CODED WIRE TAG LAB GUIDE

Before processing fish, read this manual to learn about safety precautions to prevent injury. Keep this manual in an accessible location for future reference.

Suggested Citation:

Pacific States Marine Fisheries Commission (PSMFC). 2024. Coded Wire Tag Lab Guide. 47 pages.

Acknowledgements

This collaborative document was made possible by the Pacific States Marine Fisheries Commission (PSMFC) Regional Mark Processing Center's Regional Committee on Marking and Tagging and funds from the Pacific Salmon Commission's Mark Selective Fishery Fund (Grant Agreement MSF-23-06). PSMFC staff involved in this work included Monica Diaz, Dan Webb, Jim Longwill, Lara Erikson, Nancy Leonard, and Stan Allan. The PSMFC greatly appreciates the assistance provided by the following individuals and their agencies during the drafting of this document:

Lynn Anderson, WDFW
Catrina Bean, Quinault Tribe
Kyle Beard, USFWS
Phillip Bizzel, NOAA
Forrest Bohlen, IDFG
Mike Brown, CDFW
Trevor Clark, ODFW
Carrie Cook-Tabor, USFWS
Yvonne Dettlaff, USFWS
Brian Dietz, Colville Tribes
Corey Dondero, IDFG
Cassandra Donovan, NOAA
David Drescher, Muckleshoot Tribe
Erin Ferguson, CDFW
Larry Funston, ODFW
Angie Garelick, CDFW
Gabriel Garza, ODFW
Todd Gilmore, USFWS
Sean Hildebrandt, Muckleshoot Tribe
Eric Keller, ADFG
Lea Koerber, CDFW
Gilbert Lensegrav, WDFW
Chester Lindley, CDFW
Marianne McClure, CRITFC
Jeannine Memoly, NOAA
Brian Missildine, WDFW
Kandice Morgenstern, CDFW
Andrea Pearl, Colville Tribes
Ian Pritchard, CDFW
Heather Schultz, Suquamish Tribe
Ash Shaffer, NWIFC
Jacob Shapley, WDFW
Laura Swaim, Muckleshoot Tribe
Vanessa Tuttle, NOAA
Mark Waite, CDFW
Sarah White, CDFW

Table of Contents

List of Acronyms

ADFG	Alaska Department of Fish and Game
CDFW	California Department of Fish and Wildlife
CRITFC	Columbia River Inter-Tribal Fish Commission
CWT	Coded Wire Tag
IDFG	Idaho Department of Fish and Game
NOAA	National Oceanic and Atmospheric Administration
NWIFC	Northwest Indian Fisheries Commission
ODFW	Oregon Department of Fish and Wildlife
RMIS	Regional Mark Information System
USFWS	United States Fish and Wildlife Service
WDFW	Washington Department of Fish and Wildlife

List of Figures

SAFETY AND WARNINGS

The extraction of CWTs involves the use of repetitive motion, sharp instruments and powerful coring machinery. If used incorrectly, the equipment can cause injuries to hands and/or digits. Subsequently, caution and attentiveness are required when using the equipment. Personnel should limit walking around the laboratory with knives in hand. If the instruments must be moved, they should be carried point down.

When in the laboratory, protective gloves, aprons, and eyewear should be worn and proper laboratory etiquette should be followed including no food or drinks in the dissection areas.

While processing samples, protective gloves should be worn. Heads/snouts can cause cuts or punctures of the hands and/or digits due to sharp bones, and teeth. Such injuries can lead to infections due to the presence of bacteria on the fish.

During dissection, the head should be placed on a stable surface and not held in one’s hand. Also, the processor should cut away from their body. While coring, make sure your hands are away from the corer while actively coring a head.

If a laboratory’s floor is not dry, accidents may occur. Precautions must be taken to ensure the floor is free of water spills, cardboard, or other slip-causing materials. Slip hazards from fish products (e.g., tissue, blood, mucous) must be prevented. To help minimize the risk of slipping, slip-resistant footwear should be worn and non-slip mats should be placed at cutting stations.

When the electromagnet is in use, personnel must be aware that it is a potential fire hazard and gets very hot if left on continuously for more than a few minutes. As a result, the unit should be unplugged when not in use.

Clean laboratory surfaces are essential and should be sanitized daily with a household cleaner. Measures must be taken to ensure bleach and ammonia-based products are NOT mixed.

1. INTRODUCTION

Coded wire tags (CWT) are small pieces of wire that are etched with a code and injected into the snouts of juvenile salmon and steelhead (Figure 1) where they usually remain with each fish throughout their life. The code on each CWT is unique to a group of fish (e.g., hatchery releases, stream population) as defined by the agency or organization releasing the fish. Many hatchery-reared fish are tagged with CWTs, as well as some wild populations.

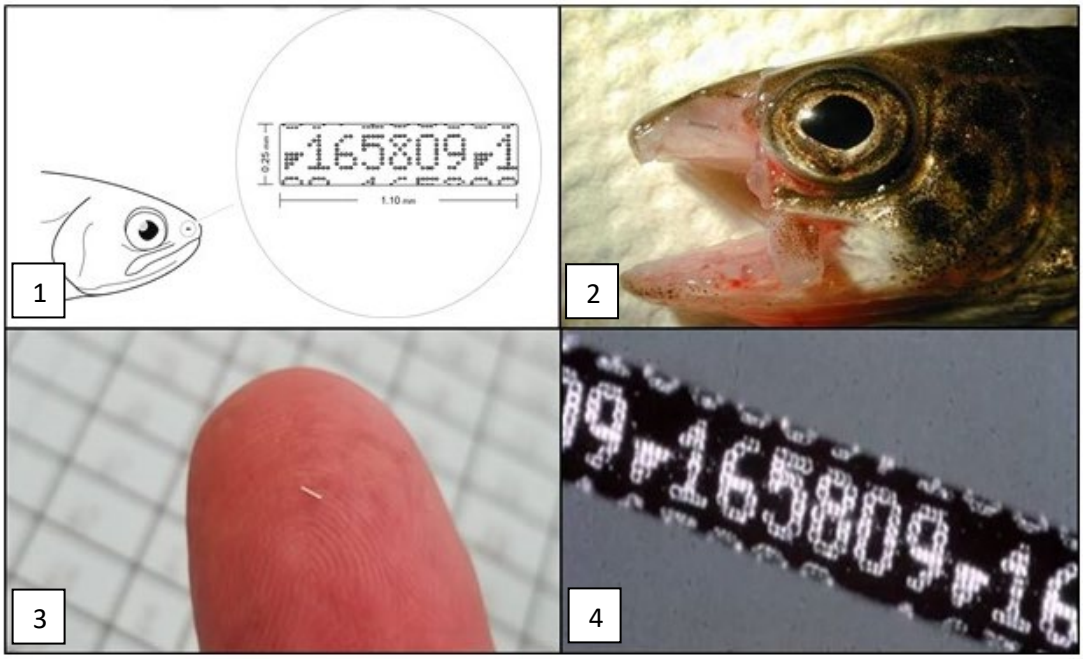


Figure 1. Locations where a CWT is injected into the snout of a juvenile salmonid (1 and 2), example of the relative size of a CWT (3), and an enlarged view of a CWT with the code 165809 (4). (Illustration: ADFW (1), Photos: ODFW (2), WDFW (3), and NMT (4))

Extracting and reading CWTs from fish allows fishery managers to identify the origin of tagged fish for management decisions. The purpose of this guide is to provide general background information for extracting and reading CWTs.

2. PREPARATION OF HEAD RECOVERY BAGS

2.1 Head Recovery Bag Identification

Due to logistics, the packaging of heads for transport to laboratories may involve different approaches depending on a facility's capacity. For some laboratories, heads are individually bagged and labeled, whereas other facilities place a pre-determined number of heads into a single bag for transport. If the field location for the initial collection of samples is at a CWT extraction facility, the bagging process does not occur. Prior to packaging and transporting heads, assess whether your entity has an established protocol.

Coded wire tag laboratories supply the external recovery label and the internal head recovery card, each with a unique ID and space for the required data to be captured at each stage. For the external recovery label, this might be a label with space to fill in required information or a barcode that is linked to an internal database. The redundancy of external label and internal card information ensures data is not lost as the samples are transported to the laboratory.

2.1.1 External Label or Large Bag Label

Large bags that contain multiple head recoveries, that are either bagged individually or not, should include a pre-printed label or barcode affixed to the bag's exterior (Figure 2). Use wire or zip-ties when affixing the label to the bag's exterior as string may break. Typically, individual head recovery bags are prepared for each head/snout. Alternatively, if heads are not placed in individual sample bags, attach an individual head recovery card or barcode directly to the head or snout before placing it in the large bag.

When selecting material for the barcodes, a high-density polyethylene film is preferred because it can withstand moisture and salmon mucus.

Information that should be included on the large bag label or incorporated into the barcode (Regional Mark Information System (RMIS)): Recovery Table) includes:

- Recovery Date (RMIS)
- Recovery Location (RMIS)
- Recovery Type
- Species (RMIS)
- Run Year (RMIS)
- Sex (male, female, jacks)
- Recorded Mark (RMIS)
- Sample Number
- Tag Status (RMIS)
- Sample Type (RMIS)
- Fishery (RMIS)

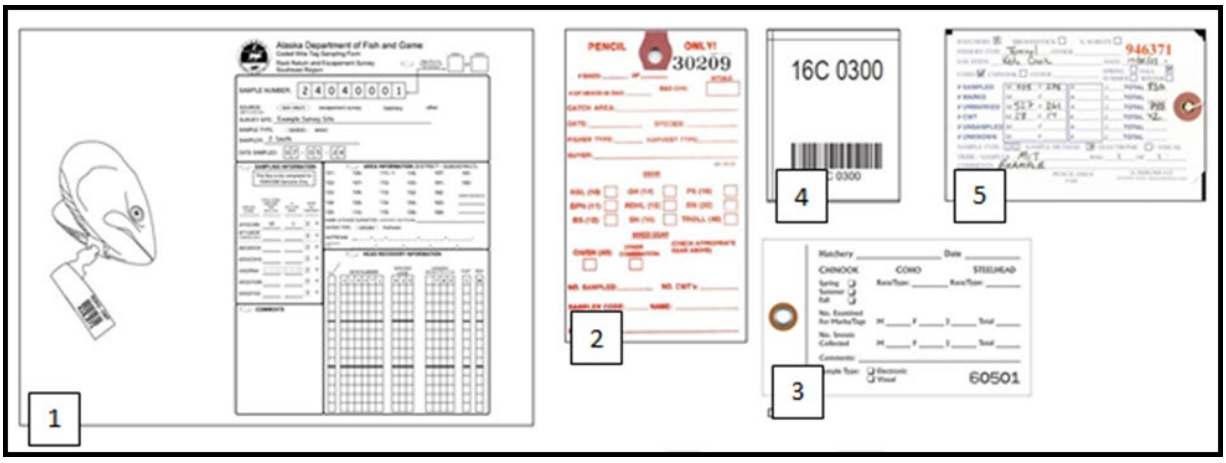


Figure 2. Head with barcode tag and linked datasheet (1), external bag labels (2), WDFW commercial tag (3), WDFW barcode (4), and tribal labels for hatchery and stream collections (5). See Appendix C for enlarged version of labels.

2.1.2 Internal Head Recovery Card

Individual head recovery bags (if using) and cards/barcodes (Figure 3) should be prepared for each head that will be submitted for CWT extraction.

For each bag, a single waterproof recovery card or barcode (Appendix C) should be sealed in the bag or properly attached to the head/snout. Information that must be included on the card or integrated into the barcode (RMIS: Recovery Table) includes:

- Recovery Date (RMIS)
- Recovery Location (RMIS)
- Recovery Type
- Species (RMIS)
- Run Year (RMIS)
- Description of the Use (e.g., CWT extraction)
- Sex (male, female, jacks)
- Recorded Mark (RMIS)
- Sample Number
- Tag Status (RMIS)
- Sample Type (RMIS)
- Fishery (RMIS)

2.2 Sampling Supplies and Distribution

Before gathering heads, ensure there are enough big bags and smaller bags for individual heads, as well as external bag labels/barcodes and internal head recovery cards/barcodes. Ensure the bag inventory remains sufficient throughout the year. Contact your CWT laboratory staff to reorder supplies.

Ensure the external bag label/barcode and the individual recovery head card/barcodes include all the required information.

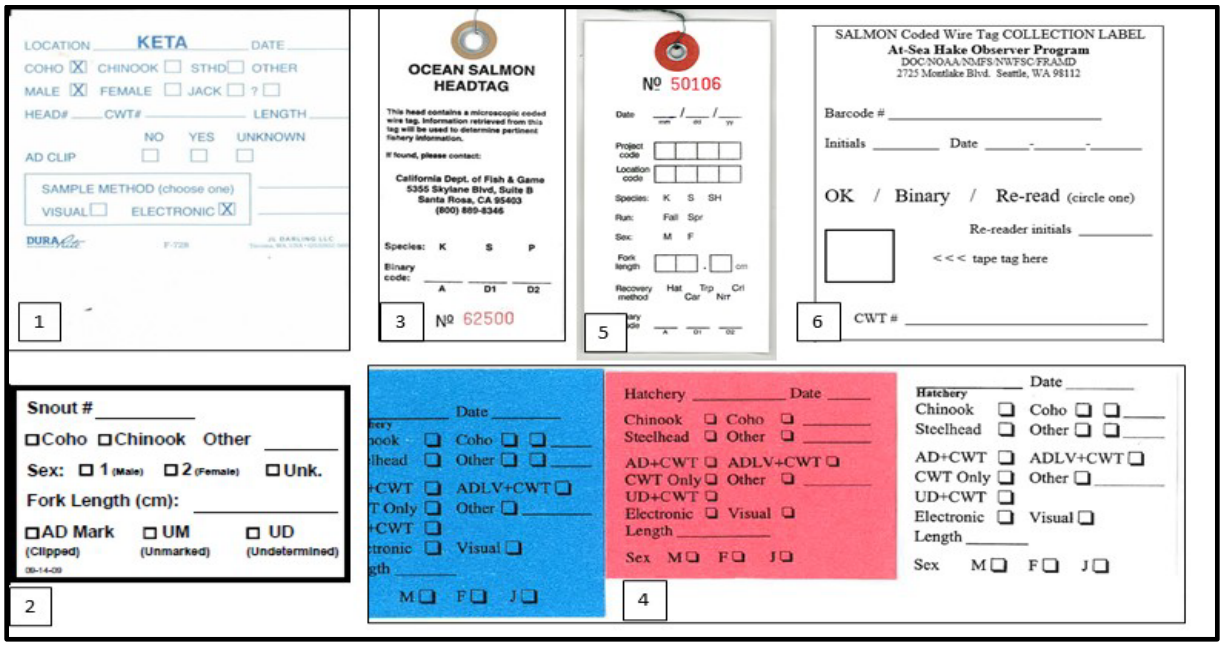


Figure 3. Examples of individual CWT head/snout recovery cards: Muckleshoot Tribe (1), WDFW (2), CDFW (3 and 5), WDFW hatchery (4), and NOAA (6).

When attaching individual head recovery cards to the heads, you should follow your entity's procedures. Record information on the card using an appropriate writing instrument that ensures the text does not become illegible. Avoid getting mucus on the cards since it can cause ink to become illegible. If attaching a barcode, avoid creasing the product by attaching the card or barcode to the snout following your laboratory protocols (e.g., knotting the bag around the snout, then inserting the card and knotting the bag again (Figures 4 and 5). Ensure there is only one card/barcode per sample.

Figure 4. Examples of how to, and not to, attach recovery cards and barcodes to individual heads. (Photos: WDFW)

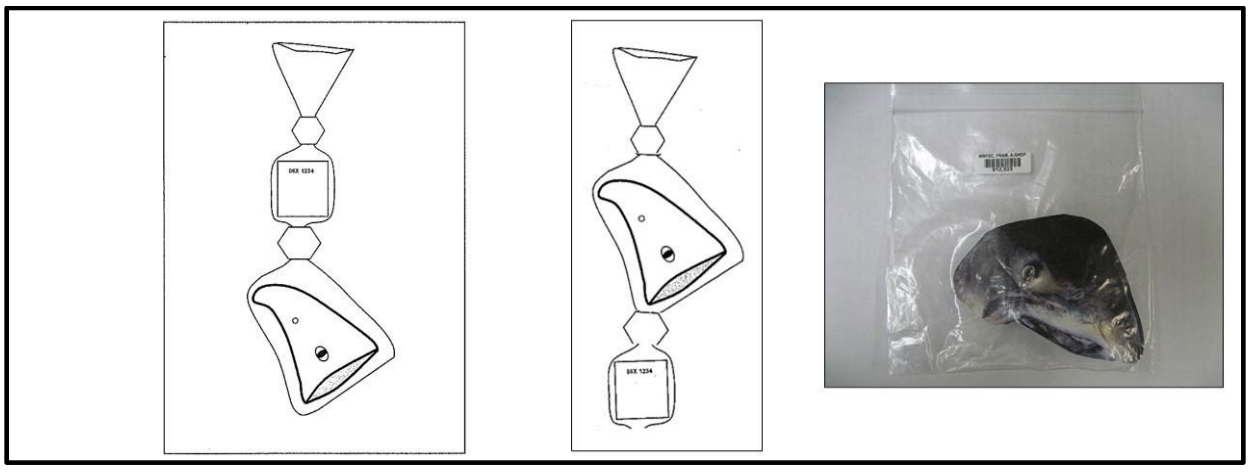


Figure 5. Examples of how to properly bag and knot individual head/snout bags. (Illustrations: ODFW, Photo: NOAA)

Heads may be transported via vehicles or airmail. Coordinate transportation between the CWT laboratory staff and recovery staff. If shipping heads, provide tracking information to the CWT laboratory staff to ensure that the staff can track the arrival of the frozen heads.

2.3 Head Recovery Bag Data Spreadsheet

A head recovery bag data spreadsheet should be created and maintained to document the year, quantity, date mailed, and person receiving the samples. This spreadsheet should also note the dates that samples are returned to the CWT laboratory. During the shipping and receiving of bags, spreadsheet updates are the responsibility of the CWT laboratory staff. Data from this spreadsheet is also used to estimate the number of bags that should be prepared for creel, rack, and spawning ground recoveries.

3. REMOVING HEADS/SNOUTS FROM FISH

When removing heads/snouts, please use caution and follow your agency's safety protocols. Because sharp instruments are used during processing, use caution to avoid accidental cuts. Salmon and steelhead heads/snouts should be handled with care since the teeth are sharp and carry bacteria that can cause an infection.

Depending on your laboratory, either the head or the snout will be collected, labeled, and scanned for a CWT. All head/snout samples should be frozen as soon as possible or, at the least, placed in a cooler with ice.

When sampling heads/snouts that contain a CWT, it is important to follow the guidelines, provided below, to ensure proper head/snout removal from the body. This will allow for the safe, accurate, and timely processing of the CWTs.

1. Cut the snout straight down, not angled, about one inch behind the eye (See Figure 6 for likely locations of CWT's). Use the rear portion of the blade, close to the handle, to cut vertically down from the top of the snout to the maxilla bone. In some cases, a clever and rubber mallet are used to complete the cut since this approach allows for the hands to be away from the blade.
2. Ensure the eyes are taken with the snout.
3. Do not take the gill plates or lower jaw
4. Separate the lower jaw from the snout if it is still connected to the snout

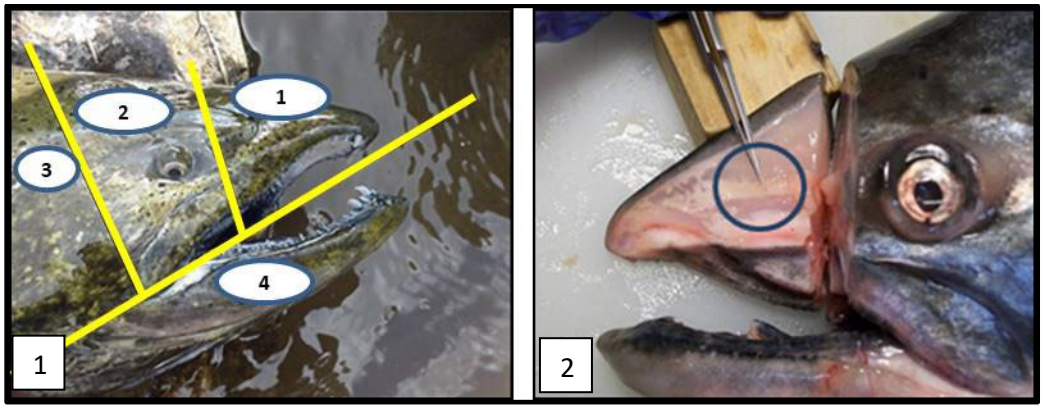


Figure 6. Areas where CWTs may be located (Photo 1). Most CWTs are typically found in area 1, occasionally in areas 2 and 3, and rarely in area 4. Location of CWT (in blue circle) found in a sample (Photo2). (Photos: CDFW)

Once the head/snout has been detached, ensure it is properly labeled with the recovery card or barcode and if using individual recovery bags ensure it is properly bagged (see Section 2.2).

Note: Although the process for removing the head/snout is typically performed as described above, some laboratories receive a wedge-cut head/snout sample obtained following the process described in Section 9.

4. TRANSFER OF HEADS/SNOUTS TO CWT LABORATORY

4.1 Storage and Transportation of Heads/Snouts

Prior to transferring the heads/snouts to the CWT laboratory, either individually bag the sample with the recovery card/barcode or securely attach the recovery card/barcode directly to the head/snout (depends on a laboratory's prescribed process). After the heads/snouts are labeled and bagged, place them in the big bags or containers. Do not overfill the bags since doing so may lead to an inability to properly store them in the freezer. Also, the excess weight may cause the bag to tear. (For additional information, see Section 2: Preparation of Head Recovery Bags)

Once the heads/snouts are labeled and/or bagged, they must be stored properly. Depending on how they are transported, a cooler may be sufficient if transport time is a short duration; however, logistics may require that they be frozen and packaged accordingly to keep them from thawing prior to transport to the CWT laboratory. Since some laboratories use air cargo or commercial services for transport, review your laboratory protocols to ensure the samples remain frozen during transport.

Ideally, the CWT laboratory staff picking up the samples from the hatchery/field office should obtain a list of the sample numbers that will be received upon arrival at the facility. At a minimum, the staff collecting the samples should have a list of locations and field staff from which samples will be acquired.

4.1.1 Contact Hatchery/Field Office Personnel

The CWT laboratory staff is responsible for contacting personnel at the hatchery/field office to arrange a date/time to pick-up or drop-off the samples. The CWT laboratory staff responsible for the pickup must ensure that they have a list of samples to be picked up upon arrival at the hatchery/field office.

4.1.2 Arrival at the Facility

Upon arriving at the hatchery/field office, request the staff to show you where the samples are located. Using the sample list, check off the label numbers as the collection is reviewed. If a sample cannot be accounted for, work with the staff to determine if the head recovery bag was inadvertently not included with the collection. Note on the sheet the status of the bag(s). When samples are received, they should be accompanied by a copy of the raw data (preferably an electronic copy) that was collected by the recovery personnel. The raw data should be saved by species and the location where the heads were collected.

4.2 Delivery to CWT Laboratory

4.2.1 Sample Placement in Freezers and Related Record Keeping

Heads that are received for CWT extraction are typically stored in a facility's walk-in freezer. Since samples from multiple facilities may be in the freezer at the same time, bags or bins from the various facilities should be staged in designated areas of the freezer or properly labeled. Ensure all groups are kept together with their head recovery bag labels facing up for easy visibility. If necessary, record the location of the sample placement on an inventory whiteboard located outside the walk-in freezer.

4.2.2 Sample Management

Routinely check the organization of the samples ensuring that the groupings have been maintained and that the head recovery bags are arranged in an order that ensures the samples with the oldest dates are positioned to be processed first (i.e., the samples should be arranged in order of oldest to newest arrival with the most recent arrival being the last sample that would be selected).

5. CWT BAG LABEL PREPARATION AND STORAGE

Upon extraction, CWTs should be stored according to your laboratory's protocols. The CWTs can be taped, with removable tape or correction tape, onto individual card stock or the recovery head card. Optionally, place each sheet or card in an individual plastic bag* and then label if necessary. For CWTs taped to individual sheets or a recovery head card, the CWT should be marked to facilitate locating the sheet/card (Figure 7). If the laboratory is not using the recovery head card to track the CWT, a CWT bag label needs to be printed with the following information (at a minimum):

- Year
- Sample number
- Species
- Collection date

For quality control, there should be a record of labels printed and confirmation that no duplicates were produced.

** Bag thickness matters since CWTs can puncture the plastic if it is too thin. Subsequently, 1" x 2" industrial poly bags with a thickness of 2mm (item # S-15165) should be used. (Source: www.uline.com)*

Bundles of read CWT bags should be stored in boxes/bins labeled with the following information (at a minimum):

- Year
- Run (if applicable)
- Number range
- Number of tags in the bundle

Figure 7. Examples of how to store read CWTs: (1) Attachment of CWTs to cards with correction tape, (2) identified tag placement using a reusable post-it and (3) CWT taped to the back of a barcode.

The bundles should consist of no more than 50 bags bound with rubber bands. No more than 1,000 bags should be stored in each storage box. Consider organizing the bags in an order according to the head label number, year, CWT code, barcode, species, date, or other category or combination of label information.

6. HEAD PREPARATION PRIOR TO DISSECTION

6.1 Protective Equipment and Laboratory Etiquette

When working in the CWT laboratory, wear the following protective gear:

- Gloves
- Aprons
- Eye protection

No food or drinks should be allowed in the set-up and dissection areas of the laboratory.

6.2 Preparation of Heads

Head cutting

If your laboratory protocol includes the use of a pneumatic core machine, do not thaw the heads and proceed to section 7.2.5

6.2.1 Thawing Heads/Snouts

Thawing-time for the heads/snouts will vary based on the temperature of the freezer in which the heads/snouts are stored. Depending on the start time for removal of the CWT, the samples can be thawed the day before, or earlier in the day prior to processing. Heads/snouts can be thawed in the sink using warm or room-temperature water (just enough to cover the bags at least halfway) before they can be processed (Figure 8). If the heads/snouts are in individual recovery bags, keep them in the bags during thawing so the recovery card stays with the head/snout.

Figure 8. Heads thawing in a laboratory sink prior to the dissection process. (Photo: CDFW)

Note: Hot water is not recommended because it causes the fish's skin to excrete additional mucus and changes the consistency of the tissue within the snout. As heads thaw, they can become messy and malodorous. The extraction method that is used (i.e., cutting or coring) will determine whether, and for how long, the heads should be thawed.

6.2.2 Removal from Head Recovery Bags

The following process is intended for heads/snouts for which head cards are not directly attached.

Once adequately thawed, remove samples from the head recovery bags and place on a tray in a grid pattern with their head recovery card. It is imperative to keep head recovery cards/barcodes with their respective head.

6.2.3 Heads/Snouts without Recovery Bags

If the heads/snouts are not individually bagged, they still need to be thawed before extracting the CWT. During the thawing process, it is imperative the barcode or head recovery card remains attached to the head/snout.

7. SETTING UP THE DISSECTION WORKSTATION

7.1 Supplies

Each dissection workstation should have the following supplies:

- V-detector
- Cutting board (should have limited damage to prevent CWTs from becoming trapped or lost)
- Hand corer
- Glass or acrylic square
- Scissors
- Plastic cup (ensure cup does not have a pour spout since it will cause a false positive for a CWT in the detector)
- Serrated knife
- Butchers knife
- Knife sharpener (sharpen blades throughout the day)
- Scalpel and extra blades
- Tag bin
- Tag bags (if using)
- Card stock sheets (if using)
- Magnetic pencil/dissecting tools
- Black grease pencil
- Watch glass
- 4B lead pencil
- Stapler
- Cloth wipes (Sontara or similar)
- Probe
- Horseshoe magnet
- Ring magnet
- Extra batteries
- Removable tape
- Paper weight
- 5-gallon buckets (2) (One of the buckets should have a handle since this will be the bucket used to store salmon head pieces after processing)
- Paper towels
- Cut resistant gloves
- Squeegee
- Vinyl/latex gloves
- Cleaning supplies
- Trash can
- Trash bags
- Air compressor (coring technique)
- Pneumatic press (coring technique)
- Coring cylinder (coring technique)

7.2 Dissection Workstation

Following the acquisition of supplies, the dissection workstation can be set up (Figure 9). Prior to setting up the workstation, all surfaces in the work area should be swept with a magnet to ensure no CWTs are present (remove and discard any tags found on the magnet). Efforts must be taken to ensure the magnets do not come into contact with the V-detector during all phases of dissecting. After sweeping the area with a magnet, sanitize the workstation surfaces before you begin cutting.

Although there is no universal approach for designing and organizing the dissection workstation, the following actions represent a hybrid of the processes used by existing CWT laboratories. Also, while you consider your setup, note that you will be using repeated motions and may be hunched over your cutting area. Take the proper steps to set your station up to be the most comfortable for your height (Section 7.2.3)

For more information on the V-detector, visit the Northwest Marine Technology website at https://www.rmpc.org/v-detector-manual-2022/

Figure 9. V-detector and workstation arrangements. (Photos: NMT (1), ODFW (2), and CDFW (3))

7.2.1 V-Detector Testing and Placement

Battery Testing

Using a head/snout with a known CWT, the V-detector's battery should be checked before each processing session as well as throughout the processing of the CWTs. If the detector does not beep, the battery needs to be checked or replaced. Alternatively, the battery can be evaluated by turning the mode selector knob to the last position on the dial with the volume gain knob set at maximum volume. If the buzzer does not sound, or the signal is weak, replace the 9-volt battery. If the battery is good, move the mode selector knob to the second position and the light should display when metal is passed in front, but there will be no sound.

Placement

With the back of the V-detector against a wall, align the processor with your non-dominant hand at a distance of ¾ arm length. This arrangement allows the processor to use their non-dominant hand to manipulate fish heads and pieces of tissue while keeping their dominant hand clean to use the tools. To avoid getting water in the V-detector, turn it over with the control end down on the surface after it has been turned on (Note: This will prohibit you from seeing the indicator light to detect if there is a signal). Newer V-detectors are equipped with a control knob cover to prevent water damage.

Signal Testing and Prevention of False Positives

To ensure the V-detector provides a signal when a metal object is passed through the machine, an item containing iron (e.g., knife, probe, or scissors) should be moved up and down within the "V" on the front side of the detector. To prevent false positive readings during processing, the processor should remove all jewelry, watches, etc. that contain iron. If unsure whether an item contains iron, the processor should check their hands and arms on the V-detector (Note: Material under fingernails may contain iron particles as well as some nail polish). It is imperative that the processor's hands do not register a positive signal prior to dissecting snouts.

7.2.2 Magnet Placement and Use

The horseshoe magnet, which is used to look for lost tags, should be within reach of the dissection station but well secured. Place a ring magnet in each sink drain to prevent misplaced tags from being washed

down a drain. It is a good practice to remove the magnet and inspect it for tags and re-install it in the drain prior to processing. If there is no pre-existing magnet in the sink, one should be sourced before processing begins. (Note: Even small movements of a strong magnet near the V-detector can produce "false" tag detection signals. Do not attach any magnets to the V-detector.)

7.2.3 Cutting Board Placement and Maintenance

Place the cutting board close to the sink containing the snouts, while centered in front of the processor. Place one or two unfolded paper towels or butcher block paper on the cutting board to help absorb mucus and to catch tags that are dropped. To decrease hunching while processing the snout, place the cutting board on supports to elevate the board with a rag placed under the board to reduce the potential for the board to slide during processing. Clean the cutting board following the dissection of each sample and check for missing CWTs. Cutting boards should be replaced if damaged with cuts and crevices.

7.2.4 Placement of Additional Equipment

Place the knives, scalpels, probe, magnetic pen, scissors, watch glass, and cup for the V-detector on a horizontal surface at a distance of at least 12 inches from the cutting board. On a table behind the processing station, place the tape, pencils, stapler, paper towels, knife sharpener, weight, gloves, and cleaning supplies. The snouts will also be staged on this table during processing. (Note: Keep knives and scalpels away from the V-detector when scanning.)

The processing of the heads/snouts will create significant waste (e.g., snout pieces, paper towels, gloves, etc.). Maintaining a clean processing station is essential to ensure misplaced CWTs can be located. The processing station should include two 5-gallon buckets, with one bucket that includes a handle and two trash bags for fish waste while the other bucket is for all other trash.

7.2.5 Coring – Preparing the Coring Station and Press

Use caution while operating a pneumatic coring press (Figure 10) and follow all laboratory safety procedures. Consider using tools that prevent heads from shifting during coring, while also placing both two hands on the coring switch to ensure they are not near the coring mechanism.

When using a coring machine, follow these steps in addition to those previously described:

- Place the coring machine on a large cutting board located on a counter.
- Assemble and install the coring head cylinder into the coring press.
- Plug the air hose into the coring press and turn on the compressor. With the compressor on, the press cylinder should fill and the coring head should rise into position.
- Engage the coring head and test the drop-down distance to ensure it makes contact with the cutting board without cutting into the board.

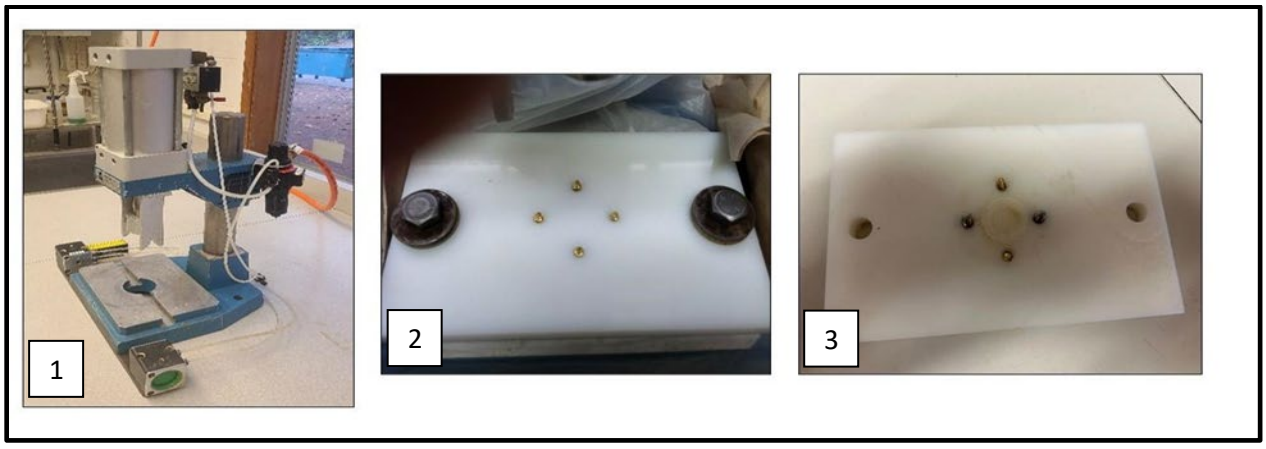


Figure 10. Pneumatic coring press (1) with attached coring cylinder and safety plates (2 and 3). (Photos: USFWS (1) and WDFW (2 and 3))

8. PREPARING HEADS/SNOUTS FOR DISSECTION

Prior to dissecting, check the heads/snouts for the presence of a CWT. The following represents a general process to verify the presence or absence of a CWT in the sample:

- Remove the head/snout and the head recovery card from the recovery bag and confirm that the sample numbers on the bag and card match. If the numbers do not match, use the raw recovery data from the recovery personnel to decipher the sample identity.
- If there is a match, place the sample and its label on a clean tray.
- Check each head/snout with a V-detector before cutting to confirm the sample has a CWT. Rapidly move the head in a vertical motion between the two panels of the V-detector (tip of the fish's mouth should point towards the detector) (Figure 11). If a signal does not occur immediately, repeat the action while varying the orientation of the sample. Take care to ensure there is no contact with the V-detector, counter, or any of the metal equipment since these actions can produce vibrations that may cause a false signal. If contact with the V-detector occurs, rescan the sample to confirm the presence or absence of a CWT.
- If a sound is not produced when the head is scanned nor does the V-detectors indicator light blink, attempt to re-magnetize the head and then recheck it in the V-detector. If a sound is still not produced, determine if the head/snout has been cut short. Depending on the observation, write NO CWT or CS (cut short) on the head card.
- Once all of the samples on a tray have been scanned for the presence of a CWT, return the tray to the freezer.
- For heads/snouts with no CWT detected, find its Recovery ID (from the paper slip) on the Dissection Data Sheet, and write NO CWT in the space for Code (*see Section 10.1 for additional information*).

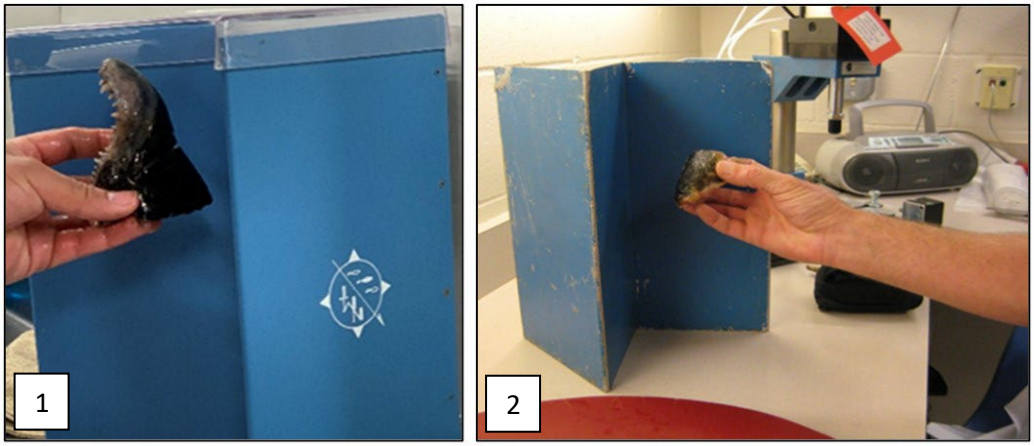


Figure 11. Demonstration of the proper use of the V-detector to check for the presence of a CWT. (Photos: CDFW (1) and USFWS (2)).

9. HEAD/SNOUT DISSECTION – TAGGED HEADS

This section focuses on how to isolate, from the head/snout sample, the section of tissue that contains the CWT. *The process for removing the head/snout from the fish's body is described in Section 3.*

9.1 Safety

Since the extraction of CWTs involves the use of sharp tools, personnel should avoid walking around the laboratory with these tools in hand. If the tools must be moved, they should always be carried point down.

To help minimize the risk of slipping, ensure the floor is free of water spills, cardboard, or other materials and place non-slip mats at the cutting stations.

To improve the ability to make precise and controlled cuts, keep the cutting tools sharp. Also, position the sample so that the largest and flattest section of the sample is in direct contact with the cutting board. Make cuts away from your body and, if coring the sample, hands should be kept away from the coring mechanism.

9.2 Dissection

An understanding of salmonid head anatomy and the typical locations where CWTs are found makes the extraction process more efficient. Tags are most often found in the nasal cartilage or the surrounding hyaline-type nasal cartilage of the snout (Figure 12). Targeting this area of the head facilitates the isolation of tissue that should contain the CWT. Tags not found in the nasal cartilage are typically found in the skin near the nares, in the connective tissue behind the eyes, or in some cases in the upper or lower jaws.

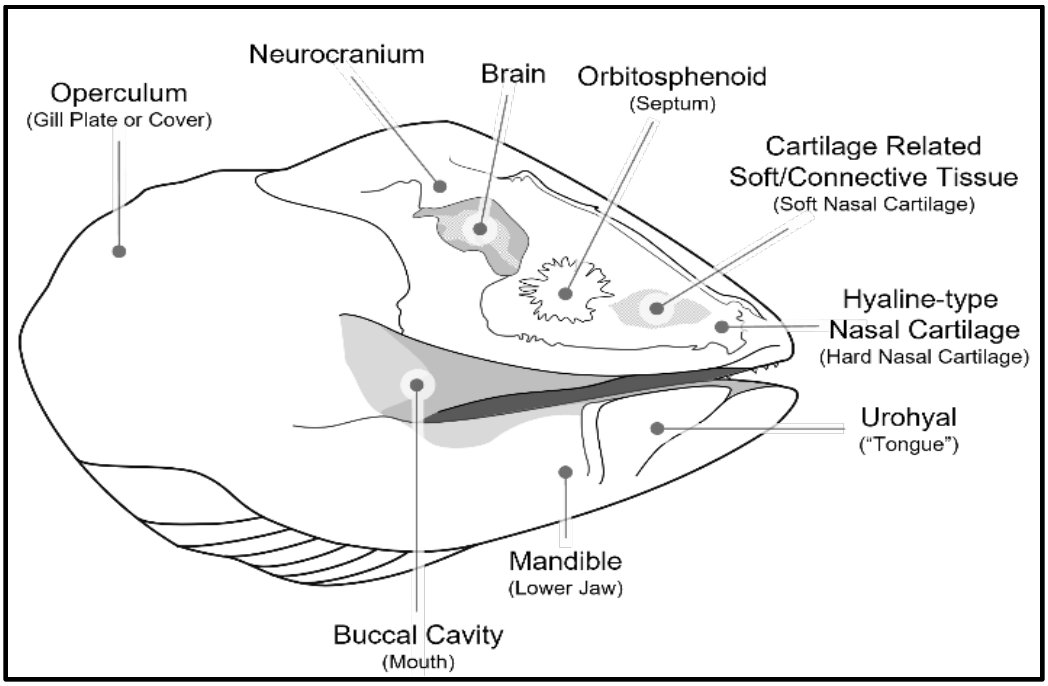


Figure 12. Anatomy of a salmonid head. (Illustration: ADFG)

Although the head/snout was scanned during the preparation phase to confirm the presence of a CWT, a quality control check is essential. Prior to initiating the dissection process, complete the following steps:

- Take one tray of heads/snouts out of the freezer.
- Conduct a final scan of the sample to confirm the presence of the CWT. If the V-detector does not confirm the presence of a CWT, place the sample with the other NO CWT samples (*see Section 10 for additional information*).
- Remove excess salt and mucus from the head/snout.
- Begin dissection once the heads/snouts have thawed enough to be cut or cored.

9.2.1 Cutting

To isolate the CWT from the head/snout delivered to the laboratory, cuts are performed to create a wedge (Figure 13) from the area of the sample where CWTs are most often located (*see Sections 3 and 9.2*). The procedure is as follows:

- If a whole head (tip of the snout to behind the operculum) is received, the first cut is in front of the eyes (Figure 13);
    - Using the non-dominant hand, grasp the head/snout from the top with the snout pointing toward the dominant hand. Place the thumb just behind the eye on the near side and the index finger just behind the eye on the far side of the head. Grip the sample firmly and place on the cutting board. Note: During dissection, never hold the head/snout in one's hand while cutting.

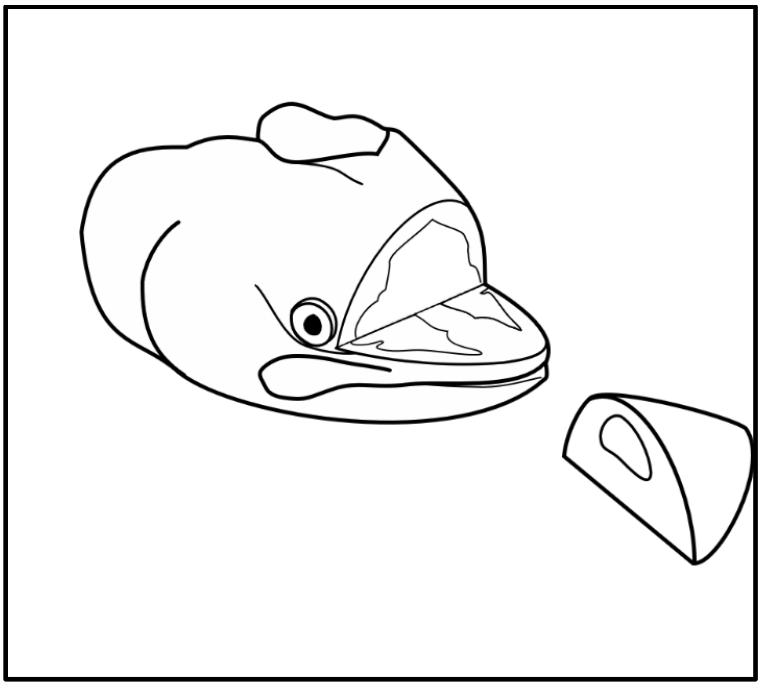


Figure 13. Wedge slice to isolate a CWT in a salmonid. (Illustration: ADFG)

  - Using the rear portion of the blade, close to the handle, cut vertically down from the top of the snout to the maxilla bone. In some cases, a cleaver and rubber mallet are used to complete the cut to ensure the processor's hands are away from the blade.
  - Using the technique described above, make a horizontal cut from the tip of the head/snout to the bottom of the first cut. **Since the area on the head where the hand is placed can be small, use extreme care when making this cut.** This cut should be at a slightly downward angle. These two cuts will produce a wedge-shaped piece of nasal tissue that likely will contain the CWT.
- If the sample that was received is a snout (i.e., tip of the snout to behind the eyes), cut lengthwise down the center of the snout separating the eyes so that the nasal cavity is visible.
- Typically, the CWT is found in the sinus cavity or in the muscle near the eye.
- Check for the CWT by passing the tissue wedge in front of the V-detector approximately 0.5 inches from the surface. When a signal occurs, divide the wedge in half and check each half on the V-detector.
- Continue checking and dividing the piece of tissue that produces a signal until the tissue that contains the CWT is small enough (approximately 1 square cm) to be pressed flat with a clean paper towel/watch glass or carefully dissected with the probe to reveal the CWT (Figure 14). When the tissue is flattened to expose the CWT, effort must be taken to avoid "grinding" the tissue since such an action can scratch the CWT which could make tag reading difficult. Remove any excess tissue around the CWT. (Caution: When flattening the tissue, too much pressure can propel the CWT beyond the dissection workstation.)
- Using the magnetic probe or pencil, transfer the CWT to a cup of water, a 50/50 mixture of water and rubbing alcohol, or an ultrasound cleaner to remove any remaining tissue prior to blotting it

dry with a paper towel. Another option is to place the CWT between two pieces of card stock and with a finger gently rub where the CWT is located. Upon completion, take care when removing the top piece of card stock since the CWT may be embedded in the paper. Once the CWT is cleaned, store it either by:

  - Taping the CWT to the data sheet with reusable tape. Avoid using regular tape as it can leave glue residue on the CWT, making it difficult to re-read.
  - Taping it to the head tag, also using reusable tape.
  - Placing it in a coin envelop. Use one envelope per CWT.
  - Placed it in an individual CWT bag (Figure 7) that contains the sample's respective label or taped to its head recovery card and circled to identify its location. Processors should note the placement of the CWT in the bag while ensuring it is lying flat to avoid puncturing the bag. To seal the bag, roll the open end over itself twice and staple through the roll. Ensure the CWT remains in the bag.

- Since some heads/snouts may contain more than one CWT, bundle the paper towel and scan the tissue using the V-detector. If the bundle does not produce a signal when scanned, discard the materials into the bio-waste bucket. If a signal occurs, follow the same process of checking and dividing to find the source of the signal.
- Once all CWTs have been found and the sample has been discarded, either place the stapled CWT bag or envelope in the tag bin or place the datasheets with the CWT taped onto them, in a binder, and select another sample for processing.

Figure 14. Demonstration of how to properly use the watch glass to locate a coded wire tag. (Photo: CDFW)

9.2.2 Coring

For all heads being cored, remove the lower jaw and keep frozen or slightly thawed (30 minutes or less), for safety. Depending on head/snout size, consider the following approaches when coring:

- Place the sample under the corer head with the tip of the snout facing up, as the CWT should be in a direct line through the center of the snout. To avoid excess gristle in the coring plug or if the head is too large to fit under the coring head, the snout can be cut off.
- Place the head upside-down, with the upper jaw facing upward and the middle of the head under the coring head. This will target the area where most CWTs are located (Figure 15).
- Another option is to cut the head vertically, down the center and between the eyes. Scan each side for the CWT, then place the side with the CWT, under the corer head, aiming for the area in the middle between the eyes and the end of the snout.

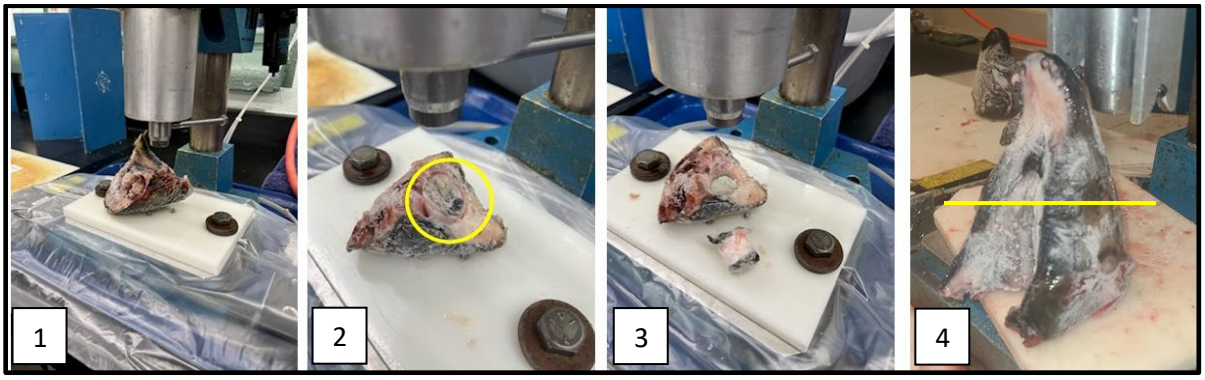


Figure 15. The frozen salmonid head is placed upside down with the lower jaw removed, on the cutting board (1). The frozen head after the coring machine has been used. Note the circular cutting in the middle of the head (2). The head after the core has been removed (3). A head too large to fit under the coring head with the area of the snout that can be cut off marked in yellow (4). (Photos: ODFW)

As cores are obtained, the core and snout should be scanned with the V-detector. Once a positive signal is obtained, place the core with the tag in the freezer to be processed later as a batch. Once all of the core samples are ready:

- Cut the core in half and check each half for a CWT.
- Place the half not containing the CWT aside.
- Cut the piece containing the CWT in half and check both halves for a CWT.
- Repeat the process until the CWT is found.

10. HEAD DISSECTION – UNIQUE SITUATIONS

10.1 Lost Signal

When a CWT signal is detected during the Preparation for Dissection and Dissection stages, but no CWT or signals are observed following the completion of the dissection process, factors leading to this situation include:

- *The initial signal(s) were caused by something other than a CWT in the head*. Possible causes for a false signal include the bumping of the V-detector or moving metal objects on the counter while scanning tissue. This illustrates the importance of scanning every sample before cutting and to only begin cutting after there is confidence that a CWT exists. Also, take the following actions:
    - Check for jewelry or nail polish that might trigger a signal when your hands are close to the V-detector. Plug-in headphones (not Bluetooth) and magnetic wallets may also produce false signals.
    - Test the surrounding environment, including the cutting board, knives, scalpels, etc. to ensure they are not producing a false signal.
- *The CWT is no longer contained in the previously scanned sample*. Occasionally while the tissue is being cut, the knife will make direct contact with the CWT and the tag will often magnetically adhere to the knife and be inadvertently extracted from the tissue. In other cases, a small piece of tissue containing the CWT may unknowingly be separated from the pieces being scanned.
- *The CWT was de-magnetized during the extraction process, thus rendering it undetectable to the V-detector.* Movement of a magnetically charged object near the CWT, while in the tissue, may cause it to lose its magnetic charge. Knives and other steel tools used during snout dissection can have a magnetic charge that may demagnetize a CWT. If the CWT loses its magnetic charge, the V-detector will no longer be able to detect it. To re-magnetize the CWT, see Section 10.4.

10.2 Lost CWT

Lost Signal and No CWT Found

Prior to determining that there is no CWT, complete the following steps:

- Limit movement through the laboratory since the CWT may be on the processor's clothing or person.
- The processor should check their hands by passing them in front of the V-detector.
- Visually check the knives, scalpel blades, and cup and then pass a cow magnet along the blades. Perform this check even if the equipment was not used.
- The processor should search their clothing with the cow magnet.
- Check the glass square by passing it in front of the V-detector.
- Check the head recovery bag and tissues by:
    - Placing one piece of the snout in the snout recovery bag and exposing it to the V-detector. If the detector signals the presence of a CWT, it is either in the bag or in the snout tissue.
    - If the detector does not indicate the presence of a CWT, place a second piece of snout into the bag with the first piece and once again scan the bag.
    - Repeat this process until the CWT is detected or until all snout pieces are in the snout bag.
- Check the cutting board with the cow magnet, wipe the board with a paper towel, and check the towel by scanning it in front of the V-detector.

- Check the countertop, surrounding floor, and V-detector by using the cow magnet. (Note: If the CWT is found on the floor, it should be marked as "lost" before the read since there is no guarantee that it is the actual CWT you were searching for.)
- The head bag and paper towels should be placed in the bucket that contains the strong magnet. The bag and towels should be left there for at least 15 minutes to allow the tag to re-magnetize before the pieces are placed in a cup and run through the V-detector at least twice.
- If there is still no identification by the V-detector, confirm the CWT as Lost.
- The CWT bag should be marked as Lost and grouped with the CWT bags that contain successfully excised CWTs. Complete a Lost CWT slip and staple it to a CWT bag.
- All pieces of a "Lost" sample, its recovery card, and the paper towel (if used) should be placed into its head recovery bag and "Lost" should be written on the bag with a permanent marker. The bag should then be placed in the designated area in the walk-in freezer.
- Record the event in a Problem Log and note the head number, loss date, and a description of the events leading to the loss of the CWT. The description should be as detailed as possible since the loss likely will not be investigated immediately.
- At the end of the day, record the number of tags "Lost" in the appropriate column on the daily excising effort sheet.

10.3 Lost CWT is Found

If a lost CWT is found, it should be paired the head card noting where it was found. Identifying in detail the location where the CWT was found on the workspace is imperative since it should not be assumed that the found CWT is the actual tag of interest. Details about an incident and the actions that were taken to locate the CWT are essential to inform the decision-making process used to determine if the CWT should be processed as a "Lost and Found" tag.

To reduce the amount of Lost and Found tags at a workstation, fully clean the workstation after losing a CWT and before starting work to extract a new CWT.

10.4 No CWT/ No CWT Detected

If a CWT signal is not detected during the Preparation for Dissection and Dissection-QC stages of the process, it is possible that the head does not contain a CWT. This scenario can occur if recovery personnel obtained a false positive signal while scanning the fish during collection. Such a false positive can occur due to interference on the CWT detection wand, from a belt buckle or watch worn by the recovery person, a hook or lure within the fish, magnetic rocks or sand stuck to the fish, or other factors. On rare occurrences, tunnel detector mishaps have also funneled untagged fish into the tagged fish pile.

The lack of an initial CWT detection signal should not automatically lead to a NO CWT classification since it is possible the sample contains a CWT, but it is undetectable. Coded wire tags can become demagnetized enough to make them undetectable. Fortunately, CWTs can also be re-magnetized using a strong magnet, rendering them detectable once again. (Note: If numerous snouts are found with no CWT present, a potential problem may exist with the V-detector and T-wand detector.)

Before a head/snout is classified as No Tag Detected (NTD), it should be exposed to a strong magnet in an attempt to re-magnetize a potential CWT as follows:

Horseshoe Magnet

- Place the head/snout close to a strong horseshoe magnet for at least 15 minutes and then scan with a 360 degree detector. The sample may need to be cut into smaller pieces, with each piece rechecked for a signal and re-magnetized. Cutting the sample into smaller pieces ensures the cuts are small enough to fit through the 360 degree detector.

Electromagnet

- Plug in the electromagnet but leave it turned off. **(Safety: The electromagnet is a potential fire hazard and will get very hot if left on for more than a few minutes at a time. Unplug the unit when not actively in use.)**
- Notify others in the laboratory that there is intent to use the electromagnet. This is essential since the electromagnet is strong enough to cause a signal on a V-detector on the other side of the laboratory, thus producing a false reading for those extracting CWTs.
- Re-scan each sample, in multiple orientations, with the V-detector. If a sample registers a signal, set it to the side for CWT extraction following the procedure previously outlined.
- Place all non-signaling samples in a bin. Once all are scanned, move the non-signaling samples to the electromagnet.
- With the electromagnet off, select a non-signaling sample and hold it upright in the middle of the electromagnet ring with the depth of the ring centered half way between the fish's eye and nares (Figure 16).

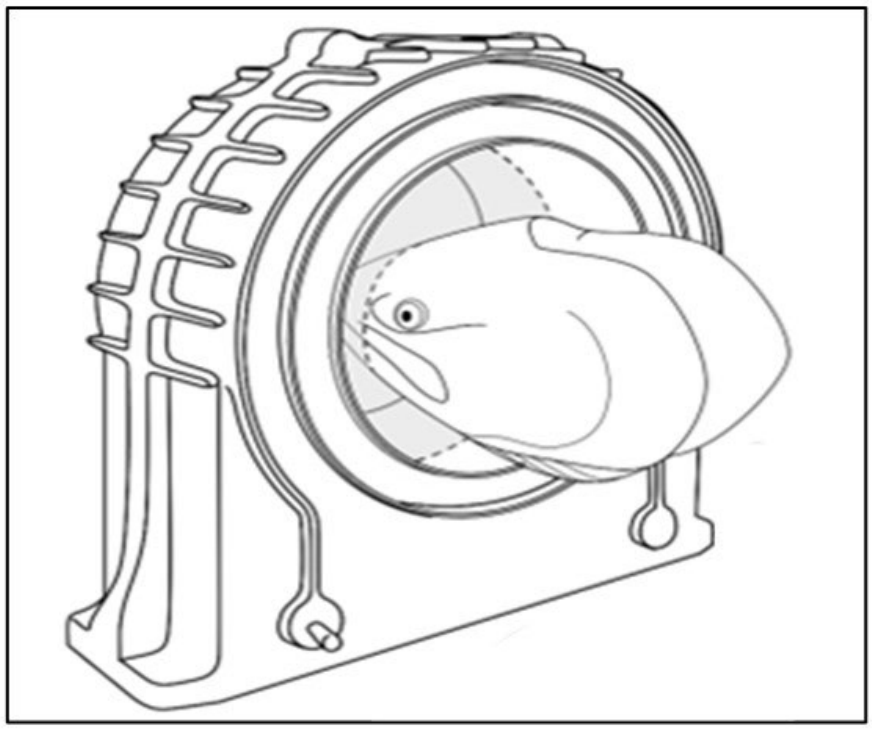


Figure 16. Proper positioning of a salmonid head in an electromagnet for magnetization of a coded wire tag. (Illustration: ADFG)

- Turn on the electromagnet and hold the sample steady for 3–5 seconds.
- Turn the electromagnet off while continuing to hold the sample steady and then withdraw the head/snout. If a CWT is present, it may have developed a charge.
- Set the sample in a new bin, and select another to be re-magnetized.
- Repeat this process with all non-signaling samples.
- When all samples have been re-magnetized, unplug the electromagnet.
- Scan all re-magnetized samples again with the V-detector. If any sample signals, set it to the side for CWT extraction, following the procedure previously outlined.

Note: When cutting re-magnetized head/snouts, keep in mind the electromagnet can apply a magnetic charge to any iron material on or in the head. If you follow a signal to a piece of debris that is not a tag, it is important to make sure that the sample does not contain a CWT in another piece of tissue. If no CWT is found after recovering all signaling material, then the specimen can be classified as NTD.

Label the CWT bag for a NTD head/snout as NTD and group it with the bags of successfully excised CWTs. Place the NTD head/snout and its head recovery card back into the head recovery bag and write NTD on the bag with a permanent marker. Place the sample in the designated area in the walk-in freezer and at the end of the day record the total number of NTD heads/snouts in the appropriate column on the daily excising effort sheet.

When a sample is found without a CWT, the information from the head recovery card is recorded on a CWT recovery form then entered into the recovery database.

11. LABORATORY SANITATION

11.1 Dissection Equipment

Adequate cleaning procedures will reduce foul odors, pest attraction and harborage, and potential cross contamination and transmission of pathogens. Clean all processing equipment (e.g., V-detector, scissors, scalpels, trays, cutting boards, knives, etc.) daily with dish soap, Simple Green, or bleach.

11.2 Laboratory Surfaces

Clean all surfaces (e.g., counters, vertical surfaces, door and freezer handles, sinks, and floors) daily with a household cleaner. **(Warning: Do not mix bleach and ammonia-based cleaners.)**

11.3 Sharps Disposal

Place all broken and dull scalpel blades in a “sharps” container that is located next to the sink.

12. WASTE STORAGE AND DISPOSAL

At the end of each processing session, remove all wastes from the laboratory. Take trash bags containing non-fish wastes (e.g., plastics, paper, etc.) to an outdoor dumpster. However, to avoid decomposition, pest attraction, and foul odors, do not place the bags containing fish wastes in outdoor dumpsters until the evening before the scheduled waste pick up. Subsequently, store all fish wastes in a compost-dedicated container in the walk-in freezer until transfer to the outdoor dumpster. Label waste bags accordingly to ensure that non-waste bags in the freezer are not inadvertently discarded. If waste management services fail to pick up the waste on the scheduled date, management should be notified immediately.

To minimize over-weighted bags, limit the amount of waste placed in each trash bag. Using trash compactor bags, a thicker bag, or double bagging can reduce the risk of bag failure.

13. PREPARATIONS TO READ CWT

13.1 Supplies

- Brass reading jig (www.nmt.us)
- Illuminator (www.nmt.us)
- Brass magnetic pencil (www.nmt.us)
- Monitor
- Dissecting microscope or CWT viewer (a dissecting microscope is not required if using a CWT viewer produced after 2019)
- Digital camera or CWT viewer
- Small magnet
- Heavy paper weight
- Pencils (4B)
- Double-sided tape (2)
- Reusable tape (2)
- Small scissors
- Rubber bands for head labels
- Paper clips to keep paperwork together for the day with big bag labels
- Calculator
- Cleaning supplies
- Big bag labels
- Sorting bins for CWTs

13.2 Laboratory Preparation

Prior to reading CWTs, sweep the reading room with a cow magnet to ensure no CWTs remain from the last reading session. Discard any found tags.

13.3 Preparing CWT Read Sheets

The CWT data can be entered directly into a database or recorded on a CWT read sheet. Regardless of the method, the data that is recorded should include, at a minimum, the required fields listed in the Regional Mark and Processing Center's most current version of the *Specifications and Definitions for the Exchange of Coded Wire Tag Data for the North American Pacific Coast* available at (https://www.rmpc.org/resources/documents/).

Note: The field names listed below might not match what is used at the laboratory. The field names associated with the laboratories are cross-walked to match what is in RMIS when the recovery data is uploaded.

The CWT read sheets can either be pre-printed or electronic. If printing the read sheet, it should include the sample ID numbers that correspond to the pre-printed CWT bag labels. Below are fields, at a minimum, that should appear on the read sheet:

- Tag - CWT is taped onto the read sheet in this location after it has been read (if using a printed read sheet).
- Tag Status - Tag read OK, No tag, Tag lost before read, Tag not readable, Unresolved discrepancy, Head not processed, Pseudo tag/ blank wire.
- Submission Date - Date of submission for this set of records.
- Recovery ID - Unique IDs assigned to each recovery record by the recovery agency.
- Recovery Date - Date closest to that in which the catch occurred in the fishery for this decoded tag.
- Run Year - Calendar year corresponding to catch of this recovery in the fishery.
- Tag ID - Snout recovery bag number.
- Recovery Location Code - Hierarchical and geographical coding scheme rendering multiple levels of resolution to Recovery Site.
- Sample Type - Recovery method.
- Recorded Mark - Any marks on the fish (e.g., AD, LV, etc.).
- Reporting Agency
- Species - Chinook, Coho, Steelhead, Sockeye, Chum, Pink, Masu, Cutthroat, Atlantic Salmon.
- Fishery - Standard code to indicate the fishery in which this recovery occurred.
- Tag Code - 6-digit code stamped on the CWT.
- Comment - Comments that pertain to the fish.

13.4 Sorting CWTs

Before CWT reading occurs, seven containers should be prepared to facilitate the sorting of CWTs during the reading process. One container should be dedicated for each of the following designations:

- Unread CWT - Required when dissection outpaces reading and there is no space in the dryer.
- First Read (Needs Entry) - CWTs successfully read once, but still require entry.
- Second Read (Needs Entry) - CWTs successfully read a second time, but still require second entry. Completed third reads can also be placed in this basket, but must be clearly labeled as third reads.
- Needs Second Read (Readers Initials) - Basket belongs to a specific reader. The CWTs in these baskets have been first read and entered; however, they require a second read from a specific individual (individual initials in the parentheses) to ensure each CWT is read independently by multiple individuals. There should be a second read basket for every reader.
- Manager Reads - CWTs from a species of concern that requires a second read from a manager. At the end of the week, management should be notified of any new CWTs placed in this basket by the data entry technician.
- Needs Third Read - CWTs that have been read and entered twice, but both readers disagreed. In these cases, a third reader is required.

- To Be Filed - CWTs that have been successfully read and entered twice and require filing. No CWTs should be filed until the snout card is completely dried to avoid mildew.

Using a calculator, check the numbers for the day prior to preparing a copy of the data sheet that is submitted to the hatchery.

13.5 Preparing the Microscope or NMT Magniviewer

Coded wire tags are typically read using a dissecting microscope or with the NMT Magniviewer (Figure 17). The Magniviewer is a small portable device incorporating a small monocular microscope and an LED light source. It is particularly well suited for field-use and in situations where a limited number of tags must be read on site. To learn more about the viewer visit https://www.rmpc.org/tag-viewer-quick-start-v1_3

If using a microscope, adjustments should be made to the height of the microscope. If necessary, the eyepieces should be cleaned with Kimwipes and adjusted to fit the individual reader's eyes.

Ensure that the light source and magnetic pencil stand are properly positioned under the lens and that the light source is turned on before reading.

13.6 Inserting the CWT into the Reader

Reading a CWT is greatly assisted by using a magnetic reading pencil and reading jig. The pencils are brass or plastic rods with a small magnetic tip which holds the CWT on end, allowing for it to be rotated under the microscope to read all faces. Touch the pencil to the tag and confirm the CWT is pointing straight out from the pencil. The reading jig is a specially shaped brass block which holds the pencils in the appropriate orientation for viewing the CWT. Place the CWT gently on the reader since it can easily become displaced.

Figure 17. Equipment used to read coded wire tags includes the NMT CWT reader (left), microscopes (center), and the NMT Magniviewer (right). (Photos: NMT (left), ODFW (center), USFWS (right))

13.7 Reading CWTs with a Microscope

Correct illumination is essential for reading CWTs under a microscope since good contrast must exist between the background and code marks to ensure effective reading. For those using a dissecting microscope, the goal should be for the illumination to make a CWT's smooth, mirror-like background look black and the dimples look white. To accomplish this, when the CWT is viewed through the microscope the background should be black. All surfaces that are visible from the CWT should also be black or dark, except the light.

Light sources include a simple gooseneck desk lamp with a standard incandescent/LED bulb (60 -100W, LED equivalent), special-purpose microscope illuminator, or a LED flashlight. When using standard bulbs, the effectiveness of the design improves if a black shroud is used to prevent the illumination of surfaces that should be dark.

If the NMT Magniviewer is used, the ideal light source is the NMT tag reading illuminator since it was specifically designed to fit over the reading jig to optimize lighting for tag reading.

14. READING A CWT

14.1 Determining the Code

Five CWT formats may be encountered when processing samples: full-length (standard, most common), half-length (not common), 1 ½- length, sequential, agency only, and binary (rare). Because the machines that cut the CWTs are not indexed to the coding on the wire, the number is repeated multiple times on the wire so that no matter where the wire is cut, the complete code appears more than once on the CWT. Since tags may not be cut at the same length, do not rely on the size of the CWT for the purpose of determining the format.

14.1.1 Full-length (Standard) CWT

A full- length CWT (Figure 18) has the following features:

- Six-digit code.
- Beginning and end of the code sequence is signaled by a triangle-shaped flag.
- No blank spaces exist between the characters.
- Four rows of code extend around the circumference of the tag.
- Entire code is printed on all four rows of the tag.
- Code is repeated within each row along the length of the tag.
- 165809: Beginning of the sequential code (flag 'triangle' indicates the beginning of the code).
- 16: Two-digit agency code. The first two digits typically identify the agency that tagged the fish since each agency has a unique code. Occasionally, when agencies may share CWTs while working on a project, the first two numbers may not represent the releasing agency. A complete list of agency codes can be viewed at https://www.rmpc.org/coordination/prefix-code/

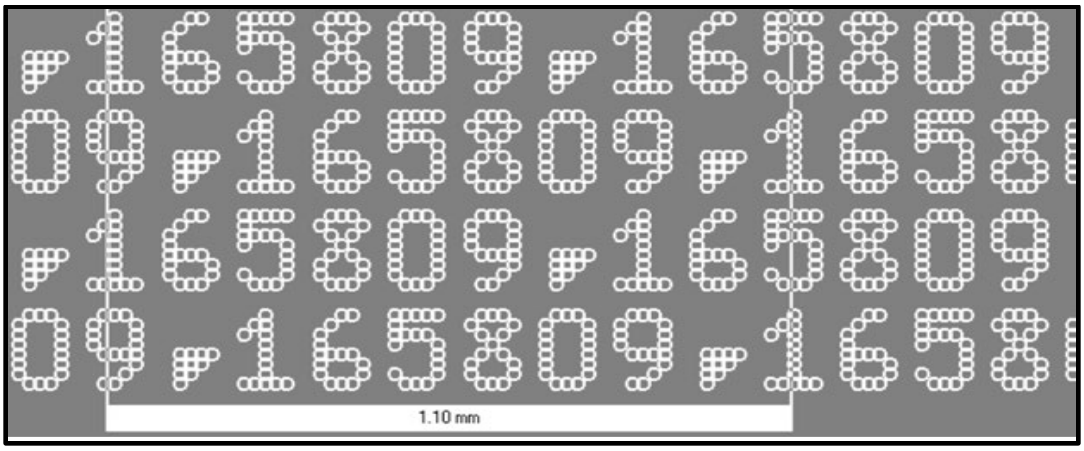


Figure 18. Full-length CWT with tag cutoff shown (Image: NMT).

The code displayed in Figure 18 is interpreted as:

- 58: Data 1.
- 09: Data 2.

The second and third sets of two-digit numbers are referred to as “Data 1” and “Data 2”, respectively. Collectively, they can describe a large amount of data concerning the tagged fish. This information can be accessed at the RMPC website through the RMIS CWT database at https://www.rmpc.org/data-selection/rmis-queries/.

The code should be recorded as it is seen on the CWT, but without the dashes after every two digits

14.1.2 1 ½-length CWT

A 1 ½ –length CWT (Figure 19) has the following features:

- Beginning of the code sequence is signaled by a flag that looks like a triangle.
- Total of 4 rows of code sequence around the circumference of the tag.

The code displayed in Figure 18 is interpreted as:

- 16 58 09: Beginning of the sequential code (flag ‘triangle’ indicates the beginning of the code).
- 16: Two-digit agency code.
- 58: Data 1.
- 09: Data 2.

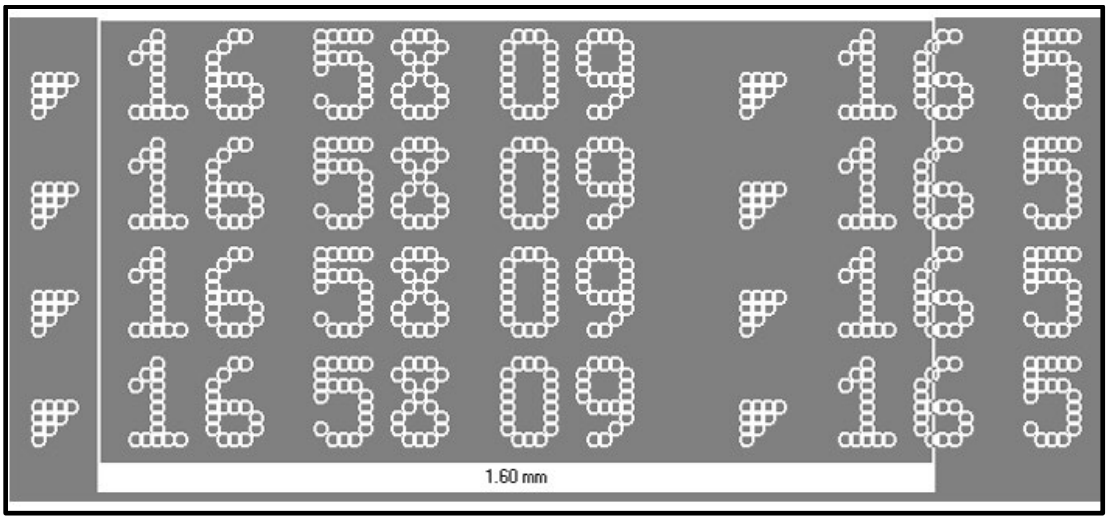


Figure 19. A 1 ½ -length CWT that has been "unrolled". The triangular flag points to the first digit of the 6 digit code (165809). The white lines in the figure show the size of the tag, and one possible cut. (Image: NMT)

14.1.3 Sequential CWT

Sequential tags (Figure 20) have the following features:

- Batch code is written along the axis of the tag in two rows and three columns followed by a sequence number written around the circumference.
- One entire sequential number is on each tag, regardless of where the wire is cut.
- Numbers are staggered by three digits around the circumference of the wire.

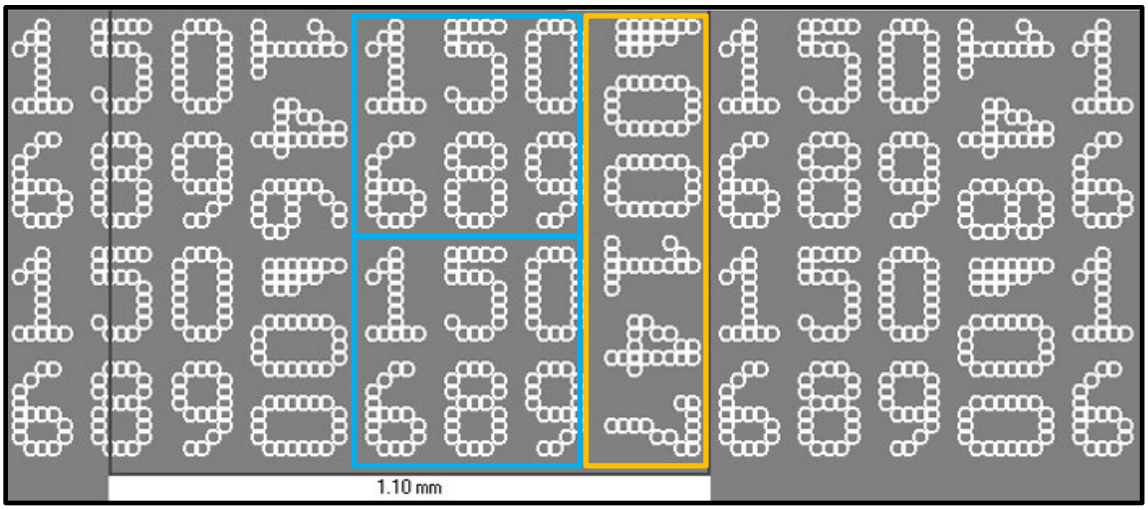


Figure 20. A sequential CWT that has been "unrolled". The numbers outlined in blue represent he batch code. The triangular flag indicates the first digit in the sequential code (e.g., orange section has sequential code 00147). The white lines in the figure show the size of the tag, and one possible cut. (Image: NMT)

The code in the orange section that is displayed in Figure 20 is interpreted as:

- 00147: Beginning of the sequential code (flag 'triangle' indicates the beginning of the code).
- 165809: First digits in the batch code.
- 16: Agency batch code.
- 58: Data 1
- 09: Data 2

Additional CWT formats include half-length, Agency only, and on a rare occasion, binary. For more information about CWT formats and reading instruction, see https://www.rmpc.org/cwt-formats-and-reading-instructions/

15. READING AND RECORDING CWT DATA

15.1 CWT Recording Sheet Preparations

Pre-printed sheets intended for a single CWT should include the following fields (field names should align with RMIS field names):

- Sample ID - Sample number that corresponds with the head and pre-printed CWT baggie labels.
- CWT - The CWT is taped here after it has been read.
- CWT Code - Data from the CWT.
- Recovery Date - Date the CWT was recovered.
- Length - Length of the fish.
- Sex - The gender of the fish
    - Male
    - Female
    - Juvenile
- Recovery Site - Recovery site code.
- Recovery Type - Recovery method.
- Mark - Any marks on the fish (AD, LV, etc.).
- Recovery Agency - The recovering agency

  A complete list of agency codes can be found at the RMPC's website http://www.rmpc.org/tag-prefix-contact-list.html
- Species - Species of the fish.
- First Reader Initials - Initials of the individual that was the first to read the CWT.
- Second Reader Initials - Initials of the individual that was the second to read the CWT.
- Comment - Any comments that pertain to the fish or CWT.

Depending on preference, completed forms should be maintained in a 3-ring binder or box.

15.2 Reading and Recording CWT Data

15.2.1 First Read

1. Identify the code and record the information on the code line.
2. Transfer the CWT to the reading/recovery sheet and affix it to the sheet with tape.
3. Draw a circle around the CWT with a pencil.
4. Complete the remaining recovery sheet data lines.
5. Place your initials by each CWT reading.
6. Optional step: Take a photo of the CWT (some laboratories take pictures in case discrepancies exist among readings, to store photos instead of CWTs, or to capture CWTs from fish that are not released from the entity's hatchery).

If a CWT was lost during this process, indicate such on the Comment line and in the Problem Log of the reading/recovery sheet. Before recording the CTW as a Lost Tag, complete the steps described in Section 9.3.

15.2.1 Second Read

During the second read, the ideal outcome is that the reader agrees with the first code read. If there is agreement, place the reader's initials adjacent to the first reader's initials. However, if there is disagreement, record results from the second read under the first read, followed by the reader's initials. In the case of a disagreement between the first two reads, a third read is required. If the third reader agrees with either of the first two reads, they should strike through the read they disagree with and initial by the read they agree with. However, if the third reader disagrees with both reads, then they should write the new read on the read sheet followed by their initials. When the third reader disagrees with the first two readers, two readers will then need to sit down and come to an agreement. If a consensus cannot be made, the tag is labeled "Unreadable".

A third reader is also used when there are CWTs used for fish labeled Species of Concern.

16. CWT STORAGE

After a CWT has been read at least twice, the completed CWT reading/recording sheet for each CWT should be filed in numerical order in a binder, storage box, or plastic bag. Label the binder, box, or plastic bag with the information identifying the range of CWTs stored in the binder (e.g., 1–100, 101–200, etc.) or by the recovery head card number range. If using binders, an inventory number (i.e., binder number of total binders (1 of 24, 2 of 24, etc.) should be affixed to the front of the binder.

If storage boxes are used, place markers at the beginning of each series of 100 and properly group or bundle them. The boxes should be number in the lower right corner as [box number]/[total box number]. At the end the season, when all CWT reading/recording sheets have been filed, update the label on the box with the range of CWTs included in each box. After five years, the CWT and associated paper cards can be discarded.

If an agency's CWT is recovered by another entity, the agency may ask for their CWT to be returned. To receive instructions on how to return the recovered CWT, refer to the RMPC's website (https://www.rmpc.org/coordination/prefix-code/) for the contact information of the entity's representative.

17. UPLOADING CWT DATA

Users of the RMIS website should be familiar with the principal CWT data specifications found in the *RMIS User Guide* available at https://www.rmpc.org/ and the current *Specifications and Definitions for the Exchange of Codded Wire Tag Data for North American Pacific Coast* found on the Regional Mark and Processing Center (RMPC)'s website. Data submission should be completed by the agency's reporting coordinator. For individual data provider information, go to https://www.rmpc.org/coordination/data-providers/

17.1 Agency Database

Enter and store all data recovered from CWTs and snout cards into a recovery database.

Initially review data for accuracy by comparing the data card against the information that was entered into the database. If differences exist, rectify in the database and finalize the entry. When completed, the processor should provide their initials.

Once all data from the CWT reading/recording form has been entered into the database, the form should be returned to a binder.

17.2 RMIS

When the data have been cross checked and are ready for upload to RMIS, it should be copied from the entity's database and submitted into the RMISDataExchange tblRecovery table to run the file export process. This process will create a file that is formatted for RMIS uploads.

APPENDIX A

ESTIMATED NUMBERS CALCULATIONS

The values in the "Number_CWT_Estimated" field are estimates of how many tagged fish each recovered tag represents in the total catch or sampled population. Example calculations are provided below for illustrative purposes only. The exact calculations of these estimates depend on the sampling program design and may be influenced by other factors such as how the total catch is determined. For questions about any specific estimate in the RMIS database, please contact the relevant reporting agency coordinator.

In most fisheries a fraction of the fish harvested are sampled for CWTs. If total catch and the sample rate are known, the number of tagged fish in the total catch can be estimated. For visual sampling programs which first inspect fish for the presence of an adipose fin clip and only electronically inspect those clipped fish for the presence of a CWT, the Number CWT Estimated may be calculated as follows:

$$Number\ CWT\ Estimated = \frac{1}{Decoding\ Rate} \times \frac{1}{Fraction\ of\ the\ Catch\ Sampled}$$

$$= \frac{1}{\frac{Clipped\ Fish\ with\ Known\ Tag\ Status}{Total\ Clipped\ Fish\ Observed} \times \frac{Tags\ Fully\ Decoded}{Tags\ Electronically\ Detected}} \times \frac{1}{\frac{Total\ Sampled}{Total\ Catch}}$$

$$= \frac{Total\ Clipped\ Fish\ Observed}{Clipped\ Fish\ with\ Known\ Tag\ Status} \times \frac{Tags\ Electronically\ Detected}{Tags\ Fully\ Decoded} \times \frac{Total\ Catch}{Total\ Sampled}$$

For electronic sampling programs which electronically inspect all sampled fish for the presence of a CWT regardless of adipose fin clip status, the Number CWT Estimated may be calculated as follows:

$$Number\ CWT\ Estimated = \frac{1}{Decoding\ Rate} \times \frac{1}{Fraction\ of\ the\ Catch\ Sampled}$$

$$= \frac{1}{\frac{Tags\ Fully\ Decoded}{Tags\ Electronically\ Detected}} \times \frac{1}{\frac{Total\ Sampled}{Total\ Catch}}$$

$$= \frac{Tags\ Electronically\ Detected}{Tags\ Fully\ Decoded} \times \frac{Total\ Catch}{Total\ Sampled}$$

If all fish in the sample collection suspected of having a CWT undergo electronic tag detection and are assigned a confirmed tag status and no tags are lost or found to be unreadable, then the "Decoding Rate" will be equal to 1 and the above examples for calculating Number CWT Estimated both simplify to:

$$Number\ CWT\ Estimated = \frac{1}{Decoding\ Rate} \times \frac{1}{Fraction\ of\ the\ Catch\ Sampled}$$

$$= \frac{1}{1} \times \frac{1}{\frac{Total\ Sampled}{Total\ Catch}}$$

$$= \frac{Total\ Catch}{Total\ Sampled}$$

APPENDIX B

CALCULATING ESTIMATED NUMBERS: AGENCY DESCRIPTIONS

IDFG

The "estimated number" for fall chinook captured in the recreational fishery based on the sample rate from the fishery – (I.e. N/n= catch sample expansion factor)

where:

N= estimated harvest in the stratum

n= number of fish sampled in the stratum

It is not adjusted for lost/unreadable tags or for the fraction of heads sampled that did not make it to the lab.

Regarding lost/unreadable tags, data were reviewed and for 985 tags recovered in these fisheries, 4 were coded as lost/unreadable.

For the fraction of heads collected that make it to the lab, there is coordination between lab staff and creel crews to resolve any discrepancies between the data sheets and the number of heads received. Similar to percent of tags that are lost/unreadable, the percentage of heads that do not make it to the lab is very low.

ADFG

For data provided to RMIS, Number_CWT_Estimated (referred to locally as expansion_factor) is calculated as follows:

Expansion Factor = Catch Sample Factor x Lost Tag Factor x Lost Head Factor

With,

Catch Sample Factor = Total # of Fish Caught / Total # of Fish Sampled

*Lost Tag Factor = Total # Tags Detected / Total # of Tags Decoded

*Lost Head Factor = Clipped Fish Observed / Clipped Fish with Known Tag Status

*In most cases the lost head factor and lost tag factor are both equal to or very close to one, so the expansion factor is usually equal to or approximately equal to the catch sample factor.

The number of fish caught, the number of fish sampled, the number of clipped fish observed, and the number of fish sampled with each tag status must be grouped by various sample strata before these calculations are performed. The department's preferred area and time strata are specific to a given fishery.

CDFW

The estimated numbers are in the 2020_CFM_CWT_Report.pdf page 3
https://www.calfish.org/Portals/2/Programs/CentralValley/CFM/docs/2020_CFM_CWT_Report.pdf

CCT

$$CWT_{Expansion} = \frac{Total\ Recovered}{Tag\ Rate} \cdot \left(\frac{1}{Sample\ Rate}\right) \cdot (XYZ)$$

NOAA-Alaska

For sampling in the Gulf of Alaska, we set estimated numbers for recoveries and the catch/sample to 1. For sampling in the Bering Sea-Aleutian Islands, estimated numbers for recoveries and the catch sample are set as # caught/# sampled.

NOAA-West Coast - At-Sea Hake Observer Program

For catch sample file: Number CWT estimated = (# caught / # sampled) * CWTs recovered [status = 1, 3, 4,7,9]

For recovery file: Number CWT estimated = (# caught/# sampled)

USFWS – Red Bluff, CA Laboratory

As far as estimated number, the laboratory uses the "Alaska Method". This method uses the formula found in the PSC Report TCDS (89)-1. This method is also used by the California DFW and provides consistency for CA recovery data. Ultimately, two variations are used with one being the standard AK method and one being a modified version. This modified version is only used for a carcass survey and expands the CWT exp_num determined from fresh carcasses to that of non-fresh carcasses, as we collect some carcasses as skeletons or after predation and that of course have a reduced chance of retaining a CWT.

est_num:
IIf([Survey]="1401",Round((([N_hat]*([n_fresh_adc]/[n_fresh])*([n_fresh_cwt_detected]/[n_fresh_head_processed]))/[n_cwt_decoded]),4),Round((1/(([mr_1st_sample_size]/[mr_1st_partition_size])*(([number_recovered_decoded]+[number_recovered_no_cwts]+[number_recovered_lost_cwts]+[number_recovered_unreadable]+[number_recovered_unresolved]+[number_recovered_pseudotags])/([number_recovered_decoded]+[number_recovered_no_cwts]+[number_recovered_lost_cwts]+[number_recovered_unreadable]+[number_recovered_unresolved]+[number_recovered_not_processed]+[number_recovered_pseudotags

]))*IIf([number_recovered_decoded]=0,1,(([number_recovered_decoded])/([number_recovered_decoded]+[number_recovered_lost_cwts]+[number_recovered_unreadable]+[number_recovered_unresolved]+[number_recovered_pseudotags])))),4))

WDFW Recovery Expansion Factor

This equation applies to both visual and electronic catch/sample strata.

(Catch/Sample) x Adj No Snouts x Adj Lost Tags x Adj Unreadable Tags

Expansion Adjustment Factor

Coded-wire tag recoveries, which are expanded based upon a catch/sample factor, are also adjusted for tags not adhering to the normal recovery process. That process is: the snout arrives at the lab, the tag is extracted from the snout, the tag is readable, and the resulting reading matches the tag's release information.

Recovery results fall into one of two general categories: with and without decoded tags. They are assigned one of the following Tag Status codes after completing the snout recovery to tag reading procedure:

Recoveries with a Decoded tag:

Tag Status 1 Code read from the wire tag matches a tag release and is consistent with release information.

Tag Status 7 Code read from the wire tag does not match a tag release, or it is not consistent with the release information.

Tag Status 9 The wire tag has no code (blank) or agency-only code.

Recoveries without a Decoded tag:

Tag Status 2 No Tag. Tag was not present in snout.

Tag Status 3 Lost Tag. Tag wire was present (dissected from the snout) but was lost prior to the reading process.

Tag Status 4 Unreadable Tag. Tag wire is present, but the code is unreadable.

Tag Status 8 No Snout. Snout was determined in the field to be from a wire-tagged fish, but the snout was not processed in the Tag Recovery Lab.

Decoded recoveries are adjusted for status 8, status 4, and status 3 recoveries using the following formulas. These adjustment factors are applied to status 1, 7, and 9 recoveries:

Adjustment for No Snouts, Tag Status 8.

$$\frac{Tags_1 + Tags_2 + Tags_3 + Tags_4 + Tags_7 + \mathbf{Tags_8} + Tags_9}{Tags_1 + Tags_2 + Tags_3 + Tags_4 + Tags_7 + Tags_9}$$

Adjustment for Lost Tags, Tag Status 3

$$\frac{Tags_1 + \mathbf{Tags_3} + Tags_4 + Tags_7 + Tags_9}{Tags_1 + Tags_4 + Tags_7 + Tags_9}$$

Adjustment for Unreadable Tags, Tag Status 4

$$\frac{Tags_1 + \mathbf{Tags_4} + Tags_7 + Tags_9}{Tags_1 + Tags_7 + Tags_9}$$

Any status 3, 4, or 8 recovery is assigned an expansion factor of zero, since its presence is accounted for in the decoded recoveries by the above adjustment equations. Decoded tags are not adjusted for status 2 "no tags".

Columbia River Information System (CRIS)

Expansion Rate Calculation

Example calculation BY17 Little White Salmon NFH upriver brights

mTags = 288
mUnReadable = 0
mUnResolved = 0
mLostTags = 7
mLostHeads = 0
mNegs = 13
mDetected = 308
mIDs = 308
FRtotal = 5824
mWanded = 5781

HeadsProcessed = 308 mTags + mUnReadable + mUnresolved + mLostTags + mNegs

Probables = 0 (mTags + mUnReadable + mUnresolved + mLostTags) / HeadsProcessed * mLostHeads

mExpand = 1.0319245036422 (FRtotal / mWanded) * (mDetected / mIDs) * (mTags + mUnReadable + mLostTags + Probables) / mTags

USFWS - Columbia River Fish and Wildlife Conservation Office

The following inputs and formula are used to calculate the estimated number for hatchery recoveries.

Input		Description
Tags		Number CWTs
UnReadable		Number unreadable
UnResolved		Number unresolved
LostTags		Number lost CWTs
LostHeads		Number lost heads
Negs		Number negs
Detected		Number CWTs detected
IDs		Number IDs
FRtotal		Number recovered at hatchery
Wanded		Number scanned for CWTs
Estimated Number Formula		
1.	HeadsProcessed =	Tags + UnReadable + Unresolved + LostTags + Negs
2.	Probables =	(Tags + UnReadable + Unresolved + LostTags) / HeadsProcessed * LostHeads
3.	Estimated Number =	(FRtotal / Wanded) * (Detected / IDs) * (Tags + UnReadable + LostTags + Probables) / Tags

ODFW

This CWT estimation calculation is applied to both visual and electronic CWT detection method sampling regimes. The calculation adjusts for sample rate, tags lost before read, and snouts not processed.
Inputs:

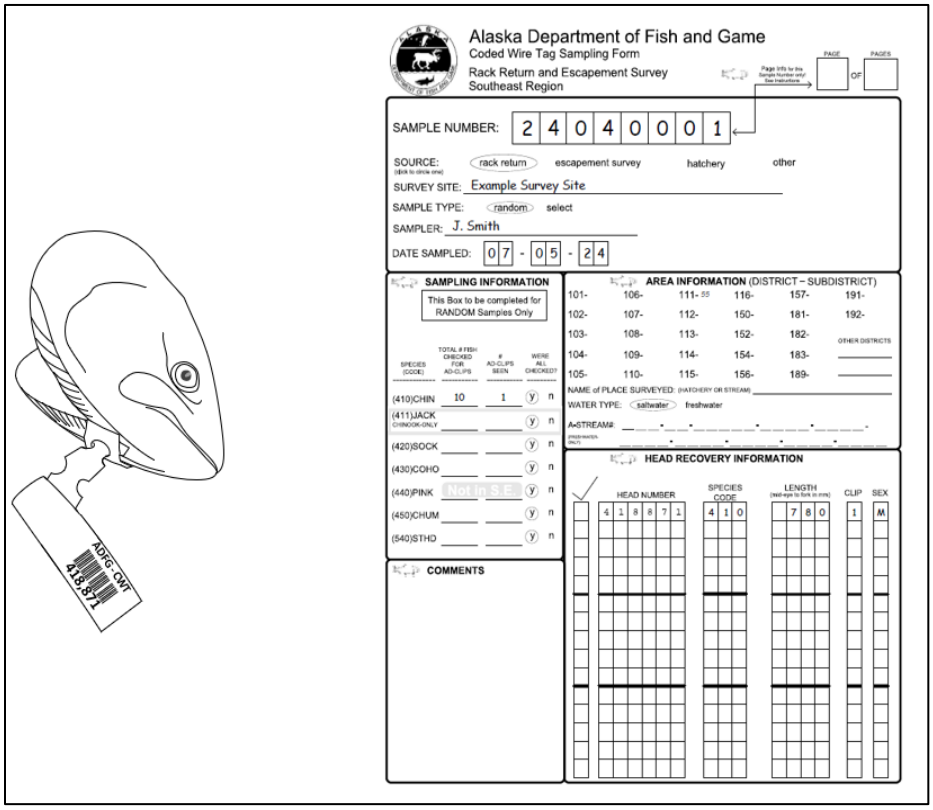
Total Estimated Catch or Escapement
Number Sampled for CWT
Number of CWTs Detected
Number of Status 1 - CWTs Read Ok
Number of Status 2 - No Tags
Number of Status 3 - Tags Lost Before Read
Number of Status 4 - Tags Not Readable
Number of Status 7 - Unresolved Discrepancies
Number of Status 8 - Snouts Not Processed
Number of Status 9 - Pseudo-tags

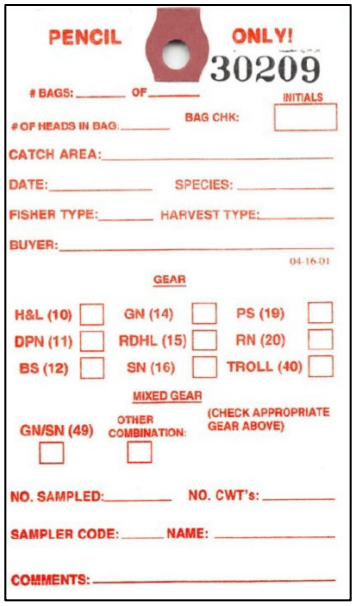
Calculation:
((Total Catch x Number of CWTs Detected)/(Number Sampled for CWT) x (Sum of Tags Read Ok,Tags Lost Before Read,& Snouts Not Processed)/(Number of CWTs Detected))/(Tags Read Ok)

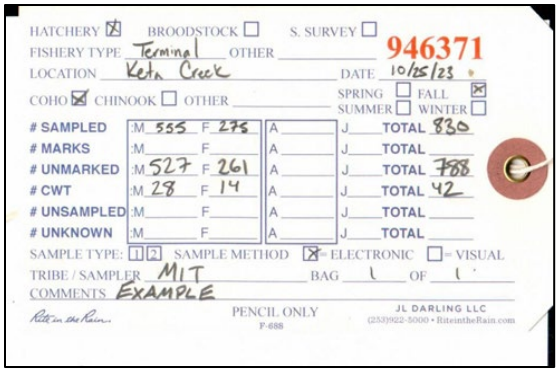
Number of CWTs Detected is equal to all snouts that rang true for tag wire or sum of status 1, 2, 3, 4, 7, 8, 9 recoveries.

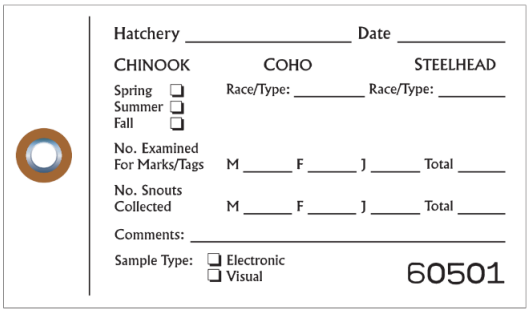
APPENDIX C

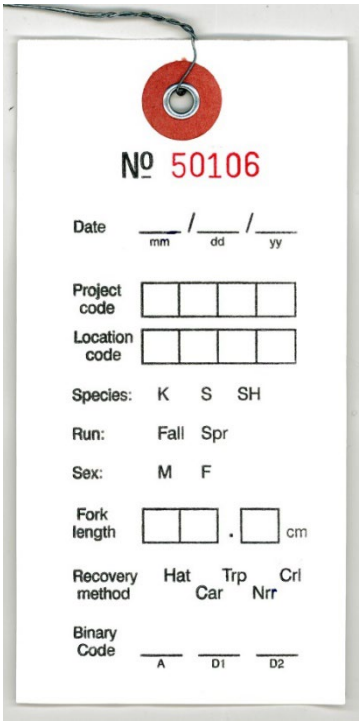
IMAGES APPEARING IN THIS DOCUMENT











SALMON Coded Wire Tag COLLECTION LABEL

At-Sea Hake Observer Program

DOC/NOAA/NMFS/NWFSC/FRAMD

2725 Montlake Blvd. Seattle, WA 98112

Barcode # _____

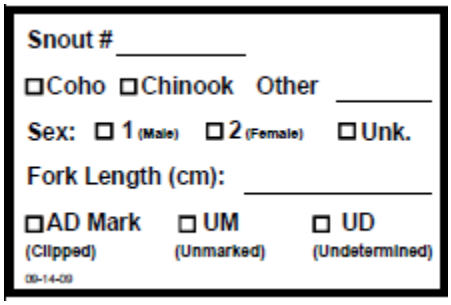
Initials _____ Date _____-_____-_____

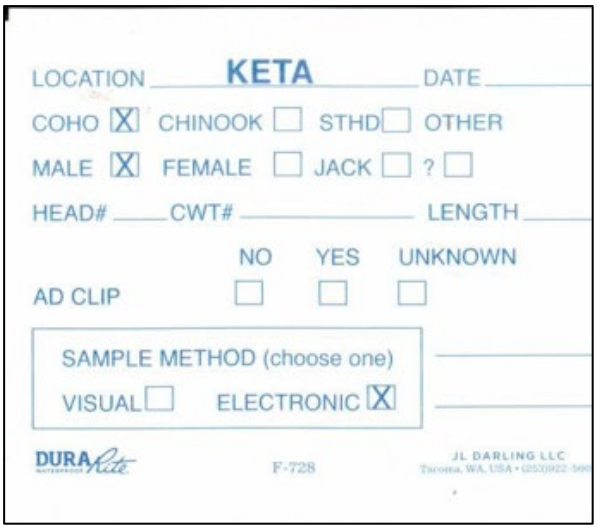
OK / Binary / Re-read (circle one)

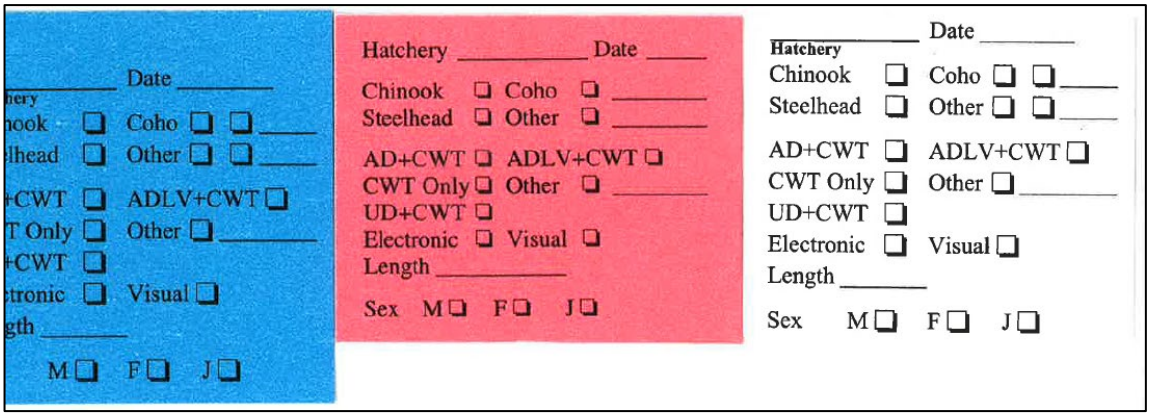
Re-reader initials _____

<<< tape tag here

CWT # _____







APPENDIX D

NMT MANUAL TO REMAGNATIZE A CWT

Northwest Marine Technology, Inc.
Shaw Island, Washington 98286 206/468-2340

BULLETIN

MAGNETIZING AND REMAGNETIZING OF IMPLANTED WIRE TAGS

There are occasional reasons to remagnetize implanted wire tags. They usually arise from inadequate initial magnetization, most commonly the result of lightly anaesthetized fish passing down the QCD non-axially, i.e., somewhat crosswise.

The tags are thus less than fully magnetized, and later attempts at magnetic detection are troublesome. Remagnetization can be accomplished either with a large permanent magnet or with a 110 volt demagnetizer of the open coil type. Either device will provide satisfactory magnetization IF some specific rules are followed. Each has its advantages. The permanent magnet needs no power; the demagnetizer has simpler rules.

For the permanent magnet, the rules have to do with the fashion in which the tag is removed from the magnetic field. The basic idea is to position the tag lengthwise along the strongest magnetic field, and then remove it without passing through regions in which the field reverses direction. The accompanying sketch shows the scheme.

The demagnetizer is simpler. It is an accident of nature that one of these devices can be used as a magnetizer, it works. Here, the rule is simply to align the tag (along with its attached fish or fish head) along the axis of coil, and within the coil as much as possible, and *momentarily* turn the demagnetizer on. The specimen can be removed in any fashion, as long as the demagnetizer is off. The second sketch illustrates this.

It is important to use a large enough device that, with the largest specimen, the tag can be brought into a sufficiently strong magnetic field. For permanent magnets we recommend Part Number S-130 from

Permag Sierra Corp.
1159 Sonora Court
Sunnyvale, California 94086

Price about $150.00.

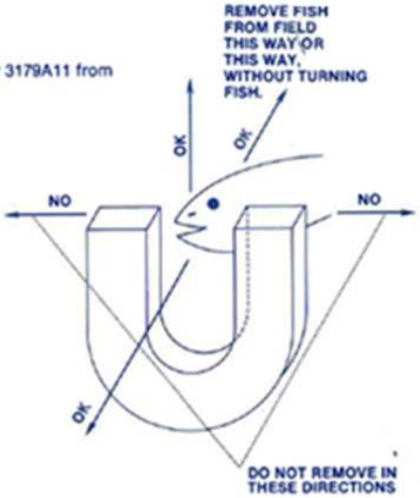
If you prefer the demagnetizer, you might try Part Number 3179A11 from

McMaster-Carr Supply Co.
9601 John Street
Santa Fe Springs, California 90670

Price about $70.00.

If you have persistent difficulties or questions, our phone number is on the letterhead.

DEMAGNETIZER



DO NOT REMOVE IN THESE DIRECTIONS