

APPENDIX X  
SPECIFIC SAMPLING PROTOCOLS AND PROCEDURES  
FOR CONDUCTING ACOUSTIC TAGGING

# ACOUSTIC TAGGING

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## Background

Operation of the Vaki Riverwatcher system over the past several years has identified adult Chinook salmon migrating upstream past Daguerre Point Dam (DPD) during the spring (February through June) period (CDFG, preliminary, unpublished data). These early returning Chinook salmon exhibit the phenotypic run timing expression of spring-run Chinook salmon. Previous monitoring and survey efforts have not focused on identifying habitat utilization of immigrating spring-run Chinook salmon, or the spatial and temporal distribution of holding habitat utilization over the summer. In addition, uncertainties remain concerning the spatial and temporal distribution of spring-run Chinook salmon spawning.

The acoustic tagging survey will consist of acoustic-tagging immigrating adult spring-run Chinook salmon and monitoring their distribution and movement in the lower Yuba River. Spring-run Chinook salmon acoustic tagging will be conducted in conjunction with the genetic sampling survey (please refer to *Appendix X – Specific Sampling Protocols and Procedures for Conducting Genetic Sampling*). The first year of the acoustic tagging survey (2009) is considered to be a pilot study and therefore, this protocol and procedure may be modified prior to acoustic tagging surveys in subsequent years.

Goals of the acoustic tagging survey include: (1) examination of habitat utilization of upstream migrating and spawning Chinook salmon exhibiting the run timing characteristics of spring-run Chinook salmon; (2) examination of the spatial and temporal distributions of holding spring-run Chinook salmon from spring through fall, and potential relationships with variable flow and water temperature regimes; and (3) examination of differential spatial and temporal distributions of spring- and fall-run Chinook salmon spawning (in conjunction with Chinook salmon redd surveys) and potential relationships with flow and water temperature regimes.

## 1.0 Survey Location

Acoustic tagging of immigrating adult spring-run Chinook salmon will occur in the lower Yuba River downstream DPD to the Yuba River and Feather River confluence. Adult spring-run Chinook salmon will be captured using hook-and-line sampling. Therefore, the exact location(s) for acoustic tagging will vary depending upon the specific locations of individual captures.

Monitoring for acoustic tagged adult spring-run Chinook salmon will occur in the lower Yuba River between Englebright Dam and Yuba River and Feather River confluence. The Heritage and Wild Trout and the Steelhead Management and Recovery Programs have recently installed 16 acoustic receivers (i.e., hydrophones) in the lower Yuba River for monitoring acoustic tag pings (see **Attachment 1**). In addition, there are plans to install an additional receiver at the downstream end of the Narrows. Recordings of acoustic tags by hydrophones also may occur outside of the lower Yuba River if tagged individuals move into other systems such as the lower Feather River.

In addition to fixed-station hydrophones (i.e., static receivers), mobile tracking surveys will be conducted to monitor acoustic-tagged spring-run Chinook from Englebright Dam to the Yuba River and Feather River confluence *via* jet boat or walking and use of a hydrophone.

## 2.0 Survey Period

Peak immigration of Central Valley adult spring-run Chinook salmon reportedly occurs during May and June (Moyle 2002). Based on preliminary Vaki Riverwatcher data, spring-run Chinook salmon generally begin passing DPD in April, and peak during May. For the 2009 pilot study, spring-run Chinook salmon acoustic tagging will be conducted during May, which will ensure that sampling efforts only target spring-run Chinook salmon. The survey period will be evaluated after the 2009 pilot study for possible modification during subsequent survey years. Testing for the detection of tag pings in various habitat types within the lower Yuba River will be conducted during April and potentially May to refine mobile tracking techniques prior to initiation of the acoustic tagging survey.

Monitoring of acoustic tags using static receivers and mobile tracking surveys will begin when acoustic tagging begins in May, and extend through fall. Mobile tracking surveys will extend until tags are recovered from spawned-out adults during the annual carcass survey.

The adult spring-run Chinook salmon acoustic tagging survey is anticipated to be a multi-year effort. The RMT Planning Group will review the data and reports annually, and will determine the overall duration of the acoustic tagging study.

## 3.0 Sampling Frequency

Hook-and-line sampling for spring-run Chinook salmon will be conducted 8 hrs per day and 6 days per week beginning in mid-May.

Static receiver hydrophones will operate continuously year-round and data will be obtained at least every other month by CDFG (The Heritage and Wild Trout and the Steelhead Management and Recovery Programs) due to logistics (two certified divers required).

Mobile tracking surveys will begin in mid-May. From below the Narrows to the Yuba River and Feather River confluence, mobile tracking surveys will be conducted every other week and CDFG will survey the other weeks. Mobile tracking surveys from below Englebright Dam to the bottom of the Narrows will be completed weekly if possible.

The frequency of hook-and-line sampling and mobile tracking surveys will be evaluated after the 2009 pilot study for potential modification during subsequent study years.

#### **4.0 Sample Size**

For the 2009 pilot study, the sample size goal will be 30 acoustic-tagged spring-run Chinook salmon. After a sample size of 30 acoustic-tagged spring-run Chinook salmon has been met, the RMT will make a decision if more spring-run Chinook salmon should be captured for genetic sampling and floy tagging. The actual sample size will depend on how many individuals are caught during hook-and-line sampling. After reviewing the sampling method used and analyzing data collected during the 2009 pilot study, an alternative sample size and capture technique may be specified for subsequent acoustic tagging surveys.

#### **5.0 Survey Protocols and Procedures**

##### **5.1 Preseason Planning - Lead Biologist Responsibilities and Coordination Activities**

All permits and authorizations required for specimen collection and sampling will be obtained annually prior to the commencement of annual acoustic tagging surveys. The current research authorization (pursuant to ESA Section 4(d)) allows for a non-lethal take of up to 100 individuals and a lethal take of 1 individual. A CDFG collecting permit also will be obtained if bait is to be used during hook-and-line sampling.

Land access permission will be required from Pacific Gas & Electric (PG&E) and the University of California at Davis (UCD) for the mobile tracking surveys.

All staff training described below (Section 6.1.2) will be conducted annually prior to initiating acoustic tagging of spring-run Chinook salmon. All equipment and materials required for acoustic tagging data collection will be obtained prior to the start of each annual acoustic-tagging survey.

The lead biologist will coordinate with CDFG for the mobile tracking surveys and data exchange.

## 5.2 Data Collection and Sampling Techniques

### 5.2.1 Pre-Survey Testing

Prior to initiation of the acoustic tagging survey, acoustic tags will be placed in various habitat types in the lower Yuba River, and mobile tracking surveys will be conducted to test the ability of detecting tag pings in the various habitat types. Mobile tracking techniques will be refined as necessary to maximize the detection of acoustic tags in all habitat types in the lower Yuba River.

### 5.2.2 Acoustic Tagging

During the 2009 pilot study, hook-and-line sampling (conducted by professional fishing guides) will be used to capture immigrating spring-run Chinook salmon for acoustic tagging. Use of hook-and-line sampling will be evaluated after the 2009 pilot study for potential modification during subsequent acoustic tagging surveys.

The VEMCO V13-1L acoustic tags with a ping rate of 60 seconds (i.e., the tags will be programmed to ping at random intervals ranging from 30 to 90 seconds) will be used for this study. The tags also will be programmed to have a “kill switch” and turn off after a pre-determined amount of time (i.e., 7 months), so that the tags do not interfere with other acoustic tagging studies after the tagged fishes have died.

Acoustic tags can be attached to fish using multiple methods including external placement, esophageal/gastric insertion, and surgical implantation. For the 2009 pilot study, the esophageal insertion method will be used, where acoustic tags are inserted into the stomachs of spring-run Chinook salmon. Esophageal insertion will be used because surgery is not required, results in reduced tag loss and reduced changes in swimming behavior (due to the tag being placed near the center of the fish’s gravity) compared to external tagging, and a relatively short recovery time is required prior to releasing the fish (Demco *et al.* 2003). Acoustic tags inserted using esophageal insertion methods are less prone to result in mortality, compared with externally attached or surgically inserted tags (Demco *et al.* 2003). However, esophageal-inserted acoustic tags may be lost through regurgitation (vomiting) or egestion (defecation) (Demco *et al.* 2003). Some fish species are known to regurgitate acoustic tags more frequently than others; for example, rainbow trout are likely to regurgitate tags while Chinook salmon typically do not regurgitate tags (Nielsen 1992, *as cited in* Demko *et al.* 2003). One large-scale 4-year radio-tagging study in the Columbia River reported that annual regurgitation rates for 838 spring/summer-run Chinook salmon ranged from 0.4% to 10.9%, with an overall rate of 3.0%, while annual regurgitation rates ranged from 0.0% to 5.6% for 45 fall-run Chinook salmon (overall rate = 2.2%) (Keefer *et al.* 2004).

The esophageal insertion method and the specific procedures used (described below) will be evaluated after the 2009 pilot study to determine if the procedures should be modified, or if an alternative method (e.g., surgical implantation) should be used during subsequent acoustic tagging surveys.

The procedures that will be used to conduct the acoustic tagging survey on immigrating spring-run Chinook salmon are described below.

At the beginning of each survey, the following data will be recorded on the data sheet (**Attachment 2**):

1. Collection data
2. Collection location
3. Collector names
4. Collector Affiliation/Phone Number
5. Weather Conditions

Professional fishing guides will use hook-and-line sampling to catch immigrating spring-run Chinook salmon downstream of DPD. Hook-and-line methods may include back-trolling small plugs and roe from a jet boat in the main salmon holding areas between the mouth of the Yuba River and DPD, along with bank fishing several pockets that are unfishable by boat.

When a professional fishing guide hooks a fish, the following data will be recorded on the data sheet (Attachment 2):

1. Time of capture
2. GPS location
3. Habitat type

When a spring-run Chinook salmon is caught, before removing the fish from the water, visually inspect the fish to deem if the fish is healthy enough to survive the tagging procedure. Examine the fish for any injuries, body conformation and color, fins, skin, scales, and mucus, and gills. Individuals displaying signs of disease or injury such that tagging the individual would likely impair its ability to continue its upstream spawning migration will not be tagged. Any Chinook deemed unhealthy for tagging and any other fish species caught will be immediately released without being removed from the water and the capture will be recorded.

If an adult spring-run Chinook salmon is deemed to be sufficiently healthy for tagging, the fish will be placed in a CO<sub>2</sub> solution for anesthetization. To avoid unnecessary stress and harm to the fish, handlers will wear gloves and be familiar with live adult Chinook salmon sampling and behavior, as described below (Section 6.1.1).

Once the fish has been anesthetized, the following measurements and data will be recorded on the data sheet (Attachment 2):

1. Fork length (mm)
2. Total length (mm)
3. Body depth (mm)
4. Sex (Male or Female)
5. Adipose fin-clipped? (Yes or No)
6. Description and photograph of any visible parasites, fungi, lesions, or other signs of disease or injury, including potential hooking injuries (Notes column)
7. Acoustic tag ID (serial) number of the tag that will be implanted into the fish

After data collection, place the fish on its back in a V-shaped trough designed to support the fish for tagging. During the tagging process keep the fish in the water or keep the fish wet by sprinkling. Coat a VEMCO V13-1L acoustic transmitter with glycerin and insert the transmitter into the individual's stomach *via* the esophagus using a plexiglass plunger (Monan *et al.* 1975), or a plastic pipette as a push-rod. Attach glycerin-coated latex surgical tubing (3 mm thick; 12 mm inside diameter) to the transmitter to decrease the likelihood that the transmitter will slide past the esophageal sphincter muscles and be regurgitated (Keefer *et al.* 2004). Because the fish is anesthetized and rubber tubing is glycerin-coated, the modifications should not impede tag insertion (Keefer *et al.* 2004). Check if the tag is inserted properly by “feeling” for when the tag passes through the esophageal sphincter; give a gentle tug to ensure the tag is properly placed.

After tagging, a caudal fin-clip will be taken for genetic sampling and the sample ID on the envelope and the status of if a tissue was taken (Yes or No) will be recorded on Attachment 2 (refer to *Appendix G- Specific Sampling Protocols and Procedures for Genetic Sampling* for more information).

A floy tag will be implanted sub-durally near the dorsal fin of the fish for identification during carcass surveys and record the floy tag number on Attachment 2.

After the fish is measured, acoustic-tagged, sampled for genetics, and floy-tagged, the fish will be immediately released back into the river where the water is relatively calm and the fish can be observed. Record the time of release on the data sheet (Attachment 2).

### 5.2.3 Acoustic Tag Monitoring

#### Static receiver hydrophones

Monitoring for acoustic-tagged spring-run Chinook salmon will occur on the lower Yuba River from Englebright Dam to the Yuba River and Feather River confluence through the use of acoustic hydrophones currently in place (J. Nelson, CDFG, 2008, pers. comm.). As of February 2009, there are 16 hydrophones located throughout the lower Yuba River, with an additional hydrophone planned to be installed at the downstream end of the Narrows (see Attachment 1). Monitoring for tag pings may also occur outside the lower Yuba River if tagged Chinook salmon move into other rivers such as the lower Feather River. Because CDFG is already conducting a separate acoustic tagging study, CDFG will download all acoustic ping data and send the RMT's lead biologist the ping data from the RMT acoustic-tagged spring-run Chinook salmon every other month. To download data from the receivers, a receiver is pulled from the river, a Bluetooth key is inserted into the unit, and a laptop equipped with Bluetooth capability and the VEMCO software is used to download the data (J. Nelson, CDFG, 2009, pers. comm.). Acoustic ping data will be downloaded from the static receivers on a 3-day schedule (under optimal conditions), as follows:

- Day 1 – Narrows to DPD (by boat)
- Day 2 – DPD to Feather River (by boat)
- Day 3 – Englebright to Narrows (by foot)

## Mobile tracking surveys

Mobile tracking surveys will be conducted to detect the locations of tagged spring-run Chinook salmon *via* a jet boat or walking. A jet boat will be used to survey from the Yuba River and Feather River confluence to the bottom of the Narrows. Surveyors will track acoustic tagged Chinook salmon from the Narrows Pool to Deer Creek and from Englebright Dam to Deer Creek by walking. Land access permission at Englebright Dam will need to be obtained from PG&E. The Narrows Pool will be accessed on the north side of the river through the UCD property. Surveyors will only survey reaches that they deem safe between Englebright Dam and Narrows Pool. One omni-directional and one directional hydrophone will be used in conjunction with an acoustic receiver for the mobile tracking surveys.

The following data will be recorded on the mobile tracking data sheet (**Attachment 3**):

1. Start time and End time of survey
2. Number of trackers
3. Weather
4. Lead/Personnel names
5. Section(s) surveyed
6. Date
7. Water visibility (ft)
8. Water temperature at beginning and end of the survey
9. Mode of tracking

For each tag detected, record the following data:

1. If a tag ID is detected, record yes (Y) or no (N)
2. Record the section number
  - 1 – Narrows to DPD
  - 2 – DPD to Feather River
  - 3 – Englebright to Deer Creek
  - 4 – Narrows Pool to Deer Creek
3. Record the GPS location using a GPS unit. The GPS location will be recorded when the acoustic signal from any given tag is strongest, as shown on the signal meter on the receiver.
  - a. Record the GPS location in the “non-detect coordinates” column for when a tag is detected by the receiver but a tag ID is not detected due to range (distance), habitat type (shallow or fast moving water) or collisions with other tags in the area. When a tag ID is not detected, record the average number of pings (i.e., 1-5).
  - b. Record the GPS location in the “detect coordinates” column when the tag ID is detected by the receiver.
4. Record the tag ID number if the tag ID is detected.

5. Record the number of cycles in the “number of cycles” column, which refers to a tag that is continuously being detected in an area when the mobile tracking vessel is passing through an area.
6. The “habitat” column refers to mesohabitat units. For the 2009 pilot study, mesohabitat identification such as run, riffle, glide and pool will be sufficient. The GPS coordinates will be subsequently used to identify mesohabitat units consistent with Appendix X – Morphological Unit and Mesohabitat Classification.

#### 5.2.4 Quality Assurance/Quality Control Processes

To minimize the potential for error, data sheets and field notebooks will be used for organization and record keeping. Each surveyor will be required to enter the recorded (listed above under Section 5.2) data into the database. The data sheets will be copied for archival. Additional QA/QC will be determined by the Lead Biologist.

### 6.0 Logistics

#### 6.1 Personnel

Acoustic tagging personnel will be responsible for conducting acoustic tagging and genetics sampling described in this protocols and procedures. All survey staff will be expected to maintain complete survey field notes. In the field, experienced survey staff will train newly hired survey staff in acoustic tagging techniques.

##### 6.1.1 Qualifications

To successfully complete data collection associated with this study, lead staff conducting the work will have the following minimum qualifications: a related 4-year college degree (e.g., fisheries biology or biology) and a minimum of 2 years of professional experience in fisheries field surveys. Specifically, staff members will have experience with:

- Use of various fish and fish habitat sampling techniques
- Experience with acoustic sampling techniques
- Experience with genetic sampling techniques
- Design and analysis of biological field studies

In addition, staff handling the fish will be familiar with the behavior of adult Chinook salmon and their response to disturbance and sensitivity to capture and restraint.

The data collection methods assume that spring-run Chinook salmon acoustic tagging (and genetic tissue sampling) will be conducted by three-person (minimum) teams to facilitate safe and efficient data collection. At least one team member will have the minimum qualifications as stated above. When mobile tracking surveys are being conducted, teams

of two will be employed and at least one team member will have the minimum qualifications as stated above.

Personnel should be in such physical shape as to allow for extended and at times strenuous hiking while carrying equipment and personal gear that may weigh 20 pounds or more. Survey staff should expect to work extended daily hours as necessary. Prior to the initiation of survey work, all survey personnel will have had to complete several training sessions on field collection techniques and safety. All necessary training will be provided during the preseason preparation and training period.

### 6.1.2 Training

This protocols and procedures will be made available to all acoustic tagging personnel to promote consistency among survey efforts and to address safety concerns. New hires will be scheduled to go on surveys with experienced acoustic tagging staff and receive training in the field. Safety, aspects of landowner relations, trespassing regulations, and acoustic tagging protocol training for all survey crew members will be scheduled and conducted prior to initiating the field season. Safety training for field crews will include first aide, wilderness medicine, swift water rescue training, boat safety, and wader safety training. Specialized training for using all-terrain vehicles, four-wheel drive vehicles, boats, or other equipment needed for conducting acoustic tagging surveys will occur during the pre-field season period. Acoustic tagging protocol training will include time for crew members to read and become familiar with the specifics of the field protocols and procedures and data management.

### 6.2 Schedule

The timing of field surveys will be important in both the collection of relevant data and the interpretation of results. The field survey period will focus on the time of year appropriate for tagging immigrating spring-run Chinook salmon (i.e., May), and monitoring tagged individuals (May through September or later). The following is a synopsis of the preparatory efforts, fieldwork, and analysis that will be completed over the course of an annual survey period.

#### **December through April**

- Conduct pre-season preparation and planning (e.g. hire field crews, coordinate logistics, scheduling, purchase of VEMCO acoustic tags, mobile receiver and hydrophones, coordinate with fishing guide, ensure activities are covered under permit, coordinate with Jonathon Nelson in conducting mobile tracking surveys and data sharing, and conduct testing of mobile tracking techniques)
- RMT Planning Group coordination
- Conduct Field Crew Technical Training
- Conduct Field Crew Safety Training

## May

- Capture and tag immigrating spring-run Chinook salmon (and collect genetic tissue samples)

## May through October (possibly into November)

- Conduct weekly mobile tracking surveys in coordination with CDFG
- Receive data from static receivers from CDFG (Jonathon Nelson)
- Share mobile tracking data with CDFG (Jonathon Nelson)

## September through April

- Finalize data QA/QC and compilation
- Data analysis and interpretation of results
- Integrate acoustic tagging results (e.g., spatial and temporal distribution) with results from other studies
- Prepare Draft Annual Monitoring Report
- RMT Planning Group Review of Draft Monitoring Report
- Prepare Final Annual Monitoring Report
- Revise Acoustic Tagging Protocols and Procedures as appropriate
- Prepare for subsequent year's Acoustic Tagging

## 6.3 Costs

### Acoustic Survey

<u>Transmitter/Equipment</u>	<u>Cost</u>	<u>Total U.S. \$</u>
V13-1L-A69-1303 tags	267.64	x 30 = 8,029.20
8 Channel DSP manual tracking receiver	5,156.12	x 1 = 5,156.12
Omni-directional hydrophone w/ 5 meter cable	320.68	x 1 = 320.68
Directional hydrophone w/ 10 meter cable	1189.87	x 1 = 1,189.87
Shipping Fees		180.00
Mark II Tag Gun	95.00	X 2 = 190.00
Mark II Tag Gun Spare Needle	18.00	X 2 = 36.00
FD-94-t-bar tags (100)	90.00	X 1 = 90.00
<b>Total</b>		<b>\$15,191.87</b>

### Fishing Guide

### Staffing

## 6.4 Equipment Lists

<b>Acoustic Tagging</b>	
• Jet boat	• Raingear
• Trimble Geoexplorer GPS unit, with data dictionary loaded	• Buckets
• Chest Waders or Wading Boots	• Data Sheets
• Knives	• Pliers
• Survey Protocols and Procedures (Acoustic Tagging and Genetic Sampling)	• Maps and Aerial Photographs
• Clipboards	• Field Notebook
• Pens, Pencils, Sharpies (permanent marker)	• Polarized Sunglasses
• Tool box	• Watch
• Brimmed Hat	• Swift Water Safety Gear
• Dry Cloth (to dry off equipment, etc.)	• First Aid Kit
• Cellular or satellite phone	• Lifejackets/Other Personal Floatation Devices (inflatable)
• Backpack or surveyor's vest	• Digital Camera
• Contact and emergency phone numbers	• V-shaped trough
• Extra Batteries	• Sprinklers (to keep fish wet)
• Food and Water	• Radios
• Plexiglass or plastic plunger/pipette	• Measuring board & tape (mm)
• Anesthetic -CO <sub>2</sub> Solution	• V13-1L-A69-1303 tags
• Mark II tag gun spare needles	• FD-94-t-bar tags
• Sun Block	• Mark II tag gun
• Gloves (to handle fish)	• Fishing Gear

<b>Mobile Tracking</b>	
• Jet boat	• Raingear
• 8 Channel DSP manual tracking receiver	• Boat oars
• Omni-directional hydrophone w/5 m cable	• Master list of Tag IDs including tags for CDFG project
• Directional hydrophone w/10 m cable	• Digital Camera
• Trimble Geoexplorer GPS unit, with data dictionary loaded	• Thermometer
• Chest Waders or Wading Boots	• Data Sheets
• Knives	• Pliers
• Extra Batteries	• Acoustic Tagging Protocols and Procedures
• Survey Protocols and Procedures	• Lifejackets/Other Personal Floatation Devices (inflatable)
• Clipboards	• Food and Water
• Pens, Pencils, Sharpies (permanent marker)	• Maps and Aerial Photographs
• Turbidity meter	• Sun Block
• Brimmed Hat	• Field Notebook
• Dry Cloth (to dry off equipment, etc.)	• Polarized Sunglasses
• Cellular or satellite phone	• Watch
• Backpack or surveyor's vest	• Swift Water Safety Gear
• Contact and emergency phone numbers	• First Aid Kit
• Hiking boots	

## 7.0 Data Management

### 7.1 Data Entry and Data Processing

#### 7.1.1 Acoustic Tagging Survey Data

All data collected for each acoustic-tagged fish (described above) and counts of all other fish species caught during the tagging survey will be electronically entered into a Microsoft Access database after each survey day.

#### 7.1.2 Static Receiver Data

Acoustic ping data from the static hydrophone receivers will be sent to the lead biologist by CDFG monthly as a VEMCO software (VUE) file. The data will be exported from VUE to Excel or an Access database monthly. Because static receivers occasionally create “ghost” acoustic tag numbers (due to ping collisions of two transmitters), those will be manually removed. Ping data (and associated GPS data) also will be filtered to remove duplicate tag

numbers when the tag was detected numerous times during one occasion. Raw data files with all ping detections will be saved as a separate file prior to data filtering and organizing.

### 7.1.3 Mobile Tracking Data

Acoustic ping data and GPS location data from mobile tracking surveys will be downloaded using VEMCO software (VR100 HS), and then exported to Excel or Access. Spring-run Chinook data from mobile tracking surveys conducted by CDFG will be electronically sent to the lead biologist as a VEMCO software file (steelhead ping data gathered during surveys conducted by the RMT will be sent to Jonathon Nelson (CDFG) as a VEMCO software file immediately after each survey). Ping data (and associated GPS data) will be filtered to remove duplicate tag numbers as described above. Data manually recorded during mobile tracking surveys (e.g., date and time of tag detections, manually recorded GPS locations, weather conditions) also will be entered into Microsoft Access database after each survey day.

All data will be stored in a Access Database, and linked with associated spatial information in ArcGIS, such that the data can be visually displayed to identify spring-run Chinook salmon movement and holding patterns.

Data will be entered weekly into an Microsoft Access database. Data will be stored at YCWA's and CDFG's offices.

## 7.2 Data Storage and Archival Procedures

All original data will be well organized, clearly labeled, and archived. Reports will be prepared annually and archived. Digital versions of the data sets, as well as hardcopies of reports, will be submitted to the RMT Planning Group. In addition, data will be sent to the California Fish Tracking Consortium (Dr. Peter Klimley; University of California at Davis; [apklimley@ucdavis.edu](mailto:apklimley@ucdavis.edu)).

- Raw Data Electronic Storage Format (Software): Microsoft Excel/Access
- Processed Data Electronic Storage Format (Software): Microsoft Excel/Access and ESRI ArcGIS

Electronic files and print copies of the field data sheets will be located at:

Yuba County Water Agency  
1220 F Street  
Marysville, CA 95901-4226

And

California Department of Fish and Game  
2545 Zanella Way, Suite F  
Chico, CA 95928

Data Retrieval Contact: M&E Lead Biologist – Colin Purdy  
Telephone Number: (530) 895 - 5522  
Email Address: [CPurdy@dfg.ca.gov](mailto:CPurdy@dfg.ca.gov)

## REFERENCES

Demco, D., A. Olson, M. Simpson, G. Kopp and D. Reiser. 2003. Acoustic Tracking Technology and Potential Applications for Salmonid Research within the San Francisco Bay and Sacramento-San Joaquin Delta. Prepared for: California Urban Water Agencies. Sacramento, CA.

Keefer, M.L., C.A. Perry, R.R. Ringe, and T.C. Bjornn. 2004. Regurgitation Rates of Intra-gastric Radio Transmitters by Adult Chinook Salmon and Steelhead during Upstream Migration in the Columbia and Snake Rivers. *North American Journal of Fisheries Management* 24:47-54, 2004.

Monan, G.E., J.H. Johnson and G.F. Esterberg. 1975. Electronic tags and related tracking techniques aid in study of migrating salmon and steelhead trout in the Columbia River Basin. *Mar. Fish. Rev.* 37: 9-15.

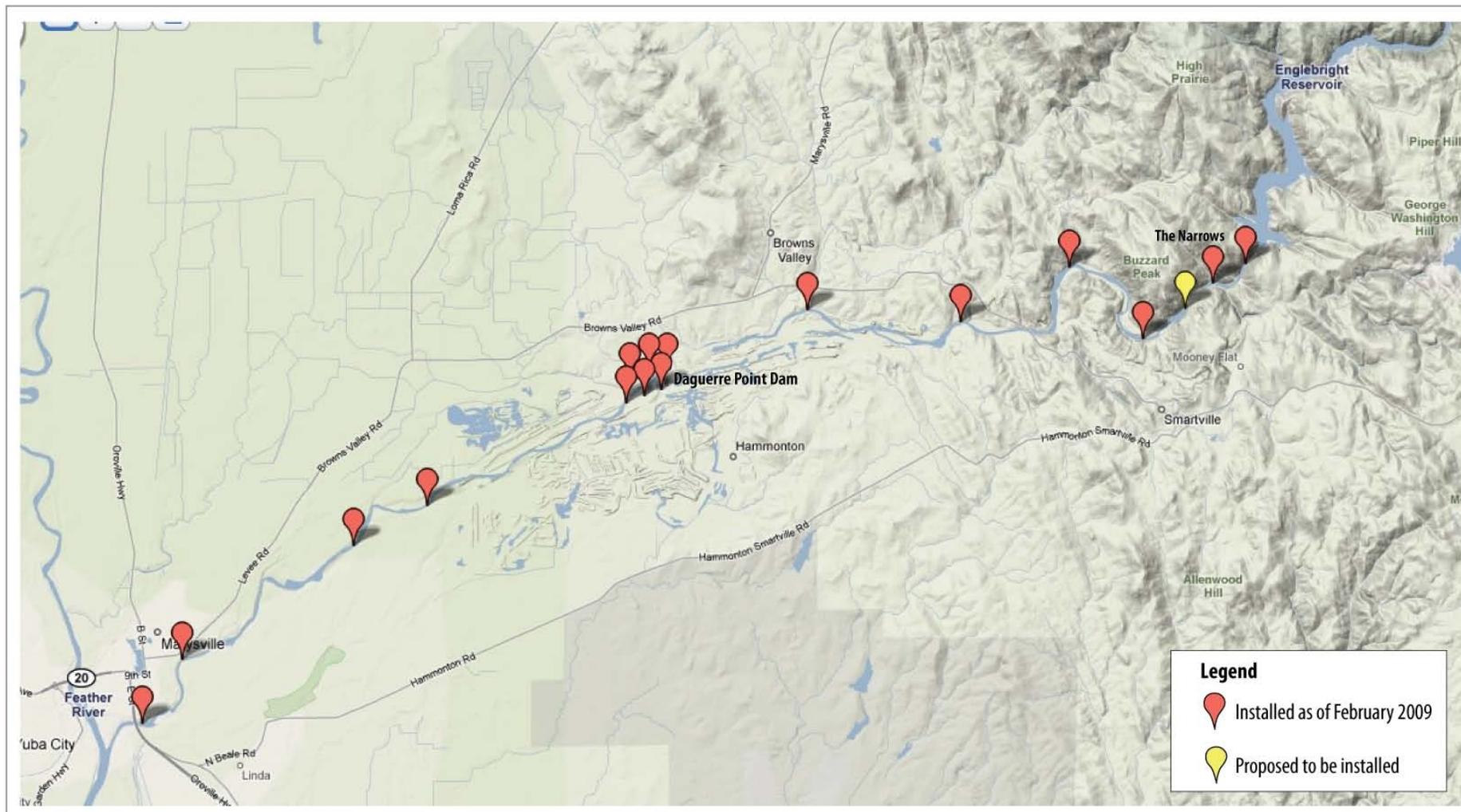
Moyle, P. B., 2002. *Inland Fishes of California*. Berkeley and Los Angeles, California: University of California Press.

*Personal Communications*

Nelson, J., CDFG, Steelhead Restoration and Management Program – (916) 445-4506, Verbal communication with D. Massa, Fisheries Biologist, CDFG 2545 Zanella Way, Suite F, Chico, Ca. 95973. Technical information regarding VEMCO acoustic arrays on the lower Yuba River. Dec. 2008

Nelson, J. CDFG, Steelhead Restoration and Management Program – (916) 445-4506, e-mail communication with Gary Reedy, South Yuba River Citizen's League. Tagging Questions Answers. January 26, 2009.

# Attachment 1



Map of Acoustic Receivers in the Lower Yuba River

## Attachment 2

Data sheet: Lower Yuba River Chinook Salmon Acoustic Tagging & Genetics Survey

Surveyor(s): \_\_\_\_\_ Survey Date: \_\_\_\_\_ Average flow (CFS): \_\_\_\_\_ Turbidity (NTU): \_\_\_\_\_

Weather (Clear, cloudy, rain, windy): \_\_\_\_\_ Survey location (area covered): \_\_\_\_\_

Fish	Sample ID Date + Sample Number (Ex. 082909-01)	Capture Time	Release Time	Capture Location RM/ GPS Y or N	Acoustic Tag ID	FL / TL (mm)	Body Depth (mm)	Sex (F, M, Unk.)	Ad- clipped Y or N	Floy Tag Number	Tissue?Y or N
1				/ Y N		/		F M U	Y N		Y N
2				/ Y N		/		F M U	Y N		Y N
3				/ Y N		/		F M U	Y N		Y N
4				/ Y N		/		F M U	Y N		Y N

Fish	Habitat Type (Pool, Riffle, Run, Glide)	Notes: (Fish condition, photo numbers of fish injuries/disease, bait used, etc.)
1		
2		
3		
4		
<b>Comments:</b>		

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