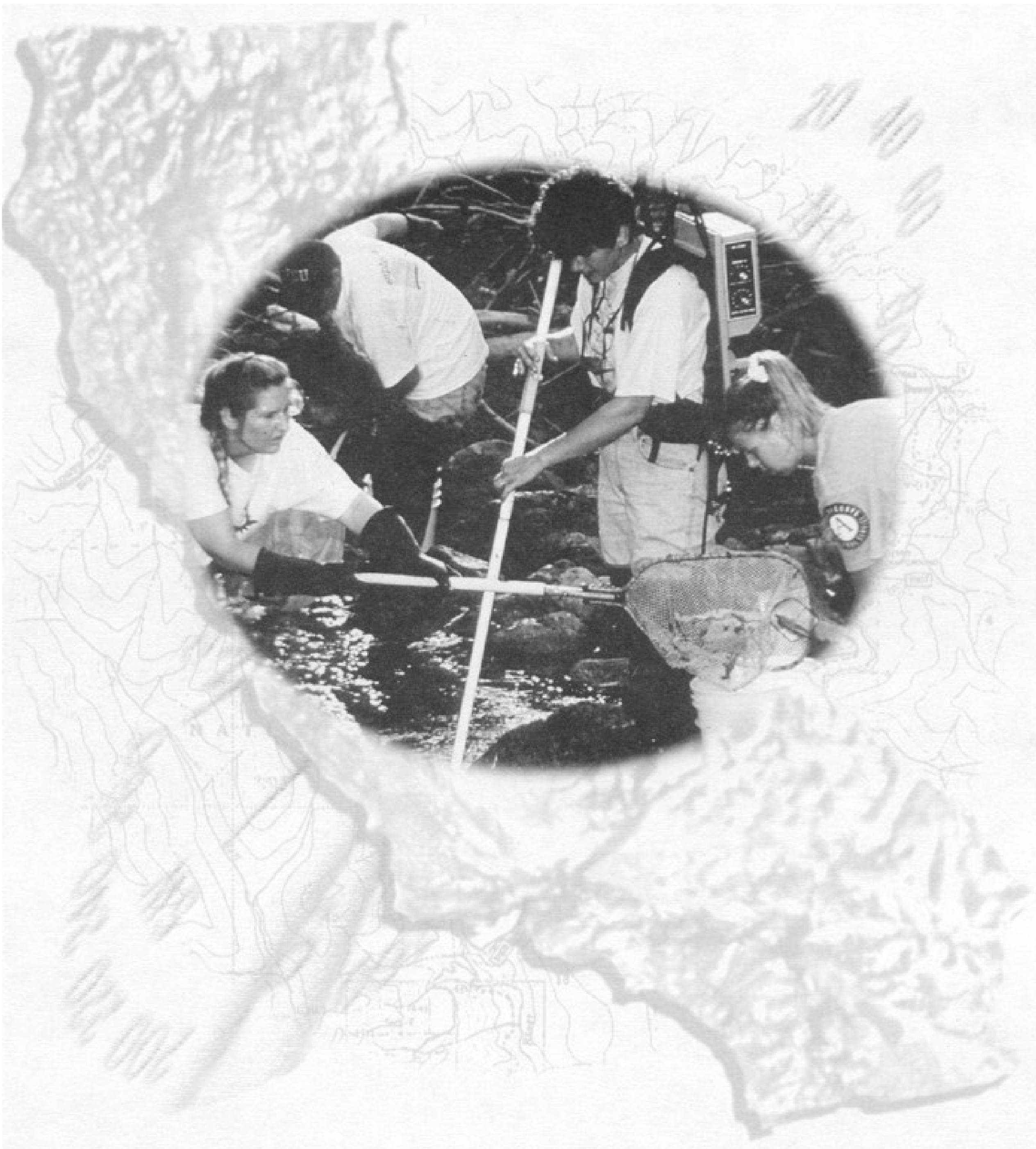
CALIFORNIA SALMONID STREAM HABITAT RESTORATION MANUAL

PART IV

FISH SAMPLING METHODS



PART IV FISH SAMPLING METHODS

Assessment surveys of watershed and stream habitat must include descriptions of fish resources within the stream. The purpose of this section is to outline simple fish sampling techniques that will help to identify fish resources within a stream or watershed. Much of the necessary information may be available from DFG files or the district fishery biologist. In order to describe the fishery, the following data should be gathered:

- Species composition
- Juvenile rearing areas or general distribution
- Spawning areas or general distribution
- Sizes (lengths) of adults and juvenile
- Age classes of juveniles (based on lengths)
- Relative abundance in selected areas
- Biomass (weight per unit volume)
- Habitat utilization
- Timing of spawning activity
- Timing of juvenile emigration

This is considered "baseline" information that provides a general assessment of fish presence, distribution and habitat utilization within a stream. It is essential to know what fish species exist within a stream and particularly the status of "target" species. The upstream range of adult spawners and juveniles is important information for planning habitat enhancement work within a stream. Relative abundance of a species may suggest trends in past or future population numbers. Age classes of juveniles may indicate the quality of summer and winter nursery areas. The amount of habitat being utilized or not being utilized by adults and juveniles is useful information for determining habitat problems and potential solutions. It should be emphasized that absence of a species from a stream cannot conclusively be determined from any single sample of that stream.

Most general fishery information required for the level of habitat assessment described in this manual can be obtained using non-capture techniques. In some instances, specialized capture techniques of trapping or electrofishing may be useful to obtain length, weight, and positive species identification data. However, most fish capture methods, including trapping and electrofishing, have a high potential for causing fish mortality if used improperly. It is highly recommended that fish capture be avoided whenever possible, and that observation techniques be employed to collect the general fishery information required for the level of habitat assessment described in this manual.

Non-capture methods involve:

- Stream bank or above water observation
- Direct or underwater observation

Any fish sampling or fish data collection must be approved and coordinated with DFG biologists and with the knowledge of the local Fish and Game Warden. State and Federal collector's permits are necessary for any technique involving capture, handling, tagging, or removal of fish from a stream or lake.

The data collected by these methods are intended for useful descriptions of fish presence, relative abundance and habitat utilization in the context of planning restoration or enhancement projects. They are not intended to produce statistically based population estimates of adult spawners, juveniles, or smolt productivity. It is beyond the scope of this manual to discuss in detail all the uses of these techniques.

STREAM BANK OBSERVATION

Observation of fish from the stream bank or other vantage point is a commonly used technique to determine presence or absence of fish. It also provides "gross" estimates of fish numbers in sampled habitats (e.g., 10-20 young-of-year steelhead). This method can be accomplished quickly and the only equipment required are polarized glasses and record forms or notebook.

The primary drawback to bank observation is difficulty with species identification. Observation experience associated with species confirmation techniques (electrofishing or trapping) can improve species identification skills. Numbers of fish observed are very rough estimates of relative abundance in selected habitats or stream reaches and should be used with caution. However, this type of information has many uses in describing existing conditions and comparing observations over several years. Useful data stems from observer consistency and careful attention to accuracy.

Opportunities for observation are usually best in pools and runs where visibility is better than in riffles. Habitats to be observed should be approached slowly and quietly from downstream; most fish orient themselves heading upstream when feeding. Patience is required to adjust the observer's eyes to the light conditions and to allow the fish to recover from any fright response caused by the observer's approach.

Juvenile salmonids should be placed in general age categories according to length:

- 0+ young-of-year (YOY), 3 inches or less
- 1+ 3 to 6 inches
- 2+ 6 inches or greater

These lengths are approximate and depend on stream systems and time of year. Generally, these size categories are obvious when groups are observed together. In most cases, the smaller size group will be more numerous.

UNDERWATER OBSERVATION

This is a cost-effective method to determine fish distribution and species composition. Underwater observation can be economically applied on a larger scale than electrofishing. Use of this method permits close observation of fish behavior and habitat utilization. Experienced divers can learn to identify, count, and record fish in a relatively short time. The effectiveness of this method can be improved when combined with electrofishing to calibrate the diver's observations.

One or more divers, equipped with a mask, snorkel, and wet or dry suit, enter a habitat unit at the downstream end and swim or crawl to the upstream end, counting, identifying, and recording all the fish they see. In small streams or habitat units, a single, experienced diver can effectively count and identify all fish in a single pass. In larger streams or complex habitat units, a combination of divers working together systematically may be necessary to determine fish numbers. Since it is difficult to dive and count fish in riffles, underwater observation is usually only conducted on sample pool and run units.

Tools and Supplies Needed

- Wet or dry suit
- Fins or wading boots
- Snorkel
- Plastic slate board
- Mask
- Waterproof felt pen

Instructions for Completing the Stream Bank or Underwater Observation Field Form

1) **Form No.** - Enter in the form number. Number the forms sequentially beginning with "01" on the first page and "02" on the second page and so on.

2) **Date** - Enter the day's date: mm/dd/yy.

3) **Stream Name** - Enter the name of the stream.

4) **T-R-S** - Enter the township, range, and section at the mouth of the stream.

5) **Drainage** - Enter the name of the drainage.

6) **Lat** - Record the latitude of the stream at the confluence taken from the 7.5-minute USGS quadrangle.

7) **Long** - Record the longitude of the stream at the confluence determined from the 7.5-minute USGS quadrangle.

8) **Quad** - Record the name of the 7.5-minute USGS quadrangle on which the confluence of the stream is located.

9) **Observer(s)** - Enter the names of the observers.

10) **Time** - Enter the time the survey began in military time (24-hour clock).

11) **Air Temperature** - Enter the air temperature to the nearest degree Fahrenheit.

12) **Water Temperature** - Enter the water temperature to the nearest degree Fahrenheit.

13) **Reach No.** - Record the sequential number of the stream reach being sampled. This reach number should be the same as the reach number on the Habitat Inventory Data Form (Part III- Habitat Inventory Data Form), which is based on sequential changes in channel type.

14) **Habitat Unit No.** - Record the habitat unit number from the Habitat Inventory Data Form.

15) **Habitat Type** - Enter the number or abbreviation for the individual habitat type being sampled. The number/abbreviation should correspond to the Habitat Unit Type on the Habitat Inventory Data Form.

16) **Reference Point** - Stream confluence, a tributary, a road crossing, or any other permanent feature identified on the 7.5-minute USGS quadrangle.

17) **Distance from the Confluence or other Known Location** - Enter the distance in feet from the reference point.

18) **Length of Stream Sampled in Feet** - Enter the length of stream sampled in feet.

19) **Observation Method** - Put a check by the sampling method used in the survey.

20) **Species/Size Class/Numbers** - Enter the species, size class, and numbers sampled or observed.

21) **Comments** - Enter any comments regarding the above observations.

STREAM BANK OR UNDERWATER OBSERVATION FIELD FORM

Form No. ______ of ______ **Date** ____/____/____

Stream Name ____ **T** _____ **R** _____ **S** _____

Drainage ____

Lat: ______________________ **Long:** ___________________ **Quad:** ____________________

Observer(s) ____

Time _____________________ **Air Temperature** _________ **Water Temperature** ________

Reach No. ________________ **Habitat Unit No.** _________ **Habitat Type** ______________

Reference Point ____

Distance from the confluence or other reference point __________________________________

Length of stream sampled in feet ____

Observation Method: ________________ **Stream Bank** __________________ **Underwater**

Species	Size Class	Numbers	Species	Size Class	Numbers

Comments ____

____

____

____

SALMON SPAWNER SURVEYS

Salmon spawner surveys (also called salmon carcass surveys) are stream bank or above-water surveys. Surveyors usually walk along the stream bank and enter the number of spawned salmon carcasses, redds, and live adults observed. This information is useful to:

- Determine if adults are returning to and spawning within a stream reach or basin area;
- Determine which species or races are utilizing the sample area;
- Determine relative abundance and distribution of carcasses, redds or live fish within a sample area;
- Recover and enter marked fish for mark studies;
- Identify preferred spawning habitat area.

Stream flow conditions can alter the timing and distribution of spawning activity within a single season and also from one year to the next. For annual comparison of data it is recommended that weekly surveys be conducted throughout the entire potential time range of spawning activity. Descriptions of spawning distribution within a basin should not rely on carcass counts conducted only during the assumed week of peak spawning. Spawner distribution within a stream system may be different for early versus late spawners.

The typical method for conducting spawner surveys is to walk along the stream bank or wade in the stream counting and entering all carcasses, redds and live fish observed. Carcasses are examined to determine species, sex, and/or missing fins. The fork lengths (FL) of fish are measured from the tip of the snout to middle of the tail to the nearest centimeter (cm). Counted carcasses are either cut in half or marked with a hog ring to eliminate being counted in subsequent surveys. With prior DFG approval, the heads of carcasses with missing adipose (Ad) fins will be removed and retained for coded-wire-tag (CWT) extraction by DFG. All data is entered on the Daily Salmon Spawning Stock Survey Field Form as indicated below.

Tools and Supplies Needed

- Thermometer
- Gaff hook, handle marked in centimeters
- Waders with non-slip soles
- Pencils
- Waterproof field enter form
- Waterproof ID tags for fish heads (Figure IV-1)
- Plastic "Ziploc" bags for fish heads
- Machete and file or hog-ring pliers and hog rings

- Vest or day pack
- Polarized glasses
- Stream map to indicate location of spawning activity
- Drinking water and food

Instructions for Completing the Daily Salmon Spawning Stock Survey Field Form

1) **Stream** - Enter the stream name.

2) **T-R-S** - Enter the township, range, and section from the USGS quadrangle.

3) **Lat** - Latitude of the confluence of the stream determined from a 7.5-minute USGS quadrangle.

4) **Long** - Longitude of the confluence of the stream determined from a 7.5-minute USGS quadrangle.

5) **Quad** - Name of the USGS 7.5-minute quadrangle containing the confluence of the stream.

6) **Drainage** - Enter the drainage name.

7) **County** - Enter the county in which the stream is located.

8) **Starting Location** - Enter the starting point of the survey reach; for example, the confluence with another stream, a highway mileage marker, a bridge, etc.

9) **Lat and Long of the Starting Location** - Enter the latitude and longitude of the starting point of the survey reach taken from a 7.5-minute USGS quadrangle.

10) **Ending Location** - Enter the ending point of the survey reach; for example, the confluence with another stream, a highway mileage marker, a bridge, etc.

11) **Lat and Long of the Ending Location** - Enter the latitude and longitude of the ending point of the survey reach taken from the 7.5-minute USGS quadrangle.

12) **Feet/Miles Surveyed** - Determine the distance of the survey using a map measurement device and a 7.5-minute USGS quadrangle. If the distance surveyed was measured using a hip chain enter the distance in feet.

13) **Date of Survey** - Enter the day's date: mm/dd/yy.

14) **Weather** - Make a check mark to indicate weather conditions: clear, overcast, rain. If weather conditions change during the survey, note this in the remarks section at the end of the page.

15) **Water Clarity** - Estimate water clarity (0-2 ft, 2-4 ft, or >4 ft) at the beginning of the survey. If water clarity changes during the survey, note this in the remarks section at the end of the page.

16) **Water Temperature** - Water temperature is to be taken in degrees Fahrenheit at the beginning of the survey.

17) **Air Temperature** - Air temperature is to be taken in degrees Fahrenheit at the beginning of the survey.

18) **Time** - Enter the time when temperatures were taken.

19) **Crew** - Enter the names of the persons doing the survey.

20) **Number of Live Fish Observed** - Enter the number of live chinook adults, chinook jacks (<55 cm FL), coho, and steelhead observed. Identification of live fish can be very difficult. If positive identification is not possible, enter the fish as an unknown.

21) **Number of Carcasses Examined** - Identify all carcasses to species and sex. Measure fork length in centimeters and enter on the form. Examine all carcasses for adipose fin clips or any other fin clip. Mark all the carcasses using hog rings or cut carcasses in half after examination.

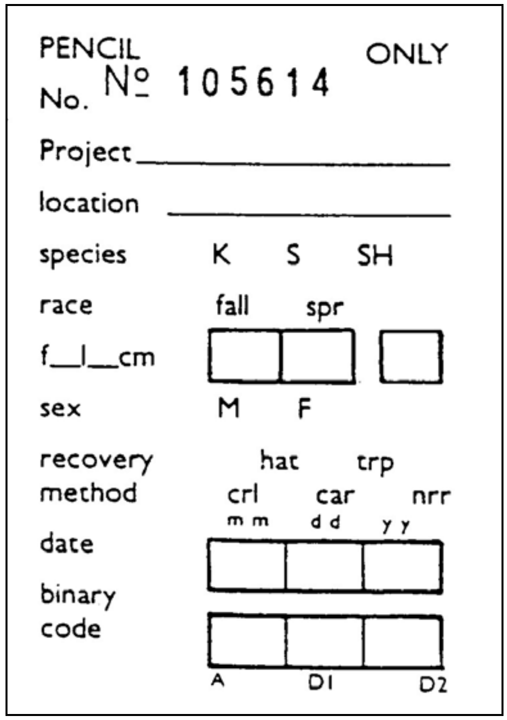
22) **Tag Number of Adipose-Clipped Fish and Snout Recoveries** - All carcasses must be examined for adipose fin clips. If the adipose fin is missing, the carcass may contain a CWT and the snout must be cut off and retained. Remove the snout by cutting across the head in the vicinity of the eyes; cut straight down from the eyes through the upper jaw and into the mouth cavity. Remove the snout in one piece. If unsure of the removal procedure, take the entire head. It is important not to lose the tag due to an improper cut. The project name, the recovery location, the species, length and sex of the fish, date and other relevant information must be entered on a tag and wired to the snout. The project name will be entered on the tag for later reference (Figure IV-1). The snout or head must be frozen in a zip-lock bag and taken to DFG where the coded-wire tags will be excised and decoded. Snouts must be individually bagged.

23) **Other Fin Clips Observed** - Enter any fin clips observed other than adipose fins.

24) **Number of Skeletons Observed** - Any fish that cannot be measured, or any identifiable parts of fish found are considered skeletons. If it is possible to identify the species, enter it appropriately; if not, enter it as unknown.

25) **Number of Redds Observed** - Enter the number and location of observed redds. This can be difficult in areas of heavy spawning due to multiple redds and super-imposition of redds.

26) **Remarks** - Add any information discovered during the survey such as barriers, landslides, etc. Include any information necessary to clarify other entries on the field form.



PENCIL ONLY
No. № 105614
Project ____________
location ____________
species K S SH
race fall spr
f__l__cm
sex M F
recovery method hat trp crl car nrr
date mm dd yy
binary code A D1 D2

Figure IV-1. Coded-wire-tag recovery form.

DAILY SALMON SPAWNING STOCK SURVEY FIELD FORM

Stream: ______________________________ **T** _______ **R** _______ **S** _______
Lat: ______________ **Long:** ______________ **Quad:** ______________
Drainage: ______________________________ **County:** ______________
Starting location: __________ **Lat:** ______________ **Long:** ______________
Ending location: __________ **Lat:** ______________ **Long:** ______________
Feet/miles surveyed: __________
Date of survey: ______/______/______ **Weather: Clear** __________ **Overcast** _____ **Rain** _________
Water clarity: 0-2 ft. __________ **2-4 ft.** ______________ **>4 ft.** ______________
Water temp: ______________ **Air temp:** ______________ **Time:** ______________
Crew: ____

Number of live fish observed: **Chinook adults** _______ **Chinook grilse** _______ **Coho** ___________
Steelhead ___________ **Unknown** __________

Number carcasses examined:

Chinook		Coho	
Male (FL)	Female (FL)	Male (FL)	Female (FL)

Tag number of adipose clipped fish and snout recoveries:

Other fin clips observed: ____

____

Number of skeletons observed:
Chinook ____________ Coho ____________ Steelhead ____________ Unknown ____________

Number of redds observed: __________

Comments:

ELECTROFISHING

Electrofishing is a fish capture technique that involves momentarily stunning fish with an electric current and quickly netting them before they recover. It is a useful capture technique when fish must be closely examined in hand. However, electrofishing can quickly kill fish if water temperatures are too high, if fish remain in the electric field too long, or if the electric charge is too powerful.

Electrofishing can cause personal injury. Electrofisher operators and crews must be trained in safety procedures and be knowledgeable about stream conditions, electrical theory, and fish physiology to prevent injury to themselves and to fish. References regarding electrofishing equipment, procedures, safety, and sampling methods are presented at the end of this section. All fish capture techniques and sampling methods must be approved and coordinated by California Department of Fish and Game personnel.

Electrofishing used during habitat inventory methods outlined in this manual is generally used to describe species composition and distribution within a stream. The single-pass method is most commonly used for these data. All fish captured are identified to species and then counted and returned to the stream. Amphibians and reptiles captured are identified and entered. The Electrofishing Field Form is used to enter this information.

In some cases, estimates of the relative abundance fish populations within a sample site may be necessary for baseline data, project evaluation, or long-term monitoring purposes. Population estimates can be determined with a standard multi-pass depletion method. For multi-pass sampling use the Electrofishing Field Form and the Electrofishing Field Form Supplemental Page for data recording.

Instructions for Completing the Electrofishing Field Form

1) **Form No.** - Enter the form number. Number the forms sequentially beginning with "01" on the first page, "02" on the second page, and so on.

2) **Date** - Enter the day's date: mm/dd/yy.

3) **Stream Name** - Enter the stream name.

4) **Site Number** - Enter the sample site number. Number the sample sites sequentially beginning at the most downstream location.

5) **Drainage** - Enter the drainage name.

6) **T-R-S** - Enter the township, range, and section at the mouth of the stream.

7) **PNMCD** - Enter the official numeric code for the stream name according to the reach file list.

8) **Lat and Long -** Latitude and longitude of the confluence of the stream determined from a 7.5-minute USGS quadrangle.

9) **Quad** - Enter the name of the USGS 7.5-minute quadrangle on which the confluence of the stream appears.

10) **Distance from Confluence -** Enter the distance from the confluence to the downstream end of the sample site.

11) **Reach Number** - Enter the sequential number of the stream reach being sampled. This reach number should be the same as the reach number on the Habitat Inventory Data Form.

12) **Channel Type** - Enter the channel type of the stream reach being sampled. This designation should be available on the Habitat Inventory Data Form.

13) **Reference Point** - Stream confluence, a tributary, a road crossing, or any other permanent feature identified on the 7.5-minute USGS quadrangle.

14) **Distance from RP** - Enter the distance in feet from the reference point to the downstream end of the sample site. Indicate upstream or downstream from the RP.

15) **Personnel** - Enter the name of the person(s) preforming the following sampling functions:
    E-Fish - operating the electrofisher
    Netting - netting stunned fish and transferring to holding buckets
    Measurements - handling fish for identification, length, and weight
    Recorded - writing the information on the field form

16) **Habitat Unit Numbers** - When applicable, enter each habitat unit number from the Habitat Inventory Data Form which lies within the sample site being electrofished. If a Habitat Inventory Data Form does not exit for the same season, leave blank.

17) **Habitat Unit Types -** Enter the number or abbreviation for each individual habitat type being electrofished within the sample site. When available, the number/abbreviation should correspond to the habitat unit type on the Habitat Inventory Data Form.

18) **Mean Length -** Enter the mean length of each habitat type within the site sampled. This information may be available from the Habitat Inventory Data Form.

19) **Mean Width** - Enter the mean width of each habitat type within the site sampled. This information may be available from the Habitat Inventory Data Form.

20) **Mean Depth** - Enter the mean depth of each habitat type within the site sampled. This information may be available from the Habitat Inventory Data Form.

21) **Time -** Enter the start and stop time, in military time (24-hour clock), of the electrofishing pass through the sample site.

22) **H_2OE** - Enter the water temperature, to the nearest degree Fahrenheit, at the beginning and end of the electrofishing pass through the sample site.

23) **AirE** - Enter the air temperature, to the nearest degree Fahrenheit, at the beginning and end of the electrofishing pass through the sample site.

24) **Conductivity** - Enter the ambient conductivity (i.e., conductivity at existing water temperature) in micro Siemens/cm (μS/cm), measured at the same time and location as the start water temperature for Pass #1.

Some meters measure ambient conductivity; check owners manual or call manufacturer. Most meters measure specific conductivity (i.e., conductivity adjusted to a reference temperature, usually 25EC; refer to owners manual). Specific conductivity can be converted to ambient conductivity by the following formula:

$$\sigma a = \sigma s / [1.02^{(Ts-Ta)}]$$

where: σa and Ta = ambient conductivity and temperature (EC)
σs and Ts = specific conductivity and temperature (EC)

25) **Flow** - Enter the flow as measured using a flow meter.

26) **Pass # -** Enter the pass number. More than one pass is usually necessary only when electrofishing in developing a population estimate.

27) **Effort** - Enter the effort from the time counter, in seconds, on the electrofisher for each pass (P_i). If more than one electrofisher is used, sum their individual efforts and enter the Total Effort for the pass (E_i).

28) **Freq**. - Enter the frequency (Hz) setting selected on the electrofisher for each pass.

29) **Output Voltage** - Enter the output voltage (volts) setting selected on the electrofisher for each pass.

30) **Species** - Enter the species of fish sampled. Start a new line for each new species.

31) **Fork Length -** Enter the length of each fish in millimeters from the tip of the snout to fork of the tail.

Summary Data:

32) **Species** - Enter the species of fish sampled. Start a new line for each new species.

33) **Catch** - Enter the total number of fish captures for each species sampled.

34) **Weight** - Enter the total weight in grams of each species. Weight data is optional.

35) **Mortalities** - Enter the number of dead fish of each species resulting from the shocking and handling operations for each pass.

36) **Comments** - Enter any comments.

Note: If electrofishing for a population estimate, enter information for each subsequent pass on the Electrofishing Field Form Supplemental Page.

The following formula (also provided in the Comment sections on the Electrofishing Field Form Supplemental Page) can be used to calculate the depletion percentage from the previous pass. This information can be helpful in a field protocol determining if a subsequent pass is required:

$$(1 - [(N_{i+1} * E_i) / (N_i * E_{i+1})]) * 100 = \text{Pass Depletion}$$

where: N_i and E_i = number of fish of a given species captured and total number of seconds shocked on the previous pass, and N_{i+1} and E_{i+1} = number of fish of a given species captured and total number of seconds shocked on the current pass.

ELECTROFISHING FIELD FORM Form # _____ of _____

Date __/__/__ Stream Name ________________ Site # ___ Drainage __________ T ___ R __ S __

PNMCD ______________ Lat ________________ Long ______________ Quad ________________
Distance from Confluence ____

Reach # ______________ Channel Type ________ Reference Point ____________________________
Distance from RP ___________________________ Up _________________ Down ________________

Personnel: E-Fish ______________________________ Netting ___________________________
Measurements ________________________ Recorder __________________________

Habitat Unit #............... |______|______|______|______|

Habitat Unit Type .... |______|______|______|______|
Mean Length .... |______|______|______|______|

Mean Width .... |______|______|______|______|
Mean Depth.................. |______|______|______|______|

	Start	Stop
Time		
H2O°		
Air°		

Conductivity (μS/cm)

Flow (cfs)

Pass# _______ Effort(s) ______ + ______ = **Total Effort(E1)** _____ (seconds) Freq. ___________ (Hz)
Output Voltage ___________

Species	Fork Length (mm)														

Summary: Species ____________ Catch ____________ Wt. _______________ Mortalities _________;
Species ____________ Catch ____________ Wt. _______________ Mortalities _________;
Species ____________ Catch ____________ Wt. _______________ Mortalities _________;
Species ____________ Catch ____________ Wt. _______________ Mortalities _________;

Comments:

ELECTROFISHING FIELD FORM
SUPPLEMENTAL PAGE Form # _____ of ____

Date __/__/__ Stream Name _________________ Site # ___ Drainage ___________ Pass # ________

Start Time ____________ **End** Time ____________ **Start** Water Temp _____ **End** Water Temp ______
Start Air Temp ________ **End** Air Temp ________
Effort(s) ______ + ______ = **Total Effort (E_2)** _____ (seconds) Freq. ____ (Hz) Output Voltage ____

Species	Fork Length (mm)														

Summary: Species ____________ Catch ____________ Wt. ________________ Mortalities _________;
Species ____________ Catch ____________ Wt. ________________ Mortalities _________;
Species ____________ Catch ____________ Wt. ________________ Mortalities _________;
Species ____________ Catch ____________ Wt. ________________ Mortalities _________;

Comments:

$(1 - [(N_2 * E_1) / (N_1 * E_2)]) * 100$ = Pass Depletion
(1 - [(____ * ____) / (____ * ____)]) * 100 = ________ Pass #2 Depletion

Site # _____ Pass # ________

Start Time ____________ **End** Time ____________ **Start** Water Temp _____ **End** Water Temp ______
Start Air Temp ________ **End** Air Temp ________
Effort(s) ______ + ______ = **Total Effort (E_2)** _____ (seconds) Freq. ____ (Hz) Output Voltage ____

Species	Fork Length (mm)														

Summary: Species ____________ Catch ____________ Wt. ________________ Mortalities _________;
Species ____________ Catch ____________ Wt. ________________ Mortalities _________;
Species ____________ Catch ____________ Wt. ________________ Mortalities _________;
Species ____________ Catch ____________ Wt. ________________ Mortalities _________;

Comments:

$(1 - [(N_3 * E_2) / (N_2 * E_3)]) * 100$ = Pass Depletion
(1 - [(____ * ____) / (____ * ____)]) * 100 = ________ Pass #3 Depletion

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