

# Coastal Northern California Salmonid Spawning Survey Protocol

Prepared By  
Sean P. Gallagher<sup>1</sup> and Morgan Knechtle 2005

## 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 2005, 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 2005) and were proposed by Boydston and MacDonald (2005) as the primary technique for regional long term monitoring of California's salmonids. The purpose of this Protocol is to describe field methods for collecting information to estimate salmonid escapement in coastal Northern California streams.

Predetermined, 2-3km reaches (See Boydston and MacDonald

---

<sup>1</sup>Primary author to whom correspondence should be addressed. California State Department of Fish and Game, 306 East Redwood, Fort Bragg, CA 95437. Phone 707-964-1492. Email: [Sgallagh@dfg.ca.gov](mailto:Sgallagh@dfg.ca.gov).

(2005) for discussion of the rotating panel design and reach selection process, and Appendix A) will be surveyed biweekly (Gallagher and Gallagher 2005) 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). Each reach should be surveyed a maximum of two weeks apart and stream flows and/or weather conditions will 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 following Gallagher and Gallagher (2005). The condition of redds measured during previous surveys will be recorded to assess the duration of redd observability and observer efficiency.

## 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 rotating panel design (Boydston and MacDonalnd 2005, 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. Caspar (CAS), Hare (HAR), and Pudding (PUD) creeks, and Little (LTR) and Noyo (NOY) rivers are of primary interest due to the history of similar work conducted on these streams and were selected to for pilot evaluation of the California Plan (Gallagher and Collins 2004). It is unlikely that, due to time and personnel constraints, other streams will be surveyed during 2006-07.

## 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 the 2006-07 season are shown on the survey maps in Appendix A. Survey reaches for the Pilot Program in 2006-07 were selected following Boydston and MacDoland (2005) by the Institute for River Ecosystems Humboldt State University (Dana McCain Personal Communication) where reach boundaries are known landmarks or tributary confluences. This process identified 78 three km reaches in these streams, 10% of

which (8 reaches) were selected following the California Plan (Trent MacDonald personal Communication). These reaches will be included in the total habitat surveys in Caspar and Pudding Creeks and the South Fork Noyo River as well as in the 33% sampling of the Upper Noyo River and Hare Creek. Together these data will allow escapement estimates at reach, stream, and regional levels. In conjunction with the spawning surveys floy tagging operations will occur on Caspar and Pudding Creeks and the South Fork Noyo River above the ECS. The entire extent of spawning habitat in Caspar and Pudding creeks and the South Fork Noyo River will be surveyed due to the history of study of these two streams and the need to look for fish marked and released at the weirs. 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

Because the data needs for the study differ between fish and redds there are two data forms: one for live fish and carcasses and one for redds and associated information. Both forms have the same header format.

### Redds and Redd Data Form

Each segment or reach should be surveyed at least biweekly (see survey schedule; Appendix B) or a maximum of 14 days apart between high flow events (Gallagher and Gallagher 2005). 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 input form (Figure 1a) for proper data recording. For safety and to decrease errors in redd identification and measurement, teams of two should walk or raft each stream reach. 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 1a, 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, reach id number, and map number from the map of the segment you are

surveying. If you are surveying a stream that has multiple reaches (reach numbers), 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 and is the same as the reach number, record that number here. Record the reach ID number in the appropriate space. Record the air and water temperature in centigrade. Estimate the water **visibility** in meters with the survey rod as the visible depth to the stream substrate **on every survey**. Estimate the **stream flow** at the bottom end of each survey section **on every survey** and 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 flow or water visibility.

## Redd Data

## Record Number

Each redd and fish gets a unique individual record number. The

Record Number is a seven number numeric code based on survey date which is linked to the stream and reach information in the header information. The first two numbers 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 of reach 12 in the Noyo River on February 15<sup>th</sup>, the number for the redd would be 0215001 and the fish would be 0215002. 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 leaving the office. This should be the second to last done before leaving, 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 for each redd on the flagging (see flagging below) and on the data form (Figure 1a). This number should be recorded on the maps (see mapping below) 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 (Fish on) 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 (Gallagher and Gallagher 2005). 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 1a). 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 1a). 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 and fish number here) do your best to identify it to species. If there is not a fish on a redd write no.

### Fish on Redd Record Number

If a fish is on a redd record that number here, if there are more than one fish on a redd record all the numbers here. Example one female and two males on redd number 1212001 record the fish numbers 1212002, 1212003, and 1212004 or write 1212002-004. 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, **you must** 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, no flag present. 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. Note that all redds that have not previously been encountered (no flag present) are by definition age 1. If you come across an unflagged redd it is age 1, if it looks older write this in the notes column. 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.

## Remeasured?

This is a yes or no column. Yes if re-measured no if not.

## Distance to Flag

This is the distance in meters from the middle of the tailspill to the flag that identifies this redd. Flagging must be tied to solid object (see flagging below). Record the distance from the tail spill to the flag in this column. Write this information on the flag also.

## Direction to Redd

This is the compass direction from the flag to the middle of the tail spill. Record this information in this column and on the flag (see flagging below).

## 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.

### Flagging

For all redds write the Record Number, Species Code, the total redd length (pot length plus tailspill length and maximum redd width, distance and direction and the year on the flagging, and Redd Age (see Figure 2 as an example). Tie the flagging securely to the closest **solid living object** directly above and perpendicular to the pot of the redd. **Do not step or walk on redds**. Measure the distance from the middle of the tailspill to the flag location and write this on the flag and in the proper column in the data form.

Measure the compass angle from the flag to the middle of the tailspill and write this on the flag and record it on the data form. If the redd is a test redd or under construction, write **REMEASURE** on the flagging and in the notes. Examine all flags during each survey (See Redd Age). 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 or 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.

## Live Fish/Carcasses Field Methods and Data Form

All fish observed will be identified to species, length and sex visually estimated, and certainty of identification and sex, condition of fish, on redd, and tag present or not will be noted. All carcasses will be measured, sexed, examined for tags and fin clips, and untagged carcasses will be marked with a uniquely numbered hog ring.

Carcasses will be marked by attaching a uniquely numbered metal tag 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 1b) 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 (Figure 1b).

## Fish Data

### 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. If it's a carcass recapture record 000 and when you return to the office and look up the tag number on previous surveys' data forms (or in database) to find this information, change it on the data form when you know it. Record the Record Number on the data form. The Record Number is a seven number numeric code based on survey date which is linked to the stream and reach information in the header information. The first two numbers 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 of reach 12 in the Noyo River on February 15<sup>th</sup>, the number for the redd would be 0215001 and the fish would be 0215002. 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 leaving the office. This should be the second to last done before leaving, 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 for each redd on the flagging (see flagging below) and on the data form (Figure 1b).

## 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 have 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 Species

If you see a number of the above characteristics and you are sure of the species use a 1 in these columns. 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.

### Sex of Fish

There are three choices here, 1) Male, 2) Female, and 3) Unknown. Coho salmon males generally have a very pronounced kype while the kype in females is less pronounced or nonexistent. Females dig redds whereas males chase other males and females and do not dig redds. As such females coho salmon will have worn caudal fins as the season progresses. Males can also show wear on their fins. Male steelhead have a somewhat pronounced kype and pink coloration along the lateral line and on the operculum. Female steelhead generally lack a kype, are rather rotund when ripe, and have pink coloration along the lateral line. Chinook salmon males have a kype and females do not.

### Certainty of Sex

If you see a number of the above characteristics and you are sure of the sex use a 1 in these columns. If you are pretty sure and saw some of the above, but not the kype 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.

### Fork Length

This is the length in cm from the tip of the snout to the fork in the caudal fin. Often for live fish this is estimated by observing fish near objects in the stream near the tip of the snout and fork in the tail, visually estimating this length, and checking it with the survey staff after the fish has swan off.

## Condition of Fish

This information will help with estimating the length of time fish are present on the spawning grounds. There are two possibilities for live fish, fresh (not yet spawned) L1 and spent (spawned out) L2. There are six possibilities for carcasses these are; 1) freshly dead clear eyes (take scales and tissue, see scale and tissue below), 2) Cloudy eyes, 3) No eyes and fungus, 4) Skin and bones with head, 5) Skin and bones no head, and 6) Loose tag no fish. Use the number codes L1 and L2 for live fish and 1 through 5 for carcasses in this column.

## Fish on Redd

If you observe a fish on a redd (yes) do your best to identify it to species, if not 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.

## Redd Number

If the fish was on a redd record the redd number from the redd data form of the redd in this column. If the fish was not on the redd draw a line through the column.

## Live or Carcass

If live write "live" in this space If it's a carcass fill in with "Carcass." 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?

Simple yes, no, or unknown. If the fish has a floy tag then yes. If the fish doesn't have a floy tag then no. If you didn't see the fish well enough to determine if the fish had a floy tag or not then unknown. Record this information here.

### Floy Tag Number

If it has a floy tag and it's a live fish, try and read the number. Record the number if you can read it, believe it or not some times you can read the number on a live fish. If you can not then write unknown here. If it's a carcass and has a tag or you find a loose tag 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 of the floy tag color, enter unknown in this column. If you are positive the live fish has no floy tag (all floy tags will be on the left or right side of the fish just below the dorsal fin) put a line through this column. For a carcass with a floy tag, enter color of tag in this column. If a carcass doesn't have a floy tag put a line through 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.

### Floy Tag Side?

Simple left or right. If no floy tag leave this column blank or cross it out.

### Operculum Punch?

Simple yes or no. Fish will be operculum punched on either the left or

right side with a variety of punch shapes, check both sides. Record yes or no here.

### Operculum Punch Shape

There are eight possibilities here. These are circle, triangle, square, star, heart, tear drop, rectangle, and flower. Record the operculum punch shape here. If it has a operculum punch but you can not tell the shape since, for example the operculum is torn, record the most likely possibility and write in the notes that you are unsure of the shape and why.

### Operculum Punch Side

Simple left or right, record which side the punch is on. If no punch leave this column blank or cross it out.

### Fin Clip, Coded Wire Tag, or Pit Tag

Look for Left or Right Maxillary, Left or Right Pelvic, Upper or Lower Caudal Fin Clips, adipose clip, 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. Fish without adipose fins are likely of hatchery origin and you should look for a coded wire tag or collect the fish head for laboratory tag detection.

### 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 (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. All crews should plan to return to the office by 5pm, so if you are in a busy reach, it's getting late, and you don't think you can finish in time stop the survey leaving enough time to return to the vehicle and then the office, mark the ending location with flagging, and return the following day to finish the survey. If you're pushing the return time, like it takes longer to hike back the vehicle then you thought use the Satellite phone and inform your supervisor that you are on your way but expect to be late. 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.
- 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, 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.

Fill out even if no redds were observed

Stream Name: Caspar Creek	Week: 52	Water Temp.: 8		<b>Species Codes:</b> Onki = Coho Salmon Onmy = Steelhead Onts = Chinook Salmon Latr = Pacific Lamprey Unkn = Unknown Species
Section Name: Below Forks	Map #: CAS 1	Air Temp.: 11		
Reach ID: CAS 1	Water Visibility (m): 1.5	Start Time: 12:50		
Date: 12/12/2005	Stream Flow (m <sup>3</sup> /s): 0.25	End Time: 13:50		
Surveyors: Mike Morrison, Scott Harris	Stage: 99.25	Drive Time: 0.75		
Weather: Light Rain	<b>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 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.</b>			
Notes: Steam Flow up at end of survey to 0.26, Visibility down to 1.45				

Record Number Code	Species	Pot Length (m)	Pot Width (m)	Pot Depth (m)	Pot Substrate	Tail Spill Length (m)	Tail Spill Width 1 (m)	Tail Spill Width 2 (m)	Tail Spill Substrate	Fish on?	Fish #	Redd	Remeasured? Yes/N	Distance Flag to Tail Spill	Direction Flag to Tail Spill	Notes
1212001	Onmy	1.2	2.2	0.15	4	1.5	1.4	1.1	b	yes	1212002	1	No	1.35m	230 degrees	fish spooked off
1212004	Onki	2.3	3.2	0.2	6	3.3	2.5	1.5	2	yes	1212003	1	no	0.25 m	145 deg	flag above pot was test now is clearly Onmy
1202105	test	1	1.2	0.1	5	1.6	1.4	1.2	4	no	0a	2	yes			remeasure again as fish still working
1202106	Onki	2.5	2.3	0.15	6	2.5	2.2	2	3	yes	1212005	2	yes			redd perpendicular to stream flow
1212006	Unkn	2.8	1.5	0.2	3	1.1	0.9	0.8	2	no	0a	1	no	1.75 m	355 deg	flag was remeasure too turbid to
1202089	Onki									no	0a	5	no			no longer present
1202085	Unkn									no		4	no			4 on flag

Figure1a. Example of properly filled out spawning ground redd survey data form.

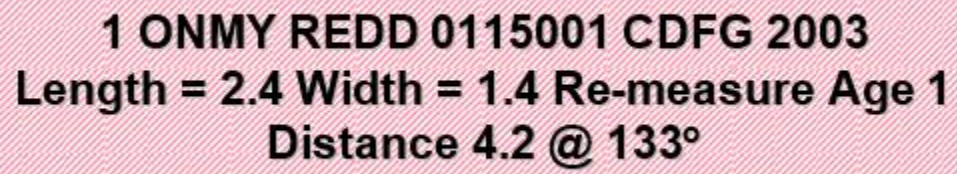
Fill out even if no fish were observed

Page 2 Of 3

Stream Name: Caspar Creek	Week: 52	Water Temp.: 8	<b>Species Codes:</b> Onki = Coho Salmon Onmy = Steelhead Onts = Chinook Salmon Latr = Lamprey Unkn = Unknown Species  <b>Certainty of Identification:</b> 1 = Sure of Id saw many key characters, 2 = Not sure only saw some characters, 3 = unknown  Species Identification: <b>Onki</b> black mouth/white gums, 13-19 anal fin rays, wide caudal peduncle, caudal fin rays rough, black spots on back and upper lobe of caudal fin only. <b>Onmy</b> : white mouth/gums, 13-19 anal fin rays, wide caudal peduncle, black spots on upper back and in rows over entire caudal fin. <b>Onts</b> black mouth/gums, 13-19 anal fin rays, narrow caudal peduncle, Caudal fin rays smooth, large black spots on both lobes of caudal fin.
Section Name: Below Forks	Map #: CAS 1	Air Temp.: 11	
Reach ID: CAS 1	Water Visibility (m): 1.5	Start Time: 12:50	
Date: 12/12/2005	Stream Flow (m <sup>3</sup> /s): 0.25	End Time: 13:50	
Surveyors: Mike Morrison, Scott Harris	Stage: 99.25	Drive Time: 0.75	
Weather: Lite Rain	Notes: Steam Flow up at end of survey to 0.26, Visibility down to 1.45		

Record # Code	Species	Certainty of Species Sex	Certainty Length of Sex	Fork (mm)	Fish Condition #	Fish On? Redd	Live or Carcass	Carcass Tag #	Recapture Tag #	Floy Tag? Floy	Floy Tag? Color	Floy Tag? Side	Opercle Punch?	Punch Shape	Punch Side	Clips or Other Marks	Notes	
1212001	onmy	1 female	2	75	fresh clear eyes/liver	yes	1212002	live	na	no	yes	unknown/Brown/Green	Left	unknown	unknown	unknown	none	spooked off redd fish was digging
1212003	onki	1 male	1	60	fresh clear eyes/liver	yes	1212004	live	na	no	no	na	na	unknown	unknown	unknown	none	saw kype and mouth
1212005	onki	1 unkn	3	55	fresh clear eyes/liver	yes	1202106	live	na	no	yes	124561 orange/blue	right	unknown	unknown	unknown	none?	able to read tag as fish against bank, could not see opercle.
1212007	onki	2 female	2	57	fresh clear eyes/liver	no	na	carcass	13	no	no	na	na	yes	square	left	right maxillary clip	took tissues and scales
000'	onki	1 male	1	55	cloudy eyes and fungus	no	na	carcass	22	yes	yes	141512 orange/blue	left	no	na	na	none	left operculum is missing don't know if fish had a punch?
1212008	unkn	na	na	na	na	no	na	unkn	na	no	yes	1415123 black/blue	unkn	unknown	unknown	na	unknown	loose floy tag picked up for collection at office
1212009	unkn	3 unkn	3	na	skull bones with head	no	na	carcass	14	no	no	na	na	yes	triangle	right	no adipose	this fish was eaten by something

Figure 1b. Correctly filled out fish and carcass data form.



**1 ONMY REDD 0115001 CDFG 2003**  
**Length = 2.4 Width = 1.4 Re-measure Age 1**  
**Distance 4.2 @ 133°**

Figure 2. Example of properly labeled flagging.

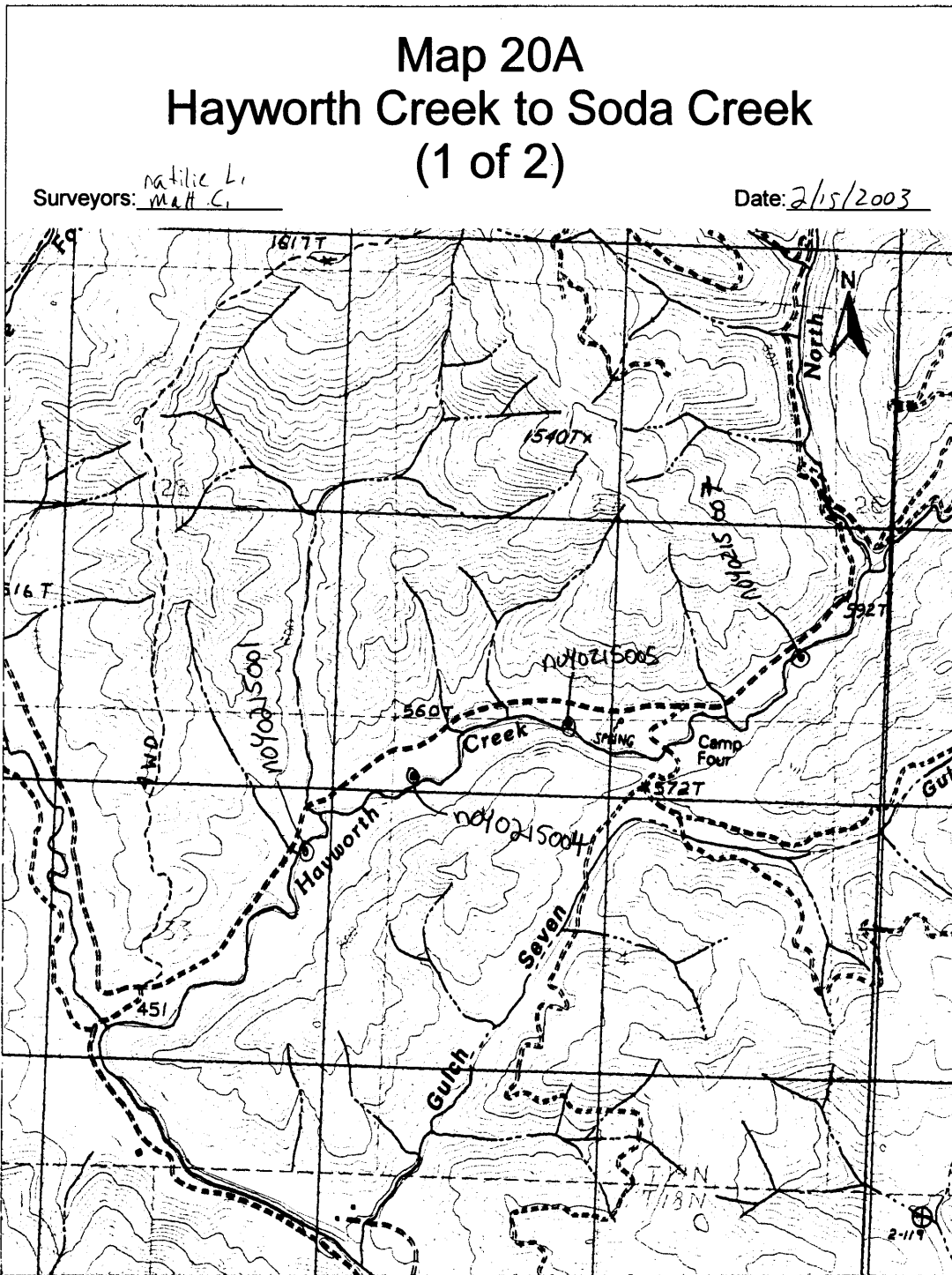


Figure 3. Example properly filled out map survey page with redd locations and record numbers tied to redd data form.

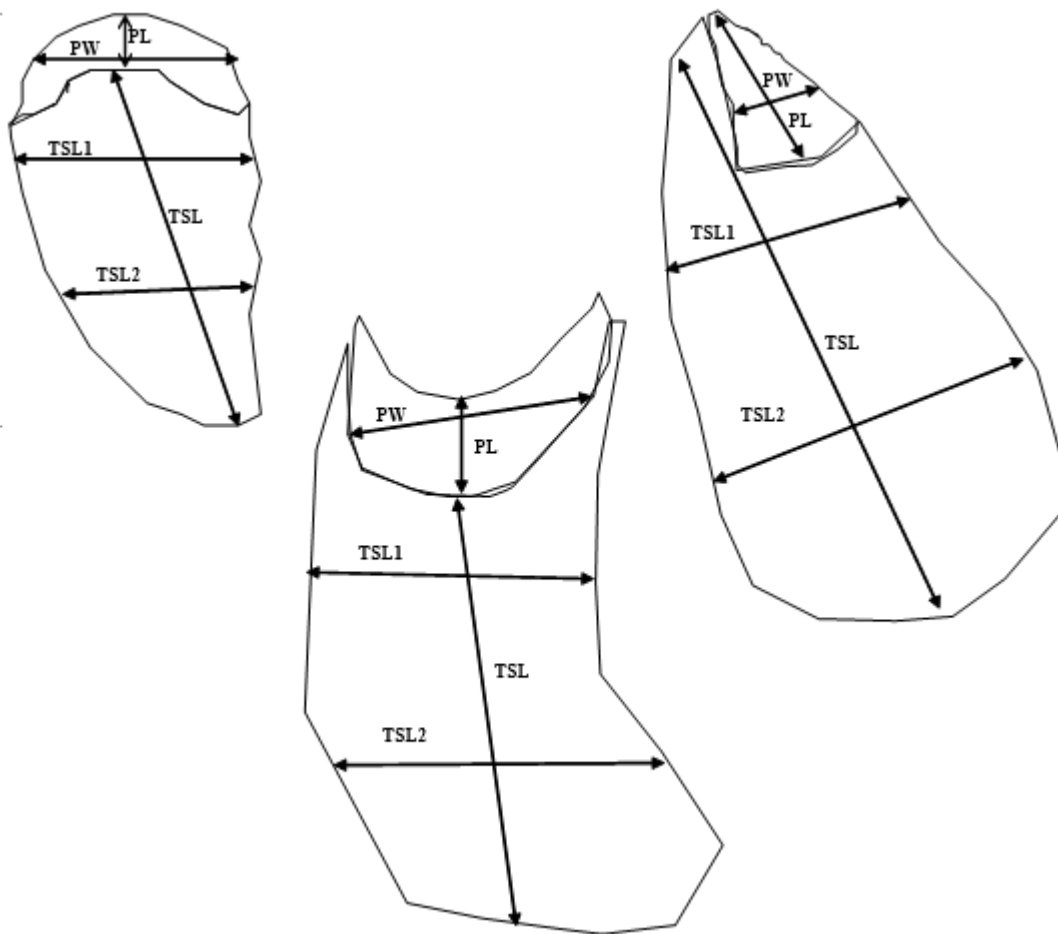


Figure 4. Measurements locations for unusual shaped redds.

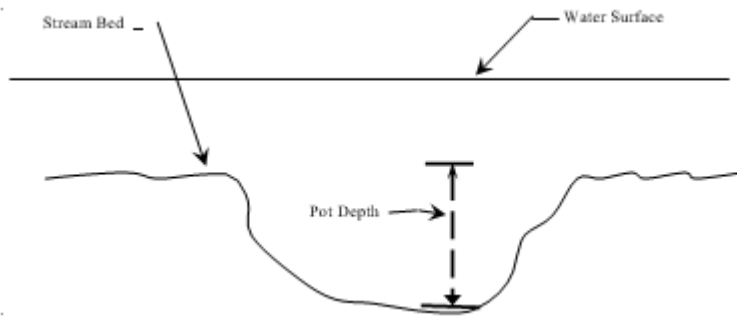


Figure 5. Cross section of a redd pot. Pot Depth is the distance from the bottom of the pot to the water surface minus the distance from the water surface to the stream bed.



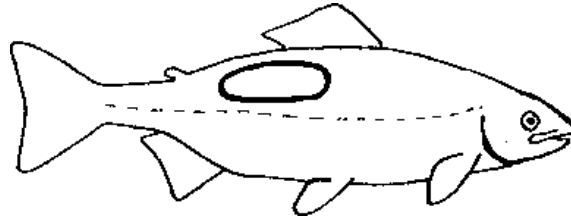
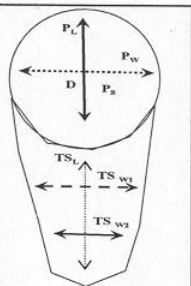


Figure 6. Correct area of fish to remove scale samples from. Remove at least 10 scales using pliers or a knife. Put scales in an envelope and record the record number, date, species, location (e.g. stream and segment name), sex, fork length, and that the scales came from a carcass.

## **Appendices**

Stream Name:		Water Temp. °(C):	Species Codes: Dnkl = Coho Dnmy = Steelhead Dnts = Cl 'brook Dknn = Unknown Dkst = Test or under construction Dlatr = Lamprey		PAGE ____ Of ____  <b>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.</b>
Section:		Drive Time (hrs):			
Date:	Week:	Start Time: End Time:			
Surveyors: Map #		Weather:			
Air Temp. °(C):		Notes:			
Water Visibility (m):	Flow m <sup>3</sup> /s:				

**FILL OUT FORM EVEN IF NO REDDS OBSERVED**

Record Number		Species		Pot Dimensions			Tail Spill Dimensions			Fish On Redd?	Redd Age	Notes:	
Stream	Month Day 000-999	Use Codes	Length (m)	Width (m)	Depth (m)	Substrate	Length (m)	Width 1 (m)	Width 2 (m)	Substrate (cm)	No/Yes (If Yes)	1-5	Continue On Back if Needed
Example: Noy0101001			PL	PW	D	PS	TSL	TSw1	TSw2	TS Sub.	Record Fish #		

Stream Name:		Water Temp. '(C):		Species Code:		CERTAINTY OF IDENTIFICATION:		PAGE ____ Of ____	
Section:		Drive Time (hrs):		Onki = Coho		1 = Sure saw mouth, gums, kype.		Onki: black mouth/white gums; 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: Pronounced kype. Females: None.	
Date:		Start Time:      End Time:		Onmy = Steelhead		2 = May be one species or another didn't see all characteristics.			
Week:		Weather:		Ont = Chinook		3 = Unknown.		Onmy: White mouth/gums, 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 rotund (when ripe), no kype, pinkish along lateral line.	
Surveyors:      Map #		Notes:		Latr = Lamprey		Directions: Identify each fish to 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 redd data form. Look for tags, clips, or brands on the fish, record if observed. Measure, or visually estimate (using the wadding staff as a guide), the fish length and sex. Mark all carcasses with a numbered hog ring. Write the tag number in the tag# column. If it's a recapture, write the tag number in the tag # column and yes in the recapture column. For recaptures record as much information as you can.		Ont: Black mouth/gums, 13-19 anal fin rays, narrow caudal peduncle, Caudal fin rays smooth, large black spots on both lobes of caudal fin. Males: Pronounced kype. Females: None.	
Air Temp. '(C):				Unkn = Unknown					
Water Visibility (m):		Flow m <sup>3</sup> /s:		Sex Code:					
				F = Female					
				M = Male					
				Un = Unknown					

FILL OUT FORM EVEN IF NO FISH OBSERVED!

Obs. #	Record Number Stream/month/day/0-999 Example: Noy0101010	Species	Certainty of Identification	Sex	Certainty of Identification	Fork Length (cm)	Fish on Redd? No/Yes If yes Redd #	Live/Carcass?	Carcass Data		Live Fish Tag Data		Notes	
									Carcass Tag #	Recapture?	Floy Tag			Clip/Oper. punch? What is it?
											Number	Color		
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														

