

STREAM INVENTORY REPORT

Nelson Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1997 on Nelson Creek beginning at the confluence with Bear River. The inventory was conducted in two parts: habitat inventory and biological inventory. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Nelson Creek. The objective of the biological inventory was to document the presence and distribution of juvenile salmonid species.

The objective of this report is to document the current habitat conditions, and recommend options for the potential enhancement of habitat for coho salmon and steelhead trout. Recommendations for habitat improvement activities are based upon target habitat values suitable for salmonids in California's north coast streams.

WATERSHED OVERVIEW

Nelson Creek is a tributary to Bear River, which drains to the Pacific Ocean. It is located in Humboldt County, California (Map 1). Nelson Creek's legal description at the confluence with Bear River is T01S R01E S16. Its location is 40.3853 degrees north latitude and 124.0811 degrees west longitude. Nelson Creek is a second order stream and has approximately 3.6 miles of blue line stream according to the USGS Scotia 7.5 minute quadrangle. Nelson Creek drains a watershed of approximately 3.0 square miles. Elevations range from about 1,280 feet at the mouth of the creek to 1,800 feet in the headwater areas. Douglas fir forest and grass dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via Mattole Road to Rainbow Ridge.

METHODS

The habitat inventory conducted in Nelson Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1991 rev. 1994). The California Conservation Corps (CCC) Technical Advisors and Watershed Stewards Project/AmeriCorps (WSP/AmeriCorps) Members that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). This inventory was conducted by a two-person team.

SAMPLING STRATEGY

The inventory uses a method that samples approximately 10% of the habitat units within the survey reach (Hopelain, 1994). All habitat units included in the survey are classified according to habitat type and their lengths are measured. All pool units are measured for maximum depth, depth of pool tail crest, dominant substrate composing the pool tail crest, and embeddedness.

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Habitat unit types encountered for the first time are further measured for all the parameters and characteristics on the field form. Additionally, from the ten habitat units on each field form page, one is randomly selected for complete measurement.

HABITAT INVENTORY COMPONENTS

A standardized habitat inventory form has been developed for use in California stream surveys and can be found in the *California Salmonid Stream Habitat Restoration Manual*. This form was used in Nelson Creek to record measurements and observations. There are nine components to the inventory form.

1. Flow:

Flow is measured in cubic feet per second (cfs) at the bottom of the stream survey reach using standard flow measuring equipment, if available. In some cases flows are estimated.

2. Channel Type:

Channel typing is conducted according to the classification system developed and revised by David Rosgen (1985 rev. 1994). This methodology is described in the *California Salmonid Stream Habitat Restoration Manual*. Channel typing is conducted simultaneously with habitat typing and follows a standard form to record measurements and observations. There are five measured parameters used to determine channel type: 1) water slope gradient, 2) entrenchment, 3) width/depth ratio, 4) substrate composition, and 5) sinuosity.

3. Temperatures:

Both water and air temperatures are measured and recorded at every tenth habitat unit. The time of the measurement is also recorded. Both temperatures are taken in degrees Fahrenheit at the middle of the habitat unit and within one foot of the water surface at classification types defined by McCain and others (1988). Habitat units are numbered sequentially and assigned a type identification number selected from a standard list of 24 habitat types. Dewatered units are labeled "dry". Nelson Creek habitat typing used standard basin level measurement criteria. These parameters require that the minimum length of a described habitat unit must be equal to or greater than the stream's mean wetted width. Channel dimensions were measured using hip chains, range finders, tape measures, and stadia rods. All units were measured for mean length; additionally, the first occurrence of each unit type and a randomly selected 10% subset of all units were sampled for all features on the sampling form (Hopelain, 1995). Pool tail crest depth at each pool unit was measured in the thalweg. All measurements were in feet to the nearest tenth.

5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out reaches is measured by the percent of the cobble that is surrounded or buried by fine sediment. In Nelson Creek, embeddedness was

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ocularly estimated. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3) and 76 - 100% (value 4). Additionally, a value of 5 was assigned to tail-outs deemed not suitable for spawning due to inappropriate substrate particle size, having a bedrock tail-out, or other considerations.

6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide salmonids protection from predation, reduce water velocities so fish can rest and conserve energy, and allow separation of territorial units to reduce density related competition. The shelter rating is calculated for each fully-described habitat unit by multiplying shelter value and percent cover. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered is made. All cover is then classified according to a list of nine cover types. In Nelson Creek, a standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) was assigned according to the complexity of the cover. Thus, shelter ratings can range from 0-300 and are expressed as mean values by habitat types within a stream.

7. Substrate Composition:

Substrate composition ranges from silt/clay sized particles to boulders and bedrock elements. In all fully-described habitat units, dominant and sub-dominant substrate elements were ocularly estimated using a list of seven size classes and recorded as a one and two respectively. In addition the dominant substrate composing the pool tail-outs is recorded for each pool.

8. Canopy:

Stream canopy density was estimated using modified handheld spherical densimeters as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In Nelson Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the center of approximately every third unit in addition to every fully-described unit, giving an approximate 30% sub-sample. In addition, the area of canopy was estimated ocularly into percentages of coniferous or deciduous trees.

9. Bank Composition and Vegetation:

Bank composition elements range from bedrock to bare soil. However, the stream banks are usually covered with grass, brush, or trees. These factors influence the ability of stream banks to withstand winter flows. In Nelson Creek, the dominant composition type and the dominant vegetation type of both the right and left banks for each fully-described unit were selected from the habitat inventory form. Additionally, the percent of each bank covered by vegetation was estimated and recorded.

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BIOLOGICAL INVENTORY

Biological sampling during stream inventory is used to determine fish species and their distribution in the stream. In Nelson Creek fish presence was observed from the stream banks, and one site was electrofished using a Smith-Root Model 12 electrofisher. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

DATA ANALYSIS

Data from the habitat inventory form are entered into Habitat, a dBASE 4.2 data entry program developed by Tim Curtis, Inland Fisheries Division, California Department of Fish and Game. This program processes and summarizes the data, and produces the following six tables:

- Riffle, flatwater, and pool habitat types
- Habitat types and measured parameters
- Pool types
- Maximum pool depths by habitat types
- Dominant substrates by habitat types
- Mean percent shelter by habitat types

Graphics are produced from the tables using Quattro Pro. Graphics developed for Nelson Creek include:

- Riffle, flatwater, pool habitats by percent occurrence
- Riffle, flatwater, pool habitats by total length
- Total habitat types by percent occurrence
- Pool types by percent occurrence
- Total pools by maximum depths
- Embeddedness
- Pool cover by cover type
- Dominant substrate in the pool tail-outs
- Percent canopy
- Bank composition by composition type
- Bank vegetation by vegetation type

HABITAT INVENTORY RESULTS

The habitat inventory of July 7 through July 15, 1997 was conducted by David Jones and Bill Malinowski (WSP/AmeriCorps). The total length of the stream surveyed was 17,560 feet with an additional 572 feet of side channel.

Flow was estimated to be 1.6 cfs during the survey period.

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Nelson Creek is a B3 channel type for the first 8,311 feet of stream reach surveyed and a B2 for the last 9,249 feet of surveyed stream reach. B3 channels are moderately entrenched, moderate gradient, riffle dominated channel, with infrequently spaced pools; very stable plan and profile; stable banks; cobble channel. B2 channels are moderately entrenched, moderate gradient, riffle dominated channel, with infrequently spaced pools; very stable plan and profile; stable banks; boulder channel.

Water temperatures taken during the survey period ranged from 56 to 61 degrees Fahrenheit. Air temperatures ranged from 56 to 74 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 44% flatwater units, 44% pool units, and 12% riffle units (Graph 1). Based on total length of Level II habitat types there were 75% flatwater units, 13% riffle units, and 9% pool units (Graph 2).

Ten Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were step runs, 42%; mid-channel pools, 23%; and low gradient riffles, 12% (Graph 3). Based on percent total length, step runs made up 75%, and low gradient riffles made up 13%.

A total of 75 pools were identified (Table 3). Main channel pools were most frequently encountered at 64% and comprised 73% of the total length of all pools (Graph 4).

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. Forty of the 75 pools (53%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 75 pool tail-outs measured, nine had a value of 1 (12%); 28 had a value of 2 (37%); eight had a value of 3 (11%); three had a value of 4 (4%) and 27 had a value of 5 (36%); (Graph 6). On this scale, a value of 1 indicates the highest quality of spawning substrate and a value of 5 indicates the tail-out is not suitable for spawning. In Nelson Creek, five of the 27 pool tail-outs which were valued at 5 had silt/clay/sand or gravel too small to be suitable for spawning as the substrate. The other tail-outs were not suitable for spawning due to the tail-outs being comprised of large cobble, boulder, bedrock or wood.

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Riffle habitat types had a mean shelter rating of 7, flatwater habitat types had a mean shelter rating of 23, and pool habitats had a mean shelter rating of 70 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 74. Main channel pools had a mean shelter rating of 67 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Nelson Creek. Large and small woody debris are lacking in nearly all habitat types. Graph 7 describes the pool cover in Nelson Creek.

Table 6 summarizes the dominant substrate by habitat type. Of the three low gradient riffles measured one had small cobble as the dominant substrate and two had large cobble. Gravel was

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the dominant substrate observed in 29 of the 75 pool tail-outs measured (39%). Small cobble was the next most frequently observed dominant substrate type and occurred in 23% of the pool tail-outs (Graph 8).

The mean percent canopy density for the stream reach surveyed was 59%. The mean percentages of deciduous and coniferous trees were 69% and 31%, respectively. Graph 9 describes the canopy in Nelson Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 59%. The mean percent left bank vegetated was 51%. The dominant elements composing the structure of the stream banks consisted of 80% cobble/gravel, 8% boulders, 7% sand/silt/clay, and 5% bedrock (Graph 10). Deciduous tree was the dominant vegetation type observed in 55% of the units surveyed. Additionally, 20% of the units surveyed had coniferous trees as the dominant vegetation type (Graph 11).

BIOLOGICAL INVENTORY RESULTS

One site was electrofished on July 14, 1997 in Nelson Creek. The site was sampled by David Jones and Bill Malinowski.

The site sampled included Habitat Units #006 through #007, a step run and plunge pool approximately 2,083 feet from the confluence with Bear River. This site had an area of 910 square feet. The site yielded 30 steelhead/rainbow trout.

DISCUSSION

Nelson Creek is a B4 channel type for the first 8,311 feet of stream surveyed and a B2 for the remaining 9,249 feet. The suitability of B4 channel types for fish habitat improvement structures is as follows: excellent for plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors and log cover. The suitability of B2 channel types for fish habitat improvement structures is as follows: excellent for plunge weirs, cover logs, and single and opposing wing deflectors.

The water temperatures recorded on the survey days July 9 through July 15, 1997 ranged from 56 to 61 degrees Fahrenheit. Air temperatures ranged from 56 to 74 degrees Fahrenheit. This is a suitable water temperature range for salmonids. To make any further conclusions, temperatures need to be monitored throughout the warm summer months, and more extensive biological sampling needs to be conducted.

Flatwater habitat types comprised 75% of the total length of this survey, riffles 13%, and pools 9%. The pools are relatively deep, with 40 of the 75 (53%) pools having a maximum depth greater than two feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum depth of at least two feet, occupy at least half the

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width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase pool habitat is recommended.

Nine of the 75 pool tail-outs measured had an embeddedness rating of 1. Thirty-nine of the pool tail-outs had embeddedness ratings of 2, 3 or 4. Twenty-seven of the pool tail-outs had a rating of 5 or were considered not suitable for spawning. Five of the 27 were not suitable for spawning due to the dominant substrate being silt/sand/clay or gravel being too small to be suitable. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. In Nelson Creek, sediment sources should be mapped and rated according to their potential sediment yields, and control measures should be taken.

The mean shelter rating for pools was 70. The shelter rating in the flatwater habitats was 23. A pool shelter rating of approximately 100 is desirable. The cover that now exists is being provided primarily by boulders in all habitat types. Additionally, large woody debris contributes a small amount. Log and root wad cover structures in the pool and flatwater habitats are needed to improve both summer and winter salmonid habitat. Log cover structures provide rearing fry with protection from predation, rest from water velocity, and also divide territorial units to reduce density related competition.

Forty-six of the 75 pool tail-outs measured had gravel or small cobble as the dominant substrate. Suitable size spawning substrate is limited in Nelson Creek.

The mean percent canopy density for the stream was 59%. This is a low percentage of canopy. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was low at 59% and 51%, respectively. In areas of stream bank erosion or where bank vegetation is at unacceptable levels, planting endemic species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

- 1) Nelson Creek should be managed as an anadromous, natural production stream.
- 2) The limited water temperature data available suggest that maximum temperatures are within the acceptable range for juvenile salmonids. To establish more complete and meaningful temperature regime information, 24-hour monitoring during the July and August temperature extreme period should be performed for 3 to 5 years.
- 3) Where feasible, design and engineer pool enhancement structures to increase the number of pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.

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- 4) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover is from boulders. Adding high quality complexity with woody cover is desirable.
- 5) Inventory and map sources of stream bank erosion and prioritize them according to present and potential sediment yield. Identified sites should then be treated to reduce the amount of fine sediments entering the stream.
- 6) Active and potential sediment sources related to the road system need to be identified, mapped, and treated according to their potential for sediment yield to the stream and its tributaries.
- 7) Increase the canopy on Nelson Creek by planting willow, alder, redwood, and Douglas fir along the stream where shade canopy is not at acceptable levels. The reaches above this survey section should be inventoried and treated as well, since the water flowing here is effected from upstream. In many cases, planting will need to be coordinated to follow bank stabilization or up slope erosion control projects.
- 8) Suitable size spawning substrate on Nelson Creek is limited to relatively few reaches. Projects should be designed at suitable sites to trap and sort spawning gravel.

COMMENTS AND LANDMARKS

The following landmarks and possible problem sites were noted. All distances are approximate and taken from the beginning of the survey reach.

Position Comments:
(ft):

0'	Start of survey at confluence with Bear River. Channel type is B3.
320'	Salmonids observed. Left bank eroding.
1,762'	Right bank erosion site measures 166' long x 80' high.
2,193'	Left bank erosion site measures 90' long x 45' high.
2,466'	Log debris accumulation, (LDA) measures 52' long with a 7.5' jump and is retaining 7.5' of sediment. Left bank erosion site measures 85' long x 25' high and right bank erosion site measures 120' long x 55' high.
2,527'	Left bank erosion site measures 164' long x 50' high.
2,686'	Left bank tributary.
2,844'	Right bank eroding.

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- 3,612' LDA measures 41' long x 97' wide x 6' high.
- 4,773' Left bank tributary, barely flowing. The water temperature was 53 degrees Fahrenheit.
- 5,156' Left bank tributary, the water temperature was 58 degrees Fahrenheit.
- 5,476' Left bank and right bank erosion sites measure 100' long x 50' high.
- 5,943' Dry right bank tributary.
- 7,316' Right bank tributary, barely flowing.
- 8,181' Right bank tributary.
- 9,733' Salmonids observed.
- 11,183' Dry left bank tributary.
- 11,628' Left bank tributary, barely flowing. The water temperature was 57 degrees Fahrenheit.
- 11,835' Dry left bank tributary.
- 12,586' Right bank erosion site measures 70' long x 40' high.
- 12,675' Left bank tributary, barely flowing. The water temperature was 57 degrees Fahrenheit.
- 12,788' Salmonids observed.
- 13,610' Old culvert.
- 15,533' Right bank tributary with high gradient. The water temperature was 56 degrees Fahrenheit.
- 16,207' Right bank tributary with high high gradient and barely flowing. The water temperature was 56 degrees Fahrenheit.
- 17,560' End of survey. No fish observed for 555 feet preceding the end of survey due to a 4' high plunge leading into a high gradient section of creek. An additional 400' of stream was walked and no fish were observed.

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REFERENCES

Flosi, G., and F. Reynolds. 1994. California salmonid stream habitat restoration manual, 2nd edition. California Department of Fish and Game, Sacramento, California.

Hopelain, J. 1995. Sampling levels for fish habitat inventory, unpublished manuscript California Department of Fish and Game, Inland Fisheries Division, Sacramento, California.

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LEVEL III and LEVEL IV HABITAT TYPE KEY

RIFFLE

Low Gradient Riffle	[LGR]	1.1
High Gradient Riffle	[HGR]	1.2

CASCADE

Cascade	[CAS]	2.1
Bedrock Sheet	[BRS]	2.2

FLATWATER

Pocket Water	[POW]	3.1
Glide	[GLD]	3.2
Run	[RUN]	3.3
Step Run	[SRN]	3.4
Edgewater	[EDW]	3.5

MAIN CHANNEL POOLS

Trench Pool	[TRP]	4.1
Mid-Channel Pool	[MCP]	4.2
Channel Confluence Pool	[CCP]	4.3
Step Pool	[STP]	4.4

SCOUR POOLS

Corner Pool	[CRP]	5.1
Lateral Scour Pool - Log Enhanced	[LSL]	5.2
Lateral Scour Pool - Root Wad Enhanced	[LSR]	5.3
Lateral Scour Pool - Bedrock Formed	[LSBk]	5.4
Lateral Scour Pool - Boulder Formed	[LSBo]	5.5
Plunge Pool	[PLP]	5.6

BACKWATER POOLS

Secondary Channel Pool	[SCP]	6.1
Backwater Pool - Boulder Formed	[BPB]	6.2
Backwater Pool - Root Wad Formed	[BPR]	6.3
Backwater Pool - Log Formed	[BPL]	6.4
Dammed Pool	[DPL]	6.5