

Rotary Screw Trapping Operational Protocol



A Detailed Protocol for Rotary Screw Trapping Field Operations for the Stanislaus and Merced Rivers

Prepared for:

U. S. Fish & Wildlife Service

Prepared by:

Ayesha Gray and Brad Cavallo

Revised by:

Clark Watry and John Montgomery

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I. Introduction

The following protocol gives detailed procedures for the daily operation of a rotary screw trap (Figure 1), including trap operation and maintenance, fish handling and marking, data collection and management, and trap efficiency estimates. Protocols were developed to provide detailed information to make field activities as safe as possible and to collect accurate and unbiased data.

Reference List

For additional information, please see Tsumura and Hume 1986, Thedinga et al. 1994, Nickelson 1998, Miller and Sadro 2005, Bottom et al. 2005, Volkhardt et al. 2007, among others.



Figure 1. Technician cleaning rotary screw trap cone.

II. Study Areas

A. Stanislaus River

The Caswell study site is located on the Stanislaus River (RM 8) at Caswell Memorial State Park. This site was selected in 1995 and juvenile Chinook salmon out-migration data have been collected every year since then. The trapping site is located approximately 100 m upstream of the park boundary. A third trap (second trap site) was installed in 2007 to increase catch numbers for a coded wire tagging program initiated this year. The third trap is located at the upstream property boundary of the park. The upstream Caswell traps are configured side-by-side (Figure 2). The third trap is located downstream approximately 100 m from the upstream traps (Figure 3). We access our trapping site by a private levee road (Brochini's property). We have established landowner agreements as well as a permit from California State Parks.



Figure 2. North and south Caswell traps.



Figure 3. Lower trap added in 2007.

The Stanislaus River, like all San Joaquin River tributaries, is regulated by dams (e.g., Goodwin, Tulloch, New Melones) and diverted by canals and agricultural pumps for city and agriculture uses. Typically, the average flow on the Stanislaus River is 300 ft³/s during a dry year; 1,000 ft³/s

during a moderate year; and 3,000 ft³/s during a wet year. Other research activities on the Stanislaus River include, rotary screw trapping at Oakdale Recreation Area, adult migration monitoring using a resistance board weir at Jacob Meyers Park, California Department of Fish and Game (CDFG) carcass surveys, temperature modeling, and habitat snorkeling. Gravel augmentation and juvenile habitat projects are on-going.

B. Merced River

The George J. Hatfield State Park trapping site (Hatfield) is located on the Merced River (RM 2) (Figure 4). This study was re-initiated from a previous study at Hagaman County Park (RM 12) suspended in 2002. The Hatfield trapping site is located at the upstream end of the day use area of the park and about 300 m downstream of a water pump. We are permitted to access this trapping site through state park property or by boat in the event traps are inaccessible by land. Similar to the Stanislaus River, the Merced River is also regulated by several upstream dams (e.g., Crocker Huffman, McSwain, and New Exchequer Dams) which divert water from the river for city and agricultural uses.



Figure 4. George J. Hatfield State Park Traps.

Typical flows on the Merced River are about 250 ft³/s; however, flows have been recorded in excess of 5,000 ft³/s during wet years. Other research activities on the Merced River include, but are not limited too: rotary screw trapping at Hopeton, CDFG carcass surveys and temperature studies. Gravel augmentation and restoration projects have occurred in the recent past and will continue into the future.

III. General Instructions



Figure 5. Warning sign on a rotary screw trap.

Safety first!

Safety should always be your primary concern. Never perform a task if it cannot be performed safely. Stay aware of your surroundings and possible hazards at all times. Make suggestions about improvements to safety procedures to your partner in the field or the Project Lead.

A minimum of two crew members will operate the trap at any time. At least one crew member must have a working cell phone when in the field.

LIFE-JACKETS ARE TO BE WORN AT ALL TIMES WHILE IN A BOAT, ON A TRAP, OR IN THE RIVER.

First aid kits, emergency road flares, and fire extinguishers will be maintained in all vehicles and boats. Be cautious to always keep hands, loose clothing, and other items away from the cone, shaft and other moving parts during trap operation. Never remove debris from cone or shaft while the trap is rotating.

Rotary screw traps and associated rigging are a possible hazard to boaters, swimmers and others using the river. Wires and cables should be marked with bright colored flagging to be easily seen. Signs should be positioned both upstream and downstream of traps to instruct boaters how to avoid the trap. Other protective measures may include flashing lights to improve trap visibility and deflectors to prevent river users and large woody debris from entering trap (Figure 5).

IV. Trap Operation and Maintenance

A. Rotary Screw Trap Description

Rotary screw traps consist of a cone, supported on two pontoons, with interior baffles to trap and transfer fish to a live-box (see Figures 1-6). Traps are usually positioned in the main flow or river thalweg and angled to catch the maximum amount of flow. The cone is lowered into fishing position with a single hand winch. Always be cautious when lowering the cone. Keep hand on winch crank handle until cone is in place, make sure latch is free, and slowly lower the cone. When raising the cone, again keep hand on winch crank handle and make sure latch is caught in gear securely. (Latches tend to wear and if not secure the winch handle may spin too quickly and cause injury). The forward end of the cone should be lowered until the shaft is at the water's surface. The trap counter records the number of rotations the trap spins in a given sampling period.

B. Trap Operation

Traps are generally checked once a day (Figure 6), but as often as necessary, to maintain a safe holding condition for fish and efficient operation of the trap. The frequency of trap checks depends on the number of fish collected, level of instream flow, debris loads and objectives of the study. The collection of larger fish may bias catch abundances as they tend to prey on small fish in the traps. Some investigators have used tree branches, other debris or plexiglass panels to create refuge for small fish inside the live-box. These measures may decrease predation; however, other problems may also arise (e.g., increased water velocities, de-scaling, etc.). If debris shields are used, ensure they are not creating additional problems.



Figure 6. Technician performing a trap check.

C. Trap Maintenance

The traps are inspected daily for damage and improper wear. The field crew will inspect the live-box seal for any cracks and proper seating around the cone. The cone shaft and bushings will be inspected for cracks and wear (Figure 7). The cone mesh will be inspected for any tears and the access doors will be inspected for proper closure. The winch system will be inspected for proper function, as well as cable and pulley wear. The counter system will be inspected for proper function. The anchor points and cabling system for the traps will be inspected for faults. The traps will be cleaned daily. The cone, pontoons, and live-box will all be scrubbed and free from debris. Maintenance will be performed as inspections warrant such activities. Please note any problems with trap condition in field notebook and report to Project Lead.



Figure 7. Technician inspecting the trap for problems.

At the end of the year, traps will be pressure washed and thoroughly inspected for any damage as well as possible improvements.

V. Data Collection and Management

A. Completing Data Sheets

Data sheets should be clear, legible, and contain all information needed to accurately interpret data (see example, Appendix 1). If there is more than one data sheet for a particular site, make sure they are labeled appropriately (e.g., site name, page 1 of 2, etc.). Please make all information clear enough so someone not familiar with field conditions can interpret data accurately (i.e., use standard abbreviations, no omitted data). There should never be any empty spaces for relevant data on a sheet. If data are not taken, draw a line through the appropriate box and write a short explanation.

Additional comments regarding any variations in procedure, notable field conditions or other pertinent information should also be recorded in field notebook. Any river conditions affecting trap operation or change in trap position should be noted.

Please use the following conventions when filling out data sheets:

1. Use a pencil, and your best and clearest non-cursive handwriting.
2. Organize the data sheet so like species are recorded together. Look at catch before you begin recording data and leave ample space to group data for each species. Use additional sheets to assure clarity of the information.
3. Completely fill out the top block and the appropriate gear section, include the crew names and data recorder's name.
4. Corrections can be made in the field by erasing if the sheet is dry, or putting a line through the mistake and clearly writing correct information nearby.
5. Never estimate information. Record measured values only. If a value cannot be measured, put a line in the box and make an explanation in the comments section.
6. Circle all dead fish on data sheet.

B. Field Quality Check

The first step of data quality assurance/quality check (QA/QC) happens in the field. After completion of sampling, review the data sheet and make sure all information is complete, or collect any missing values. Common errors include blanks, illegible entries, clarity of plus count tallying, incorrect species or station codes, and unclear comments. The field quality check should occur before leaving the site so additional data can be collected if necessary.

This is the first of four checks that must be completed for the data to be properly QA/QC'd. The other three are done as, or after, the data are entered into the computer (see Section E below).

C. Data Delivery

Data sheets need to be delivered to the Project Lead at the end of each shift. Please do not leave data sheets in vehicles or in clipboards as they may get lost or damaged. USFWS employees will exchange data sheets according to the schedule and accepted procedures. Extra precautions should always be taken to insure delivery of data to the appropriate person(s).

D. Data Entry

Data are maintained in a Microsoft Access database. Data are entered as soon as possible after collection, ideally on a daily basis. Care should be taken to assure data are entered correctly. The Project Lead will provide all necessary instructions to enter data into the database.

E. QA/QC Procedure

The goal is to generate accurate, error-free data that can be analyzed with confidence by us and others to address immediate and future fisheries management needs. The accuracy of data are checked by insuring data are collected and recorded without error, and entered error-free into the database.

1. Field Data Check

This first step of the QA/QC procedure is described above (Section B). Field techs will check data sheets and initial immediately upon leaving the site.

2. Data Entry Quality Check

Data are entered and then verified to insure they have been entered correctly. Date and initials of person entering data will be noted on each data sheet.

3. Data Entry Verification I

The verification will check for entry errors by comparing data sheets with hard copy queries from the database. Corrections if needed will be made to the database. As each data sheet is checked, sheets will be signed with initials of person and date verified (QC1).

4. Data Entry Verification II

The second hard copy verification of data will be repeated by a different technician than QC 1. Corrections, if needed, will be made to database. Data sheets will be signed with initials of person verifying data and date verified (QC 2).

When data quality checks are complete each datasheet should have four sets of initials and dates on it: Field Checked By person and date; Data Entry person and Date, Data Entry Verification I (QC1 By) person and Date, and Data Entry Verification II (QC2 By) person and Date. After the QA/QC of data is complete, database tables will be write-protected and copied to ensure that unintentional changes are not made.

VI. Fish Handling

A. General

Fish, especially young salmonids (Figures 8 and 9), are sensitive to changes in temperature, oxygen levels, sunlight and a variety of other factors. All work should take place out of direct sunlight, and care should be taken to ensure cool water temperatures with adequate dissolved oxygen levels. Proper care of fish is extremely important as some species captured may be (or become) listed under either the federal or state Endangered Species Act (ESA). Special care should be taken to ensure all fish are handled properly and mortalities are extremely low. In general, fish should spend as little time as possible away from their river environment.

When removing fish from the live-box, be careful not to injure fish between the rim of the scoop net and the wall of the live-box. The live-box corners are typically where fish are injured and killed. Make every effort to chase fish out of live-box corners before netting them. Excess debris in the scoop net can injure fish and cause fish to be out of water too long while the debris is sorted through on the deck.



Figure 8. Chinook salmon sac-fry.



Figure 9. First Chinook salmon fry of 2007.

B. Temperature/Oxygen Monitoring

Coolers may be used instead of buckets as insulated walls keep water temperatures lower longer. When using buckets, locate buckets in shade, check holding water temperature regularly and change water when temperatures are 2°C greater than river water temperature. When transferring fish between locations (e.g., hauling tank to river, bucket to holding tank, etc.), always check temperature difference between environments. Differences greater than 2°C should be avoided since this change can cause loss of equilibrium and stress. Make sure fish are not over-crowded (i.e., <25 smolts or <50 fry per bucket; 100-150 individuals per standard-size cooler). Dissolved oxygen levels should be maintained between 7 and 10 mg/L, and an aerator should be used to help maintain DO levels. Use a DO meter to check holding water periodically, and refresh water if DO level falls below 5 mg/L.

If fish exhibit strange behavior, transfer them to another bucket/cooler to replenish oxygen and gently lower water temperatures.

C. Direct Sunlight

While working with fish, avoid their exposure to direct sunlight. Find or create a shaded place to measure and weigh fish. Cover all buckets and net pens while in use.

D. Anesthesia

We used tricaine methanesulfonate (Western Chemical, Inc.; Tricaine-S) to anesthetize fish for safe handling, which is a safe and effective anesthetic for fish and other ectotherms. The action of Tricaine-S is readily reversed when fish are transferred to fresh water. The effectiveness is related to a variety of factors including concentration, fish size, water temperature, stock solution age, and exposure to sunlight.

Fish are immersed in a bath of Tricaine-S (10-60 mg/L concentration; we are using 26.4 mg/L) and the following sensory and motor responses of the fish characterize progressively deeper levels of anesthesia:

1. **Sedation:** Decreased reactivity to visual and vibrational stimuli; gill activity reduced
2. **Total Loss of Equilibrium:** Fish turns over; locomotion increases; fish swims or extends fins in response to pressure on caudal fin or peduncle.
3. **Total Loss of Reflex:** No response to pressure on caudal fin or peduncle; opercular rate slow and erratic.
4. **Medullary Collapse:** Gill activity ceases.

Overexposure (in time or concentration) to Tricaine-S will lead to death for fish and other ectotherms. Observe gill activity; immediately transfer fish to fresh water if gill activity ceases. Monitor time while fish are immersed in Tricaine-S bath. A rough estimate of safe exposure time can be made by multiplying the time required to reach sedation by 2.5. Use the box on the back of the datasheet to determine the safe exposure time. Know your safe exposure time and do not exceed.

i. Precautions for the Use of Tricaine-S:

- Avoid inhaling or getting in eyes.
- Always conduct preliminary tests on a few fish to determine rates of anesthesia and time for safe exposure.
- Do not overexpose fish.
- Do not anesthetize more fish than can be handled during time for safe exposure.
- Do not use water containing chlorine (i.e., tap water).
- Insure adequate oxygen in anesthetic solution (i.e., use an air stone).
- Discard anesthetic solutions when fouled with mucus or metabolic wastes.
- Do not discard Tricaine-S solutions into water supplies of natural waters.
- Store solutions and dry powder in a cool place away from light. Tricaine-S solutions may change color to yellow or brown when exposed to light.
- Discard stock solutions when they lose effectiveness (90 days).

ii. Mixing Instructions

A stock solution of Tricaine-S is prepared at the lab and then 15 mL of the stock solution is added to 4 L of water in the field. All Tricaine-S solutions should be checked with a few fish to determine potency. See below for detailed mixing instructions.

StressCoat, which helps replace slime coat and protect scales on a fish, will be used in Tricaine-S water and recovery buckets. Add 2.5 ml per 4 L (small-bucket) and 5 ml in 5 gallons (nearly full recovery bucket).

Equipment:

- | | |
|---|--|
| <input type="checkbox"/> Scale | <input type="checkbox"/> Water |
| <input type="checkbox"/> Container for mixing | <input type="checkbox"/> Funnel |
| <input type="checkbox"/> Latex gloves | <input type="checkbox"/> 1 L container |
| <input type="checkbox"/> Tricaine-S powder | |

iii. Procedure

To prepare a stock solution (10.4 g/L) of Tricaine-S:

1. Weigh 10.4 g Tricaine-S using scale.
2. Add Tricaine-S to stock container.
3. Fill to the 1 L marked line with purified water.
4. Check the pH (with pH test strips). If pH is less than 7, add 2.5 ml. baking soda and check pH again.

To prepare Tricaine-S to anesthetize fish (39 mg/L):

1. Add 15 mL to 4 L of water (fill line in half buckets).
2. Mix well.
3. Add a few fish (2-3) and record time to sedation.
4. If time to sedation is 4-5 minutes, proceed with fish processing. If time to sedation is > 5 minutes add an additional 5 mL of Tricaine-S stock solution, use different test fish and record time to sedation. If time to sedation is < 2 minutes, add more water, use different test fish and record time to sedation again.
5. Use a sharpie to put date prepared on stock solution.

E. Selecting Fish to Measure

A random sample of fish will be measured and weighed and photographed (following project objectives). A dip net should ALWAYS be used (never use bare hands) when catching fish to be measured. Fish should be selected randomly for measurement to prevent biases for or against the slow or larger fish in the container. Juvenile salmon will also be grouped according to age class (age-0, fry/parr/smolt; age-1, smolt). Each morning the first 25 salmonids (of each species) in each trap will be randomly sampled. All fish measurements will be fork length (FL) to the nearest 1.0 mm, and weight to the nearest 0.1 g. The first 20 of all non-salmonid fish species will be measured every trap check (no need to weigh these other species of fish). For species without a forked tail (i.e., sculpins, mosquitofish, and some bullhead), length will be measured laterally along the mid-line to the posterior edge of the tail (Figure 10). Measure and weigh one fish at a time. Hands, dipnets, and measuring boards should always be wet before coming in contact with fish. Weight measurements should be the final step in the sampling process to allow for expulsion of retained water. Furthermore, fish should be lightly tapped (i.e., once on each side) onto a dampened sponge to remove excess water before the fish is placed in the cup to measure weight.

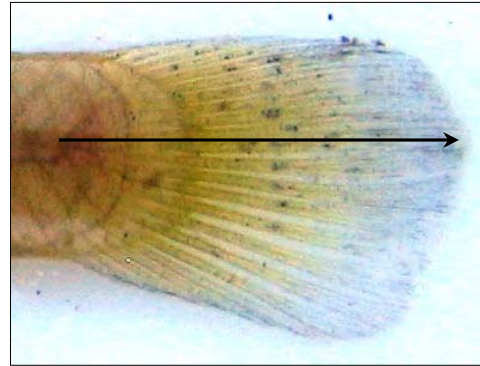


Figure 10. Diagram of where to measure length on a fish without a forked caudal fin.

V. Daily Procedures

A. Trap Safety

Always wear a life-jacket when working on the trap. Be cautious when moving around on the trap. A number of hazards exist on and around the trap (e.g., winch, cleats, cables, frayed cable, etc.). Stay aware of these hazards and always use great caution when moving and working on traps. NEVER move across the number one crossbeam (in front of the trapping cone) when the trap is fishing. A catwalk may be installed on the front of the trap to aid in taking flow, clearing cone debris, etc. Always use extreme caution on the catwalk. Pay attention to other crew-member locations and activities on the trap, boat traffic and boat wakes, and during high flow conditions, watch for large debris that may collide with the trap and have an unexpected effect.

All crew members need to be at attention when a boat is approaching and docking at trap. NEVER place any part of your body between the boat and trap during approach or while moored. The boat operator should drive slowly when approaching the trap and use fenders if available. Crewmembers should be able to step, not jump, from the boat to the pontoon. Make sure fenders are adjusted properly to prevent contact damage to boat or trap. Be very careful when stepping on or off the trap, or walking on the trap. Pontoons and live-box lid may be slippery, due to ice/frost in winter and algal growth in spring/summer. Check winch cable and mooring cables for fraying. Use caution when handling cables to avoid injury to hands.

When raising or lowering the cone or live-box door, everyone should be aware and in a safe position. The person changing cone position or opening live-box door should communicate their actions to others and make sure other field technicians have heard them and are aware. When the

trapping cone is being lowered, keep hands and feet away from crossbeam when it contacts the pontoon. Always secure the live-box door when in the open position.

B. Equipment Checklist

Clipboard containing:

- | | |
|--|---|
| <input type="checkbox"/> Data sheets | <input type="checkbox"/> Knife |
| <input type="checkbox"/> Tricaine-S stock solution | <input type="checkbox"/> Water sample vials (2) |
| <input type="checkbox"/> Laminated code key | <input type="checkbox"/> Syringe |
| <input type="checkbox"/> Pencils/Sharpies | <input type="checkbox"/> Scale sample envelopes |
| <input type="checkbox"/> Fish ID book | <input type="checkbox"/> Stop watch |
| <input type="checkbox"/> Thermometer | |

Toolbox containing:

- | | |
|--|--|
| <input type="checkbox"/> First-aid kit | <input type="checkbox"/> Screw drivers |
| <input type="checkbox"/> Flashlight | <input type="checkbox"/> Nylon rope |
| <input type="checkbox"/> Rescue rope | <input type="checkbox"/> Zip ties |
| <input type="checkbox"/> Pocketknife | <input type="checkbox"/> Dykes |
| <input type="checkbox"/> Counter bolts/nuts | <input type="checkbox"/> WD-40 |
| <input type="checkbox"/> Flagging | <input type="checkbox"/> Winch handle |
| <input type="checkbox"/> Crescent wrenches (2) | |

Other:

- | | |
|---|--|
| <input type="checkbox"/> Paddles | <input type="checkbox"/> Waders |
| <input type="checkbox"/> Life-jackets | <input type="checkbox"/> Wading boots |
| <input type="checkbox"/> Park/gate keys | <input type="checkbox"/> Flow meter |
| <input type="checkbox"/> Ice chest | <input type="checkbox"/> John boat |
| <input type="checkbox"/> Digital camera | <input type="checkbox"/> Measuring board |
| <input type="checkbox"/> 1/2 bucket for Tricaine-S | <input type="checkbox"/> Scoop nets (2) |
| <input type="checkbox"/> Chainsaw (when flows are high) | <input type="checkbox"/> Scrub brushes (2) |
| <input type="checkbox"/> Dip net (1) | |

C. Trap Check Procedures

All bolded text in this section refers to Trap Data Sheet components (Appendix 1).

i. Overview

- a) Record **Location, Station, Gear Status, Recorder/Crew, Field Checked By** and **Date** on data sheet.

Determine **Gear Status** to track when traps are raised and lowered and when the trap has been serviced. Gear status code definitions are as follows:

0 = Cone lowered and fishing begins (no sample taken, trap set)

3 = Cone raised

- b) Observe trap function and make sure it is operating properly.

Important: Sometimes it may be necessary to stop the trap or raise the cone to remove debris, depending on debris level this step may need to be performed only after the live-box has been cleared. NEVER reach into a moving cone!

- c) Record **Before Revs** prior to boarding trap.

Determining Trap Revolutions per Minute (RPM): Revolutions per minute to the nearest tenth will be recorded at the start (**Before Revs**) and end (**After Revs** see below) of the sample period.

BEFORE REVOLUTIONS DO NOT NEED TO BE RECORDED IF TRAP IS STOPPED ON ARRIVAL.

Determine RPM as follows:

1. As the screw trap cone spins, find a marker on the cone (i.e., counter bolt) to watch, and use a stopwatch to determine how many seconds it takes the cone to complete three rotations.
2. Record the total time it takes for the cone to complete three rotations and record this value in appropriate space.

- d) Determine **Condition Code** and record on data sheet.

Condition code describes trap activity during the sampling period and describes an element of variability in trap performance. **Condition code** definitions are as follows:

1	Good	Indicates the trap is fishing and operating well (normal)
2	Fair	Describes situations resulting in partial blockage, but water and fish are still delivered to the live-box (e.g., partial cell block)
3	Poor	Describes situations when both cells are completely blocked and/or the trap is stopped upon arrival (e.g., conditions preventing fish collection in the trap or allowing fish to escape from the live-box while the trap is fishing)
4	No Sample Taken	Describes any situation when fish were not able to be collected from the trap (i.e., usually applies to when the trap was set)

- e) Scrub and clean exterior of cone with a brush.
- f) Record the **Gauge Height** and measure the **Water Temperature**, Dissolved Oxygen (**D.O.**), **Velocity**, and **Turbidity**; record values on data sheet.

Gauge Height

Gauge height will be measured to the nearest 0.01 ft and recorded at each trap check. The gauge is marked in 1/10th and 1/100th ft intervals; the 0.01 ft intervals correspond to the tops and bottoms of the solid bars related to each 0.1 ft increment. The gauge height is read by determining the level of the water surface in relation to the solid bars where the bottoms of the solid bars are odd 1/100th values and the tops are even 1/100th values, the extended tips of the solid bars indicate 0 or 5 1/100th values (Figure 11).

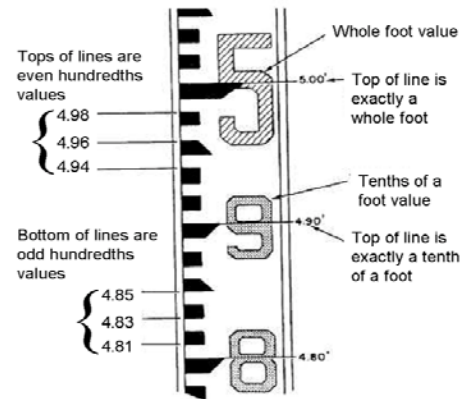


Figure 11. Diagram of how to read a staff gauge.

Water Temperature and Dissolved Oxygen

Dissolved oxygen is a function of water temperature (i.e., lower temperature water has a higher capacity to hold dissolved oxygen); therefore, both affect salmon survival. Measure the water temperature (°C) and dissolved oxygen (mg/L) values during each trap check using a digital handheld meter (YSI Environmental, Inc.; Model 550A). Submerge the probe in at least 0.5 meter of water and wait until a stable reading is obtained. Record the reading in the appropriate space on the data sheet.

Water Velocity

Measure the average water velocity in front of each screw trap, approximately halfway between the right pontoon and shaft and 0.5 m below the surface; record value on the corresponding data sheet. Make sure the flow meter is using ft/s and be sure to re-zero the readings for average and maximum velocity before taking a reading. Refer to Appendix 5 for more information about the use and maintenance of the flow meter.

Turbidity

Each day a water sample is collected for water turbidity measurement. Collect water in a clean glass or plastic vial. Label the vial on the lid and the side with date and sampling location with a Sharpie. At the end of the day, measure the turbidity level (NTU) using a nephelometer (LaMotte Company; Model 2020 Turbidimeter) for each sample and record the value on corresponding data sheets. Refer to manual for more information about the use, calibration and maintenance of the turbidimeter.

- g) Record **Debris Level**

Debris levels are estimated using the following as a rough guideline:

Light: less than one 10 gallon tub

Medium: 1–3, 10 gallon tubs.

Heavy: 4–6, 10 gallon tubs.

Very heavy: Greater than six 10 gallon tubs.

- h) Clear fish and debris from live-box (See section 2 for details).
- i) When finished, step off trap and record **After Revs** according to the aforementioned procedure.

ii. Cleaning the Live-box(es)

DO NOT raise the trap cone before cleaning the live-box.

Raising the trapping cone creates a gap through which fish can escape, so it is best to clean the live-box while trap is operating.

Make sure to keep hands and nets away from moving parts of trap.

- a) Fill bucket about 1/2 full of water.
- b) Scoop no more than 1/2 net full of debris at a time. Gently empty contents onto the trap deck.
 During sunny days the deck can become quite hot, care should be taken to cool the deck with river water before emptying net contents onto deck.
- c) Carefully sort through the debris using a stick (or other probe). **DO NOT use your hands**; hypodermic needles or other sharp objects are sometimes encountered. Return natural debris to the river; collect man-made trash and dispose properly.
- d) Carefully find and remove all fish (some will be very small). Place them into your bucket. Make sure fish are not overcrowded in buckets (< 25 small fish per bucket).
- e) Make sure water temperature in bucket remains no more than 2°C greater than the river water temperature and D.O. remains within acceptable parameters (7–10 mg/L). Add cool water, frozen water bottles, or replace the water if it becomes too warm. *Always use aerators to help maintain D.O. levels.*
- f) If there are too many fish to hold in buckets or coolers while processing, leave fish in the live-box and process fish in small batches.
- g) Once the live-box is cleared, record Sample Time and Total Revolutions when done clearing out live-box*.

Sample Time and **Total Revs** should be recorded immediately after the live-box processing has been completed. Follow the same procedure for the night check. If the trap is stopped by debris, record the counter reading and explain the circumstances in the comments section then clear the live-box and cone of debris and fish and record the final counter reading in the **Total Revs** blank.

DO NOT clear the counter during a night check.

**If additional debris is cleared from cone after clearing the live-box due to a stoppage, re-clear live-box of debris taking care to look for additional fish.*

iii. Processing the Trap Catch

- a) Prepare Tricaine-S in the small bucket; fill to line (4 L) and add 15 mL of Tricaine-S stock solution. Test solution strength with a few fish; sedation should occur within 2–5 minutes. The solution may need slight adjustments depending on the size of fish, water

temperature, and age of stock solution. If solution is too weak and fish are not sedated after 5 minutes, put test fish in fresh water, add another 5 mL, and test again with fresh test fish. If solution is too strong (i.e., fish become sedated in < 1 minute), discard solution, remix, and retest with different fish.

- b) Fill at least 2 buckets (or coolers) about 3/4 full of fresh river water for recovering fish. Use one bucket for juvenile Chinook and the other for all other species.

ALL SAMPLE FISH MUST BE ANESTHETIZED TO WEIGH AND MEASURE.

The first 25 Chinook juveniles and the first 20 of all other species need to be sampled. Also record Smolt Index (**SI**; see Appendix 2) and Gill Rating (**GR**; see Section d, Figure 13) for all salmonids collected.

- c) Add fish to be measured to Tricaine-S solution after it has been tested. Do not put more than about 10 fish in Tricaine-S at any one time.

d) Fish Health Assessment

- i. Observe fish carefully prior to sedation to identify potentially moribund (dying) fish.
- ii. Once sedated, look for lesions, commonly across the back in a saddle shape (Figure 12; ‘saddleback lesion’).
- iii. Look for indications of pin-point hemorrhaging, or for hemorrhaging at fin bases (careful, hemorrhaging can also result from handling).
- iv. Look for small black spots (~2 mm) anywhere on the body which indicates ‘Black spot’ a disease caused by parasitic larvae.
- v. Place fish on dorsum (back) and gently press down on jaw to open operculum, a blunt probe can also be used, to carefully expose gill filaments for observation. Note gill color and rate accordingly (Figure 13).



Figure 12. Example of a ‘saddleback lesion’ on a fish infected with *Columnaris*.



Figure 13. Gill Rating (**GR**) color scale ranging from 1 = pale to 5 = deep red.

IMPORTANT: immediately call Project Manager or Project Assistant to report moribund fish observations or the incidence of any of the above symptoms. **DO NOT** release any fish at this time; prepare to be advised for potential further action. CDFG will be informed immediately and consulted for further action. It may be imperative to mort and fix specimens immediately (Appendix 6), be sure to have fixing agents and equipment for preservation available on site. Time is of the essence and fish need to be preserved promptly.

- e) Determine Smolt Index (**SI**) and Gill Rating (**GR**), and measure **FL** (mm) and weight to the nearest 0.1 g (**WT**) for each salmonid and record these values on the data sheet.
- f) **ALWAYS** check juvenile Chinook salmon for marks every trap check. Check for marks as fish are being measured, or use a plexiglass viewer (if available) for fish not measured.
- g) Photograph the 1st and 5th salmonid (for each species), then every 5th fish thereafter (i.e., fish number 1, 5, 10, 15, etc.); also photograph any other fish of special interest (different morphology, disease, condition, etc.), representative specimens from the sample, or fish for which specific identification is uncertain. More photos are better than not enough.

You only have one opportunity to take a photo.

- Photograph fish after all other information has been collected. The plexiglass viewer (if available) can be used for more realistic photos, and works well for capturing fin details, especially for unidentifiable species.
- Following photograph, place fish in recovery bucket then photograph the datasheet with a pencil pointing to the data for fish just photographed (Figure 14).
- On the backside of the data form in the ‘Photo Log’ record the Fish #. For salmonids, record **Species Code** (e.g., CHNF) followed by a dash then the data cell number (i.e., row by column number: CHNF-01; Figure 14). For non-salmonids record ‘Species Code’ (e.g., PL) followed by a dash then column number (e.g., PL-2; Figure 15). In this example, other entries would include SASU-1, PL-1, PRS-1, MQK-1, and LP-1. Also, take note of the total number of photos taken for each sample (not including datasheet photo shot) and record value in **# of Photos** column. Specific notes are not required, but should be recorded if additional information is warranted; attempt to relate specific notes to individual photos.

Species Code (RBT or CHNF)	SI	GR	L	W	T	SI	GR	F	L
	CHNF	5/5	111	12.9	/	/	/	/	/
1	/	/	/	/	/	/	/	/	/
2	/	/	/	/	/	/	/	/	/

Figure 14. Datasheet photo shot of salmonid data.

Other Species	1	2	3	4	5
SASU	58				
PL	131	143			
PRS	79				
MQK	33				
LP	100				

Figure 15. Datasheet photo shot of incidental species data.

- h) Scale samples will be taken from Chinook and steelhead smolts sampled for length and weight; no more than 50 Chinook scale samples should be collected per week. Scale samples are collected using a clean pocketknife to gently scrape a few scales from the fish behind the dorsal fin above the lateral line. The scales are then wiped onto a piece of water proof paper and placed into a coin envelope. Label envelopes with the **Date**, **Station**, **Species**, **SI**, **FL** and **WT**.
- i) Count the number of individuals of each species that exceeds the number measured, and record value in the **Plus Count** column associated with that species.
- j) After fish have recovered (i.e., swimming and reacting normally), salmonids and incidental fish may be released separately at pre-designated locations downstream from the traps. If

at least 5 juvenile Chinook are captured then these fish should be held, marked and used for an efficiency release that evening; results of efficiency tests will be pooled with results from subsequent trials conducted under similar environmental conditions. Individual release group sizes will be > 10 fish. Immediately notify Project Manager or Assistant to coordinate mark and release activities with CDFG. Fish will be saved in a net pen or live car which is labeled with date, number of fish and mark (if no mark, label natural) on flagging which you attach to net pen in a visible spot. Clean the net pens each time you add or remove fish.

iv. Evening Check Procedures

In general, evening checks follow the same procedures as day checks with the exception that the cone is not cleaned and the counter is not reset. Data that needs to be collected during a night check, and for all trap checks, is indicated on the data sheet by all caps.

Take extra care when working at night!

VI. Fish Marking

A. General

Fish are marked utilizing commonly accepted marking techniques as described for other mark-recapture studies (e.g., Baker and Modde 1977; Gaines and Martin 2004, Bottom et al. 2005, Miller and Sadro 2005, Rayton 2006).

First, fish can be marked with photonic dye using a needless injector that places a small, semi-permanent dye mark between fin rays (Figure 16). Photonic dye marks are usually placed on the caudal fin for fry-size fish; however, the dorsal and anal fins can also be marked when fish are larger than 45 mm. Photonic dye marks may last for several weeks.

A second marking method is by immersion, using Bismarck Brown Y (Sigma-Aldrich, Inc.) in solution, to produce a whole body mark (Figure 17). Prominent brownish coloration around the mouth, operculum, and on the ventral fins (i.e., pectoral, pelvic and anal) distinguish fish dyed by immersion in Bismarck Brown Y solution. The whole body dye generally only lasts a few days (e.g., 3 to 5 d); however, fish used for trap efficiencies typically pass the trap after only 1 to 3 days.



Figure 16. Chinook salmon fry marked with a pink color on the caudal fin (CFP).



Figure 17. Sub-yearling smolt marked by immersion in Bismarck Brown Y solution. Note: mark is most prominent and visible around the mouth, operculum and on the ventral fins (i.e., pectoral, pelvic and anal), especially when compared with unmarked fish.

B. Equipment Checklist

Clipboard with:

- | | |
|--|----------------------------------|
| <input type="checkbox"/> Tricaine-S solution | <input type="checkbox"/> Syringe |
| <input type="checkbox"/> Data Sheets | <input type="checkbox"/> Pencils |
| <input type="checkbox"/> Thermometer | |

MadaJet toolbox with:

- | | |
|--|--|
| <input type="checkbox"/> Extra seals | <input type="checkbox"/> Aerator |
| <input type="checkbox"/> Marine grease | <input type="checkbox"/> Nylon rope for net pens |
| <input type="checkbox"/> Alcohol | <input type="checkbox"/> Waders |
| <input type="checkbox"/> Toothbrush | <input type="checkbox"/> Wading boots |
| <input type="checkbox"/> Dye powder | <input type="checkbox"/> Ice chests |
| <input type="checkbox"/> Inoculators | <input type="checkbox"/> Card table |
| <input type="checkbox"/> Towels | <input type="checkbox"/> Chairs |
| <input type="checkbox"/> Dye and syringe | <input type="checkbox"/> Large bottle of water |
| <input type="checkbox"/> Half-bucket(s) | <input type="checkbox"/> Latex gloves |
| <input type="checkbox"/> 3–5 Buckets | <input type="checkbox"/> Spade |
| <input type="checkbox"/> Dip net | <input type="checkbox"/> Tool box |
| <input type="checkbox"/> Scoop net | <input type="checkbox"/> Net pen |
| <input type="checkbox"/> Canopy | |
| <input type="checkbox"/> Stress coat | |

C. Photonic Dye Marking Procedure

1. Set up your location.

- a) Set up work station (Figure 18) including table, chairs and canopy (not shown).
- b) Start a new Marking Data Sheet (Appendix 3) and record: **Date; Project Location; Crew; Observers** (if present); **Origin of Stock; GPS (Lat/Long); Release Code; Mark Applied** (Appendix 5); **Holding Temp; Holding DO; and Start Time.**
- c) Connect marking guns to CO₂ tank and regulator.
- d) Attach marking dye hose and start flow.
- e) Use a wet plastic cutting board as a marking surface.



Figure 18. Typical set-up for dye marking Chinook salmon.

- f) Fill cooler 1/2 way with water, attach aerator, add StressCoat (see ‘Mixing Instructions’ above) and up to 150 fish at a time.
- g) Mix Tricaine-S as described above in half bucket.
- h) Fill recovery buckets about 1/2 full and add Stress Coat and aerator. A cooler can be used to hold fish, but when transferring fish always use a bucket.
- i) Place about 20 fish per marking station in the Tricaine-S after it has been tested.

2. *Start marking*

- a) Measure **FL** and determine **SI**; record values on backside of Fish Marking Data Sheet and place fish on plastic cutting board one at a time for marking. Repeat this step for up to 50 fish (50 fish per Lot sampled if Hatchery fish are selected from multiple Lots; note **Lot #** and **Total from Lot** on datasheet).
- b) Apply the mark by starting with one pressure key turned out on the gun. Lightly place the gun tip onto the appropriate fin and pull the trigger. Be careful, do not place tip and mark too close to the body or fin margin (see Figure 16 for proper mark placement).

Turn out one key at a time to increase gun pressure; test before marking.

If fin splits when marked, adjust gun pressure or position.

- c) Count marked fish and place in recovery bucket; tally on data sheet (**Mark Tally**; note number of fish per tally mark).
- Always check to ensure fish are recovering normally and have visible marks.*
- d) If the gun jams, remove fish from Tricaine-S before trying to fix jam. Guns can usually be fixed by running clean water through them or reversing the tip. NEVER put river water in the guns...they will clog! If this does not solve the problem after a few attempts, try using a different tip.
 - e) When approximately 75 marked fish have accumulated in recovery bucket, transfer fish to net pen.
 - f) After 150 fish have been marked mix new (and test) Tricaine-S in 1/2 bucket, as it loses its effectiveness.
 - g) After all fish have been marked, record your **End Time** and the total number of fish marked on your data sheet. Mortalities should be recorded on datasheet and subtracted from total count. (Note: **Save all mortalities; it is a condition of our Scientific Collecting Permits!**)
 - h) After all fish have been transferred to net pen, use a sharpie and some flagging to label the pen with date, mark applied, number of fish in pen, and expected release date.

3. *Clean up*

- a) Carefully position net pen, seal Velcro and reinforce with zip ties. Review date, mark applied and number marked on the flagging for correctness.
- b) Attach net pen to secure location (e.g., back of trap). Tie net pens so the water surface is about 1-2 inches below the underside of the plastic rim.

- c) Clean and load up all supplies. Marking guns should be cleaned thoroughly with clean water and medical cleaner. NEVER put a gun back into its case with dye in it.
- d) Field check data sheet(s) for completeness and correctness.
- e) Return all supplies to storage.
- f) Make sure equipment is ready to be used again.

D. Bismarck Brown Y Dye Marking Procedure

1. Prepare solution (21 mg/L)

- a) Fill a large tub/tote with 75 L water (approximately 20 gal).
- b) Measure out 1.6 g Bismarck Brown Y.
- c) Thoroughly mix Bismarck Brown Y.
- d) Place aerator and thermometer in tub.

Keep water well oxygenated; use ice to maintain water temperatures.

2. Immerse fish

- a) Count out fish to be dyed with Bismarck Brown Y and place into dye solution.

DO NOT anesthetize fish prior to immersion in dye solution.

- b) Record number of fish, time and temperature on data sheet.
- c) Set lid over tub to prevent fish from escaping and to protect fish from direct sunlight.
- d) Observe water temperature and fish activity regularly (every 5 to 10 minutes).
- e) Gently stir water while observing fish.

Fish will initially behave erratically and appear sluggish while in solution.

- f) Immediately remove individual fish displaying prolonged abnormal behavior and place into well-aerated recovery water.

3. Remove fish

- a) Remove fish from solution after a minimum of 50 min in solution.
- b) Immediately place fish in cool, well-aerated recovery water.
- c) Record end time.

VII. Trap Efficiencies

A. General

Trap efficiency is affected by river stage, environmental conditions, trap placement, life stage and species of fish. Population abundance of juvenile migrants can be estimated using the trap-efficiency method of releasing marked fish upstream of each trap (Thedinga et al. 1994). Our objective was to mark and release fish daily (if suitable numbers of fish were available), and all recaptures per week are pooled so estimated number of migrants were stratified by week. When

catch numbers are low efficiency estimates are limited by the available number of fish for marking. We determined a minimum release size of 25 marked fish. Each size-class of juvenile Chinook (age-0, fry/parr/smolt) is treated separately as the efficiency of the trap is known to differ by species and size. By measuring trap efficiency as often as possible, we are minimizing experimental bias in estimates which can cause over- or underestimations of population abundance. We released marked fish in small groups on either side of the river (based on a coin toss) to aid in uniform mixing of unmarked and marked fish. Thedinga et al. (1994) determined marked fish released at standard release sites were uniformly mixed with unmarked population when river side was alternated. Fish are released at night to minimize predation and maximize movement.

After evening check, marked fish will be released for trap efficiency estimates. Night crew will monitor trap after release for one hour to insure collection and record of marked fish (avoiding the possibility of predation pressures within trap will affect recapture number).

B. Procedure

1. Check marked fish to determine mark retention and mortality

- a) Fill buckets 1/2 full of water and retrieve fish marked by morning crew.
- b) Check each fish for a mark using a plexiglass viewer. Count the number of fish with visible marks and the number of mortalities, and record on Experimental Release Data Sheet (Appendix 4). Fish without visible marks **MUST** be released **BELOW** trap as they will not be used in efficiency test and could be confused for wild fish if not marked otherwise.

2. Release marked fish upstream of trap

- a) Marked fish will be released upstream of trap and then crew will monitor the trap to determine number of marked fish recaptured.
- b) Fish will be released when dark, after the trap has been processed (i.e., note 'pre-release trap check' in the comments on the Trap Data Sheet). A standard release site will be used for all releases. Small groups of fish (i.e., 5-10) should be released evenly across the channel using a long-handled net, or by wading if flow is low. The side of the river where fish are released should be recorded on data sheet.
- c) Avoid the use of lanterns or other lights as fish are released (i.e., if possible to do so safely). Avoid running boat between release point and the trap after release has begun. If a boat is used to release fish and must travel downstream after release, remain 15 min at the release point after release and float or row downstream.
- d) At the time of release, make sure the following are known and recorded on the Experimental Release Data Sheet (see Appendix 4): **Release Date and Time, Water Temperature, Number of Fish to be Released, Number of Mortalities, and Mark Color** (or type).
- e) Once all fish have been released record the **End Time** on the data sheet.
- f) Wait one hour from the end time before the first check after the release.

3. Check live-box for recapture of marked fish

- a) After 1 hour, clean live-box according to the evening check procedure. Record and process all fish collected by usual procedure and record on Trap Data Sheet. Carefully

- check all juvenile Chinook salmon for marks. Record fork length (**FL**) of all marked fish collected. Note in comments '1st post-release trap check'.
- b) Wait another hour and conduct a second trap check. Note in comments '2nd post-release trap check'.
 - c) If >1% of the release group is recaptured after the second check, wait an additional hour and check trap again. Continue following these guidelines until hourly recapture rates are <1%.
 - d) Any remaining marked fish will be collected during the morning trap check.
 - e) Make sure data sheets are complete and delivered to the Project Assistant as soon as possible.
 - f) Make sure site is clean and no equipment is left behind.

XII. References

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Appendix 1: Example Screw Trap Data Sheet

DATE: _____ SAMPLE TIME: _____ CRAMER FISH SCIENCES Pg ____ of ____
 LOCATION: _____ STATION: _____ RECORDER/CREW: _____ FIELD CHECKED BY: _____ WEATHER CODE: _____
 CONDITION CODE: _____ DEBRIS LEVEL: _____ TOTAL REVS: GUAGE HEIGHT: _____ (ft) WATER TEMP: _____ ° C D.O.: _____ (mg/L)
 Before Revs: _____ (sec) After Revs: _____ (sec) Gear Status: _____ Water Velocity: _____ (ft/s) Turbidity: (NTU)
 Comments: _____

Species Code (RBT or CHNF)	1		2		3		4		5		6		7		8		9		10		Plus Count
	SI/GR	W/T	F/L	F/L	SI/GR	W/T	F/L	F/L	SI/GR	W/T	F/L	F/L	SI/GR	W/T	F/L	F/L	SI/GR	W/T	F/L	F/L	
0	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	
1	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	
2	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	
3	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	
4	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	
5	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	
6	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	
Other Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Plus Count

SI/GR = Smolt Index and Gill Rating - Text in all caps to be collected at every trap check -

FOR OFFICE USE ONLY Entered By: _____ On Date: _____ QC₁ By: _____ On Date: _____ QC₂ By: _____ On Date: _____

Appendix 2: Smolt Index Protocol

The Smolt Index is to determine the life stage of salmonids, including Chinook and rainbow trout/steelhead. Smolt Index should be recorded for each fish measured and weighed.

Rainbow Trout/Steelhead Smolt Index Protocol

Smolt Index	Life Stage	Criteria
1	Yolk-sac Fry	– Newly emerged with visible yolk sac
2	Fry	– Recently emerged with sac absorbed (button up fry) – Seam along mid-ventral line visible – Pigmentation undeveloped
3	Parr	– Seam along mid-ventral line not visible – Scales firmly set – Darkly pigmented with distinct parr marks – No silvery coloration
4	Silvery Parr	– Parr marks visible but faded – Intermediate degree of silvering
5	Smolt	– Parr marks highly faded or absent – Bright silver or nearly white coloration – Scales easily shed (deciduous) – Black trailing edge on caudal fin – More slender body
6	Adult	– > 300 mm FL – If < 300 mm FL, must be extruding eggs or milt

Chinook Salmon Smolt Index Protocol

Smolt Index	Life Stage	Criteria
1	Yolk-sac Fry	– Newly emerged with visible yolk sac
2	Fry	– Recently emerged with sac absorbed (button up fry) – Seam along mid-ventral line visible – Pigmentation undeveloped
3	Parr	– Seam along mid-ventral line not visible – Scales firmly set – Darkly pigmented with distinct to slightly faded parr marks – No to slight silvery coloration
5	Smolt	– Parr marks highly faded or absent – Bright silver or nearly white coloration – Scales easily shed (deciduous) – Black trailing edge on caudal fin – More slender body

Appendix 3: Marking Data Sheet

Fish Marking Data Sheet

Marking

Date: _____ Project Location: _____
 Crew: _____ Observers: _____
 Origin of Stock: _____ GPS (Lat/Long): _____
 Release Code: _____ Mark Applied: _____
 Holding Temp: _____ °C Holding DO: _____ mg/L
 Start Time: _____ End Time: _____

Mark Tally (each tally = ___ fish)

Morts: _____ Total # Marked: _____
 Comments: _____

Knock down solution: _____ ml / _____ L Time to sedation: _____ min. X 2.5 = _____ min. max exp time.
 Maintenance solution: _____ ml / _____ L Time to sedation: _____ min. X 2.5 = _____ min. max exp time.

Transportation (*Check Water Temp and DO every 20 min)

Holding tank temp Air temp: _____ °C
 Before: _____ °C After: _____ °C

Holding tank DO
 Before: _____ mg/L After: _____ mg/L
 Time Departed: _____ Time Arrived (holding site): _____
 Total Trip Time: _____

Planting

Destination: _____ Site GPS (Lat/Long): _____
 Site Description: _____ Transport/Planting Morts: _____
 Holding method: _____ Plant Time: _____
 River Temp: _____ °C River DO: _____ mg/L

*For temp $\geq 2^{\circ}\text{C}$ difference, gradually acclimate fish by adding river water to the tank. 10 min/ 2°C

Comments: _____

Appendix 4: Release Data Sheet

Experimental Release Data Sheet

Location: _____ GPS (Lat/Long): _____

Date: _____ Release Code: _____

Crew: _____

Mark: _____ Mark Position: _____

Weather Code: _____

Water Temp: _____ °C D.O.: _____ mg/L

Method (Circle one): Boat N. Bank S. Bank Other _____

Release Start Time: _____ Release End Time: _____

Marked

Total # QC'd: _____ # QC'd Unmarked: _____

% Mark Retention: _____ Total Marked Released: _____

Morts

Marking Morts: _____ Transport Morts: _____

Pre-release Morts: _____ Total Morts: _____

****Release ALL unmarked fish downstream of trap**

Comments: _____

Appendix 5: Flow Meter Instructions

Quick Reference

Flow Probe FP101 & 201

Water Velocity Measurement

Maximum & Average Velocities Displayed Digitally In 8 Languages.



- **Factory-calibrated & ready for immediate use:**



- **Blow on the propeller** for 5 – 10 seconds to ensure it turns freely.
- The Flow Probe computer display uses **2 buttons** for normal operation:

- **Reset the computer display** by holding the top button down for 2 seconds. Instantaneous velocity is always displayed. Scroll through display modes with the bottom button to select Average or Maximum speed. Velocity is displayed in ft/sec or m/sec (Instantaneous velocity to nearest 0.5, Max to nearest 0.1, Avg to nearest 0.01).



- **Orient the propeller** directly into the flow using the arrow indicator aimed downstream



- With the propeller at your measuring point, **hold the probe in place for several seconds**, and then remove the probe. The Average Velocity reading will hold once the propeller stops turning. **Conversely, move the probe in a smooth vertical motion** (as if painting with a brush) to attain the Average Velocity of a water column.

Some things to be aware of:

- Be sure the white end piece is securely snapped into place.
- While the top of the computer is water resistant, operation can be affected if water gets into the connectors that hold it to the probe. If the probe head gets wet, remove the white housing from the probe, separate the computer from the housing and take out the battery. Allow to dry completely.



In the U.S. call toll free at 1-800-876-1172
International: 916-638-3429
Fax: 916-638-3270
Email: globalw@globalw.com

Visit our online catalog at: www.globalw.com
Our Address:
11390 Amalgam Way
Gold River, CA 95670

Appendix 6: Davidson’s Fixative Procedure List and MSDS

Read the Material Safety Data Sheet (MSDS) and follow all recommended safety procedures.

Begin by putting on all of the necessary safety gear (i.e., goggles, gloves, and apron).

- Fill out a water proof data label for the specimen to be placed in the jar after completion.
- **Make sure you are in a well-ventilated space.**
- Next, gather all the materials needed to fix the specimen:
 - Davidson’s Fixative
 - Sample jar
 - Fish specimen
 - Scalpel or razor blade
 - Alcohol swab
 - Plastic tray (to work in)
 - Paper towels
- Take the scalpel and sterilize it using an alcohol swab.
- Next, carefully cut open the specimen from the vent to just below the jaw (this is to expose the internal organs to the fixative...be sure not to cut anything more than the skin and tissue.)
- Next, pour the fixative into the sample jar.
- Place the specimen in the jar (fully submerged).
- Leave specimen in fixative for 48 hours.
- Clean up work area and dispose of gloves.
- After 48 hours, follow the safety guidelines above and remove the specimen from the fixative. Place specimen in another jar with 70% isopropyl alcohol.
- Thoroughly clean up work area when finished.

MATERIAL SAFETY DATA SHEET
DAVIDSON'S FIXATIVE

Section I—IDENTIFICATION

PRODUCT: Davidson's Fixative

PRODUCT CODE NO.: 12010

Section II—HAZARDOUS INGREDIENTS

COMPOSITION	%	TLV	HAZARD
Formaldehyde	7.4%	2 ppm	Irritant
Acetic acid	10.0%	10 ppm	Harmful/toxic
Ethyl alcohol	28.2%	1000 ppm	Flammable
Methyl alcohol	1.4%	200 ppm	Flammable, poisonous
Petroleum naptha	0.3%	500 ppm	Flammable

Section III—HEALTH AND FIRST AID INFORMATION

INHALATION: Irritation of upper respiratory tract. Bronchitis and bronchopneumonia can result from prolonged exposure. Inflammation of eyelids can occur. Formaldehyde exposure is under investigation. In case of exposure, remove patient to fresh air from contaminated area. If patient is not breathing, apply artificial respiration and, if qualified, administer oxygen. Immediately call a physician. Keep the patient warm.

INGESTION: Abdominal pain, unconsciousness, collapse. Poisonous, can damage the central nervous system and internal organs and cause blindness. In all cases, immediately call a physician. Wash out mouth thoroughly with water. If the patient is conscious, give milk or water freely to drink to dilute the chemical, induce vomiting. Repeat.

EYE CONTACT: Can cause irritation and eye burns. Immediately call a physician. Rinse the eyes with a gentle stream of water for at least 15 minutes, keeping the eyelids separated. Repeat if pain persists.

SKIN CONTACT: Can cause irritation, burns, hardening or tanning of skin, cracking and ulceration, or dermatitis. Wash thoroughly with soap and water. Remove and wash contaminated clothing before re-use. Call a physician.

Section IV— PHYSICAL DATA

BOILING POINT: n. av.

VAPOUR DENSITY (AIR=1): n. av.

SOLUBILITY IN WATER: Miscible

APPEARANCE AND COLOUR: Clear colorless with an acetic acid odor

SPECIFIC GRAVITY: n. av.

pH: n. av.

Section V - FIRE AND EXPLOSION HAZARDS

FLASH POINT: n. av.

FLAMMABLE LIMITS IN AIR; % BY VOL. LOWER: n. av.

FLAMMABLE LIMITS IN AIR; % BY VOL. UPPER: n. av.

FIRE FIGHTING PROCEDURES & PRECAUTIONS: Water spray, dry chemicals, carbon dioxide or vaporizing liquid. Wear self-contained breathing apparatus.

FIRE & EXPLOSION HAZARDS: May emit toxic vapors.

Section VI - REACTIVITY

STABILITY: Stable

HAZARDOUS POLYMERIZATION: Will not occur

CONDITIONS & MATERIALS TO AVOID: Avoid cool temperatures

HAZARDOUS DECOMPOSITION PRODUCTS: Unknown

Section VII - EMPLOYEE PROTECTION

CONTROL MEASURES: In case of a spill, shut off all possible sources of ignition. Wear gloves and goggles. Dike any liquid to prevent its spread to public water sources. Mop up with plenty of water and treat with dilute ammonia solution. Run to waste diluting greatly with running water. Ventilate the contaminated area well to dispel any vapor. If formaldehyde solution enters sewers or drains inform local authorities.

RESPIRATORY PROTECTION: Respirators should be used and for large quantities self contained breathing apparatus should be used.

PROTECTIVE CLOTHING: Protective clothing or aprons should be used. Gloves should be used.

EYE PROTECTION: Safety goggles should be used.

VENTILATION: Use only with adequate ventilation. Local exhaust system or fume cupboard should be used.

WASTE DISPOSAL: Pour the liquid in a hole in an open area. Wear a respirator. Ensure disposal method complies with local, provincial and federal regulations governing disposal.

Section VIII - REGULATORY CONTROLS

DEPT. OF TRANSPORTATION: Regulated under Transport of Dangerous Goods.

DOT CLASSIFICATION: Class 8 U.N. 1760

DOT PROPER SHIPPING NAME: CORROSIVE LIQUID, NOS (Formaldehyde solution)

OTHER DOT INFORMATION: Packing group III, Limited Quantity 5 L

WHMIS CLASSIFICATION: D2A

OTHER REGULATORY REQUIREMENT: None

Section IX—OTHER INFORMATION

High concentrations of vapor inhaled for long periods can cause laryngitis, bronchitis or bronchial pneumonia. Prolonged contact with skin can cause cracking of skin and ulceration, particularly around fingernails. Use in an adequately ventilated area.

PREPARED BY: MSDS Department

DATE: Update January 10, 2008

Appendix 7: Equipment Sterilization Procedures

The following procedures for cleaning New Zealand Mud Snail (NZMS) infested wading gear can be followed upon exiting NZMS infested waters. Wading gear should be cleaned prior to leaving the site. If this is not possible then wading gear should be completely sealed inside of a large plastic bag and cleaned before it is used in any other waters. Three different cleaning protocols have been tested and found to be effective using specific cleaning solutions:

1) Immersion Procedure

- a. Remove wading gear upon exiting NZMS infested waters. Avoid allowing infested wading gear to come in contact with interior surfaces of vehicles or camping gear such as tents or trailers. NZMS can be transferred to any surface they come in contact with and they could later be transferred back to cleaned wading gear. Turn waders right side out and remove insoles from wading boots.
- b. Place waders, wading boots, boot insoles and the streambed contact end of a wading stick, if used, in a container of sufficient size to allow the gear to be completely covered by a cleaning solution.
- c. Pour sufficient cleaning solution into the container with the infested wading gear to completely cover the gear. It may be necessary to weight down the gear to ensure that it remains immersed in the cleaning solution.
- d. Allow the wading gear to remain in the cleaning solution for at least 5 minutes.
- e. Remove wading gear from the cleaning solution one piece at a time and inspect it to make sure that all debris that could harbor NZMS has been removed from the gear as well as any NZMS that could be lodged in cracks or crevices. If necessary, use a stiff plastic bristled brush such as a kitchen brush to remove any remaining debris and mud.
- f. Rinse wading gear in clean water. **DO NOT USE WATER FROM THE NZMS INFESTED SOURCE.** This may reintroduce NZMS to the wading gear.
- g. Return cleaned wading gear to its appropriate storage container.

2) Dry Sack Procedure

- a. Remove wading gear upon exiting NZMS infested waters. Avoid allowing infested wading gear to come in contact with interior surfaces of vehicles or camping gear such as tents or trailers. NZMS can be transferred to any surface they come in contact with and they could later be transferred back to cleaned wading gear. Turn waders right side out and remove insoles from wading boots.
- b. Place waders, wading boots, and boot insoles into a dry sack (recommended size: 65 liter). Walking sticks will need to be cleaned separately outside of the dry sack to avoid rupturing the sack.
- c. Add 8 to 10 liters of cleaning solution to dry sack and seal dry sack.
- d. Pick up the dry sack and shake it back and forth using a rolling motion to ensure that the contents are thoroughly coated with the cleaning solution. Continue shaking for approximately 30 seconds.

- e. Let dry sack sit undisturbed for at least 5 minutes. Then repeat the shaking and mixing for another 30 seconds.
- f. Open the dry sack and remove the contents one piece at a time and inspect it to make sure that all debris that could harbor NZMS has been removed from the gear as well as any NZMS that could be lodged in cracks or crevices. If necessary, use a stiff plastic bristled brush such as a kitchen brush to remove any remaining debris and mud.
- g. Rinse wading gear in clean water. **DO NOT USE WATER FROM THE NZMS INFESTED SOURCE.** This may reintroduce NZMS to the wading gear.
- h. Return cleaned wading gear to its appropriate storage container.

3) Spray Bottle Procedure (Note: this procedure has only been tested using a copper sulfate cleaning solution).

- a. Remove wading gear upon exiting NZMS infested waters. Avoid allowing infested wading gear to come in contact with interior surfaces of vehicles or camping gear such as tents or trailers. NZMS can be transferred to any surface they come in contact with and they could later be transferred back to cleaned wading gear. Turn waders right side out and remove insoles from wading boots.
- b. Place waders, wading boots, boot insoles and the streambed contact end of a wading stick, if used, in a container of sufficient size to allow the gear to be easily accessed.
- c. Using a standard 1 liter squeeze-trigger type spray bottle containing the cleaning solution, spray the wading gear to the point of saturation and runoff with the cleaning solution. Be sure to treat the inside of the wading boots as well as the outside. Use the stream setting to be sure and dislodge any debris from the wading boots. Be sure to treat both top and under side of gravel guards if they are permanently attached to the waders.
- d. Allow the wading gear to set for at least 5 minutes with the cleaning solution on it. Remove the wading gear one piece at a time and inspect it to make sure that all debris that could harbor NZMS has been removed from the gear as well as any NZMS that could be lodged in cracks or crevices. If necessary, use a stiff plastic bristled brush such as a kitchen brush to remove any remaining debris and mud.
- e. Rinse wading gear in clean water. **DO NOT USE WATER FROM THE NZMS INFESTED SOURCE.** This may reintroduce NZMS to the wading gear.
- f. Return cleaned wading gear to its appropriate storage container.

4) Cleaning Solutions.

- a. Copper sulfate: Dissolve 3.785 grams of copper sulfate pentahydrate crystals (99.1% purity) for each gallon of solution you want to make. This will achieve a concentration of 252 mg/L of copper in the cleaning solution.
- b. Benzethonium chloride: Dissolve 7.57 grams of benzethonium chloride (97% purity) for each gallon of cleaning solution you want to make. This will achieve a concentration of 1,947 mg/L in the cleaning solution.

- c. Formula 409® Disinfectant: Dilute the commercially available solution 1:1 with clean water to achieve the needed concentration for the cleaning solution (i.e. 1 gallon of Formula 409® Disinfectant to 1 gallon of water).

5) Tank Disinfection Procedure

- a. Use a 200 ppm active chlorine solution
- b. Determine the percentage of active chlorine in commercial liquid bleach or bleaching powder.
 - 1. For example, the percentage of active chlorine in store bought liquid bleach (initial volume = 5.14 L) is 6%.

- 2. Calculate initial chlorine concentration:

$$6\% / 100 \times 1,000,000 = 60,000 \text{ ppm.}$$

Conclusion: The concentration of chlorine in store bought liquid is 60,000 ppm.

- c. Calculate total volume that will be treated with 5.14 L of store bought liquid bleach at a final chlorine concentration of 200 ppm.

- 1. Example calculation:

- i. Variables:

Initial bleach $Volume_1 = 5.14 \text{ L}$

Initial chlorine $Concentration_1 = 60,000 \text{ ppm}$

Final $Volume_2 \text{ treated} = \text{unknown}$

Final chlorine $Concentration_2 \text{ in tank} = 200 \text{ ppm}$

- ii. Equation:

$$Volume_1 (Concentration_1) = Volume_2 (Concentration_2)$$

- iii. Calculation:

$$5.14 \text{ L} (60,000 \text{ ppm}) = V_2 (200 \text{ ppm})$$

$$308,400 = V_2 (200 \text{ ppm})$$

$$1,542 \text{ L} = V_2$$

- 2. Conclusion: One standard store bought container of bleach (5.14L) will treat 1,542 L (407 gallons) at a final chlorine concentration of 200 ppm.
- 3. Adjust the foregoing calculation according to unknown variables.
- d. Tank treatment
 - 1. Pour the bleach slowly into the tank, mixing as you pour and then fill the tank up to full capacity with clean water.
 - 2. Let the bleach stand in the tank for 1 hour.
 - 3. Completely empty the tank and rinse thoroughly with clean water.

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