Summer Juvenile Salmonid Population Monitoring Protocol

Green Diamond Resource Company

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D.3.8 Summer Juvenile Salmonid Population Estimates

D.3.8.1 Background and Objectives

The objectives of the summer juvenile salmonid population surveys are to estimate summer populations of young-of-the-year (YOY) coho, age 1+ and older (parr) steelhead, and cutthroat trout and to track trends in these populations over time. In the Little River HPA there is a third objective. Summer population estimates may be combined with out-migrant trapping data and spawning surveys in an attempt to understand the mortality associated with specific life-history stages (e.g., over-winter survival).

This study is a long-term trend monitoring project that is not intended to have adaptive management thresholds. The sampling and process variance associated with calculating the population estimates and the uncertainty related to the possible causes of observed long-term trends preclude the use of summer population estimates as measurable thresholds for adaptive management. While changes (positive or negative) in summer population estimates will clearly be a source of interest, it remains unclear what, if any, changes can be related to management. As enough data is acquired, it may be possible to conduct a trend analysis associated with other monitoring projects discussed in the AHCP. The summer population data, in combination with other monitoring efforts, may provide valuable information about the relationships between coho populations in different streams throughout the Plan Area, and the climactic and/or habitat conditions which affect summer population size. In addition, trends in summer population estimates will be valuable in determining the recovery status of coho populations within the Plan Area.

Green Diamond's summer juvenile salmonid population monitoring program was first implemented in 1995 and the field sampling design and associated estimators have been modified over time to incorporate advances in methodologies for estimating fish populations. A modified Hankin and Reeves (1988) field sampling protocol has been used from 1995-present (Mohr and Hankin 2005, in draft). Green Diamond assisted with data collection for the development of this sampling method. This sampling design has several important modifications that allowed for reduced electrofishing through increased snorkeling counts and increased statistical validity of salmonid population estimates through the use of estimators with bias adjustments. This type of sampling design, with reduced electrofishing, is especially useful for listed fish species where mortalities need to be minimized and was specifically designed for use in small clear water streams of the California north coast.

Minor modifications to Green Diamond's field protocol have occurred over time to improve data consistency and quality among years. In 1999, classifications of shallow and deep pools were redefined using a strict depth threshold of 1 meter for maximum depth. Pools with depths ≤ 1.0 meter were considered shallow and those greater were deep pools. Prior to this improvement, distinguishing between these habitat types was a judgment call and variation occurred among field personnel. In 2001, two stream habitat categories (run and shallow pool) were combined into a more general category, called shallow unit. Prior to this change, stream habitats were categorized into 5 types. This modification helped eliminate the variation noted among field personnel distinguishing between these two habitat types and improved fish population

estimates by increasing the sample size of calibrated shallow units. Following each modification, data were retrospectively adjusted to allow for comparisons among years. The last modification was the method used to record data in the field. Since 2006, ruggedized field computers have been used to record survey data and aid in randomly selecting sample units. This update has increased work efficiency, reduced the potential for data entry and transcription errors, and minimized the potential for sampling bias during unit selection.

D.3.8.2 Methods

The field sampling design was specifically developed for estimating juvenile salmonid populations in small clear streams when populations are at low abundances and densities (Mohr and Hankin 2005, in draft). This approach is an extension of the two-phase fish sampling design originally described by Hankin and Reeves (1988) and Dolloff et al. (1993). The summer population estimate surveys are typically conducted from late July to early October, when habitat conditions are stable and ideal for electrofishing and snorkel surveys. Each survey is generally divided into three stages. The first stage is a habitat survey where the entire sampling reach is categorized by habitat type (e.g., riffle, deep pool, shallow unit, and “other”), habitat characteristics are measured, and a predetermined proportion of habitat units from each habitat type is selected for fish sampling. Among the selected habitat units, fish sampling is then conducted but the sampling approach varies among habitat types. A single phase depletion electrofishing sampling is conducted in selected riffle units. A two-phase sampling is conducted on all other habitat types except “other” habitats. The two-phased approach uses a combination of snorkel survey fish counts with some electrofishing for calibration. Phase I sampling consists of snorkeling each selected unit once to obtain an initial count of fish within that unit. A subset of the Phase I sample units are then selected for Phase II sampling again using a random stratified selection routine. Phase II sampling is contingent upon the habitat type and number of fish observed during Phase I sampling. Fish sampling is not conducted on “other” habitat units. Additional details on the protocols for habitat surveys, unit selection, electrofishing, snorkel surveys, and population estimation are provided below.

D.3.8.3 Habitat Survey

The survey begins at the downstream end of the sample reach and continues until the end of coho salmon anadromy. The extent of coho anadromy is verified by the snorkel surveys. Working upstream the habitat crew classifies stream habitats into riffles, shallow units (shallow pools, runs, and glides), deep pools, and other (e.g., cascades, complex pools, and dry channels). The characteristics used to distinguish between stream habitat types are those described by Bisson et al. (1981). Maximum water depth is used to distinguish shallow pool and deep pool habitats. Pools with depths ≤ 1.0 meter are considered shallow and categorized as shallow units and those greater are deep pools. The dimensions of each habitat unit are recorded, when possible, by measuring length, three wetted widths and maximum water depth. When a habitat attribute (e.g., water depth) cannot be measured with certainty due to habitat complexity (e.g., undercut banks or accumulations of wood debris) it is not collected.

D.3.8.4 Sample Unit Selection

A stratified-random selection method is used to identify shallow units and deep pools and a random systematic selection method is used to identify riffles that will be sampled for fish. This approach ensures that habitat units will be selected from throughout the entire sampling reach (i.e., prevents bias of sampled units in the lower, middle or upper segments of the sample reach) and prevents the potential for field personnel to predict the units to be sampled for either Phase I or II sampling. Unit selection takes place in conjunction with habitat typing, using a program on a field computer. After each habitat unit is identified, categorized and measured, the computer program indicates if the unit has been selected for Phase I and Phase II sampling. Habitat units selected for fish sampling are flagged and labeled to indicate where Phase I and Phase II sampling is required.

The number of units selected for sampling is predetermined using sampling rates which vary among the habitat types sampled and the two phases of sampling. Sampling rates for deep pools are 50% for Phase I sampling (i.e., single pass snorkel survey) and 100% for Phase II sampling (i.e., multi-pass snorkel survey). Shallow units are sampled at a rate of 50% for both Phase I sampling (i.e., single pass snorkel survey) and Phase II survey (i.e., multi-pass snorkeling or electrofishing calibration). Riffles are sampled, using electrofishing, at a rate of 8.5% (1 in 12 habitat units) with a random start. Efforts are made to maintain consistent sampling rates among years and sites; however, atypically high numbers of fish may warrant reducing the sampling rate(s) in an effort to minimize the potential impacts from electrofishing and improve work efficiency.

D.3.8.5 Fish Survey: Phase I

Phase I fish surveys are conducted in riffles, shallow units and deep pools. Fish are sampled in riffles using electrofishing and by snorkeling in shallow units and deep pools. Descriptions of the protocols for Phase I electrofishing and Phase I snorkel surveys are provided below.

D.3.8.5.1 Phase I Electrofishing Survey

A multi-pass (≥ 3) depletion electrofishing survey is conducted in all selected riffle units. The electrofishing technique and procedure used is specific to waters containing listed salmonids and designed to reduce fish injury and increase electrofishing efficiency (NMFS 2000). Prior to electrofishing, block nets are placed at the top and bottom of the units so no fish can enter or leave the unit while sampling. The effort (pass time) on each pass should be approximately equal (+/- 10%). Data is collected on a field computer and is organized into three relational data tables where data about the survey, electrofisher settings, and captures are recorded. The information recorded in each table is as follows:

Survey data:

- Unique Identification Number
- Creek Name

- Date
- Crew members
- Habitat Unit Number
- Habitat Type (e.g., riffle, shallow unit, deep pool, other)
- Water Temperature (ºC, collected prior to electrofishing)
- Conductivity (µS/cm, collected prior to electrofishing)
- Total Pass Count (sum of electrofishing passes conducted)
- Comments

Electrofisher settings:

- Unique Identification Number
- Efisher Settings (e.g., pulse or direct current)
- Efisher Voltage
- Efisher Model
- Pass Time (seconds elapsed for each pass completed)
- Comments

Captures

- Unique Identification Number
- Pass Number
- Species (list includes all aquatic species likely observed)
- Age Class (e.g., 0+, 1+)
- Condition (e.g., live or mortality)
- Count
- Length (fork-length, mm, recorded for 1+ salmonids, 0+ coho and Chinook)
- Weight (grams, recorded for 1+ salmonids, 0+ coho and Chinook)
- Comments

D.3.8.5.2 Phase I Snorkel Survey

The initial fish counts are obtained by snorkeling each of the randomly selected (i.e., flagged) shallow units and deep pools while progressing upstream. Divers generally leap-frog each other as they work upstream. To avoid a potential for sampling bias between Phase I and Phase II snorkel surveys, it is critical that the diver(s) are unaware if the unit is to be calibrated prior to conducting the first survey. The diver(s) enter the unit to be surveyed from the lower end without disturbing the fish and progress through the length of the unit counting the fish as they go. A "clicker" is carried to record fish numbers for abundant species. Dive lights are used to increase detection probability. Fish counts are conducted for: 0+ coho, 1+ coho, 0+ Chinook, 1+ steelhead, 1+ cutthroat trout and other species in the survey. The presence of 0+ trout may be noted, but are not counted. Following completion of one pass, the diver will check the upstream flag to see if the unit was selected for calibration. Units selected for calibration and meeting the required criteria will also be sampled using the Phase II snorkel survey protocol (see section D.3.8.6.1 below).

While conducting a snorkel survey the diver(s) record the following data:

- Unit Number – The unit number assigned by the habitat crew. This number is found on the flags that bound the habitat unit.

- Diver – Initials of the diver(s) for that unit. If divers on the same team share the same initials, follow the initials with a number and indicate in comments which diver uses the numbers.

- Species Code – Code indicating species:

CODE	SPECIES
CO	Coho
CH	Chinook
SH	Steelhead
CT	Cutthroat
UT	Unknown Trout
Oi	Other species #I

(Other species is for use if surveyor is interested in species not on the list. The surveyor assigns number I and notes in comments the species names with the corresponding number.)

- Age Class – Age class of the species counted (0+, 1+)

- Count – The number of fish counted during pass 1 for each species and age class.

- Calibration – Indicates if the unit was selected for calibration (Y = yes or N = no) based on label noted by the habitat typing crew on flagging at upstream end of unit.

- Electrofish – Indicates if the unit needs to be calibrated with electrofishing (Y = yes or N = no). If "Y" then unit was selected for calibration and the diver observed more than 20 of a target species during the first pass.

- Creek – The stream name being surveyed.

- Date – The date sampling is conducted.

D.3.8.6 Fish Survey: Phase II (Calibration)

Phase II sampling is conducted using a more accurate method of estimating fish numbers to allow for adjustment of diver counts and calculating errors of estimation within selected units. The methods used during Phase II fish sampling are: (1) multi-pass electrofishing or (2) three pass snorkel survey. The survey method used for a selected habitat unit is determined based on the habitat type and result from Phase I sampling. The criteria used to determine the type of Phase II sampling required for each habitat type is as follows:

- Shallow Units – If the fish count is ≤ 20 fish and there is not excessive complexity that would prevent seeing all the fish without risk of double counting, then the calibration is

done using a multi-pass snorkel survey (see section D.3.8.6.1 for protocol details). If the first phase count for a target species is > 20, then calibration is done using a multi-pass (≥ 3) depletion electrofishing method (see section D.3.8.6.2 for protocol details).

- Deep Pools – Irrespective of the fish count from Phase I sampling, only the three pass snorkel survey (see section D.3.8.6.1 for details) is applied to deep pools selected for calibration. Electrofishing is ineffective in deep pools due to water depths that prohibit wading and the safe use of the backpack electrofishing equipment.

D.3.8.6.1 Phase II Snorkel Survey

The Phase II snorkel survey uses the multi-pass snorkel survey. This survey requires three additional dive passes through each selected unit. Following each dive pass, a brief (~ 5 minutes) wait is required to allow water clarity and fish behavior to equalize between passes. Efforts are made to apply equal effort (i.e., dive time) during each pass. Additional dives are conducted immediately following the first dive and determining the Phase II sampling requirement.

The same sampling protocol and data collected during the Phase I snorkel survey is applied to each additional dive pass (see section D.3.8.5.2 for protocol details). Phase II survey data are recorded onto the same data sheets as the Phase I survey data. The Phase I data are recorded in the Dive 1 column while the Phase II data are recorded in the appropriate Dive 2, Dive 3, or Dive 4 columns.

D.3.8.6.2 Phase II Electrofishing Survey

Phase II electrofishing is conducted on selected sample units no more than two days after the Phase I dive survey. The sampling method and data collected is the same multi-pass (≥ 3) depletion protocol used for Phase I sampling of riffles (see section D.3.8.5.1 for protocol details).

D.3.8.7 Population Estimate

Annual population estimates for juvenile salmonids are generated annually by Green Diamond. Detailed information on the assumptions, applicability and validation of the estimators used to generate juvenile salmonid population estimates can be found in (Mohr and Hankin 2005, in draft). The primary improvements in these estimators over alternatives are: (1) the addition of bias adjustments associated with diver counts and electrofishing probabilities of detection and (2) the reduced bias of bounded counts (Robson and Whitlock, 1964) and jackknife estimators. Where the estimators are not appropriate for use, due to either protocol variance or limited sample size, hard counts are used, and are marked as such in data tables and graphs. The improved estimators have been applied to the full data set, so earlier data summaries (e.g., 1995-2000) may present slightly different estimates than those presented in more recent reports.

D.3.8.8 Literature Cited

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