the naked eye for several months, and can be detected using a black light for up to two years. Marked fish are then placed in a tub containing freshwater and allowed to recover (regain equilibrium). Water in the tubs used to hold the smolts prior, during, and after marking will be changed frequently to maintain suitable water temperature and dissolved oxygen levels. After regaining equilibrium, each fish will be check to insure that they were successfully marked, and released into a separate raceway. Marked fish are then held in the raceway (grouped together by lot) until released into the Russian River.

A total of 20,000 steelhead smolts will be divided into four uniquely marked Lots. The different lots will be distinguished by injecting a biological dye (Alcian Blue) into either the right pelvic fin (Lot 1), caudal fin (Lot 2), anal fin (Lot 3) and the dorsal fin (Lot 4). Each Lot will contain approximately 5,000 fish.

Figure 3. Radio telemetry study site showing smolt release location, Mirabel Dam, smolt trap, and fixed automatic radio telemetry station.

4.1.2 Marking Quality Control

Marked fish from each Lot will be subsampled to determine the percentage that have marks readily detectable to the eye. A subsample of 250 fish (5.0 percent) will be randomly sampled by dip netting fish from the raceway (after the fish had been crowded to one end). Fish will be examined for marks, and categorized as either "Marked" (mark was readily apparent), "poorly marked" (mark is visible upon close inspection), or "not marked" (mark is not visible). All fish recorded as poorly marked will be remarked. If greater than three percent of the fish inspected (8 fish) are categorized as not marked, then the entire lot will be reexamined, and all fish categorized as poorly or not marked will receive a remarked.

4.1.3 Fish Releases

The timing of the release of each Lot will be dependent on streamflow and inflation of the Dam. Marked fish will be released in four groups of 5,000 fish each. Two releases will be made before the dam is inflated, and two groups after the dam is inflated. To examine the influence of pre-inflation flow on travel time, one group will be released at the approximate inflation flow and another at twice the approximate inflation flow. Since 1994, average flow during inflation was 868 cfs or 24.6 m^3/s.

The first group of fish will be released, after April 1, when flows at the USGS Hacienda Bridge Gauging Station approach 2000 cfs (56.6 m^3/s). The second group will be released when flows are less than or equal to 1000 cfs (28.3 m^3/s). The two post-inflation releases will be staggered by 14 days. The post inflation releases will occur after the water level in the impoundment has stabilized (See Appendix A, Manning 2000, for a detail discussion of the release strategy).

Smolts will be transported to the release site in CDFG's fish transportation truck. The water tank on the truck is equipped with a refrigeration system to maintain suitably cool water temperatures and a dissolved oxygen (DO) injection system to maintain suitable DO levels during transportation. The release point is approximately 400 m (¼ River Mile) above the upstream end of the section of river influenced by Wohler Impoundment. The river immediately upstream of the impounded section is bordered by a levee approximately 30 feet high. To facilitate the release of fish, three 20 foot long, eight inch diameter PVC pipes will be fastened together to provide a chute for the fish to pass through from the truck to the river. The end of the PVC pipe will be set at an approximately 45° angle so that the smolts dropped no more than five feet before landing in the river. This system function well during the initial study, as there were no observed moralities (e.g., no fish were observed floating downstream of the release point).

4.1.4 Rotary Screw Trap Methodology

Rotary screw traps (screw traps) are designed to capture downstream migrating juvenile fish. The screw traps are generally fished in the main channel where the water velocities are highest and the water column is the deepest (thalweg) since emigrating smolts tend to be concentrated in these areas.

Maintaining the trap in the desired location within the channel requires a series of cables secured to the shoreline. The cable infrastructure and support system consisted of an anchor and a series of cables to maintain the trap in place as well as to move the trap across the channel. The cable system is anchored to two 30 foot by 10 inch H-beam piles driven approximately 27 feet (vertically) into the river bank directly across from each other. The cabling system consists of four components; the main line, the bridle, the lateral adjustment cable, and the visual barrier support cable.

The main line consists of a 170 foot long, 0.75-inch steel cable. This cable is pulled across the river, stretched taut, and secured to the H-beam piles. The bridle consisted of a 20 foot length of 0.75-inch steel cable attached to a block with cable clamps on one end and attached to a one inch pear ring on the other end. Two 14 foot long 0.63-inch cables are attached to the pear ring on one end and then secured to the traps pontoons with shackles on the other end. The lateral adjustment cable consisted of a continuous length of .38-inch galvanized steel cable. The cable is run through two 4-inch blocks attached to the piles. The ends of the cable are attached to the eight-inch block on the main line, creating a continuous loop (similar in theory to a clothes line). This looped cable is used to move the trap into position and also to adjust the traps position as required. Once the trap is positioned appropriately, a cable clamp secures the lateral adjustment cable in position. A 0.38-inch safety break-a-way cable is connected to the rear corner of the trap and to an anchor point on the shoreline. In the event of a mainline cable failure the trap will rotate 180° and swing into shore where it can be recovered. Orange floats are strung out along a cable at 10 foot intervals to provide a warning for canoeist/kayakers and low flying rescue aircraft.

Screw traps of two sizes (diameter) will be fished during this study, an eight foot diameter trap, and two five foot diameter traps. Rotary screw traps are lowered into the water column until half of the cone is submerged. Thus, an 8-foot diameter trap requires a minimum depth greater than four feet to operate. The 5-foot diameter trap requires a minimum depth of 2.5 feet. All traps will be fished simultaneously as long as sufficient depth can be maintained below the traps. Screw traps will be operated throughout the primary smolt emigration period.

Three rotary screw traps will be used during the study. An eight-foot diameter trap and two five-foot diameter traps will be fished prior to the inflation of the dam, and two five-foot diameter traps will be used after the inflation of the dam (the eight-foot trap will be fished as long as sufficient depth is available in the trapping area). The screw trap is a cone consisting of perforated stainless steel panels which houses an internal Archimedes screw. Water striking the angled surface of the internal screw rotates the cone and screw assembly. As the assembly rotates, fish are trapped within the chambers formed by the screw and moved rearward into the live box at the back of the trap. The live box provides a low velocity resting area for fish captured by the trap. Debris such as leaves and small twigs entering the live box are impinged on a rotating debris screen located at the back of the live box. As the screen rotates, debris is carried out of the box, maintaining a relatively clean environment for the fish held in the live box. The cone is mounted between two pontoons and is lowered and raised with a bipod and windlass located at the front of the cone.

All fish captured in the screw trap will be netted and placed in five gallon buckets containing fresh river water. Alka-seltzer will be used as an anesthetic. Fish captured will be identified to species, measured to the nearest mm (FL) and placed in a recovery bucket containing fresh river water. Recovery buckets will be equipped with a small aerator to maintain dissolved oxygen levels. Once fish have regained equilibrium, they will be released into the river. The date and time of capture will also be recorded for each marked smolt recaptured. The Agency has developed a rotary screw trap protocol that provides a more detailed description of the trap checking and fish handling procedures (Appendix B).

4.2 RADIO TELEMETRY

The methodology for the radio telemetry study is fairly involved. A separate detailed description of the procedures for this study are presented in Appendix A (Manning 2000). Radio telemetry is the use of radio transmitters (radio tags) and receivers to track the movement of animals. Innovations over the last 10 years now permit the use of micro transmitters in salmonid smolts. Radio tags are small battery operated transmitters (dimensions 8 x 20 mm; weight 1.8 g) that are surgically implanted in the fish. Each radio tag emits a unique signal that identifies an individual fish. Depending on the pulse rate of the signal, operational life of the tags ranges from 16 to 19 days. Research has shown that survival of tagged fish is high and signal recovery rates over the expected operational life of a tag are greater than 90%.

The signal is monitored by a sensitive antenna and receiver that is either carried manually and/or fixed to a permanent location. In this study, we will employ both types of antennas to track smolt movement. A hand held antenna will be used (from a boat) to track the movement of fish within the study area. A fixed antenna and receiver will be placed downstream of the Rubber Dam site to record the date and time that smolts pass out of the study area. Signal range is dependent on water depth, conductivity, temperature, and river morphology, but is typically 200-400 m.

4.3 DATA ANALYSIS

Data analysis will include a comparison of the average travel time through the impounded reach, pre- and post-dam inflation, based on the results of both the mark-recapture and radio telemetry studies. A description of the smolt movement through the study area will also be included.

Screw trapping results will also be provided for wild salmonids collected while the screw trap is in operation. Data presented will include numbers of each species caught, age and length, seasonal timing of the end of the migration period (screw traps cannot be operated during the beginning of the emigration period due to the possibility of excessively high streamflows), and the results of microsatellite (DNA) analysis conducted by the Bodega Marine Lab.

5.0 ADULT UPSTREAM MIGRATION

The upstream spawning migration of adult anadromous salmonids in the Russian River primarily occurs between September and May, but some adult fish may be in the river during any month of the year. Dam inflation and deflation can occur during any month of the year, but excluding severe drought years, the dam is inflated between early April and early June, and deflated between late September and mid December. Thus, during normal rainfall years, the Rubber Dam is inflated at the start of the chinook salmon migration period in the fall, and at the end of the spring coho salmon and steelhead migration periods. The dam is approximately four meters in height, and forms an effective barrier to upstream migration of fish. The dam is equipped with two denil type fish ladders to provide access around the dam, however, the effectiveness of the ladders have not been tested. The objective of this task is to evaluate fish passage through the denil fish ladders leading around the Rubber Dam using underwater video cameras and direct observation techniques (snorkel surveys).

5.1 VIDEO MONITORING

Adult salmonid passage through the fish ladders will be assessed using underwater video cameras. The video system utilized at the fish ladders was designed specifically for this project. The system consists of two Sony™ ultra-high resolution monochrome video cameras with wide angle (105°) lenses housed in waterproof cases. The images captured by the cameras are recorded on two Sony S-VHS time lapse video cassette recorders. The recording rate for the time lapse photography will be one frame every 0.2 seconds (24 hour setting). The images are viewed on a Sony ultra-high resolution dual input monochrome monitor. Lighting for each video camera is provided by four 36 LED high intensity red illuminators in waterproof housings that are mounted directly onto the camera housings.

A square metal housing (exit box), measuring 4'x4'x7', was mounted to the upstream exit of the each fish ladder. The exit boxes are smooth sided, and conform to the sides of the fish ladders. The design of the exit boxes does not change the hydraulics of the fish ladders. To facilitate fish identification, A highly reflective background is attached to the back wall and the floor of the exit boxes. The cameras are mounted in custom manufactured boxes extending off the downstream side of the exit boxes. The boxes are and constructed of 3/16" steel. A plexiglass window was inserted between the exit and the camera boxes. The cameras will be in operation whenever the dam is inflated (approximately May through mid November).

5.1.1 Video Tape Review

Video tapes of the fish ladders are reviewed on high quality VCRs that have a wide range of slow motion and freeze frame capabilities. When a fish is observed, tapes are reviewed frame by frame to determine the species and direction (upstream or downstream) of the fish. For each fish observed, the tape reviewer records the species, direction (upstream or downstream), date, and time of passage out of the ladder.

5.2 DIRECT OBSERVATION SURVEYS

In addition, surveys will be conducted to determine if upstream migrants are present in the river below the dam. This is an important consideration because the observation of salmonids migrating through the ladder does not guarantee that all fish in the river are able to detect and ascend the ladder. Conversely, the lack of fish passing through the ladder may indicate the lack of fish in the river at that time, and not reflect the operation of the fish passage facilities. Direct observation (snorkel surveys) techniques will be utilized to assess adult salmonid numbers below the dam. Survey teams will consist of two divers and one spotter. The divers will enter the river just downstream of the dam, and transverse the river along the base of the dam searching for adult salmonids. The third team member will stand on the bluff on the west side of the river. This site offers a good vantage point to observe salmon that might be spooked away from the dam by the divers (the river just below the dam becomes very shallow, and an adult salmonid swimming downstream from this area should be easily visible to the spotter. Surveys will be conducted on a biweekly basis.

The effectiveness of this technique is limited by water clarity. However, if relatively large numbers of salmonids are present below the dam, this technique should be suitable to detect their presence. The main advantage of this technique is that there is little disturbance of the fish compared to techniques such as beach seining.

5.3 DATA ANALYSIS

The number of anadromous fish (chinook salmon, steelhead, and Pacific lamprey) viewed on the video tapes will counted, and the time and date of their passage through the fish ladder will be recorded. The number of adult salmonids observed below the dam will also be recorded.

6.0 WOHLER POOL FISH COMMUNITY

The Rubber Dam impounds approximately two miles of river, creating essentially a two mile long pool. Since pools are the preferred habitat of adult predatory fish (e.g., pikeminnow and smallmouth bass), the habitat created behind the Rubber Dam may results in an increase in the populations of these predators. Concentrating numbers of adult predators may lead to an increase in predation on salmonid smolts. This may be particularly true if smolts have difficulty migrating through the impoundment (see Section 2.0). Predator populations will be assessed using a boat electrofishing methodology. Electrofishing employs an electric current to stun fish, allowing for easy capture. This method is particularly effective on large fish that inhabit relatively shallow habitats (< ten feet deep). The following study is designed to determine if adult piscivorous fish are concentrated in the Wohler Pool.

6.1 BOAT ELECTROFISHING

The study area was divided into four (possibly five) reaches; the "Below Wohler Reach," the "Wohler Pool Reach," the "Benoist Reach," and the "Riverine Reach" (the Benoist and Riverine reaches are located upstream of the Wohler Pool) (Figure 4). The Wohler Pool Reach was further divided into two subreaches of equal length (an upstream and a downstream half). The Reaches selected outside of the influence of Rubber Dam were not intended to be replicates for the Wohler Pool Reach. These Reaches were selected to assess fish populations in the vicinity of Wohler Pool, and to determine if the conditions present in the Wohler Pool Reach lead to larger populations of predatory fish compared to habitats just upstream and downstream of the dam.

6.1.1 SAMPLING SITE SELECTION

Within each reach or subreach, nine sampling unit will be randomly selected; three along the left bank, three along the right bank, and three down the middle of the channel. Each reach will be divided into nine equal lengths measuring 180 m (585 feet). Starting at the downstream end of a reach, a starting "side" will be randomly selected (i.e., either the left bank, mid channel, or right bank). Once a starting point has been selected, a distance of 180 m will be measured upstream, and this will constitute sampling station #1. At the upstream end of sampling station one, one of the two remaining "sides" will be randomly selected, and a distance of 180 m will be measured upstream. This will constitute sampling station #2 for that Reach. The remaining side will then be selected as sampling station #3. At the upstream end of sampling station three, the station order will be repeated with sampling station #4 being the same side as sampling station #1. This strategy for selecting sampling locations will be repeated for each Reach. The advantages of this strategy are the stations can easily be laid out during the day, and, more importantly, easily located at night, and the entire study reach has an equal chance of being selected for sampling (thus the assumption of randomness is maintained).

6.1.2 Boat Electrofishing

A 16′ foot Smith-Root, Inc. electrofishing boat (model SR 16S) will be employed to collect fish. The electrofishing boat has an onboard generator that sends an electric current through two anodes mounted to the front of the boat. A series of cathodes are also mounted on the front of the boat to complete the current. The strength of the current is controlled by the boat operator, and is maintained at the minimum level required to effectively capture fish. The front of the boat is designed as a flat platform enclosed on the front and sides with safety railing. The platform is large enough to allow to crew members to net fish stunned during electrofishing. Fish are collected using nets that measure 17" X 17", mounted on eight foot long fiberglass handles. The motor is mounted on a transom jack which allows the engine to be raised or lowered depending on water depth. The transom jack combined with the shallow draft of the boat allows for the safe operation in water less than two feet deep. A series of flood lights mounted on the front and rear of the boat allow for safe operation during night time sampling efforts.

Electrofishing will be conducted in late July/early August to minimize the potential of encountering adult salmonids. Electrofishing will be conducted during hours of darkness. Smallmouth bass have been shown to be more vulnerable to electrofishing conducted at night, compared to daytime electrofishing surveys. In addition, the potential to encounter kayakers and other recreational user groups is greatly reduced. At each station, electrofishing will begin at the downstream end, and proceed upstream. Along banks with cover (e.g., overhanging and aquatic vegetation) the boat is maneuvered such that the anodes are placed in the cover prior to the current being delivered to the water. This minimizes the potential of alerting fish to the presence of the current, and increases capture rates. Delivery of the current through the anode is controlled with a series of foot switches. The netter in control of the electrofisher will switch the device on and off to control when the current is applied. In this way, the current is applied only when the anodes are in position to fish. In addition, if a large number of fish are stunned, the unit can be shut off so that stunned fish can be netted without being subjected to continued exposure to the current. A timer records the effort (i.e., number of seconds that the electrofisher is in operation) at each station.

During electrofishing, an attempt will be made to net all fish stunned. However, special emphasis will be placed on capturing target species (adult piscivorous fish) and juvenile salmonids. Stunned fish that are netted will be held in a live well. The live well is equipped with a recirculating pump and an aerator to supply fresh, well oxygenated water to the holding tank. Captured fish will be identified to species and measured to the nearest 0.5 cm. FL. Scale samples will be collected from representative fish to determine the age structure of the fish community.

6.1.3 Habitat Data

Habitat data will collected at each discrete sampling site prior to electrofishing. Data will be collected by two biologist in kayaks. Each discrete sampling unit will be classified by habitat type (e.g., pool, riffle, run). In addition habitat information collected will include; average and maximum depth (recorded as the average and maximum depth out to a depth of approximately 10 feet from shore), bank substrate composition, shoreline vegetative cover, instream cover (including percent of sampling station with overhanging vegetation (out to at least five feet), aquatic vegetation, large woody debris, and large rocks). Habitat data collected in the mid channel stations will be collected along a straight line down the middle of the channel.

Figure 4 Proposed boat electrofishing station locations

6.2 DATA ANALYSIS

Fish Community Structure: Data on species composition, relative abundance, distribution, age, and size structure of all species collected will be compared for each reach. Species abundance will be based on catch-per-unit-effort (i.e., the number of fish caught per minute of sampling) using the time that the electrofisher was in operation at each station. Age analysis will be based on scale analysis and length-frequency histograms.

Predatory Abundance: The main focus of this study is to determine if the populations of fish capable of preying on salmonids is higher within the Wohler Pool compared to the river outside the influence of the impoundment. Although the Wohler Pool does not provide rearing habitat for salmonids, emigrating smolts must pass through the Wohler Reach on their way to the ocean. Wohler Pool may influence predator populations in one of two ways. First, the impoundment may provide rearing habitat for juveniles of piscivorous species. Secondly, The impoundment may provide habitat for adults of piscivorous species. Predator abundance data will be analyzed using both juvenile and adult data to determine if either case is occurring.

Adult predator populations will be divided into two categories based on size of prey that can be consumed. Obviously, the size of the predator will dictate the size of the prey that can be consumed. Two size classes of salmonids are vulnerable to predation (by predatory fish); YOY salmonids and steelhead smolts. Chinook salmon collected in the Russian River in 1999 ranged in length from 55 to 106 (average 89) mm FL, in April and May. Emigrating steelhead smolts ranged in size from 147 to 250 (average 174) mm FL during the same time frame. In addition, nine steelhead parr/smolts were collected in and above Wohler Pool in August, 1999. These steelhead ranged in size from 120 to 195 (average 137) mm FL. A literature review will be conducted to determine the size that each predator species must be in order to feed on 1) a 50 mm (2 inch) chinook salmon smolt, and 2) a 125 mm (5 inch) steelhead smolt. Potential predators evaluated will include smallmouth bass and Sacramento pikeminnow. If additional predators are captured during future sampling efforts, they will be included in the analysis.

Statistical Analysis: Predator abundance and fish community structure will be analyzed using Multidimensional Scaling and One Way ANOVA. Multidimensional Scaling will be used to detect differences in fish communities between the different Reaches. Species count data is typically not normally distributed, thus, the multivariate method selected has to be less sensitive to violations of normality and homogeneity of variance and normal distribution. Non-normal distributions are common in aquatic ecology, where sampling often revolves around counting organisms that are either abundant or very rare or even absent. Multidimensional scaling appears to be fairly robust with respect to departures from normality, and is thus a suitable method for analyzing these types of data. Statistics will be run on the overall catch (adult and juvenile fish) and on adults (since electrofishing is more effective at capturing adult fish, including juvenile fish may bias the results).

A One Way ANOVA will be used to determine if a significant difference in adult predator populations exist between Reaches. If assumptions of ANOVA are not met, data will be either transformed or an equivalent non-parametric procedure will be conducted.

7.0 FUTURE MODIFIATIONS TO FINAL STUDY PLAN

The five year study plan will remain a “living document” whereby portions of the study plan may be expanded or deleted depending on the information collected during the study. Using an adaptive management strategy will allow the sampling program to be focused on evaluating potential impacts related to the operation of the dam on listed salmonid populations. This strategy allows the focus of the study to be driven by the data collected. If potential impacts originally identified in the study are shown not to adversely affect salmonids, those portion of the study can be deleted. Conversely, if data collection identifies potential impacts not included in this study, the program can be expanded to evaluate these newly identified potential impacts. Expanding or deleting portions of the final study plan will only occur if unanimous agreement is reach between the Agency, NMFS, and CDFG.