

# Coastal Northern California Salmonid Spawning Survey Protocol

Prepared By  
Sean P. Gallagher<sup>1</sup> and Morgan Knechtle  
Draft, 19 November 2003

## INTRODUCTION

Coho (*Oncorhynchus kisutch*) and Chinook salmon (*O. tshawytscha*) and steelhead (*O. mykiss*) are listed as Threatened under the Endangered Species Act in coastal Northern California (Federal Register 1997, 1999, 2000). Breeding population size is important for assessing population status (McElhany et al. 2000). The National Marine Fisheries Service focuses on the number of adults escaping to spawn to evaluate the natural viability of salmon populations for recovery planning (Busby et al. 1996). There is a need for a reliable technique for long term monitoring of adult Chinook and Coho salmon and steelhead populations in coastal Northern California.

Spawning surveys; redd counts, live fish observations, carcass mark-recapture surveys, and releases above weirs and counting structures are commonly used to assess salmonid population abundance (Maahs 1997, Rieman and Myers 1997, Susac and Jacobs 1999, Jacobs et al. 2001, Gallagher 2002, 2003, Gallagher and Gallagher In Preparation, Hannon and Healey 2002). The California State Department of Fish and Game's Anadromous Fisheries Resource Assessment and Monitoring Program has been testing, modifying, and evaluating various approaches for estimating salmonid populations in Northern California since its inception in 1999. Spawning surveys, which include redd measurement, redd counts, live fish counts, and carcass marking, in a stratified index sampling scheme (Irvine et al 1992) have been shown to produce reasonable population estimates with reduced field effort (Gallagher 2003, Gallagher and Gallagher In Preparation). The purpose of this Protocol is to describe field methods for collecting information to estimate salmonid escapement in coastal Northern California streams. Predetermined, randomly selected survey reaches (Appendix A) will be surveyed weekly beginning in late-November, with one survey occurring prior to fish entering spawning areas, and continuing until late-April (or when new redds and fish are no longer observed). Some reaches may be temporally surveyed a maximum of two weeks apart and stream flows and/or weather conditions will likely have some bearing on the temporal intensity of surveys. All redds will be identified to species, measured, and geo-referenced. All live and dead fish will be identified, measured, and marked (carcasses only). Redd longevity and observer efficiency in redd detection should be estimated for each watershed each year. The condition of redds measured during previous surveys will be recorded to assess the duration of redd observability and observer efficiency. To further evaluate observer efficiency, one reach should be selected and surveyed by two crews each week, one crew measuring redds and recording data but not flagging new redds, followed by the second crew measuring and flagging all new redds.

## STUDY AREA

The current study area is coastal Mendocino County, although it should be expanded to include other rivers and streams throughout coastal Northern California in a stratified sampling design (Gallagher and Gallagher In Preparation) or a rotating panel design (see the Oregon Plan for Salmonids at [www.oregon-plan.org](http://www.oregon-plan.org)) in order to estimate salmonid escapement within and among ESU's. To determine the entire length of spawning habitat in streams where the extent of spawning habitat is not known, it should be determined by surveying the entire area of suspected habitat during the first year with each survey continuing for about one hour above the last redd observed or to assumed barriers. The Albion River (ALB), Caspar (CAS), Hare (HAR), and Pudding (PUD) creeks, The Little (LTR), Noyo (NOY), Little North Fork Big (LNFB), and the Ten Mile (TEN) rivers are of primary interest due to the history of similar

---

<sup>1</sup> Primary author to whom correspondence should be addressed. California State Department of Fish and Game, 1031 South Main Street, Suite A, Fort Bragg, CA 95437. Phone 707-964-1492. Email: [Sgallagh@dfg.ca.gov](mailto:Sgallagh@dfg.ca.gov). Draft, 11/19/2003.

work conducted on these streams. It is unlikely that, due to time and personnel constraints, other streams will be surveyed during 2003-04.

### Survey Segments

Survey segments (the length of stream that can be surveyed in a day) and reaches (stream segments between two tributaries or other landmarks, from 0.5 to 8 km in length) for priority streams are shown on the survey maps in Appendix A. The entire extent of spawning habitat in Caspar Creek in three reaches; Below Forks (CAS), South Fork (CSF), and the North Fork (CNF) and Little River (LR) will be surveyed due to the history of study of these two streams and the need to look for coho salmon marked and released at the Noyo Egg Collecting Station. Randomly selected reaches (stratified index sampling) will be surveyed on the Noyo River (NOY) and in Hare (HAR) and Pudding creeks (PUD). Specific segment abbreviations for the South Fork Noyo are: North Fork South Fork Noyo (NFS), South Fork Noyo above the North Fork South Fork (SFA), South Fork Noyo below the North Fork South Fork (SFB), and Parlin (PAR). Nine reaches were selected based on professional judgment and history of previous surveys in the Ten Mile River (TEN). Six reaches (approximately 50% of the available spawning habitat) in the South Fork and main stem Albion River (ALB) were selected due to history of previous surveys. The Little North Fork Big River will be surveyed by SONAR. Other streams, given time and resources, will be surveyed to determine extent of spawning habitat, establish survey segments, identify access points, and acquire landowner permission to conduct surveys.

## FIELD METHODS

### Redds and Redd data Form

Each segment or reach should be surveyed every week (see survey schedule; Appendix B) or a maximum of 14 days apart between high flow events. All redds will be marked in the field with flagging to avoid double counting and determine the duration of redd longevity and observer efficiency, measured, and geo-referenced. See the example redd data form (Figure 1) for proper data recording. For safety and to decrease errors in redd identification and measurement, teams of two should walk or raft stream reaches every week. On each survey, surveyors will look for new and old redds and examine all flagging from this season (inspect all flags and look for "REMEASURE" written on them, if it says this, do it! And write on the flag that you did!).

### Header Information

Fill in redd and fish data forms header information for each survey even if nothing is observed (Figure 1, Appendix C are blank data forms. Note: extra space for detailed notes is on the back of both data forms). Use the stream name, segment or reach name or number, and map number from the map of the segment you are surveying. If you are surveying a stream that has multiple reaches, use a new data form for each segment and write the section number in the section space in the data form header, even if no redds are observed. It is very important to keep the data for each reach separate and identify the reach each redd came from. For surveys in streams with multiple reaches, redds at the lower end of the section which are on the boundary line are not counted, those at the upper end of the section that are on the boundary line are counted. Record the date of the survey. If a survey section takes more than one day note the date of the second day in the notes. The week number is the Julian week, the first week in January is week one and the last week in December is week 52. Write the names of the people doing the survey in the surveyor's space. The map number is shown on the header information on the map page for each reach, record that number here. Record the air and water temperature in centigrade and estimate the water visibility in meters with the survey rod as the visible depth to the stream substrate. Estimate the stream flow at the bottom end of each survey section or record the stage from the stage gauge, if present. A quick way to estimate the stream flow is to; (1) measure the wetted width of the channel perpendicular to the flow (in meters) in a run area that lacks surface turbulence, under cut banks, and overhanging vegetation; (2) measure the depth of the water (in meters) across the channel at three or four points and average these; (3) multiply the width by the average depth; (4) hold the wadding staff parallel to the stream flow just above the water surface so that you have one meter in view, use a leaf or spit at the top end of the one meter mark on the wadding staff

while using the second hand of a watch or counting one-one thousand, etc to estimate how long it takes the leaf to float one meter; (5) multiply the number of seconds it took the leaf to float one meter by the result from number 3 above, which results in flow in cubic meters per second. Record the drive time as the total drive time to and from the survey site. Record the start and end time of the survey as the time from leaving the vehicle until returning to it. Record the current weather conditions (i.e. sunny and cold, light wind, etc.). Note conditions of importance such as land slides or road conditions or changes in stream visibility.

Identify each redd to the species assumed to have made it. This will improve with experience, generally steelhead (onmy) redds have a distinct pot and tail spill and often have larger substrate in the pot. This may not be true in all cases. Coho salmon (onki) redds are generally large and the pot has smaller substrate. After you see a few coho on redds you will get a feel for how they look. Chinook salmon (onts) redds are large and similar to coho redds. Lamprey (latr) redds are usually small round pots with little or no tail spill and have fine particles in the pot. The above descriptions are generalities and experience is the only way to learn to identify the redds when fish are not observed. Use the species codes on the data form.

### Flagging

For all redds record the Record Number, Species Code, CDFG, the number of redds, the total redd length and maximum redd width, and the year on the flagging (see Figure 2 as an example). If there are multiple redds in a riffle, note the location of the redd on the flag as left bank (lb), right bank (rb) looking down stream, or middle (mid). Tie the flagging securely to the closest **solid living thing** directly above and perpendicular to the pot of the redd. **Do not step or walk on redds**. Preferably tie the flag so it hangs right over the top of the pot. If you can not hang the flag above the pot or very near the redd, record the direction and distance to the redd from where you tied it (write this on the flagging). If it's a test redd or under construction, write **REMEASURE** on the flagging and in the notes. Examine all flags during each survey (See Redd Age, below). If the redd was identified as test during previous surveys and it has changed (i.e. gotten larger) or is now clearly a redd of one species of another, record the Record Number from the flagging on the data form and re-measure the redd. Cross out test and remeasure on the flagging and write the redd species and date on the flagging. Leave the record number unchanged. Record all appropriate data. Record the location of the redd on the map.

### Mapping

Mark the location of all new redds on the field maps. Pay attention to stream and landform features such as left (look down stream) and right bank tributaries, notable river bends, and other features to keep track of your location so that when you find a redd you can place it's location on the map. Draw a dot on the map and connect this with a line to a place on the map away from the stream where you can write the record number for the redd (Figure 3). Record this on the map for all redds observed. If there were no redds or fish observed for a survey, there is no need to include the map in the data packet at the end of the day. Reuse this map on a future survey.

### Record Number

Each redd and fish gets a unique individual record number. The Record Number consists of an alphanumeric code. The alphabetical part is the stream name code (see above, Survey Reaches). For instance, a survey on a reach in Hare Creek would have the abbreviation HAR. This is followed by six numbers. The first two are the month, 01 would be January and November would be 11. The second two numbers are the day of the month such that the second of the month would be 02 and the 15<sup>th</sup> would be 15. The following three numbers range from 001 to 999 and each redd and fish gets a consecutively higher number each day. For example, you see a fish on a redd during a survey in the Noyo River on February 15<sup>th</sup>, the number for the redd would be NOY0215001 and the fish would be NOY0215002. In instances where more than one crew is on a river (surveying separate segments) divide the 001-999 by the number of crews. The crew on the lowest segment gets the lowest set of numbers and the crew on the highest segment gets the highest set of numbers. For example, three crews are in Pudding Creek on the same day, the lower crew gets 001-333, the middle crew uses 334-666, and the crew surveying the upper segment gets 667-999. Make sure each crew knows their numbers before you leave the office. This should be the second to last

thing you do before you leave, the first being that you have all the necessary equipment, maps, and data forms and know where you and all other crews are going. Write the record number on the flagging for each redd and on the data form. This number should be recorded on the maps for each redd observed and on the data forms.

### Species

Visually identify the species of each redd to the best of your abilities. Use the species code on the data form for fish and redds. Record this on the data form and on the flagging. If a redd is under construction and a fish is on the redd and you clearly identify it, use the species code (i.e. Onmy, Onki, Onts, or Latr), record all data and write "Remeasure" in the notes and on the flag. If the redd is classified as test or under construction write this on the flagging and record the total length and width (sum of the pot and tail spill length and the maximum width) on the flagging with the word **REMEASURE**. If you come across a flag with the above on it, re-measure it. If it is now clearly one species or another use this species code with the previously used record number on the data form, record all appropriate data on the data form. If it hasn't changed don't re-measure it. Do note the redd age (see Redd Age, below). If you remeasure a test redd and reclassify it, cross out "test" and "remeasure" on the flagging and write the species and date on the flag. Leave the original record number on the flag.

### Redd Measurements

The purpose of measuring redds is to accurately estimate the area of the redd so that these data can be used to differentiate species and estimate escapement. The pot area and tail spill area are calculated from the field measurements treating the pot as a circle or ellipse and the tail spill as a circle, square, triangle, or rectangle depending on the individual measurements. The figure on the top of the redd data form is an idealized redd showing where each measurement should be taken (Figure 1). In most cases the redds you find in the stream will not conform to this idealized shape. In these cases, remember that we are interested in calculating the total area of the redd. So measure them such that this is possible. The examples in Figure 4 shows some of the common "unusual" redd shapes we've encountered and where and how to measure these such that the area can be best calculated.

### Pot Dimensions

Pot Length (PL) is the total length of the pot parallel to the stream flow in meters to the nearest decimeter (Figure 1). Measure in meters from the top to bottom edge. When the pot is irregularly shaped, do your best to estimate the total length (Figure 4). Record this information on the data form.

Pot Width (PW) is maximum width of the pot perpendicular to the stream flow or pot length in meters to the nearest decimeter. Measure in meters from one edge to the other. When the pot is irregularly shaped, do your best to estimate the maximum width (Figure 4). Record this on the data form.

Pot Depth (PD) is the maximum depth of the excavation relative to the undisturbed stream bed (Figure 5) in meters to the nearest decimeter. Use the staff to measure the depth. Record this on the data form in meters.

Pot Substrate (PS) is the size of the dominant substrate in the pot. Visually estimate, using your staff gauge to calibrate your eye, the size of the dominant substrate in the pot in centimeters. The substrate size is the length of the diameter of the smallest axis that will pass through a sieve, in centimeters. Record this on the data form.

### Tail Spill Dimensions

Tail Spill Length (TsL) is the total length of the tail spill parallel to the stream flow in meters to the nearest decimeter (Figure 1). Measure it in meters from the top edge of the middle of the pot to bottom edge of the tail spill. When the tail spill is irregularly shaped, do your best to estimate the total length (Figure 4). Record this on the data form.

Tail Spill Width 1 (TSw1) is the maximum width of the tail spill perpendicular to the stream flow or pot length in meters to the nearest decimeter. Measure it in meters from one edge to the other **1/3** of the distance down from the top of the tail spill. When the tail spill is irregularly shaped, do your best to estimate the maximum width (Figure 4). Record this on the data form.

Tail Spill Width 2 (TSw2) is the maximum width of the tail spill perpendicular to the stream flow or pot length in meters to the nearest decimeter. Measure it in meters from one edge to the other **2/3** of the distance down from the top of the tail spill. When the tail spill is irregularly shaped, do your best to estimate the maximum width (Figure 4). Record this on the data form.

Tail Spill Substrate (TS) is the size of the dominant substrate in the tail spill in centimeters. Visually estimate, using your staff gauge to calibrate your eye, the size of the dominant substrate in the tail spill in centimeters. The substrate size is the length of the diameter of the smallest axis that will pass through a sieve in centimeters. Record this on the data form.

#### Fish On Redd

If you observe a fish on a redd (record yes) do your best to identify it to species. Record the fish record number in this column and on the fish data form with all the appropriate data **write remeasure in the notes and on the flag**. If the fish is on the redd and you don't want to disturb it, visually estimate all redd and fish data, record this on the data forms and that you visually estimated the measurements, and flag the redd, **write remeasure on the flag and in the notes**. If there was no fish then record no. It is important that all fish on redds are recorded on both data forms, with the data completely filled out. Do not skip this. If you have to, visually estimate the redd measurements. Record every thing on the data forms.

#### Redd Age

To determine how long we are able to observed redds we are going to estimate the redd age and record if and when it was previously measured. Record the redd age as 1 = new since last survey, but still clear. 2 = Still measurable but already measured. 3 = No longer measurable but still apparent. 4 = No redd apparent only a flag. 5 = Poor conditions can not determine if measurable or not. On a subsequent survey when a redd is no longer apparent and the flag is still there, record a 4 in this column and write 4 and circle it on the flag. Note you did this in the notes. During surveys when you find a redd flag with a circled 4 on it, just keep on going there is no need to record any further information about this redd. If however, a new redd has been constructed in this spot do note the presence of the old 4'd flag in the notes and record all information for this new redd.

#### Notes

Record if the redd is irregularly shaped (not a circle, ellipsis, oval, square, or rhomboid). What shape is it? Record the part of the stream where the redd is located (in the middle, side or edge, above or under a log, etc.). Record other pertinent information, stuff that won't help our understanding, such as two salamanders in hole, is not needed. Use the back of the page with the record number followed by additional information.

Page \_\_ of \_\_ Page

The redd data form is page 1 to n, depending on how many redd data forms are used for each survey. The fish data form is page 2 or n +1, depending on how many redd data forms are used for each survey, to fish page n. If there are no redds or fish, don't include the maps, otherwise the map pages are the next numbers consecutively following the fish data page numbers. Fill out the entire data forms for each survey, even if nothing is observed. Staple together and file appropriately when you return to the office at the end of the day.

Each segment should be surveyed every week. All fish observed will be identified to species, length and sex visually estimated, and certainty of identification noted. All carcasses will be measured, sexed, and tagged with uniquely numbered hog ring tags. Tag carcasses with a uniquely numbered metal tag attaching it **only** to the lower left jaw. If the fish has no lower jaw it is considered a skeleton (or part of a fish), record all information on skeletons and note in the notes that is what it is. Recaptured carcasses tag numbers will be recorded. Look for floy tags and operculum punches on all carcasses. If the carcass is fresh (eyes still there and clear) take scales and tissue. See below and the example fish data form (Figure 6) for proper data recording. Do not flag or map fish.

#### Header Information

Fill this part of the data form as you did for the redd data form. Fill it out even if you don't see any live fish or find any carcasses.

#### Record Number

The record number is a unique individual number for each fish (or redd). The system is the same as for redds. Fish and redds are numbered consecutively from the first observation each day, recaptured carcasses don't get a new record number. Wait until you return to the office and look up the tag number on previous surveys' data forms (or in database) to find this information. Record the Record Number on the data form. It consists of an alphanumeric code. The alphabetical part is the stream name code (see above, Survey Segments), for instance a survey on a reach in Hare Creek would have the abbreviation HAR. This is followed by six numbers. The first two are the month, 01 would be January and November would be 11. The second two numbers are the day of the month such that the second of the month would be 02 and the 15<sup>th</sup> would be 15. The following three numbers range from 001 to 999 and each redd and fish gets a consecutively higher number each day. For example, you see a fish on a redd on a survey in the Noyo River on February 15<sup>th</sup>, the number for the redd would be NOY0215001 and the fish would be NOY0215002. In instances where more than one crew is on a river (surveying separate segments) divide the 001-999 by the number of crews. The crew on the lowest segment gets the lowest set of numbers and the crew on the highest segment gets the highest set of numbers. For example three crews are in Pudding Creek on the same day, the lower crew gets 001-333, the middle crew gets 334-666, and the upper segment gets 667-999. Make sure each crew knows their numbers before you leave the office. This should be the second to last thing you do before you leave, the first being that you have all the necessary equipment, maps, and data forms.

#### Species

Visually identify the fish species to the best of your abilities. Use the species code on the data form for fish and redds. Record this on the data form. If a redd is under construction and a fish is on the redd and you clearly identify it, use the species code (i.e. Onmy, Onki, Onts, Latr, or Unkn) for the redd and the fish, write "under construction" in the notes and "remeasure" on the redd flag.

#### Identification

Chinook salmon have a black mouth with black gums, 13-19 anal fin rays, a narrow caudal peduncle, the caudal fin rays are smooth, they have large black spots on the back and both lobes of the caudal fin, and a generally thick body. Males generally have a pronounced kype and females don't. Ripe females are generally rotund.

Coho salmon have a black mouth and white gums, 13-19 anal fin rays, a wide caudal peduncle, small black spots on the upper back and upper lobe of the caudal fin only, and a generally thick body. Males generally have a pronounced kype and females don't. Ripe females are generally rotund.

Steelhead have a white mouth and white gums, 8-12 anal fin rays, a wide caudal peduncle, the caudal fin rays are smooth, small black spots on the back, uniform rows of black spots along the caudal fin, and a generally slender body. Males generally have pronounced to somewhat pronounced kype, very pink

operculum, and a pink stripe along the lateral line. Ripe females are generally rotund, no kype, and a pink stripe along the lateral line.

The above identifications mainly rely on relative differences so that you may need to have two species in hand to tell them apart (i.e. wide versus narrow caudal peduncle). As with any key, you should use combinations of the above characteristics to identify fish. As a general rule, if you see the mouth, (I've found it the best character) and can tell the color of mouth and gums this is most desirable. Don't rely on things not in a taxonomic key, such as the size of the eye or color of the adipose fin, to determine species. If you can't tell, it's unknown.

#### Certainty of Observation

If you see a number of the above characteristics and you are sure of the species and/or sex use a 1 in this column. If you are pretty sure and saw some of the above, but not the mouth use a 2 in this column. If you are only somewhat sure, only saw the fish briefly, or you don't know use a 3.

#### Fish on Redd

If you observe a fish on a redd (yes) do your best to identify it to species. Record the redd record number in this column and on the redd data form with all the appropriate data. If there was no fish then record no. It is important that all fish on redds are recorded on both data forms, with the data completely filled out. Do not skip this. If you have to, visually estimate the data. Record every thing on the data forms.

#### Live or Carcass

If live write "live" in this space. If it's a carcass fill in with "Carc." If it's a carcass check for tags, operculum punches, and fin clips. Record this information. If it's fresh (clear eyes) take scales (see Figure 7) and tissue, record this in the notes column. Tissue samples are generally a five cm square taken from the upper portion of the caudal fin. Fold the tissue sample in write in rain paper and place the sample in an envelope and record all pertinent information (as for scales, Figure 7) and note this is a tissue sample. Place the tissue sample in the tissue drier when back at the office.

#### Carcass Tag Number

If it's a carcass and untagged, tag it and record the number here. Only tag carcasses on the lower left jaw. If it has no jaw it is a skeleton. Record all data for skeletons and write skeleton in the notes section of the data form. If it's a recapture record the tag number here and write yes in the recapture column.

#### Carcass Recapture

Simple yes or no. If it has a hog tag enter "yes" and record the number in the tag number column. If it has a floy tag see below. Recaptured fish don't get a new record number. Wait until you return to the office and look up the tag number on previous surveys' data forms (or in data base) to find this information.

#### Floy Tag Number

If it has a floy tag and it's a live fish, try and read the number. Record this information. If it's a carcass and has a tag or a loose tag found in the stream, enter the number in this column.

#### Floy Tag Color

For a live fish observation that you are both positive a floy tag is present and positive of floy tag color, enter color of tag in this column. If you are positive the live fish has a floy tag, but not on floy tag color, enter a 2 in this column. If you are positive the live fish has no floy tag (all floy tags will be on the left side of the fish just below the dorsal fin) enter a 3 in this column. If you are not sure if the live fish had a floy tag, enter a 4 in this column. For a carcass with a floy tag, enter color of tag in this column. For a carcass

without a floy tag enter a 3 in this column. For a loose floy tag found in the stream enter tag color in this column. Issue a record number for a loose floy tag found in the stream. Please pick up and bring back to the office all floy tags found in carcasses/skeletons or found loose lying in the stream. Treat floy tags found in skeletons as if they were loose tags, record all information and write came from skeleton in the notes.

#### Fin Clip, Operculum Punch, or Brand

Look for Left or Right Maxillary, Left or Right Pelvic, Upper or Lower Caudal Fin Clips, and Operculum Punches on live fish and carcasses. If they have one or more of these, record what it is. Do not use abbreviations for fin clips as it can be confusing. Write out the clip type in full, if there is not enough room use the notes section and back of the data form. Use the notes column to record more information.

#### Notes

Record other pertinent information, stuff that won't help our understanding, such as two logs over the stream or nice fish, is not needed. Use the back of the page with the record number followed by additional information.

#### Page \_\_ of \_\_ Page

The redd data form is page 1 to n, depending on how many redd data forms are used for each survey. The fish data form is page 2 or n +1, depending on how many redd data forms are used for each survey, to fish page n. If there are no redds or fish, don't include the maps, otherwise the map pages are the next numbers consecutively following the fish data page numbers. Fill out the entire data forms for each survey, even if nothing is observed. Staple together and file appropriately when you return to the office at the end of the day.

#### Back at the Office

Put data forms in order and make sure every thing is filled out properly. Staple together and file in proper spot. Don't leave data forms in the data box or lying about the office, unless the forms are wet and need to dry. Store all equipment in the proper place. If you finish early, enter the data into the data base at the end of each day. All data should be entered into the data base at the end of each day, unless you get back late.

#### Notes on Field Safety

Always work in pairs. Bring extra food, water, and clothing. Plan your route and always look ahead while walking in the stream and especially while kayaking downstream. Bring all appropriate safety gear while kayaking. Bring the satellite phone and office and home phone numbers of coworkers (AFRAMP office and home phone numbers are programmed into the phones memory, other numbers can be added as needed). Make sure other crews know what segment you're doing each day and ETA for return to the office. Don't ride the quads (aka ATV's) if you've not had the proper training. Use extra caution when loading and unloading the quads. Park the truck so that the truck is level and the rear tires are down slope so that the tail gate is as close to the ground as possible and so that the ramp is more level than steep. **Wear the Helmet at all times.** While unloading put the atv in 4 low, lean forward while going up and down the ramp. Don't sit. Or unload by putting the quad in four low and reverse and walking it down the ramp. Pay attention to what you are doing. Don't speed and watch for other traffic. Be respectful of the locals and drive < 15 MPH on all roads (see Irmulco Road Corporation's Road use recommendations, Appendix D). Drive slowly past all residences. Don't drive in the ditch. Drive with the lights on. There is a spare key for all the AFRAMP Fort Bragg vehicles in the brake light above the cab. If you're not done with the survey and it's getting on towards 4 pm, stop the survey and return to office. Always plan to be back by 5pm. All crew members should have ATV, CPR/First Aid, and Swift Water Rescue training.

#### References

- Busby, P., Wainwright, T., Bryant, G., Lierheimer, L., Waples, R., Waknitz, W., and Lagomarsino, I. 1996. Status Review of West Coast Steelhead from Washington, Idaho, Oregon, and California. National Oceanic and Atmospheric Administration, Springfield, VA 22161. NOAA Technical Memorandum NMFS-NWFSC-27. 261 pp.
- Federal Register. 2000. Endangered and Threatened Species: Threatened Status for one Steelhead Evolutionarily Significant Unit in California. Federal Register, Washington D.C. 65: 36704-36094.
- Federal Register. 1999. Endangered and Threatened Species; Threatened Status for two Chinook Salmon Evolutionarily Significant Unit (ESU) in California; Final Rule. Federal Register, Washington D.C. 64: 50933-50415.
- Federal Register. 1997. Endangered and Threatened Species: Threatened Status for Coho salmon in the Southern Oregon/Northern California Coast Evolutionarily Significant Unit in California. Federal Register, Washington D.C. 62: 24588-24609.
- Gallagher, S. P. 2003. Development and application of a technique to distinguish between Coho salmon (*Oncorhynchus kisutch*) and steelhead (*Oncorhynchus mykiss*) redds and estimate adult populations from spawning surveys in several coastal Mendocino County rivers. California. California State Department of Fish and Game, Steelhead Research and Monitoring Program, Fort Bragg, CA. 954374. 70pp. Draft.
- Gallagher, S. P. 2002. Results of the 2000-2001 Coho salmon (*Oncorhynchus kisutch*) and steelhead (*Oncorhynchus mykiss*) spawning surveys on the Noyo River, California. California State Department of Fish and Game, Steelhead Research and Monitoring Program, Fort Bragg, CA. Report FB-09-Draft, November 2001. 61 pp.
- Hannon, J. and Healey, M. 2002. American River steelhead redd surveys, 2001-2002. U.S. Bureau of Reclamation, Sacramento, CA. 19 pp.
- Irvine, J. R., Bocking, R. C., English, K. K., and Labelle, M. 1992. Estimating Coho (*Oncorhynchus kisutch*) spawning escapements by conducting visual surveys in areas selected using stratified random and stratified index sampling designs. Can. J. Fish. Aquat. Sci. 49:1972-1981.
- Jacobs, S., Firman, J., and Susac, G. 2001. Status of Oregon coastal stocks of anadromous salmonids, 1999-2000; Monitoring program report number OPSW-ODFW-2001-3, Oregon Department of Fish and Wildlife, Portland, Oregon. 83 pp.
- Maahs, M. 1997. The 1996-97 Salmonid Spawning Survey for Portions of the Ten Mile River, Garcia River, and Caspar Creek. Prepared for the Humboldt County Resource Conservation District. Salmon Trollers Marketing Association, Inc., Fort Bragg, California. 26 pp.
- McElhany, P., M. Ruckelshaus, M. Ford, T. Wainwright, and Bjorkstedt, E. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-42, 158p.
- Rieman, B. E. and Myers, D. L. 1997. Use of redd counts to detect trends in bull trout (*Salvelinus confluentus*) populations. Conservation Biol. 11:1015-1018.
- Susac, G., L., and Jacobs, S. E. 1999. Evaluation of spawning ground surveys for indexing the abundance of winter steelhead in Oregon coastal basins. Annual progress report 1 July 1997 to 30 June 1998. Oregon Department of Fish and Wildlife, Corvallis, Oregon. 25 pp.

|   |  |   |  |  |
|---|--|---|--|--|
| Stream Name:<br><b>Hayworth creek</b>               | Water Temp. (°C):<br><b>8</b>  | Species Codes:<br>Redd = CR<br>Substrate = CR<br>Flow = CR<br>Fish = CR<br>Fish = CR<br>Fish = CR |  | Directions: Visually identify each redd to species. Record the record number. Mark redd location with record number on the map. If a fish is on a redd record this on both fish and redd data forms, write fish number of redd form and redd number of fish form. If you can not measure a redd visually estimate the dimensions, record in appropriate spaces on data form, and write in the notes "estimated measurements." Flag all redds and write record number, species, year, and total length and width of redd on the flag. If test or under construction write "REMEASURE" and total length and maximum width on the flag. Remeasure all test and under construction redds on next survey. Redd age: 1 = New since last survey. 2 = Still measurable. 3 = Not measurable but still apparent. 4 = No longer there. 5 = poor conditions- can not measure or determine age. |
| Section:<br><b>Mouth to Barrier</b>                 | Drive Time (hrs):<br><b>3.5</b>  | Date:<br><b>2/15/2003</b> Week:<br><b>7</b>   |  |  |
| Start Time:<br><b>0900</b> End Time:<br><b>1500</b> | Weather:<br><b>Light rain then clearing</b>                                | Notes:<br><b>Flow lower than last week stage height = 1.15</b>                                    |  |  |
| Air Temp. (°C):<br><b>9</b>                         | Water Viability (m):<br><b>1.20</b> Flow m <sup>3</sup> /s:<br><b>0.62</b> |   |  |  |

| Record Number<br>Stream Month Day 000-999<br>Example: NoY0101001 | Species<br>Use Codes | Pot Dimensions   |                 |                |                 | Tail Spill Dimensions |                     |                     |                           | Fish On Redd?<br>No/Yes (If Yes)<br>Record Fish # | Redd Age<br>1-5 | Notes<br>Continue Or Back If Needed              |
|--|----------------------|------------------|-----------------|----------------|-----------------|-----------------------|---------------------|---------------------|---------------------------|---|-----------------|--|
|  |                      | Length (m)<br>PL | Width (m)<br>PW | Depth (m)<br>D | Substrate<br>PS | Length (m)<br>TSL     | Width 1 (m)<br>TSw1 | Width 2 (m)<br>TSw2 | Substrate (cm)<br>TS Sub. |   |                 |  |
| NoY0215001   | Onki                 | 2.2              | 1.9             | 0.2            | 8               | 3.2                   | 1.8                 | 1.4                 | 6                         | YES NoY0215002<br>NoY0215001                      | 1               | Wrote remeasure on flag & estimated measurements |
| NoY0116006   | Onki                 | 2.6              | 2.2             | 0.15           | 7               | 4.1                   | 2.2                 | 1.6                 | 5                         | NO  | 2               | was test, remeasured now it's on ki.             |
| NoY0215004   | Onmy                 | 1.8              | 1.6             | 0.1            | 10              | 2.1                   | 1.5                 | 0.9                 | 8                         | NO  | 1               |  |
| NoY0215005   | test                 | 0.9              | 1.0             | 0.05           | 2               | 1.2                   | 0.9                 | 0.3                 | 5                         | YES<br>NoY0215006                                 | 1               | Wrote remeasure on flag.                         |
| NoY0215007   | Unkn                 | 3.3              | 2.5             | 0.25           | 13              | 4.8                   | 2.5                 | 1.5                 | 7                         | NO  | 1               |  |
| NoY1217011   | Onki                 | 2.8              | 2.2             | 0.15           | 7               | 2.5                   | 2.1                 | 1.8                 | 9                         | NO  | 2               |  |
| NoY0122012   | Onki                 | 2.2              | 2.1             | 0.10           | 5               | 3.6                   | 2.0                 | 1.5                 | 7                         | NO  | 2               |  |
| NoY0215009   | Onmy                 | 1.7              | 1.5             | 0.20           | 4               | 2.1                   | 1.3                 | 0.7                 | 6                         | YES<br>NoY0215010                                 | 1               |  |
| NoY1202002   | Onki                 | -                | -               | -              | -               | -                     | -                   | -                   | -                         | NO  | 4               | flag only wrote (4) on flag.                     |

Figure 1. Example of properly filled out redd spawning survey data form.

**1 ONMY REDD NOY0115001 CDFG 2003**  
**Length = 2.4 Width = 1.4 Remeasure**

properly labeled flagging.

Figure 2. Example of

# Map 20A Hayworth Creek to Soda Creek (1 of 2)

Surveyors: Nahtic L.  
Matt C.

Date: 2/15/2003

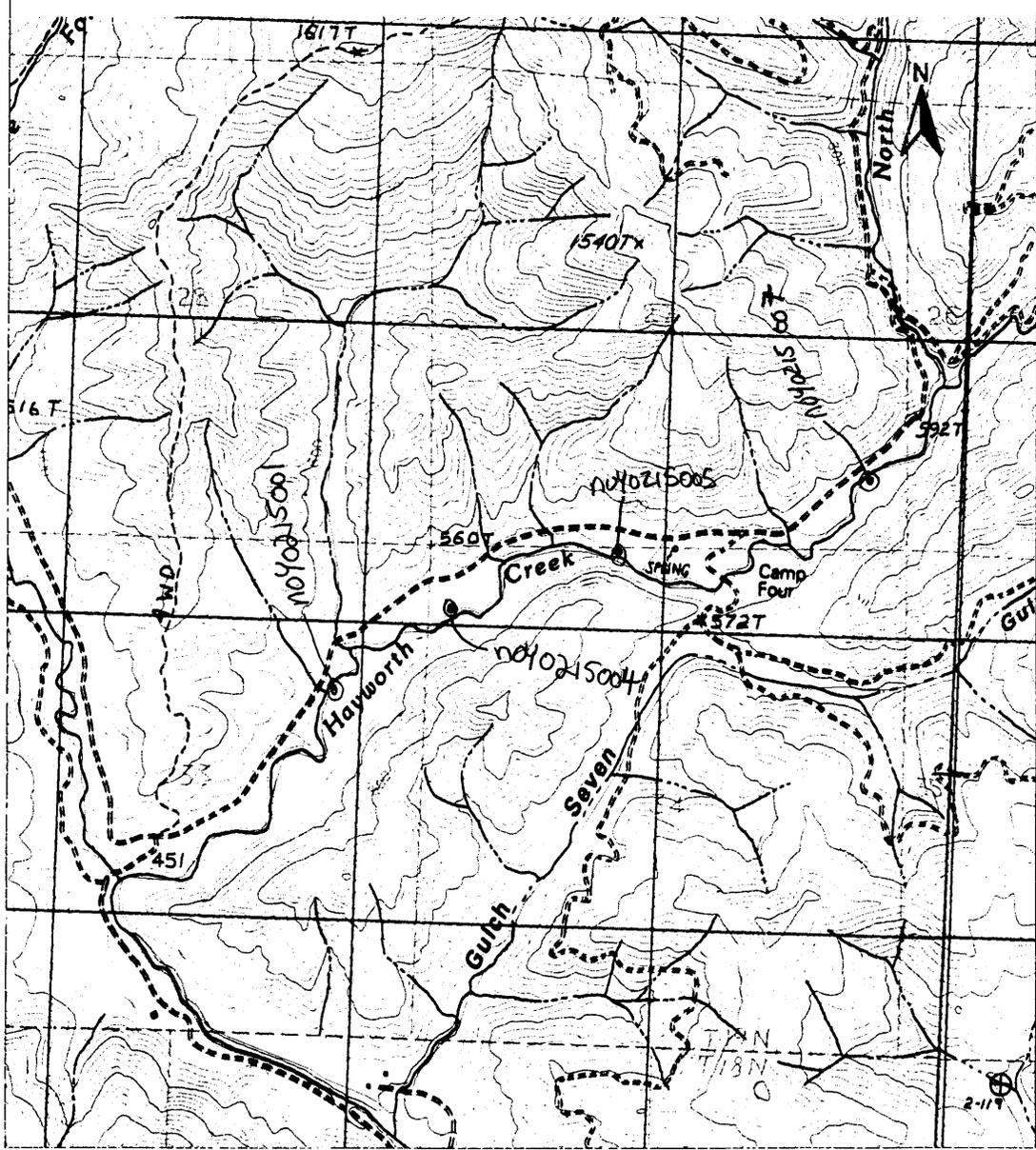


Figure 3a. Example properly filled out map survey page with redd locations and record numbers tied to redd data form.

# Map 20B Hayworth Creek to Soda Creek (2 of 2)

Surveyors: Natalie L. M.A.C.

Date: 2/15/2003

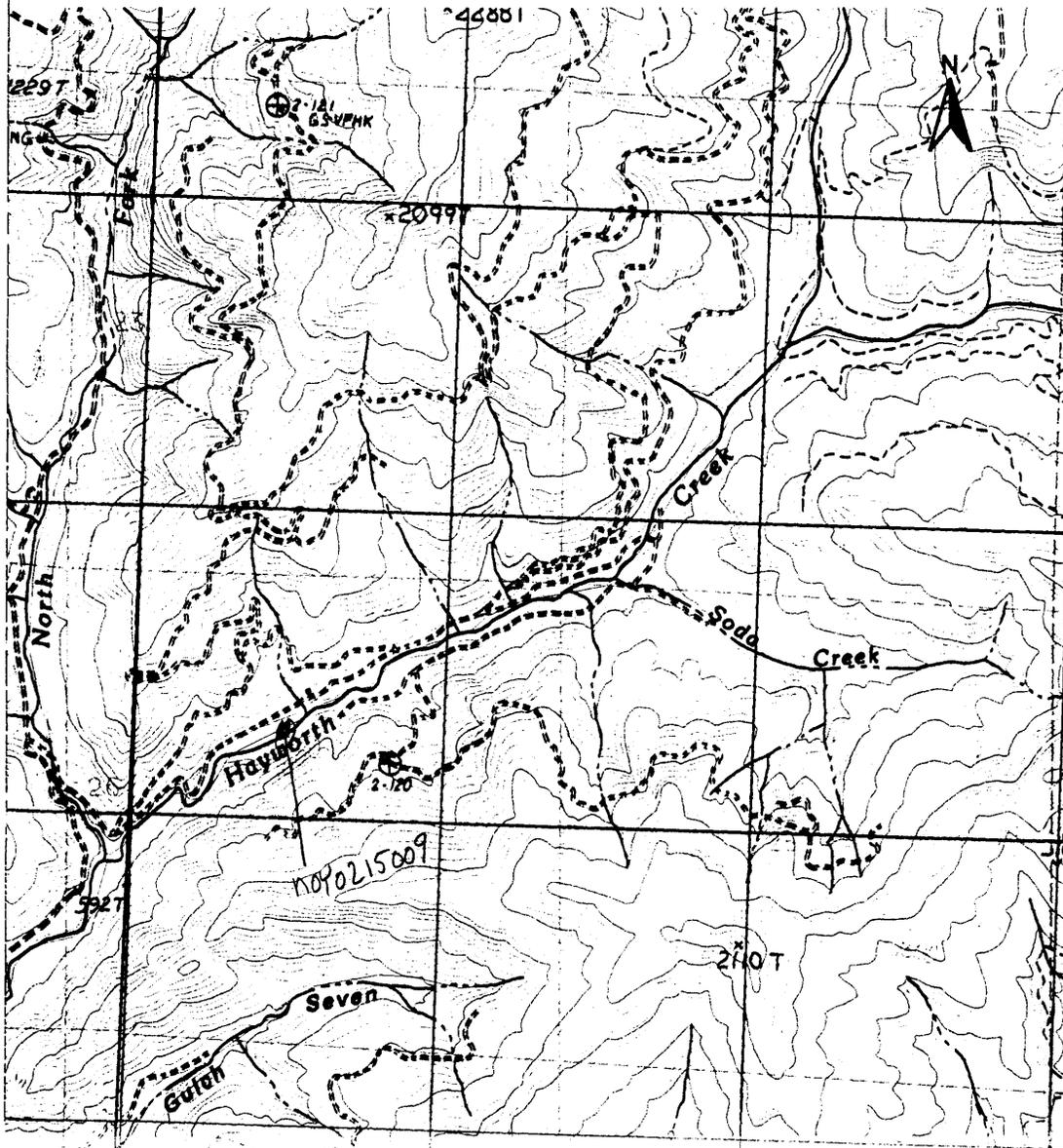


Figure 3b. Example of a properly filled out map page denoting redd record numbers and locations.

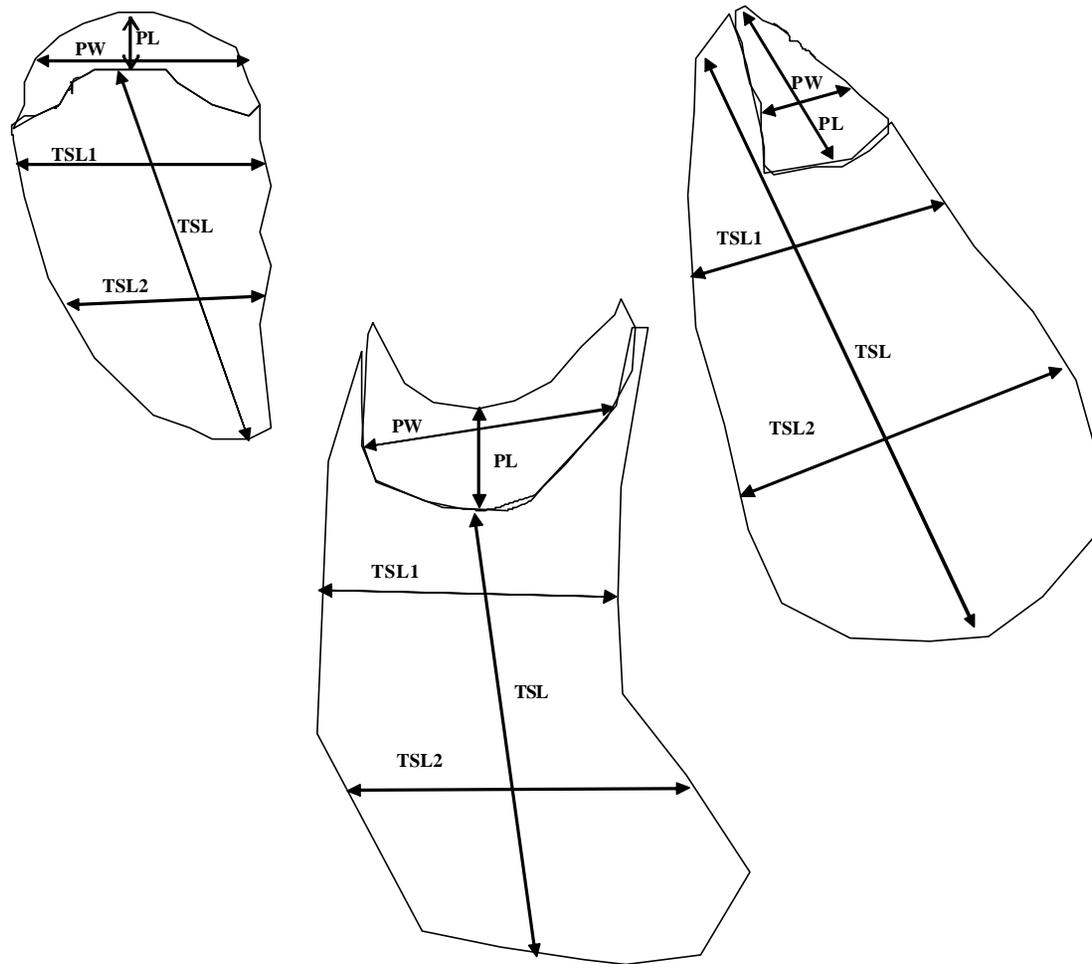


Figure 4. Measurements locations for unusual shaped redds.

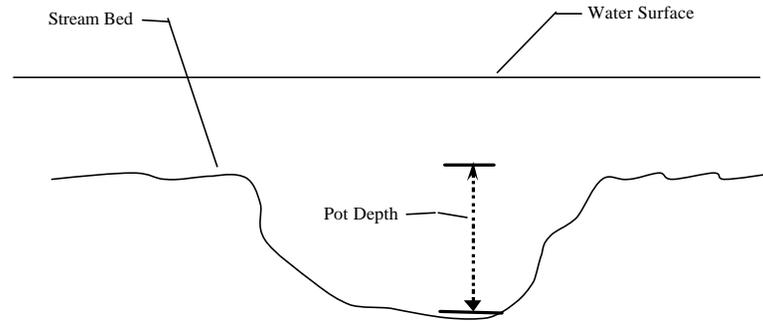


Figure 5. Cross section of a redd pot. Pot Depth is the distance from the bottom of the pot to the water surface minus the distance from the water surface to the stream bed.

|   |   |   |  |   |
|---|---|---|--|---|
| Stream Name:<br>Haywood Creek             | Water Temp. °C: 8   | Species Code:<br>Onki = Coho                        | CERTAINTY OF IDENTIFICATION:<br>1 = Saw size mouth, gills, lips.<br>2 = May be one species or another didn't see all characteristics.<br>3 = Unknown.  | PAGE 2 OF 4   |
| Section:<br>Maurto Backer                 | Drive Time (hr): 3.5                                      | Onmy = Steelhead                                    |  |   |
| Date:<br>2/15/2003                        | Week:<br>7  | 0900 Start Time: 1500 End Time:                     | Ons = Chinook  | Onki: black mouth/white gills; 13-19 anal fin rays, wide caudal peduncle, caudal fin rays rough, small black spots on upper back and upper lobe of caudal fin only. Males: Preannounced type. Females: None.<br>Onmy: White mouth/gills; 6-12 anal fin rays, wide caudal peduncle. Caudal rays smooth, small black spots on upper back and in soft-ray rows along caudal fin. Males: preannounced to somewhat preannounced type, very pink along lateral line and on operculum, slender body. Females: Very robust (when ripe), no lips, pinkish along lateral line.<br>Ons: Black mouth/pink, 13-19 anal fin rays, narrow caudal peduncle, caudal fin rays smooth, large black spots on both lobes of caudal fin. Males: Preannounced type. Females: None. |
| M.A.H. column<br>with 5 bars<br>Surveyors | Map: 20A-B  | Weather: 6+ rain then sun                           | Latr = Lamprey   |   |
| Air Temp. °C: 9                           | Notes:<br>Flow down since last week<br>stage height = 115 | Sex Code:<br>F = Female<br>M = Male<br>Ua = Unknown | Directions: Identify each fish in species and sex. Record certainty of identification using codes. Record if a fish is on or near a road and write the road record number on the fish data form and the fish record number on the fish data form. Look for tags, clips, or brands on the fish, record if observed. If none, or visually estimate (using the wading staff as a guide), the fish length and sex. Mark all carcasses with a numbered tag ring. Write the tag number in the tag column. If it's a recapture, write the tag number in the tag column and rec in the recapture column. For recaptures record as much information as you can. |   |
| Water Visibility (m): 1.20                | Flow (m/s): 0.62  |   |  |   |

FILL OUT FORM EVEN IF NO FISH OBSERVED!

| Obs. # | Record Number<br>Stream/reach/day/9-999<br>Example: N0901010 | Species | Certainty of Identification | Sex | Certainty of Identification | Fork Length (cm) | Fish on Road?<br>No/Yes<br>If yes Road # | Carcass Data  |               | Live Fish Tag Data |               | Clip/Oper. punch?<br>What is it? | Notes<br>Continue on back if needed |                      |
|--------|--|---------|-----------------------------|-----|-----------------------------|------------------|--|---------------|---------------|--------------------|---------------|----------------------------------|-------------------------------------|----------------------|
|        |  |         |                             |     |                             |                  |  | Live/Carcass? | Carcass Tag # | Recapture?         | Tag<br>Number |                                  |                                     | Color                |
| 1      | N040215002   | onki    | 1                           | F   | 1                           | 70               | yes<br>N040215001                        | Live          | -             | no                 | ?             | pink                             | none                                | On road with 0215003 |
| 2      | N040215003   | onki    | 1                           | M   | 3                           | 65               | yes<br>N040215001                        | Live          | -             | no                 | none          | -                                | none                                | on road with 0215002 |
| 3      | N040215006   | onmy    | 2                           | F   | 2                           | 75               | yes<br>N040215005                        | Live          | -             | no                 | none          | -                                | none                                |                      |
| 4      | N040215008   | onts    | 1                           | F   | 1                           | 95               | no                                       | car           | 35            | no                 | none          | -                                | lost maxillary                      | head only.           |
| 5      | N04?   | onki    | 1                           | M   | 1                           | 65               | no                                       | car           | 20            | yes                | none          | -                                | none                                |                      |
| 6      | N040215010   | onmy    | 2                           | F   | 2                           | 80               | yes<br>N040215009                        | Live          | -             | no                 | none          | -                                | none                                |                      |
| 7      | N040215011   | onki    | 1                           | M   | 1                           | 55               | no                                       | car           | 36            | no                 | none          | -                                | none                                |                      |
| 8      | N04?   | onki    | 1                           | F   | 1                           | ?                | no                                       | car           | 26            | yes                | none          | -                                | none                                | Lower jaw only       |
| 9      |  |         |                             |     |                             |                  |  |               |               |                    |               |                                  |                                     |                      |
| 10     |  |         |                             |     |                             |                  |  |               |               |                    |               |                                  |                                     |                      |
| 11     |  |         |                             |     |                             |                  |  |               |               |                    |               |                                  |                                     |                      |
| 12     |  |         |                             |     |                             |                  |  |               |               |                    |               |                                  |                                     |                      |
| 13     |  |         |                             |     |                             |                  |  |               |               |                    |               |                                  |                                     |                      |
| 14     |  |         |                             |     |                             |                  |  |               |               |                    |               |                                  |                                     |                      |
| 15     |  |         |                             |     |                             |                  |  |               |               |                    |               |                                  |                                     |                      |
| 16     |  |         |                             |     |                             |                  |  |               |               |                    |               |                                  |                                     |                      |
| 17     |  |         |                             |     |                             |                  |  |               |               |                    |               |                                  |                                     |                      |
| 18     |  |         |                             |     |                             |                  |  |               |               |                    |               |                                  |                                     |                      |
| 19     |  |         |                             |     |                             |                  |  |               |               |                    |               |                                  |                                     |                      |
| 20     |  |         |                             |     |                             |                  |  |               |               |                    |               |                                  |                                     |                      |
| 21     |  |         |                             |     |                             |                  |  |               |               |                    |               |                                  |                                     |                      |

Figure 6. Example of a properly filled out fish and carcass data form.

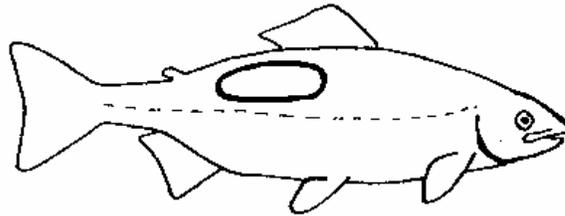


Figure 7. Correct area of fish to remove scale samples from. Remove at least 10 scales using pliers or a knife. Put scales in an envelope and record the record number, date, species, location (e.g. stream and segment name), sex, fork length, and that the scales came from a carcass.

## Appendices





|                      |       |  |  |  |  |
|----------------------|-------|--|--|--|--|
| Stream Name:         |       | Water Temp. (°C):  | Species Code:<br>Oaki = Coho<br>Oamy = Steelhead<br>Onts = Chinook<br>Latr = Lamprey<br>Unka = Unknown | CERTAINTY OF IDENTIFICATION:<br>1 = Sure saw mouth, gams, kype.<br>2 = May be one species or another didn't see all characteristics.<br>3 = Unknown. | PAGE ____ Of ____<br><br>Oaki: black mouth/white gams; 11-19 anal fin rays, wide caudal peduncle, caudal fin rays rough, small black spots on upper back and upper lobe of caudal fin only. Males: Pronounced kype. Females: None.<br>Oamy: White mouth/gams, 8-12 anal fin rays, wide caudal peduncle. Caudal rays smooth, small black spots on upper back and in uniform rows along caudal fin. Males: pronounced to somewhat pronounced kype, very pink along lateral line and on operculum, slender body. Females: Very varied (when ripe), no kype, pinkish along lateral line.<br>Onts: Black mouth/gams, 11-19 anal fin rays, narrow caudal peduncle. Caudal fin rays smooth, large black spots on both lobes of caudal fin. Males: Pronounced kype. Females: None. |
| Section:             |       | Drive Time (hrs):  |  |  |  |
| Date:                | Week: | Start Time:  | End Time:  |  |  |
| Surveyors:           |       | Map #:   |  |  |  |
| Air Temp. (°C):      |       | Weather:   |  |  |  |
| Water Viability (m): |       | Flow m <sup>3</sup> /s:  |  |  |  |
|                      |       | Notes:   |  |  |  |
|                      |       | Sex Code:<br>F = Female<br>M = Male<br>Un = Unknown  |  |  |  |
|                      |       | Directions: Identify each fish in species and sex. Record certainty of identification using codes. Record if a fish is on or near a redd and write the redd record number on the fish data form and the fish record number on the field data form. Look for tags, clips, or brands on the fish, record if observed. Measure, or visually estimate (using the wading staff as a guide), the fish length and sex. Mark all carcasses with a numbered tag ring. Write the tag number in the tag# column. If it's a recapture, write the tag number in the tag # column and rec in the recapture column. For recaptures record as much information as you can. |  |  |  |

FILL OUT FORM EVEN IF NO FISH OBSERVED!

| Obs. # | Record Number<br>Stream/month/day/B-999<br>Example: Noy0101010 | Species | Certainty of Identification | Sex | Certainty of Identification | Fork Length (mm) | Fish on Redd?<br>No/Yes<br>If yes Redd # | Live/Carcass? | Carcass Data  |            | Live Fish Tag Data |       | Clip/Oper. punch?<br>What is it? | Notes<br>Continue on back if needed. |
|--------|--|---------|-----------------------------|-----|-----------------------------|------------------|--|---------------|---------------|------------|--------------------|-------|----------------------------------|--------------------------------------|
|        |  |         |                             |     |                             |                  |  |               | Carcass Tag # | Recapture? | Flot Tag<br>Number | Color |                                  |                                      |
| 1      |  |         |                             |     |                             |                  |  |               |               |            |                    |       |                                  |                                      |
| 2      |  |         |                             |     |                             |                  |  |               |               |            |                    |       |                                  |                                      |
| 3      |  |         |                             |     |                             |                  |  |               |               |            |                    |       |                                  |                                      |
| 4      |  |         |                             |     |                             |                  |  |               |               |            |                    |       |                                  |                                      |
| 5      |  |         |                             |     |                             |                  |  |               |               |            |                    |       |                                  |                                      |
| 6      |  |         |                             |     |                             |                  |  |               |               |            |                    |       |                                  |                                      |
| 7      |  |         |                             |     |                             |                  |  |               |               |            |                    |       |                                  |                                      |
| 8      |  |         |                             |     |                             |                  |  |               |               |            |                    |       |                                  |                                      |
| 9      |  |         |                             |     |                             |                  |  |               |               |            |                    |       |                                  |                                      |
| 10     |  |         |                             |     |                             |                  |  |               |               |            |                    |       |                                  |                                      |
| 11     |  |         |                             |     |                             |                  |  |               |               |            |                    |       |                                  |                                      |
| 12     |  |         |                             |     |                             |                  |  |               |               |            |                    |       |                                  |                                      |
| 13     |  |         |                             |     |                             |                  |  |               |               |            |                    |       |                                  |                                      |
| 14     |  |         |                             |     |                             |                  |  |               |               |            |                    |       |                                  |                                      |
| 15     |  |         |                             |     |                             |                  |  |               |               |            |                    |       |                                  |                                      |
| 16     |  |         |                             |     |                             |                  |  |               |               |            |                    |       |                                  |                                      |
| 17     |  |         |                             |     |                             |                  |  |               |               |            |                    |       |                                  |                                      |
| 18     |  |         |                             |     |                             |                  |  |               |               |            |                    |       |                                  |                                      |
| 19     |  |         |                             |     |                             |                  |  |               |               |            |                    |       |                                  |                                      |
| 20     |  |         |                             |     |                             |                  |  |               |               |            |                    |       |                                  |                                      |
| 21     |  |         |                             |     |                             |                  |  |               |               |            |                    |       |                                  |                                      |