Weir Mark-Recapture/Resight Protocols

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INTRODUCTION

Coho salmon (*Oncorhynchus kisutch*), Chinook salmon (*O. tshawytscha*) and steelhead (*O. mykiss*) are all listed under the Endangered Species Act (ESA) in coastal Northern California (Federal Register 1997, 1999, 2000). Estimating the adult escapement of these fish returning to spawn is important for assessing population status (McElhaney et al. 2000). The National Oceanic and Atmospheric Administration's (NOAA) Fisheries Service would prefer to focus on the number of returning adult spawners to evaluate the viability of salmon populations as part of the recovery planning process (Busby et al. 1996). There is a need for a reliable technique to make an accurate and unbiased estimate of the returning adult salmonids to monitor the long term trends of these listed salmonid populations in coastal Northern California.

In general, the most reliable estimates of Pacific salmon escapement are derived from counts at fish ways or weirs (Busby et al. 1996). However, because semi-permanent structures require sufficient capital investment and temporary structures are hard to maintain, operate, and capture only a small proportion of the returning adults throughout the winter stream flows, there are very few fish ways or weirs in northern California. In lieu of weirs, spawning surveys have been used which monitor live observations of fish and count and measure redd size. Estimates from these observations have recently been shown to produce reasonable population estimates with reduced field effort (Gallagher 2003, Gallagher and Gallagher 2005). However, the spawning survey methods have not been completely evaluated as to their accuracy and whether they are unbiased estimators of the adult salmonid spawning populations.

The Action Plan for Monitoring Coastal Anadromous Salmonids (Boydstun and MacDonald 2005), supported by NOAA Fisheries and the California Department of Fish and Game, recommends that a portable weir design be used to implement a mark-recapture/resight program in a few randomly selected tributary streams to calibrate the spawning survey based estimates throughout the whole region. In addition, the Plan recommends that a life history monitoring program be conducted in a small number of coastal streams. These programs will generally have more permanent type structures associated for monitoring both adult salmonid escapement and juvenile rearing and out-migration. However, some of these selected streams may need to use a portable weir design in the interim time period it takes to fund and construct more permanent structures. This protocol is designed for both temporary and permanent types of weir monitoring programs.

The goal of this program is to implement a successful mark-recapture and/or resight program to accurately estimate the number of returning adult salmonids. This requires the application of a sufficient number of tags to a portion of each major pulse of adult salmonids entering the stream to ensure the recovery and/or resighting of tagged fish.

OBJECTIVES

1. Capture, mark, release and resight or recapture a significant portion of each pulse of adult salmon and steelhead entering the stream at the weir/trap without inducing significant mortality (<1-5%).
2. Determine adult size, run composition, and temporal distribution of each species entering the river or stream.
3. Develop a reliable estimate of adult salmonid escapement in selected streams, determine length of residence time for each species, and compare with spawning survey based estimates.
4. Collect genetic tissue samples and scale samples from adult salmonids for genetic and life history evaluation.

STUDY AREA

The current study area is coastal Northern California, extending from the Oregon border in the North to Santa Cruz County streams in the south, including the Klamath-Trinity River system and tributaries to San Francisco Bay, but excluding populations from the Sacramento-San Joaquin River system. Climate in this region is under maritime influence, and includes abundant rainfall levels due to the interaction between marine weather systems and the mountainous nature of the region, summer fog, and moderate temperatures (Busby et al. 1996). Topographically, the region is generally rugged with steep canyons with a narrow coastal plain composed of sand, silt, and gravel. Tributary streams generally are short and have a steep gradient. As a result, surface runoff is rapid and water storage is relatively short term during dry periods. These streams are especially prone to low flows during times of drought and rainfall averages 60-240 cm per year, with generally lower levels along the central California coast. River flows peak during winter rain storms common in December through February. During summer months, stream flows are correspondingly at their lowest and temperatures at their highest. There is usually no precipitation during this period of time and the dry period may expand to 2 or 3 months every few years. The region is generally heavily forested with conifers, primarily coastal Redwood (*Sequoia sempervirens*), and Douglas Fir (*Psuedotsuga menziesii*), with various pine and hardwood species also present. Forest undergrowth is composed of numerous types of shrubs and herbaceous plants.

EQUIPMENT AND GENERAL PROTOCOLS

Permanent or semi-permanent dams or fish ladder structures are expensive to build and are generally rare. However, when one of these structures does exist, significant costs can be avoided by utilizing the structure, and the likelihood of successfully operating and maintaining the structure throughout the winter streamflows improves. In other areas, a portable weir design is generally required because some of the selected streams may be remote and accessible only by foot and ATV. Many of these streams will be prone to large fluctuations in discharge and often carry a large amount of debris, thus requiring a weir to withstand washout and continue fishing effectively through most high stream flow events. Complete removal of the weir may or may not be required annually. Resistance board weirs are a relatively new alternative to rigid weir designs, which generally washout during debris laden high stream flow events. The resistance board design will temporarily submerge under high debris loads and water pressure, thus making it less likely to washout (Tobin, 1994).

A resistance board weir consists primarily of an array of rectangular panels that are anchored to the stream bed. These floating panels are anchored by a substrate rail and rail apron. The floating weir panels are attached to the fish passage chute(s) and live trap by bulkhead adaptors and attached to rigid weir sections at each stream bank (Tobin, 1994). The floating panels consist of evenly spaced tubular pickets aligned parallel to the direction of the stream flow. The downstream portion of these pickets rides above the water surface by a resistance board that applies upward pressure to the picket end as a result of the water pressure from flowing water. The resulting barrier will inhibit adult fish migration, yet allow water and debris to pass. One or more openings may be designed in the weir, to allow for upstream and downstream migration of both adults and juvenile salmonids. Tailoring resistance board size and position will maximize lift, while panel length, picket spacing, and picket diameter will reduce the downward pressure applied by the flow and debris.

One can not assume that the weir/trap will catch 100% of the adult salmonids returning to spawn across all stream flow events. Therefore, captured adult salmonids will have to be tagged or marked with a unique identifying tag or mark to estimate the population abundance. One must first consider whether the marked fish will be recovered and handled at multiple trap sites and/or some other location or strictly resighted in the spawning surveys above the weir/trap site before selecting an appropriate tag. Generally, one of the two principal types of anchor tags will most likely be used; either the dart tag or the T-bar tag. The head of the tag or anchor is embedded in the fish body and the protruding portion, or shaft, is usually a vinyl shaft that displays all the information. These tags are available in a wide variety of sizes, colors, and styles from Floy Tag & Manufacturing, Inc., Seattle, Washington (206 524-2700)

Floy tags are generally inserted below the dorsal fin, into the white muscle tissue, by means of an applicator (Guy et al. 1996). Tags should be inserted at an acute angle to the body so that they lie next to the body when the fish is swimming. These tags have several advantages over other tags: 1) they can be applied quickly, and 2) they can carry a considerable amount of information on the surface of the tag shaft. The primary disadvantage of these tags is tag loss. Therefore, a secondary mark such as a fin clip or opercular punch, which is also used to collect genetic tissue, must be used as a secondary mark to assess tag loss.

A closed population model has generally been utilized to approximate adult salmonid populations in Northern California, because very few adult salmonids are marked and subsequently recaptured or resighted. The assumptions to this model are considered to be generally violated when applying it to salmonid populations. Sykes and Botsford (1986) described utilizing the Jolly-Seber model (open population model) on chinook salmon carcasses to estimate the escapement into Bogus Creek, California. Ricker (1975) indicated that at least four or more sampling occasions with a minimum of 3-4 recaptures per sampling event are necessary to produce a Jolly-Seber estimate of an adult salmonid population. Krebs (1989) indicated one strategy for estimating populations using mark-recapture data when the closed population assumptions are violated is to go ahead and use these methods recognizing that the resulting estimates are biased and are only indices of the population size. Another suggested strategy is to design ways of satisfying the closed population assumptions.

The Department's Anadromous Fisheries Resource Assessment and Monitoring Program (AFRAMP) recommend that if the primary means of recovering tags are to be resightings in spawning surveys, that the lower tag (closest to the fish and generally larger) colors be used to identify species as well as side of the fish marked, and the upper tag (Furthest from fish and smallest) colors be rotated weekly to stratify the population into distinct time components. Stratifying the mark-recapture over time will do a better job of satisfying the assumptions of the closed population model and/or the Jolly-Seber open population model, and estimation of residence time (*rt*) for use in the Area-Under-the-Curve (AUC) population estimation procedure.

TEMPORARY WEIR SITE SELECTION

Tobin (1994) indicates that one must consider the flow and debris characteristics of a stream when designing the resistance board weir. The performance is dependent upon the velocity, debris load, and volume of stream flow. Ideal sites are generally characterized by wide, shallow areas of the stream with a stable substrate foundation (Tobin 1994). Water depth should be less than 1 meter during normal low flow and slow to moderate water velocity is preferred. The appropriate stream cross-section will have a relatively level streambed with uniform flow, and the stream banks should be close to vertical and high enough to contain water during floods. The stream bottom should consist of coarse gravel to cobble, smaller material such as silt, sand or small gravel is more likely to erode.

FIELD METHODS

Initiation of trapping: It appears that based on recent historical information from Pudding Creek and Caspar Creek that fish have been arriving at the stream mouths sometime close to when the watersheds have accumulated approximately 8-10 inches of rain. However, this could be altered by the intensity and timing of rain. Typically, in recent years we have seen the runs begin in late November – early December. However, historically it can be as early as October or as late as January for coastal Mendocino County streams.

Prior to leaving office: Daily prior to traveling to the weir site check the weather and flow conditions. Check the nearest stream flow gage, preferably the United States Geological Survey (USGS) Noyo River stream gage (http://waterdata.usgs.gov/ca/nwis/uc?11468500), the weather forecast (http://www.wrh.noaa.gov/Eureka/index.shtml) on the internet, and the South Fork Caspar Creek streamflow and cumulative rainfall data (http://www.fs.fed.us/psw/topics/water/tts/webplots/tts_plot.shtml). If a large storm and lots of rain are predicted, you may be required to monitor and clean the trap throughout the day and evening. If it has continuously rained and stream flows are rising rapidly and are at or above the level where the trap can be safely checked, probably about 1 m depth in trap box, do not attempt to service the weir or trap. Always bring all items needed to check the trap (Table 1), process fish, and record data. Drive safely out to the weir. Take extra caution on private dirt roads, drive slowly and do not add extra wear and tear to the road!

Pudding Creek Dam operation:
The Pudding Creek dam has a temporary stage gage painted on the south wall. The fish ladder does not flow until the pond level reaches approximately 3.0’ on the stage gage. The maximum flow for fish to negotiate the fish ladder is approximately 8-10” of water over the top board. The maximum level of water in the pond before the water level tops the trap box is approximately 4.0’ on the stage gage. Try hard not allow the water level in the pond to top this level. Excessive runoff is allowed to bypass the fish ladder through opening of a number of gates to the north of the ladder. The first gate adjacent to the fish ladder is always the first gate to be opened to allow excess runoff to bypass the ladder. This gate is a half gate and blocks fish migration even when it is open fully. It also helps with attracting fish towards the fish ladder. Additional gates are opened successively down the dam to the north as needed to keep the pond level well below 4.0’. Each additional gate beyond the first gate are full gates

and **do** allow fish to bypass the fish ladder when opened. The optimal stage level for maintaining flow in the fish ladder is approximately 3.5'.

After a heavy rain it takes approximately 8-10 hours for the first of the runoff to reach the pond. However, this depends partly on how much rain the watershed has recently had prior to the next storm event. Whoever is on operational duty will have to monitor the stage levels and the weather reports to predict how much runoff may occur overnight and adjust the number of gates and amount open to maintain fish ladder flow and optimal pond levels. Field staff my have to make multiple visits during the night to ensure enough gates are open during heavy and extended rainfall or close gates if the rain did not materialize to prevent dewatering of the fish ladder. When in doubt, it always better to open to much overnight so the pond level does not exceed the top of the fish trap and dam.

When large numbers of coho salmon arrive in the lagoon and are noticed below the dam spill way, a very good technique for attracting fish into the fish ladder during large runoff events is to lower the pond level in the morning very rapidly (i.e. open lots of gates) till the pond level is reduced below the 3.5' stage level. Then shut all the gates and allow the pond level to build back up and only allow the excess runoff to travel down the fish ladder. This will attract the fish into the ladder (not the spill) and then as the ladder fills with fish and the pond level increases, the ladder door and the bottom barrier can be installed. Then gates can be reopened while the fish in the ladder are netted and worked up. This procedure can be repeated through out the day until no further fish show up in the ladder.

Before entering the fish ladder to net fish, be sure to install the bottom barrier first and then the upper trap door second to reduce the stream flow in the fish ladder while netting fish in it. The half gate can then be opened to help attract more fish in the lagoon to the dam spillway and reduce the water pressure on the trap door. When all the fish are netted out of the fish ladder, then the bottom barrier should be removed first then the upper trap door second. If there is too much water pressure on the trap door, 1 or more of the gates can be opened temporarily to reduce the water pressure for removal of the trap door. Then all the gates can be shut again to direct all the flow into the fish ladder and attract another school of fish into it.

<u>Checking Temporary Weirs</u>:
Look and listen upstream and downstream of the weir for fish and predators. Put trap block/door in trap box to block fish from escaping. Remove the trap box lid. Try and net fish that are congregated along the downstream edge of the weir first. Put these in the trap box and process after all fish are captured. Next, try and net fish that are congregated upstream of the weir. Process these fish first (I am assuming they are recaptures and do not need tagged or tissue samples taken, if they are not, then process these fish accordingly) and release upstream

of the weir. Note if there are predators or evidence of predators in the vicinity. Do not release tagged fish anywhere near predators.

Processing the fish:
Prior to tagging fish, make sure of the appropriate tag colors for the species and week (see tagging schedule). Primary tag colors will be used to identify the species as well as the side of the fish tagged. Secondary tag colors will change every week, Sunday through Saturday. Remove fish one at a time and place in the tagging cradle (preferably in water), identify the fish to species, measure fork length, determine sex, determine condition, inspect for marks and fin clips, tag the fish (see tagging directions), and read and record the tag number and color. Next use the appropriate hand punch to punch a weekly specific shape into the appropriate species operculum side. Record all data either on datasheet or into a electronic datalogger if available. Take a random systematic sample of genetic tissue and scale samples as predetermined.

Releasing tagged fish:
Place all handled fish in a live car if available and revive the fish if necessary in an area of low flow. Fish can be revived by gently holding them underneath the pectoral fin area with one hand and tail of the fish in the other hand in the water and ensure moving water is passed through the mouth and gills of the fish. The fish is assumed to be revived when it can swim off on its own without turning belly up. Once all fish are handled, tagged and recovered, or if the live car is full, move the fish in the live car in the water upstream to the first pool above the weir and release. Make sure the fish do not move back down stream against the weir or into the downstream trap.

Releasing recaptured fish:
Recaptured fish should be immediately processed. Tag number and color should be read and recorded, fork length re-measured, condition noted, and released downstream of the weir. Recaptured fish, if processed quickly and are not in poor condition, can be carried in the dip net to the downstream side of the weir and released. The live car should be reserved for freshly tagged fish, unless the recaptured fish is in poor condition (i.e. spent and acting like they will not survive). These fish should be kept in the trap until all fish are processed and released. Then these fish can be transported in the live car to a suitable low flow site downstream of the weir to recover. If the fish looks dies, then remove the entire head, place the head in a plastic zip lock bag, with a tissue envelope (with all the data filled out) and brought back to the office and placed in a freezer. Otoliths will be recovered from these fish heads at a DFG office. The remainder of the fish should be released far enough downstream to not attract attention and or predators.

Resetting the temporary weir:

1. Remove trap block and replace the trap lid.

2. Clean the trap of all debris that has accumulated on it.
3. Check the along the weir and trap box for scour. Put sand bags in if needed along the trap box.
4. Check the anchors and apron for scour.
5. Check the anchors and if loose reset them in the substrate.
6. Check again for fish and/or predators along the weir.
7. Check the staff gage and record the stage height.
8. Fill out the weir Journal/log and record time of visit, stage height, operation of the dam gates, any predators (man or animal), weather, and any other pertinent observations and initial the entry!

Back at the office:

1. Replace all equipment back in the appropriate place and clean out vehicle.
2. Transfer weir data into the weir Access database. Place datalogger batteries into charger as needed.
3. Place scale samples in the designated box in the office. Place genetic tissue samples into a food dehydrator located in the shop and turn the timer on for 4 hours to dehydrate the tissue sample. The following day place these tissue samples into a tissue storage box.

DATA RECORDING

Each day make sure all data on the datalogger has been transferred into the weir Access database and make sure the datalogger batteries are fully charged before leaving the office.

Weir Data Sheet Instructions

Header Information:

1. **Date:** Write the days date in the following format – **01/16/05**.
2. **Stream:** Write the main watershed name, such as Noyo for any location within the Noyo River watershed.
3. **Location:** Indicate the precise location of the weir, such as **Caspar FRBW-** for Caspar floating resistance board weir.
4. **Julian Week:** Determine from a Julian calendar what week of the calendar year it is. Basically the Julian calendar starts on the 1^{st} of January, whatever day it falls on, and changes every 8^{th} day (i.e. January 1-7 = JW 1 and January 8-14 = JW 2).
5. **Start Time:** Write the time that you arrived at the weir to check it, using the 24 hour clock. Such as **0900** for 9:00AM and **2100** for 9:00 PM.
6. **Finish Time:** Write the time that you finished checking cleaning and maintaining the weir, using the same time format as above.

7. **Air Temp:** Write the air temperature from a hand held thermometer in degrees Centigrade after it has adjusted for 3-5 minutes.
8. **Water Temp:** Write the water temperature from a hand held thermometer in degrees Centigrade after it has adjusted for 3-5 minutes.
9. **Start Stage (ft):** Read the stage gage near the weir when you first arrive and indicate the reading on it in 1/100 of a foot, such as 1.71.
10. **Final stage (ft):** Read the stage gage near the weir when you are done checking and maintaining the weir and indicate the reading on it in 1/100 of a foot, such as 1.71.
11. **Observers:** Put the initials of the data recorder.
12. **Tagger:** Write the initials of the person(s) who did the tagging of fish.
13. **Weather:** Describe the weather at the time of the servicing of the weir.

<u>Specimen Information:</u>

1. **Fish ID #:** Write the fish ID # in the following format **1210001,** which represents the number of the month, in this case December=12**,** then the day of the month, in this case the 10^{th}, followed by a three digit number for each fish captured consecutively for that day.
2. **Species:** Indicate the species of the fish using the four digit scientific name code. **Onmy** = Steelhead, **Onki** = Coho, **Onts** = Chinook, **Latr** = Lamprey.
3. **Condition:** Indicate the condition of the fresh after inspecting it using the following codes. **F** = fresh, **D** = dark, **S** = spent or spawned, and **M** = mortality.
4. **Sex:** Inspect the fish and try and determine the sex of the fish. Male steelhead tend to have longer more pointed heads and develop a hook shape to their jaw, and they are generally more colorful than female fish. Females tend to be less colorful, deeper in the body, and a more rounded blunt shape head. Use the following coding **M** = male, **F** = female. **U** = unknown.
5. **FL (mm):** Measure the fork length of the fish to the nearest millimeter and record it in this box.
6. **Fin clips:** Inspect the fish for any maxillary or fin clips and use the following coding: **Ad** = adipose fin clip, **UC** = upper caudal fin clip, **LC** lower caudal fin clip, **R Pec** – right pectoral fin , **L Pec** = left pectoral fin, **R Max** = right maxillary clip (upper bone in the lip), **L Max** = left maxillary clip.
7. **Floy Mark :** Use **T** for tagged or marked, or **R** if it is a recaptured fish, and if the fish is not marked or a recapture then put a **N** in the box to indicate no tags.
8. **Floy Number:** Indicate the numeric number of the tag.
9. **FLoy Location:** For Floy tags indicate which side of the fish the tag was applied, right or left.
10. **Floy Colors:** Indicate what the colors of the Floy tag are, starting with the primary color that indicates species. See tagging schedule!
11. **Op Punch:** Indicate if the fish was mark secondarily, for this program a operculum punch with a **T** for tagged, **R** for recapture, or **N** for no tag..

12. **OP Punch Location:** Indicate which side of the fish that it received an operculum punch, **R** for right and **L** for left and then a **U** for upper,**M** for middle, and **L** for lower portion of the operculum.
13. **OP Punch Shape:** Indicate the shape of the operculum punch, whether it was a square, circle, triangle, rectangle, tear drop, star, flower, heart, or oval shape.
14. **Scales:** Put a check mark in this box to indicate if scale samples were taken, and write the fish record number from the scale envelope in the Fish ID Number location.
15. **GT:** Put a check mark in this box to indicate if a genetic tissue sample was taken, and write the fish record number from the tissue envelope in the Fish ID Number location. **Note:** Scale and genetic tissue envelopes should have matching Fish ID Numbers for the same fish, if not change them to match!
16. **Wounds:** Describe any wounds or parasites, such as **hook** for hook scar, **predator** for seal, otter, or bird gashes, **sea lice,** or other and write what it is in the comments.
17. **Comments:** Other significant observations should be noted here and in the additional note section with footmarks.

Weir Trapping Data Form Page_____of _____

Date:	Julian Week:	Air Temp (C):	Start Stage:
Stream:	Start Time:	Water Temp (C):	End Stage:
Location:	End Time:	Final Stage (ft):	Observer:
Weather:			Tagger:

	Fish ID #	Species	Condition F/I/S/M	Sex M/F/U	FL (mm)	Fin Clips	Floy Mark T/R/N	Floy Number	Floy Location	Floy Colors	OP Punch T/R/N	OP Punch Location	OP Punch Shape	Scales √	GT √	Released U/D	Wounds HS/PD/PS	Comments
1																		
2																		
3																		
4																		
5																		
6																		
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Fish ID #	Species Codes	Condition Codes	Fin Clip Codes	Sex	Floy Mark	Floy Location	Floy Colors	OP Punch	OP Punch Location	Shape	Released	Wounds
Ex: 1210007 is the 007th fish caught on 10-Dec	Onki = coho Onmy = steelhead Onts = Chinook Latr = Lamprey	F = Fresh D = Dark S = Spent M=Mortaility	Ad = Adipose L Max = Left Maxillary R Max = Right Maxillary Rpec = right pectoral Lpec = left pectoral	m=male f=female u=unk	T=tagged R=recaptured N=no/none	R=right side L=left side	Ex: Red/Yel, Red/Red Blu/Grn	T=punched R=recaptured N=no/none u=unknown	Ex: LM=left middle RU=right upper LL= left lower RM=right middle	Circle, triangle square, oval rectangle, star heart, flower tear drop	U=upstream D=down	HS=hook scar PD= predator PR=parasite In comments describe location and type

Additional Notes:

Figure 1. Weir trapping data form.

ADDITIONAL PROCEDURES

If recovery or resighting of marked fish is planned through conducting spawning surveys of the stream, then consult the protocols for conducting spawning surveys for information on this procedure.

Tissue Samples:

1. Genetic tissues samples should be taken from a random systematic sample of coho salmon. This will be determined by the run strength ahead of time and a random number will be selected at the start of each day from a table of random numbers to use as the random start point. Such as, 7 was selected from the table of random numbers for a given day so we would process 6 fish before we take tissue samples from the seventh fish and then every tenth fish after we would take additional tissue samples. Genetic tissue and scale samples should be taken from every steelhead and Chinook salmon sampled.

2. Use either clean scissors to cut a small piece (about 2 cm square) of fin tissue from the upper caudal fin (tail) or a paper punch with a trap to punch a hole in the opercular plate. An opercular hole punch is preferred, because it is used as a secondary mark to assess tag shed rates.

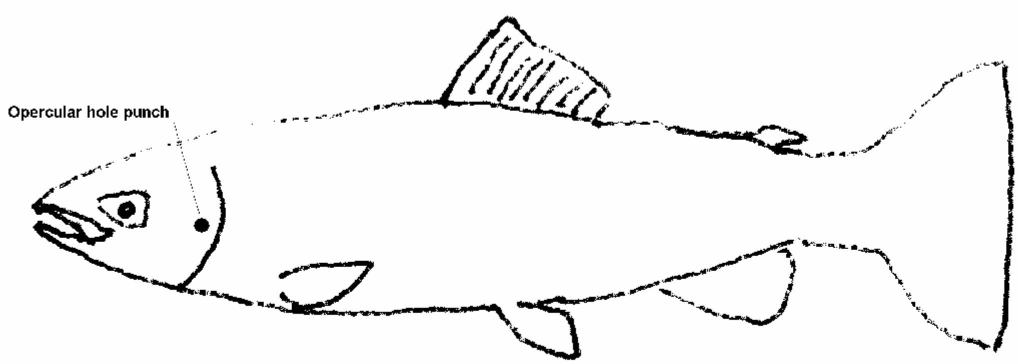
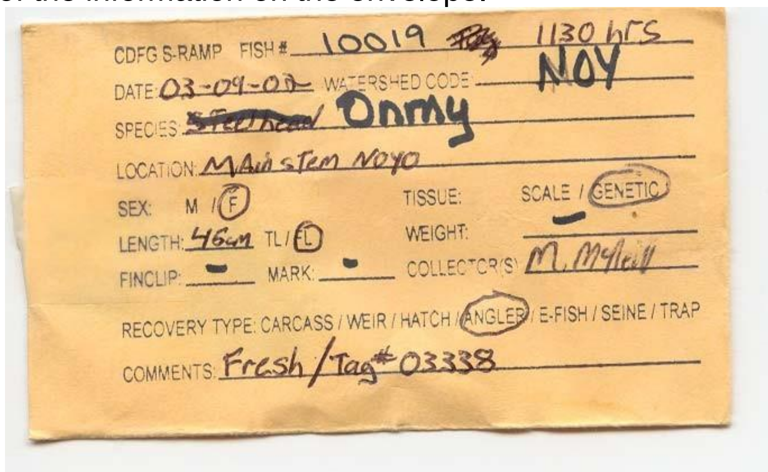


Fig. 1. Appropriate location for opercular hole punch and collection of genetic tissue sample from an adult salmonid.

3. Place the tissue sample on a piece of Rite in the Rain paper square, fold the square and place it in an envelope. Use one envelope for each tissue sample

taken, and make sure it corresponds to the correct fish number and envelope that contain the scales samples.

4. Record all of the information on the envelope.



CDFG S-RAMP FISH # 10019 1130 hrs
DATE: WATERSHED CODE NOY
SPECIES: Onmy
LOCATION: MAin sTem NOYO
SEX: M / F
TISSUE: SCALE / GENETIC
LENGTH: 46cm TL / FL
WEIGHT:
FINCLIP: —
MARK: —
COLLECTOR(S):
RECOVERY TYPE: CARCASS / WEIR / HATCH / ANGLER / E-FISH / SEINE / TRAP
COMMENTS: Fresh / Tag# 03338

Fig. 2. Picture of correctly filled out genetic tissue envelope.

Note: Samples must be dried as soon as possible. Air-drying in the sun is the quickest (never more than 8 hours in the sun). Air-drying tissue samples inside a facility usually takes about 24 hours. Air-drying with a food dehydrator can shorten this to about 4-6 hours, especially when samples are collected during the wet winter months. When tissue is dry to the touch, seal the envelope.

5) Scale Tissue Sample: Use either a small pocketknife blade to scrape off scales, or tweezers to individually remove, 6 to 18 scales from the area between the posterior part of the dorsal fin and the lateral line on one side of the fish (Figure 6). Clean knife and/or tweezers between samples to prevent contamination.

Fig. 3. Scrape and/or remove 6-18 scales from this area of the fish.

6) Wipe the scales onto a parchment paper square, fold the square in half and place into an envelope. Clean the knife or tweezers between samples to prevent contamination. **Use one envelope per fish, and make sure it has the same fish number as the genetic tissue envelope!!!**

7) Otolith Sampling: Please take from **any adult steelhead carcass** found in good shape a genetic tissue sample, scale sample, and the fish head. Place the fish head in a zip-lock bag with the corresponding tissue number and tissue data on a piece of Rite-in-the-Rain paper, and transport back to the office/lab and place in a freezer till the head and tissue samples can be transported to an AFRAMP field office.

8) Record all of the information requested on the envelopes (Figure 7). **Note:** Record numbers on the envelopes are to be written or stamped on the envelope ahead of field sampling. We are currently using a five digit numbering system. The first number on the far left indicates office location (ex. 10199 indicates it came from Fort Bragg). 10000 = Fort Bragg, 20000 = Arcata, 30000 = Weaverville, 40000 = Yreka. In addition, duplicate envelopes should be taped together to ensure that genetic tissue and scale samples are collected from each fish with the corresponding record number on it.

Date: Date when the sample was taken (ex. **Mm/dd/yyyy** – 01/16/2002).
Watershed Code: Watershed from which the sample was taken (Table 1) (ex. **Noy** = Noyo River).
Species: Species code for species sampled (ex. **Onts** = Chinook, **Onmy** = steelhead, **Onki** = Coho, **Oncl** = coastal cutthroat trout).
Location: Specific location within watershed where sample was taken (ex. **Northspur**).
Sex: Circle male or female if known or leave blank if unknown.
Tissue: Circle **Genetic** for genetic tissue or **Scale** for scale sample.
Length: Write the length in millimeters, and circle **FL** for fork length or **TL** for total length, (ex. **95 cm FL**).
Weight: Weight in grams (ex. **Leave blank for adults**).
Finclip: Indicate any finclips (ex. Adipose clip – AD, upper caudal – UC).
Mark: Indicate type of mark or tag.
Collectors: Write the collectors' first initial and entire last name.
Recovery Type: Circle appropriate means of capturing specimen.
Comments: Indicate any marks or injuries in this location**. And for geographic areas where both trout (coastal cutthroat and steelhead) species exist,** indicate the presence or absence of the two distinguishing characteristics for coastal cutthroat trout, the slash and the length of the maxillary in relation to the eye orbit.

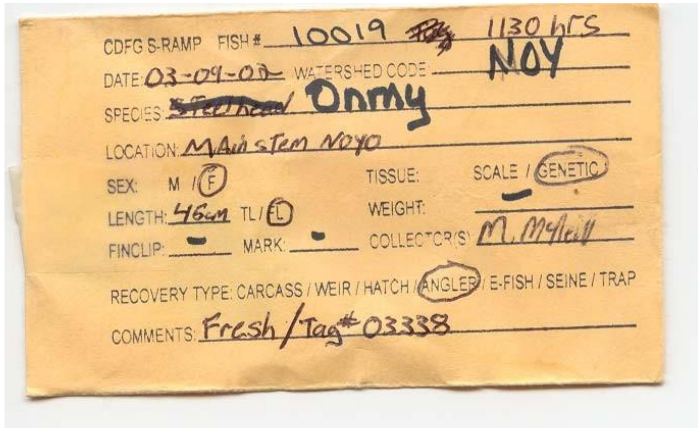


Fig. 4. Picture of correctly filled out scale sample envelope.

HATCHERY MARKS

Examine all adult salmonids captured for signs of hatchery marks. The vast majority of hatchery salmonids will have an adipose fin clip, indicating that the fish has a coded wire tag. A few hatcheries will use other batch marks such as right or left pectoral fin clips or right or left maxillary clips to indicate that the fish was of hatchery origin. An even smaller amount of fish may not have any fin clips but may show signs of being raised in a hatchery environment by erosion of the dorsal, pectoral, and pelvic fins. Be sure to identify these fish and record the precise mark in the appropriate column of the data record sheets.

SAMPLING EFFICIENCY

The sampling efficiency of the weir will be determined later by the ratio of the number of tagged to untagged fish subsequently recovered or resighted in the spawning surveys. No additional procedures are necessary for this method to determine the sampling efficiency.

AUXILLARY HABITAT DATA

Auxiliary habitat data that will be collected for this monitoring aspect of the program will include: Air temperature, stream temperature, stream flow or stage height, and turbidity or visibility of the stream.

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Table 1. List of equipment needed for operation and monitoring of all weirs.

At least two crew people
Waders and wading shoes
Warm clothes and rain gear
PFD's or float coats during high flows
Data boxes or dataloggers with armored boxes w/pencils and extra stylus
Dip nets
Floy tags, tagging guns, extra needles, sharpener and Operculum Punches
Pocket knife for scale samples
Rite-in-the-rain Tissue Sample Envelopes
Satellite Phone in dry bag
First Aid Kit
Tagging Schedule
Weir Journal
Phone # list to supervisors, office and crew members
Phone # list to wardens
Gaffs for LWD and SWD removal
Tagging Cradle
Gate keys or combinations
Flashlights
Extra Sand bags and shovel
Tool Box for repairs
Machete for clearing brush